ATTACHMENT 3

Hope Creek Generating Station

Facility Operating License NPF-57
Docket No. 50-354

Extended Power Uprate

Hope Creek Steam Dryer Vibration Test

STI Technologies, Inc. Technical Report # PA2168, Revision 1

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Hope Creek Steam Dryer Vibration Test

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Introduction

Test Article Identification

The tests described in this report were performed on the steam dryer intended for Hope Creek Unit 2. The dryer has been stored on the plant grounds since it was purchased roughly 20 years ago.

Test Objective

In response to a request for additional information (RAI) associated with PSEG's application for Extended Power Uprate (EPU) for Hope Creek, Continuum Dynamics Incorporated (CDI) developed a finite element model of the Hope Creek Unit 1 steam dryer. The model predicts stresses in the steam dryer in response to hydrodynamic loads. The purpose of these tests is to provide data for verification and validation of the model under prescribed boundary and environmental conditions. Specifically, CDI requested acceleration measurements at specified locations on the dryer in response to sine dwell excitation at selected natural frequencies. Correlation of the model and experimental results will be performed by CDI.

References

Test Plan to Determine Bias and Uncertainty of FEM Analysis of Hope Creek Steam Dryer, Continuum Dynamics Incorporated, Ewing, NJ

Preparation

Environmental

In preparation for the test, the dryer was moved from the yard where it has been stored into a heated warehouse. Moving the dryer indoors provided several benefits. First, protecting the dryer from sun (solar heating) and outdoor air temperature fluctuations ensures that the material properties (Young's modulus in particular) remain relatively constant during the test. Second, protecting the dryer from wind and rain (sleet) increases the signal to noise ratio of the data. Finally, the testing indoors protects the data acquisition equipment from adverse weather.

Boundary Conditions

The dryer was detached from the shipping and handling cradle and suspended from a gantry crane as shown in Figure 1. Four 25,000 lb Kevlar slings were used to attach the dryer to the crane as requested by CDI in the test plan.

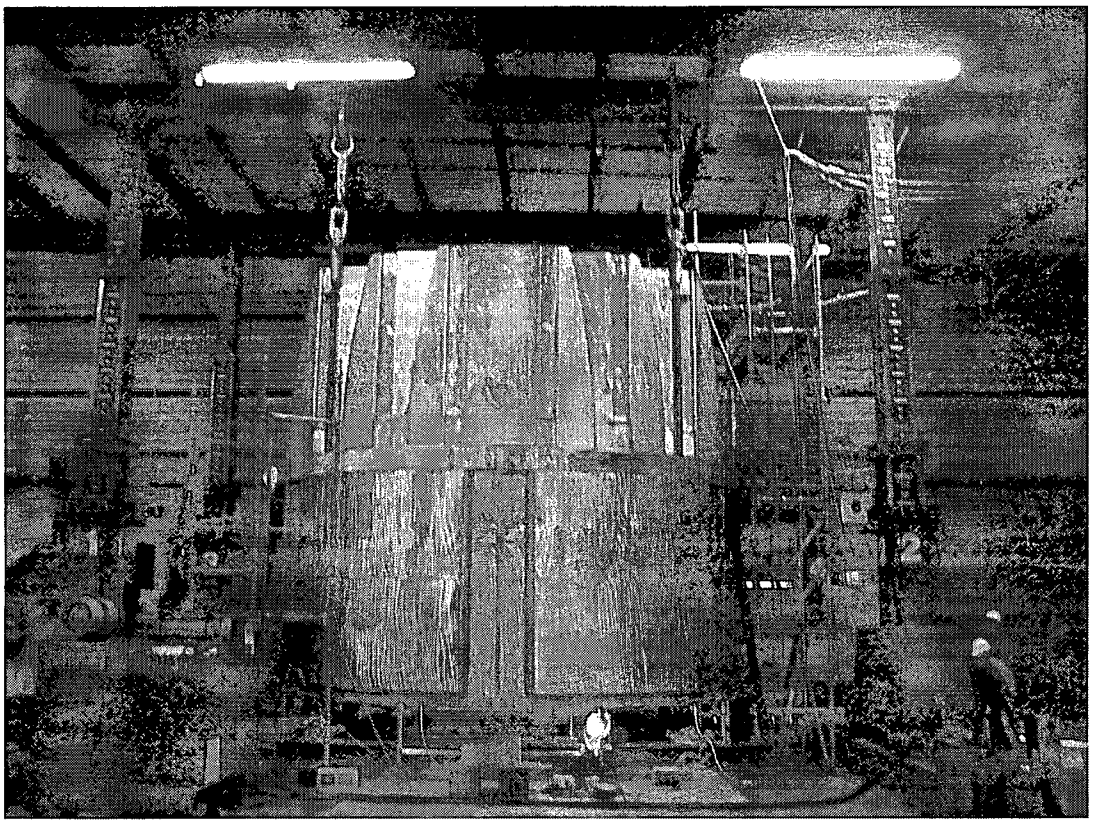

Figure 1 Suspended dryer

Marking

The 142 accelerometer locations specified by CDI were marked on the dryer by PSEG personnel using a laser level and tape measure.

Equipment

Excitation

A 100 pound force electrodynamic shaker was used to excite vibration of the dryer. The shaker was suspended by chains from scaffolding surrounding the work area. Roughly 100 pounds of mass was attached to the shaker to increase its inertial reaction force. A representative shaker setup is shown in Figure 2. The shaker was attached to the dryer with a stinger and a load cell (PCB model 208A03) at the dryer end to measure the applied force. Detailed specifications for the load cell are provided in Appendix A. At driving points 1, 4, 5, 6, and 8 the load cell was glued to the dryer using a cyanoacrylate adhesive. At the remaining locations (2, 3, & 7), adhesion problems necessitated drilling and taping a 10-32 by 1/4"hole to attach the load cell.

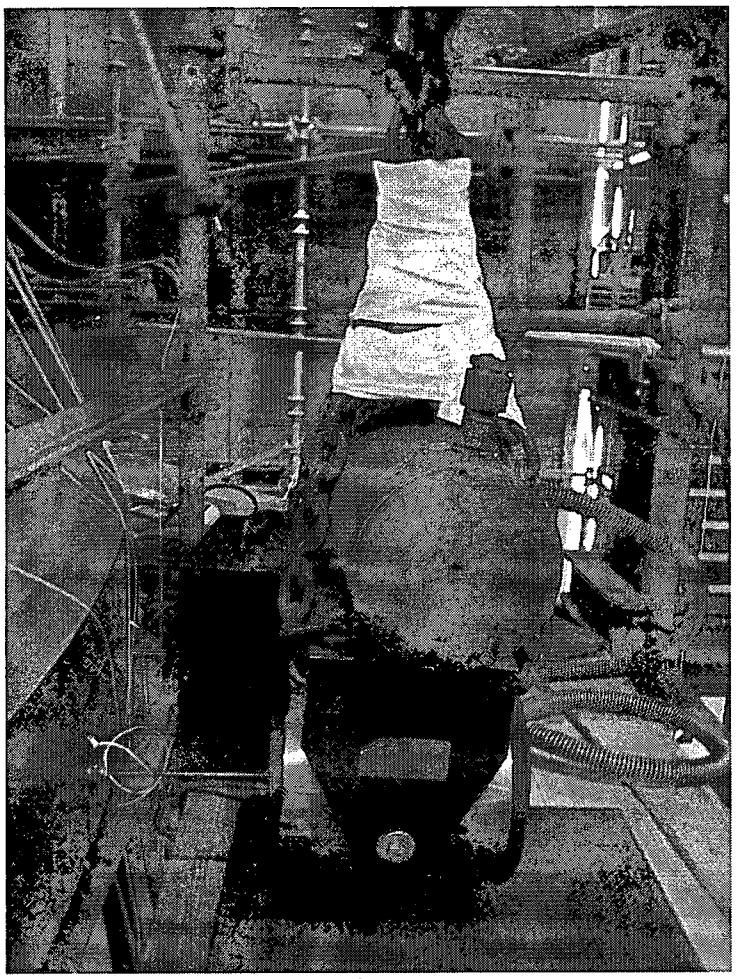

Figure 2 Representative Shaker Setup

Response

An array of up to 20 accelerometers (PCB model 352C68) was used to measure the acceleration of specified locations on the dryer. Detailed specifications for the sensors are provided in Appendix A. The accelerometers were attached to the dryer with a wax adhesive intended for vibration testing and the cables were secured with masking tape. All of the accelerometers were oriented so as to measure acceleration in the direction normal to the surface of the dryer as prescribed by CDI. Digital photos of the accelerometer locations are provided in the zip file entitled "HopeCreek_DryerPhotos.zip"

Data Acquisition and Signal Processing

A 24 channel dynamic signal analyzer was used to acquire and process the signals from the sensors. ICP signal conditioning in the analyzer allows direct connection of the sensors. The signals were digitized using 24 bit resolution and a sampling rate of 625Hz. Power spectra functions were calculated for each signal using 16384 lines to achieve a frequency resolution 0.019 Hz in the frequency band up to 250 Hz. A Hanning window was used to mitigate leakage in the Fourier transform.

Procedures

Quality Assurance

The tests were performed under PSEG's quality program. STI provided all requested quality documentation (NIST traceable calibration certificates, personnel qualifications, and detailed test procedures) to PSEG in accordance with the quality plan. An end to end instrumentation check was performed using a hand-held calibrated shaker to verify calibration and channel assignments. Each major step in the test procedure was reviewed and approved.

Driving Points

The structure was excited by attaching the shaker at eight different locations shown in Figure 3. Driving points 1, 2, and 3 are normal to the surface of the upper support ring. Driving points 4 and 5 are normal to the lower support ring. Driving points 6, 7, and 8 are axial to the tie bars on the out-board end. For each driving point, CDI requested acceleration response data at a unique set of locations specified in the CDI test plan.

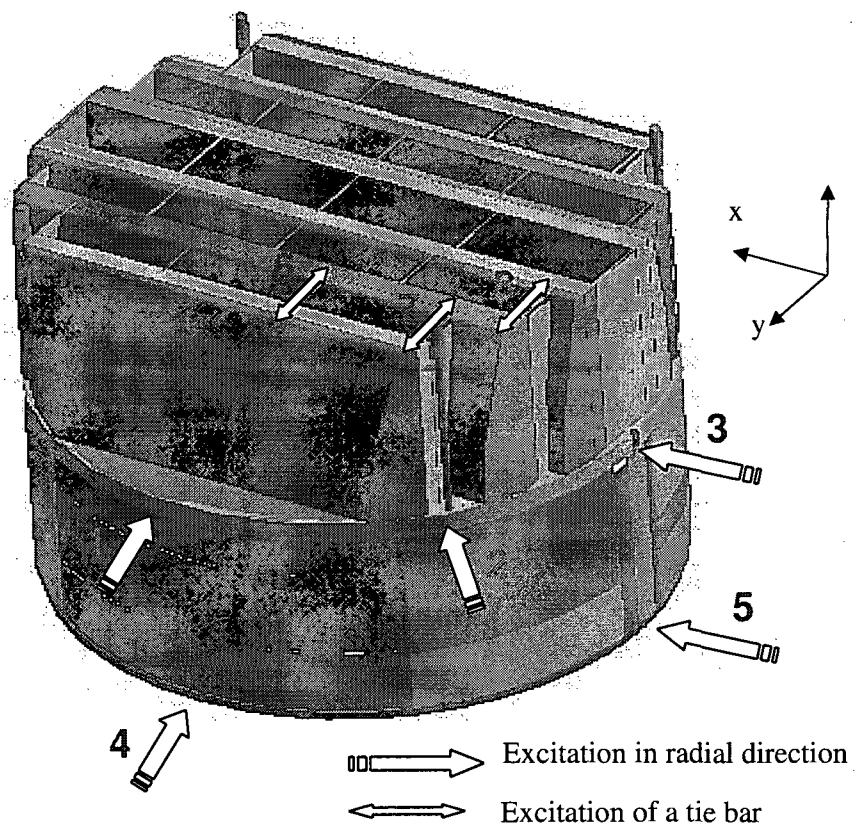

Figure 3 Driving Points (Courtesy of CDI)

Natural Frequency Identification

The sine sweep method was used to identify the most prominent natural frequencies excited from each driving point. The frequency range of interest from 10 to 250Hz was swept in two parts from 10 to 60 Hz and from 50 to 250 Hz using sweep rates of 0.96 Hz/s and 3.85 Hz/s respectively. In the test plan, CDI provided frequencies of interest for each driving point, and requested identification of the three natural frequencies with the highest gain within ±10% of the specified frequencies. At the selected natural frequencies at least 95% of the signals have coherence greater than 0.9. A coherence value above 0.9 indicates good quality data.

Response Amplitude Measurement

The structure was excited by a sinusoidal force at each of the natural frequencies identified by the sine sweep for a given driving point. In this sine dwell test, the structure was driven for at least 100 cycles to reach steady state before data collection began. Auto power spectra of the acceleration at the response measurement locations corresponding to the active driving point were calculated. The RMS acceleration at the driving frequency was extracted from the power spectra. Correlation of the predicted and measured acceleration values will be performed by CDI.

Temperature Measurement

The temperature of the dryer was measured at the two locations shown in Figure 4 before and after data collection at each driving point.

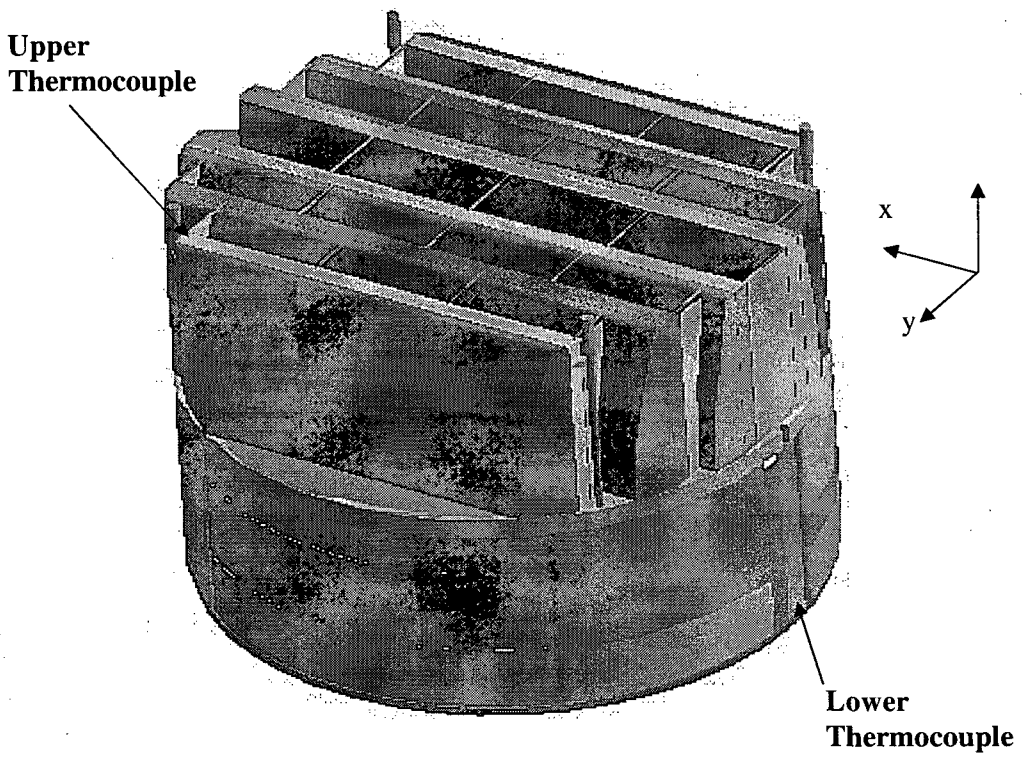

Figure 4 Temperature measurement locations (Courtesy of CDI)

Rigid Body Natural Frequencies

The rigid body modes of the suspended dryer were measured. Low frequency swing (pendulum) modes of the dryer were excited by pushing on the lower support ring in two orthogonal (horizontal) directions perpendicular and parallel to gantry suspension. Vertical modes were excited by pulling up on the lower support ring, and the twist mode was excited by pushing in the tangential direction to the lower support ring. Damping is estimated from the logarithmic decrement of the time domain data.

Frequency (Hz)	Damping Est
0.41	0.6%
0.62	0.6%
5.28	0.9%
5.72	0.9%

Results

Acceleration Amplitude Tables

Tables 1 through 8 list the results from dwell tests at eight driving points identified as DP1, DP2, etc. For each driving point, the applied force and acceleration response of the dryer at 16 to 20 locations (unique to each driving point) are given for each dwell frequency. Please see the associated spreadsheet named "HopeCreek_DryerVibTest.xls" for electronic copies of the following tables.

Table 1 Driving Point 1 Results

Frequency (Hz)	DP1	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
103.626	28.355	0.283	0.114	0.110	0.006	0.001	0.014	0.012	0.100	0.008	0.004	0.025	0.325	0.003	0.007	0.005	0.038	0.010	0.022	0.083	0.005
107.651	28.086	0.616	0.236	0.641	0.068	0.013	0.039	0.073	0.410	0.055	0.022	0.086	0.306	0.029	0.009	0.075	0.154	0.040	0.493	0.016	0.049
110.931	27.982	0.196	0.320	0.330	0.015	0.006	0.049	0.050	0.114	0.030	0.018	0.044	0.099	0.035	0.007	0.008	0.015	0.009	0.117	0.053	0.012
111.084	27.950	0.304	0.482	0.407	0.012	0.011	0.067	0.089	0.277	0.026	0.025	0.044	0.163	0.039	0.011	0.015	0.039	0.021	0.183	0.090	0.011
113.068	27.901	0.492	0.762	0.018	0.013	0.001	0.175	0.139	0.815	0.143	0.021	0.146	0.127	0.008	0.005	0.006	0.078	0.021	0.222	0.752	0.076
113.697	27.975	0.113	0.151	0.100	0.009	0.002	0.084	0.070	0.122	0.019	0.019	0.069	0.049	0.013	0.003	0.005	0.114	0.011	0.031	0.174	0.049
136.986	27.103	0.022	0.041	0.192	0.037	0.023	0.017	0.056	0.087	0.009	0.026	0.025	0.036	0.037	0.009	0.017	0.072	0.020	0.024	0.009	0.030
132.713	27.148	0.089	0.126	0.041	0.013	0.018	0.031	0.087	0.115	0.161	0.032	0.092	0.113	0.031	0.041	0.057	0.050	0.026	0.027	0.046	0.052
135.078	27.113	0.239	0.067	0.047	0.027	0.009	0.029	0.041	0.050	0.059	0.032	0.015	0.046	0.017	0.018	0.018	0.016	0.017	0.289	0.162	0.009
155.048	26.757	0.048	0.276	0.173	0.031	0.014	0.028	0.091	0.112	0.192	0.010	0.112	0.021	0.033	0.004	0.009	0.153	0.042	0.068	0.119	0.101
156.307	26.652	0.188	0.103	0.094	0.015	0.015	0.034	0.072	0.158	0.041	0.026	0.006	0.061	0.004	0.002	0.020	0.090	0.018	0.030	0.210	0.052
172.215	25.969	0.212	0.127	0.020	0.034	0.016	0.044	0.095	0.055	0.009	0.016	0.061	0.131	0.074	0.013	0.020	0.028	0.039	0.030	0.166	0.039
173.206	25.981	0.176	0.142	0.057	0.008	0.015	0.045	0.085	0.046	0.014	0.032	0.002	0.045	0.027	0.009	0.042	0.054	0.025	0.053	0.329	0.053
184.536	25.980	0.031	0.163	0.062	0.023	0.026	0.097	0.060	0.045	0.053	0.041	0.074	0.054	0.003	0.007	0.029	0.059	0.019	0.054	0.107	0.071
190.830	25.948	0.039	0.190	0.081	0.006	0.020	0.065	0.024	0.063	0.153	0.019	0.112	0.383	0.021	0.029	0.017	0.051	0.020	0.269	0.310	0.058
192.146	25.924	0.024	0.320	0.046	0.022	0.021	0.083	0.090	0.245	0.091	0.033	0.037	0.092	0.029	0.038	0.054	0.039	0.006	0.256	0.384	0.035
205.860	25.820	0.175	0.129	0.107	0.036	0.003	0.049	0.114	0.038	0.102	0.023	0.129	0.096	0.022	0.004	0.068	0.068	0.006	0.096	0.113	0.040
212.269	25.749	0.118	0.045	0.036	0.163	0.069	0.102	0.194	0.010	0.014	0.031	0.253	0.302	0.031	0.008	0.240	0.109	0.032	0.172	0.113	0.166
217.133	25.603	0.294	0.930	0.052	0.087	0.021	0.138	0.227	0.781	0.117	0.017	0.289	0.299	0.092	0.043	0.041	0.261	0.205	0.571	1.025	0.173
218.029	25.571	0.301	0.932	0.049	0.080	0.036	0.128	0.039	0.760	0.255	0.068	0.313	0.228	0.079	0.035	0.043	0.093	0.107	0.296	0.680	0.186
222.225	25.556	0.427	0.234	0.182	0.026	0.010	0.087	0.332	0.158	0.175	0.109	0.319	0.355	0.056	0.028	0.061	0.048	0.034	0.399	0.313	0.063
225.029	25.623	0.468	0.341	0.041	0.065	0.013	0.094	0.237	0.365	0.110	0.053	0.169	0.078	0.045	0.027	0.113	0.026	0.026	0.359	0.102	0.082
248.680	25.527	0.366	0.485	0.167	0.022	0.043	0.057	0.081	0.419	0.060	0.115	0.014	0.029	0.085	0.011	0.025	0.120	0.102	0.086	0.200	0.105

Table 2 Driving Point 2 Results

Point	DP2	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
Frequency (Hz)																					
18.520	120.494	0.079	0.474	0.477	0.002	0.064	0.006	0.086	0.002	0.000	0.002	0.655	0.006	0.022	0.002	0.002	0.002	0.005	0.328	0.002	0.002
19.588	168.421	0.244	0.036	0.044	0.002	0.078	0.002	0.039	0.001	0.000	0.001	0.263	0.003	0.108	0.002	0.004	0.003	0.001	0.061	0.003	0.001
20.123	165.932	0.747	0.020	0.167	0.006	0.246	0.002	0.039	0.001	0.001	0.001	0.817	0.012	0.303	0.004	0.003	0.001	0.002	0.091	0.003	0.001
24.700	57.022	0.006	0.235	0.463	0.001	0.011	0.004	0.072	0.002	0.007	0.001	0.230	0.006	0.144	0.007	0.000	0.003	0.002	0.189	0.011	0.007
25.311	57.165	0.009	0.112	0.075	0.010	0.008	0.008	0.007	0.017	0.009	0.013	0.128	0.011	0.050	0.005	0.005	0.018	0.007	0.049	0.006	0.018
27.561	56.221	0.048	0.029	0.064	0.006	0.012	0.002	0.044	0.008	0.005	0.006	0.060	0.004	0.122	0.020	0.002	0.007	0.001	0.052	0.010	0.008
29.202	55.711	0.033	0.026	0.217	0.003	0.003	0.001	0.054	0.007	0.002	0.006	0.159	0.004	0.135	0.025	0.000	0.001	0.001	0.122	0.004	0.007
30.975	55.086	0.026	0.031	0.389	0.003	0.043	0.001	0.010	0.000	0.005	0.001	0.283	0.004	0.159	0.136	0.002	0.001	0.003	0.243	0.002	0.001
31.853	54.965	0.005	0.121	0.075	0.002	0.007	0.002	0.005	0.002	0.001	0.002	0.095	0.003	0.013	0.038	0.001	0.000	0.003	0.054	0.002	0.002
38.795	52.913	0.013	0.110	0.027	0.003	0.122	0.003	0.010	0.011	0.003	0.005	0.092	0.004	0.121	0.010	0.015	0.004	0.004	0.134	0.077	0.009
38.986	52.932	0.025	0.077	0.045	0.005	0.087	0.002	0.005	0.008	0.004	0.010	0.067	0.007	0.076	0.038	0.011	0.003	0.002	0.171	0.156	0.007
40.665	101.579	0.433	0.146	0.028	0.002	0.342	0.006	0.012	0.018	0.005	0.021	0.357	0.003	0.084	0.010	0.012	0.004	0.004	0.007	0.013	0.011
45.929	98.748	0.019	0.012	0.216	0.002	0.003	0.011	0.004	0.004	0.003	0.005	0.001	0.001	0.006	0.005	0.004	0.002	0.092	0.141	0.002	0.003
59.853	89.253	0.028	0.188	0.038	0.021	0.065	0.008	0.040	0.010	0.005	0.004	0.159	0.034	0.136	0.084	0.007	0.018	0.016	0.016	0.022	0.005
55.237	95.529	0.077	0.042	0.042	0.002	0.045	0.006	0.007	0.005	0.001	0.017	0.119	0.014	0.041	0.002	0.021	0.002	0.004	0.010	0.004	0.039
57.201	94.783	0.036	0.009	0.046	0.312	0.005	0.011	0.028	0.039	0.003	0.016	0.023	0.611	0.025	0.009	0.014	0.004	0.004	0.066	0.005	0.002
57.659	94.919	0.028	0.083	0.503	0.038	0.016	0.008	0.172	0.039	0.002	0.018	0.115	0.022	0.053	0.008	0.027	0.003	0.004	0.578	0.008	0.004
59.872	94.439	0.028	0.217	0.041	0.022	0.076	0.007	0.043	0.014	0.006	0.005	0.186	0.042	0.157	0.074	0.008	0.019	0.016	0.018	0.027	0.008
62.542	93.602	0.222	0.011	0.035	0.145	0.054	0.022	0.031	0.029	0.004	0.017	0.087	0.223	0.467	0.088	0.011	0.058	0.010	0.075	0.245	0.010
64.697	92.914	0.005	0.040	0.348	0.034	0.007	0.043	0.009	0.164	0.032	0.193	0.003	0.064	0.033	0.026	0.009	0.006	0.115	0.068	0.030	0.016
69.752	91.238	0.006	0.063	0.492	0.005	0.022	0.115	0.069	0.053	0.076	0.013	0.034	0.058	0.036	0.012	0.071	0.032	0.070	0.637	0.011	0.085
78.659	89.364	0.188	0.221	0.022	0.015	0.015	0.801	0.045	0.715	0.017	0.513	0.165	0.043	0.175	0.027	0.050	0.021	0.108	0.090	0.136	0.443
78.773	89.406	0.113	0.201	0.013	0.022	0.027	0.979	0.023	0.145	0.073	0.097	0.073	0.050	0.187	0.006	0.022	0.053	0.117	0.090	0.412	0.088
86.422	87.982	0.310	0.245	0.094	0.083	0.076	0.014	0.016	0.011	0.193	0.007	0.546	0.055	0.134	0.032	0.024	0.038	0.023	0.766	0.006	0.004
88.768	87.854	0.032	0.020	0.027	0.022	0.057	0.077	0.028	0.002	0.056	0.024	0.018	0.015	0.014	0.076	0.038	3.456	0.043	0.038	0.017	0.016
99.487	44.234	0.122	0.120	0.343	0.343	0.066	0.016	0.022	0.010	0.054	0.017	0.079	0.247	0.164	0.011	0.049	0.034	0.037	0.167	0.030	0.017
102.558	44.167	0.048	0.573	0.056	0.010	0.007	0.031	0.010	0.010	0.010	0.072	0.587	0.029	0.511	0.007	0.024	0.030	0.044	0.025	0.019	0.026
108.967	43.722	0.235	0.202	0.021	0.015	0.212	0.053	0.042	0.017	0.019	0.008	0.254	0.008	0.201	0.011	0.006	0.079	0.075	0.030	0.026	0.004
110.779	43.645	0.084	0.113	0.035	0.010	0.080	0.056	0.008	0.052	0.033	0.211	0.322	0.015	0.251	0.142	0.009	0.147	0.084	0.012	0.013	0.044
114.288	43.416	0.091	0.174	0.053	0.163	0.147	0.071	0.147	0.044	0.013	0.104	0.189	0.104	0.020	0.043	0.005	0.064	0.086	0.075	0.004	0.024
110.989	43.629	0.055	0.072	0.049	0.111	0.064	0.040	0.022	0.070	0.026	0.158	0.208	0.073	0.164	0.035	0.026	0.136	0.094	0.017	0.006	0.023
120.201	43.043	0.146	0.115	0.142	0.009	0.082	0.047	0.121	0.004	0.013	0.012	0.186	0.017	0.201	0.006	0.033	0.061	0.020	0.277	0.059	0.004
123.196	42.923	0.038	0.112	0.015	0.171	0.089	0.075	0.014	0.010	0.018	0.049	0.138	0.302	0.297	0.011	0.042	0.067	0.012	0.110	0.012	0.004
135.174	42.267	0.009	0.051	0.179	0.112	0.022	0.020	0.087	0.045	0.007	0.028	0.034	0.023	0.036	0.034	0.122	0.022	0.588	0.116	0.185	0.030
148.926	41.509	0.192	0.184	0.331	0.015	0.252	0.062	0.090	0.022	0.003	0.010	0.025	0.018	0.115	0.011	0.069	0.097	0.299	0.516	0.030	0.023
149.364	41.480	0.069	0.239	0.382	0.023	0.148	0.014	0.110	0.004	0.010	0.008	0.053	0.031	0.245	0.021	0.054	0.062	0.086	0.196	0.010	0.002
168.133	40.666	0.080	0.265	0.051	0.043	0.355	0.039	0.040	0.075	0.009	0.059	0.239	0.044	0.092	0.044	0.033	0.035	0.024	0.058	0.417	0.034
174.179	40.677	0.056	0.115	0.320	0.025	0.008	0.090	0.052	0.016	0.064	0.008	0.079	0.077	0.180	0.129	0.020	0.160	0.596	0.081	0.012	0.038
175.266	40.660	0.136	0.070	0.271	0.017	0.015	0.124	0.071	0.005	0.022	0.035	0.211	0.014	0.128	0.082	0.068	0.120	0.458	0.094	0.046	0.016
177.021	40.631	0.199	0.115	0.159	0.018	0.237	0.009	0.178	0.031	0.069	0.018	0.657	0.030	0.148	0.030	0.070	0.167	0.048	0.035	0.008	0.052
215.874	39.857	0.040	0.041	0.286	0.310	0.090	0.042	0.148	0.021	0.054	0.041	0.118	0.584	0.173	0.041	0.049	0.042	0.058	0.255	0.005	0.028
218.811	39.868	0.306	0.260	0.118	0.028	0.153	0.134	0.071	0.017	0.064	0.036	0.159	0.038	0.075	0.036	0.039	0.236	0.016	0.062	0.126	0.026
220.432	39.841	0.113	0.038	0.253	0.021	0.064	0.268	0.580	0.018	0.015	0.051	0.220	0.027	0.015	0.039	0.020	0.017	0.074	0.360	0.049	0.039
230.598	39.679	0.196	0.348	0.304	0.076	0.034	0.282	0.025	0.038	0.013	0.011	0.257	0.156	0.131	0.036	0.026	0.009	0.352	0.195	0.026	0.008
231.094	39.679	0.052	0.060	0.824	0.095	0.022	0.336	0.078	0.013	0.029	0.017	0.042	0.209	0.046	0.067	0.008	0.011	0.492	0.485	0.010	0.003
241.547	39.830	0.395	0.383	0.061	0.086	0.087	0.058	0.137	0.019	0.203	0.071	0.490	0.028	0.235	0.032	0.097	0.095	0.028	0.030	0.012	0.023
246.334	40.026	0.050	0.147	1.030	0.398	0.050	0.270	0.033	0.070	0.092	0.018	0.132	0.260	0.063	0.097	0.036	0.071	0.062	0.293	0.032	0.028
93.632	45.182	0.137	0.094	0.053	0.990	0.172	0.039	0.119	0.017	0.031	0.037	0.149	0.077	0.019	0.007	0.061	0.009	0.016	0.042	0.002	0.018
96.817	44.959	0.051	0.065	0.177	0.020	0.009	0.101	0.064	0.300	0.038	0.363	0.062	0.018	0.040	0.021	0.053	0.026	0.070	0.200	0.031	0.258

Table 3 Driving Point 3 Results

Point	DP3	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
Frequency (Hz)																					
24.700	49.942	0.002	0.003	0.065	0.074	0.000	0.008	0.033	0.003	0.008	0.106	0.002	0.000	0.008	0.126	0.008	0.002	0.006	0.039	0.002	0.003
24.910	49.902	0.000	0.001	0.017	0.036	0.001	0.002	0.021	0.001	0.004	0.052	0.001	0.001	0.002	0.057	0.001	0.002	0.001	0.012	0.000	0.002
25.158	49.778	0.000	0.002	0.161	0.077	0.001	0.001	0.091	0.005	0.003	0.100	0.004	0.004	0.001	0.087	0.001	0.000	0.001	0.170	0.001	0.012
29.202	135.429	0.001	0.001	0.205	0.161	0.000	0.001	0.259	0.000	0.005	0.174	0.000	0.002	0.001	0.262	0.002	0.000	0.001	0.191	0.001	0.018
30.231	133.397	0.000	0.001	0.115	0.018	0.001	0.000	0.134	0.001	0.000	0.049	0.001	0.001	0.000	0.130	0.000	0.000	0.001	0.111	0.000	0.002
30.975	132.639	0.002	0.001	0.473	0.641	0.001	0.002	0.105	0.002	0.001	0.014	0.001	0.003	0.003	0.037	0.007	0.005	0.003	0.498	0.001	0.129
48.027	122.507	0.001	0.001	0.005	0.005	0.001	0.017	0.007	0.001	0.007	0.209	0.000	0.001	0.014	0.253	0.031	0.000	0.014	0.006	0.001	0.003
48.943	122.023	0.003	0.001	0.003	0.004	0.001	0.063	0.003	0.001	0.047	0.005	0.000	0.001	0.052	0.020	0.120	0.003	0.050	0.003	0.001	0.001
49.706	121.246	0.001	0.002	0.034	0.015	0.001	0.041	0.039	0.002	0.049	0.046	0.000	0.002	0.035	0.050	0.113	0.002	0.035	0.009	0.001	0.001
54.684	119.931	0.000	0.000	0.058	0.037	0.001	0.004	0.264	0.003	0.008	0.116	0.001	0.002	0.003	0.198	0.003	0.001	0.002	0.045	0.000	0.002
56.324	119.143	0.001	0.001	0.077	0.112	0.002	0.011	0.362	0.006	0.017	0.137	0.002	0.002	0.009	0.342	0.012	0.005	0.003	0.074	0.001	0.006
57.659	117.903	0.002	0.001	0.016	1.024	0.001	0.014	0.099	0.005	0.011	0.118	0.001	0.005	0.011	0.214	0.058	0.004	0.005	0.006	0.001	0.008
62.637	115.870	0.010	0.006	0.234	0.049	0.027	0.015	0.025	0.033	0.188	0.013	0.005	0.002	0.026	0.016	0.178	0.041	0.049	0.197	0.010	0.083
68.359	114.479	0.001	0.009	0.599	0.072	0.023	0.045	0.065	0.025	0.061	0.020	0.001	0.006	0.029	0.026	0.039	0.030	0.009	0.284	0.001	0.134
73.814	77.052	0.017	0.022	0.164	0.010	0.008	0.067	0.098	0.256	0.173	0.078	0.011	0.009	0.066	0.064	0.006	0.008	0.067	0.027	0.021	0.009
74.387	77.317	0.011	0.016	0.172	0.032	0.028	0.097	0.096	0.141	0.097	0.054	0.009	0.005	0.115	0.166	0.025	0.025	0.106	0.059	0.014	0.013
88.444	75.255	0.004	0.009	0.032	0.012	1.462	0.312	0.077	0.030	0.017	0.014	0.005	0.030	0.086	0.050	0.020	0.015	0.195	0.018	0.002	0.025
88.673	75.334	0.016	0.016	0.022	0.015	2.157	0.119	0.020	0.038	0.027	0.003	0.006	0.019	0.033	0.029	0.012	0.086	0.079	0.007	0.003	0.038
88.997	75.333	0.008	0.010	0.001	0.027	0.739	0.212	0.137	0.061	0.007	0.024	0.006	0.008	0.060	0.142	0.045	0.097	0.100	0.005	0.005	0.017
94.814	74.544	0.017	0.014	0.165	0.229	0.074	0.028	0.056	0.256	0.018	0.134	0.008	0.011	0.052	0.263	0.063	0.044	0.062	0.088	0.008	0.032
110.855	72.579	0.484	0.573	0.155	0.029	0.055	0.011	0.019	0.003	0.014	0.018	0.002	0.004	0.017	0.015	0.011	0.007	0.006	0.017	0.003	0.043
114.307	72.239	0.033	0.018	0.274	0.181	0.055	0.045	0.247	0.069	0.514	0.054	0.006	0.031	0.051	0.162	0.064	0.029	0.015	0.006	0.012	0.073
115.471	71.992	0.035	0.040	0.036	0.061	0.038	0.009	0.034	1.029	0.029	0.019	0.006	0.009	0.016	0.053	0.114	0.058	0.065	0.029	0.122	0.125
123.653	71.288	0.006	0.014	0.142	0.053	0.048	0.032	0.051	0.005	0.012	0.041	0.002	0.552	0.007	0.152	0.003	0.092	0.015	0.092	0.007	0.007
130.882	70.630	0.012	0.028	0.055	0.157	0.057	0.090	0.167	0.024	0.142	0.052	0.003	0.033	0.010	0.265	0.051	0.159	0.036	0.032	0.004	0.036
141.182	69.808	0.008	0.009	0.053	0.157	0.013	0.021	0.507	0.030	0.003	0.155	0.004	0.008	0.078	0.100	0.070	0.072	0.060	0.083	0.008	0.076
145.893	69.592	0.005	0.011	0.074	0.077	0.022	0.027	0.163	0.005	0.021	0.142	0.003	0.099	0.187	0.354	0.016	0.103	0.025	0.060	0.006	0.062
153.542	68.955	0.002	0.001	0.112	0.150	0.024	0.013	0.058	0.022	0.004	0.228	0.003	0.022	0.063	0.544	0.003	0.152	0.025	0.018	0.007	0.009
156.364	68.891	0.003	0.004	0.058	0.041	0.399	0.008	0.278	0.016	0.045	0.215	0.004	0.104	0.032	0.354	0.112	0.061	0.014	0.004	0.002	0.051
173.740	67.608	0.005	0.003	0.127	0.068	0.092	0.097	0.007	0.008	0.049	0.047	0.005	0.012	0.127	0.224	0.016	0.021	0.119	0.147	0.005	0.293
173.397	67.635	0.002	0.003	0.053	0.031	0.106	0.018	0.032	0.008	0.017	0.026	0.006	0.013	0.122	0.114	0.071	0.030	0.289	0.068	0.001	0.361
201.950	66.309	0.019	0.024	0.071	0.046	0.161	0.272	0.114	0.013	0.013	0.097	0.003	0.024	0.348	0.237	0.028	0.168	0.131	0.039	0.031	0.008
203.228	66.335	0.006	0.010	0.039	0.064	0.082	0.058	0.218	0.003	0.040	0.241	0.017	0.002	0.047	0.747	0.099	0.021	0.028	0.071	0.019	0.027
203.915	66.300	0.010	0.007	0.540	0.192	0.072	0.082	0.110	0.011	0.015	0.200	0.003	0.011	0.035	0.470	0.060	0.154	0.011	0.284	0.035	0.004
209.846	66.346	0.006	0.009	0.087	0.391	0.005	0.003	0.439	0.111	0.028	0.258	0.013	0.014	0.086	0.446	0.087	0.152	0.020	0.071	0.106	0.009
211.201	66.225	0.004	0.005	0.039	0.570	0.052	0.046	0.131	0.688	0.022	0.145	0.011	0.007	0.083	0.070	0.038	0.037	0.082	0.040	0.515	0.012
211.468	66.204	0.002	0.006	0.051	0.764	0.024	0.057	0.141	0.441	0.068	0.029	0.009	0.007	0.065	0.051	0.041	0.083	0.100	0.060	0.315	0.048
227.547	65.816	0.003	0.002	0.089	0.098	0.025	0.416	0.240	0.029	0.031	0.043	0.009	0.009	0.161	1.032	0.129	0.095	0.205	0.035	0.012	0.126
245.056	65.381	0.005	0.008	0.434	0.049	0.050	0.044	0.485	0.427	0.029	0.053	0.010	0.418	0.094	0.392	0.109	0.196	0.066	0.178	0.251	0.035
19.588	101.603	0.001	0.001	0.085	0.122	0.001	0.003	0.032	0.001	0.002	0.022	0.001	0.001	0.004	0.012	0.003	0.001	0.002	0.079	0.000	0.001
38.795	44.469	0.001	0.001	0.063	0.091	0.003	0.005	0.012	0.002	0.140	0.006	0.001	0.003	0.005	0.022	0.002	0.001	0.006	0.049	0.000	0.005
39.463	44.410	0.004	0.004	0.025	0.045	0.007	0.009	0.018	0.006	0.041	0.037	0.006	0.005	0.006	0.065	0.003	0.003	0.006	0.017	0.002	0.003
58.918	118.078	0.000	0.002	0.031	0.029	0.004	0.030	0.046	0.007	0.005	0.044	0.002	0.001	0.011	0.087	0.004	0.006	0.042	0.003	0.000	0.094

Table 4 Driving Point 4 Results

Frequency (Hz)	Point	DP4	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417
	Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
18.501		5.309	0.131	0.435	0.262	0.430	0.211	1.168	0.116	0.139	0.255	0.140	0.214	0.030	0.283	0.188	0.977	0.152	0.174
19.035		34.449	0.057	0.113	0.059	0.104	0.048	1.623	0.054	0.046	0.095	0.040	0.055	0.079	0.266	0.044	0.102	0.123	0.065
19.150		27.117	0.049	0.218	0.076	0.177	0.061	1.153	0.131	0.096	0.205	0.015	0.098	0.169	0.218	0.011	0.235	0.245	0.134
29.202		23.148	0.577	0.491	0.032	0.275	0.032	0.948	0.130	0.143	0.325	0.229	0.164	0.711	1.804	0.493	0.287	0.180	0.178
32.005		26.853	0.770	0.649	0.055	0.348	0.051	0.581	0.229	0.149	0.289	0.307	0.214	0.959	0.321	0.533	1.914	0.541	0.161
33.340		34.636	0.034	0.072	0.050	0.067	0.038	0.007	0.033	0.022	0.032	0.027	0.036	0.038	0.037	0.037	0.230	0.028	0.024
37.861		65.515	0.064	0.232	0.213	0.226	0.163	0.030	0.128	0.030	0.068	0.111	0.119	0.111	0.919	0.134	0.196	0.146	0.024
43.488		28.381	0.405	0.302	0.298	0.039	0.220	0.359	0.262	0.087	0.221	0.547	0.080	0.462	0.301	0.070	0.311	0.427	0.107
44.785		17.696	1.264	1.251	1.098	0.050	0.809	0.506	0.990	0.328	0.920	2.125	0.384	1.641	1.612	0.104	1.795	1.641	0.378
50.106		30.124	0.107	0.225	0.404	0.083	0.313	0.165	0.389	0.081	0.239	0.584	0.093	0.108	0.052	0.256	0.327	0.257	0.099
52.452		60.485	0.813	0.744	0.953	0.282	0.828	0.282	0.183	0.101	1.165	0.264	0.544	0.557	1.019	0.061	0.287	0.212	0.255
52.147		60.648	0.152	0.331	0.395	0.061	0.302	0.158	0.441	0.078	0.053	0.703	0.173	0.125	0.110	0.433	0.071	0.209	0.071
53.329		141.704	0.857	0.770	0.536	0.108	0.510	0.103	0.561	0.141	1.174	0.557	0.551	0.377	0.198	0.081	0.056	0.095	0.273
55.294		88.438	0.210	0.161	0.513	0.080	0.441	0.409	0.114	0.074	0.201	0.355	0.141	0.189	0.484	0.397	0.559	0.141	0.087
66.032		84.775	0.566	0.470	0.587	0.108	0.421	0.617	0.457	0.089	0.825	1.050	0.418	0.399	0.601	1.009	0.550	0.223	0.094
66.204		85.439	0.461	0.376	0.475	0.091	0.334	0.590	0.371	0.080	0.782	0.834	0.298	0.339	0.408	0.851	0.428	0.141	0.146
72.365		55.750	0.311	0.292	0.686	0.439	0.749	0.838	0.331	0.157	0.317	0.097	0.440	0.132	1.299	0.793	0.302	0.541	0.090
75.302		55.236	0.334	0.178	0.325	1.160	0.794	0.828	1.386	0.275	0.016	0.108	1.605	0.634	1.612	0.351	1.295	1.778	0.337
81.463		25.125	0.310	0.089	0.513	0.549	0.845	1.097	0.694	0.509	1.016	0.916	0.264	0.117	0.914	0.469	0.447	0.243	0.741
82.321		25.185	0.361	0.493	1.089	0.743	1.449	0.659	0.312	0.467	0.260	1.154	0.123	0.128	0.431	0.260	2.016	0.588	0.605
83.504		10.829	0.027	0.576	0.073	0.334	0.125	0.730	0.469	0.611	0.408	0.105	0.296	0.326	0.657	0.486	0.539	0.534	0.577
94.852		26.617	0.299	0.136	0.291	0.371	0.100	0.313	0.135	0.139	0.673	0.341	0.340	0.338	0.353	0.170	0.481	0.360	0.282
104.370		26.730	0.537	0.531	0.120	0.363	0.982	0.391	0.577	0.054	0.274	0.364	0.473	0.756	0.421	0.085	0.103	0.463	0.125
105.686		25.110	1.690	0.081	0.738	0.401	1.451	0.613	1.266	0.061	0.216	0.267	0.757	1.484	1.826	0.425	0.838	0.722	0.105
121.021		26.462	0.293	0.430	0.273	0.051	0.436	0.289	0.080	0.339	0.424	0.255	0.097	0.228	0.145	0.153	0.547	0.357	0.139
123.634		12.060	0.430	0.499	0.266	0.155	0.203	0.117	0.197	0.597	0.163	0.082	0.087	0.018	2.884	0.777	1.538	0.721	0.315
127.430		13.363	0.109	0.265	0.368	0.107	0.159	0.031	0.070	0.134	0.107	0.063	0.160	0.031	0.107	0.139	0.066	0.164	0.110
147.457		12.948	0.092	0.115	0.520	0.279	0.100	0.075	0.179	0.037	0.059	0.184	0.238	0.335	0.127	0.199	0.432	0.175	0.070
147.705		12.915	0.087	0.096	0.491	0.226	0.139	0.166	0.205	0.021	0.009	0.171	0.162	0.327	0.168	0.164	0.440	0.143	0.049
146.618		12.904	0.098	0.222	0.466	0.210	0.045	0.136	0.285	0.038	0.052	0.364	0.142	0.442	0.075	0.285	0.102	0.175	0.015
161.018		12.689	0.079	0.391	0.293	0.021	0.109	0.077	0.544	0.070	0.236	0.428	0.351	0.042	0.192	0.566	0.378	0.220	0.064
169.010		11.895	0.139	0.147	0.373	0.015	0.910	0.029	0.168	0.553	0.385	0.050	0.232	0.136	0.378	0.163	0.669	0.430	0.282
155.506		12.980	0.119	0.264	0.224	0.042	0.084	0.098	0.117	0.081	0.190	0.235	0.357	0.238	0.515	0.062	0.045	0.177	0.113
188.065		12.752	0.409	0.036	0.156	0.053	0.200	0.211	0.331	0.067	0.380	0.145	0.120	0.416	0.098	0.236	0.332	0.141	0.195
193.119		12.594	0.185	0.236	0.128	0.161	0.192	0.079	0.198	0.073	0.304	0.119	0.347	0.164	0.112	0.075	0.249	0.156	0.161
209.427		12.329	0.368	0.601	0.445	0.124	0.524	0.889	0.310	0.244	0.437	0.566	0.852	0.190	0.374	0.768	0.581	0.377	0.223
212.708		14.913	0.723	0.908	1.113	0.079	0.170	0.440	0.901	0.309	0.907	0.635	0.413	0.653	0.051	0.067	0.333	0.260	0.408
214.119		15.607	0.203	0.471	0.506	0.140	0.365	0.031	0.224	0.079	0.370	0.191	0.364	0.239	0.395	0.338	0.232	0.149	0.228
247.288		9.698	0.045	0.322	0.177	0.018	0.389	0.210	0.088	0.110	0.117	0.167	0.209	0.037	0.221	0.103	1.007	0.036	0.085
247.784		9.684	0.093	0.323	0.200	0.026	0.328	0.198	0.080	0.117	0.155	0.126	0.193	0.041	0.157	0.151	0.404	0.058	0.102
247.898		9.588	0.119	0.295	0.269	0.053	0.412	0.180	0.076	0.155	0.132	0.138	0.296	0.026	0.137	0.206	0.354	0.050	0.151
249.176		6.380	0.120	0.108	0.252	0.114	0.348	0.094	0.035	0.117	0.030	0.128	0.231	0.032	0.088	0.143	0.150	0.069	0.142

Table 5 Driving Point 5 Results

Frequency (Hz)	DP5	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517
Point	DP5	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517
Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
18.692	31.351	0.080	0.026	0.017	0.056	0.293	0.151	0.023	0.108	0.049	0.015	0.021	0.704	0.011	0.011	0.019	0.023	0.020
18.692	31.311	0.082	0.026	0.017	0.056	0.298	0.154	0.023	0.110	0.049	0.016	0.022	0.718	0.011	0.011	0.020	0.024	0.021
19.054	31.395	0.048	0.059	0.010	0.103	0.382	0.147	0.015	0.136	0.050	0.010	0.089	0.683	0.009	0.009	0.010	0.013	0.015
24.624	9.068	0.138	0.134	0.245	0.280	0.214	0.298	0.568	0.146	0.535	0.391	0.085	0.379	0.261	0.136	0.465	0.444	0.440
24.738	23.340	0.162	0.120	0.257	0.266	0.226	0.311	0.526	0.216	0.498	0.362	0.094	0.374	0.275	0.146	0.424	0.455	0.407
27.180	11.740	0.288	0.089	0.271	0.251	0.528	0.754	0.520	0.124	0.660	0.318	0.124	0.646	0.614	0.394	0.246	0.590	0.327
29.221	29.226	0.137	0.251	0.383	0.512	0.308	0.198	0.049	0.365	0.588	0.032	0.502	0.332	0.345	0.263	0.264	0.096	0.092
30.994	26.592	0.051	0.493	0.078	0.490	0.172	0.042	0.061	0.188	0.152	0.049	0.056	0.067	0.090	0.059	0.051	0.087	0.061
31.891	23.318	0.255	0.107	0.505	0.206	0.666	0.343	0.300	0.139	0.302	0.175	0.080	0.339	0.278	0.216	0.080	0.124	0.172
39.005	25.507	0.055	0.312	0.156	0.297	0.311	0.103	0.156	0.227	0.048	0.084	0.063	0.448	0.086	0.091	0.030	0.020	0.067
39.692	24.780	0.026	0.153	0.232	0.024	0.150	0.028	0.242	0.101	0.124	0.135	0.192	1.007	0.198	0.168	0.053	0.136	0.124
41.180	26.639	0.110	0.349	0.304	0.854	0.287	0.082	0.251	0.128	0.525	0.218	0.378	0.634	0.239	0.194	0.238	0.330	0.289
48.046	25.331	0.061	0.033	0.014	0.057	0.015	0.035	0.161	0.021	0.030	0.063	1.684	0.276	0.164	0.075	0.088	0.328	0.052
49.667	23.619	0.266	0.203	0.157	0.330	0.347	0.427	0.671	0.132	0.183	0.403	0.341	0.019	0.053	0.315	0.071	0.505	0.260
56.324	23.919	0.163	0.645	0.079	0.229	1.264	0.633	0.182	0.411	0.123	0.158	0.740	0.427	0.065	0.040	0.048	0.355	0.119
56.324	24.647	0.170	0.639	0.077	0.235	1.301	0.652	0.193	0.424	0.128	0.153	0.756	0.440	0.065	0.037	0.048	0.365	0.112
57.259	21.957	0.331	1.231	0.463	0.330	0.772	0.077	0.435	0.133	0.577	0.629	1.088	0.204	0.081	0.621	0.173	0.118	0.578
57.678	24.659	0.149	1.764	0.165	1.767	0.352	0.036	0.197	0.055	1.181	0.165	0.177	0.055	0.083	0.337	0.061	0.195	0.044
63.553	19.093	0.853	0.431	0.314	0.380	1.027	0.096	0.336	0.687	0.192	0.447	1.361	0.187	0.265	0.390	0.326	0.670	0.038
71.526	21.182	0.371	3.959	0.328	0.585	0.391	0.135	0.541	0.258	0.767	0.513	0.545	0.620	0.132	0.464	0.054	0.082	0.343
72.498	19.854	0.068	1.997	0.513	0.926	0.330	0.015	0.935	0.190	0.463	0.732	0.596	0.861	0.351	0.313	0.231	0.220	0.352
81.463	16.939	0.055	4.672	0.818	0.734	0.367	0.480	1.361	0.137	0.942	0.456	1.269	1.620	0.170	0.207	0.257	0.391	0.081
82.321	22.946	0.087	1.829	0.463	1.810	0.069	0.229	0.501	0.076	0.866	0.367	0.322	0.178	0.202	0.391	0.147	0.131	0.273
77.877	19.959	0.741	0.040	0.262	1.220	0.394	0.297	0.220	0.871	0.412	0.312	0.340	0.584	0.274	0.866	0.069	0.183	0.155
92.697	21.738	0.238	0.733	0.128	1.037	0.823	0.106	0.262	0.804	0.237	0.099	0.444	0.110	0.042	0.034	0.143	0.336	0.164
93.708	20.855	0.042	0.993	0.197	0.907	0.253	0.079	0.413	0.216	0.210	0.028	0.394	0.364	0.033	0.187	0.304	0.269	0.051
100.384	22.070	0.138	0.173	0.537	1.664	0.736	0.078	0.403	0.183	1.793	0.109	0.124	0.675	0.054	0.052	0.084	0.042	0.244
114.632	15.972	0.134	1.177	0.407	0.538	0.308	0.116	0.990	0.369	0.081	0.174	2.345	0.888	0.011	0.277	0.082	0.742	0.021
116.119	12.779	0.615	0.689	0.704	1.781	1.007	0.321	1.666	2.533	0.242	0.373	2.449	1.785	0.144	0.804	0.051	2.555	0.046
117.702	18.959	0.080	0.879	0.211	1.134	1.262	0.244	0.837	0.666	0.381	0.283	1.275	0.285	0.068	0.321	0.092	0.456	0.213
131.817	18.114	0.178	2.004	0.362	1.531	0.479	0.222	0.271	0.089	0.342	0.155	2.142	1.834	1.120	1.485	0.284	0.541	0.255
120.621	21.362	0.023	2.129	0.043	1.844	0.196	0.239	0.276	0.328	0.323	0.101	0.717	0.179	0.127	0.125	0.021	0.209	0.052
125.885	21.262	0.147	0.781	0.260	2.455	0.171	0.030	0.332	0.041	0.396	0.462	0.079	0.850	0.209	0.226	0.228	0.288	0.596
127.392	21.490	0.099	0.920	0.099	1.784	0.432	0.034	0.245	0.275	0.113	0.143	0.218	0.086	0.149	0.070	0.017	0.052	0.207
154.934	21.439	0.085	0.703	0.118	1.938	0.073	0.045	0.288	0.055	0.377	0.112	0.825	0.311	0.125	0.041	0.050	0.183	0.120
159.416	20.697	0.315	1.735	0.205	0.534	0.091	0.129	0.298	0.128	0.201	0.073	0.263	0.249	0.172	0.188	0.084	0.233	0.067
161.591	20.279	0.194	1.915	0.291	0.339	0.464	0.168	0.384	0.301	0.222	0.202	0.945	0.383	0.257	0.178	0.080	0.070	0.141
165.749	19.943	0.113	1.780	0.077	1.214	0.103	0.076	0.127	0.493	1.138	0.104	0.684	0.247	0.229	0.342	0.095	0.079	0.070
171.108	19.976	0.184	2.965	0.063	1.088	0.178	0.076	0.188	0.298	0.164	0.073	0.676	0.460	0.237	0.197	0.055	0.090	0.097
174.732	20.017	0.133	2.128	0.101	0.676	0.092	0.190	0.325	0.245	0.105	0.113	0.910	0.605	0.191	0.146	0.123	0.047	0.034
198.727	19.349	0.114	0.863	0.392	0.648	0.164	0.288	0.244	0.150	0.253	0.221	0.956	0.574	0.104	0.133	0.152	0.258	0.084
209.846	20.238	0.245	0.506	0.139	0.887	0.185	0.053	0.632	0.091	0.353	0.152	0.972	0.454	0.148	0.185	0.156	0.219	0.156

Table 6 Driving Point 6 Results

Frequency (Hz)	DP6	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616
Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
30.556	88.896	0.065	0.020	0.000	0.002	0.017	0.001	0.166	0.013	0.820	0.005	0.002	0.006	0.000	0.023	0.014	0.015
30.975	87.594	0.019	0.004	0.003	0.005	0.010	0.005	0.028	0.004	0.155	0.003	0.005	0.008	0.004	0.202	0.128	0.003
35.877	84.731	0.013	0.002	0.001	0.001	0.011	0.001	0.001	0.003	0.014	0.004	0.000	0.008	0.004	0.021	0.008	0.004
38.795	83.121	0.044	0.004	0.002	0.009	0.040	0.003	0.003	0.011	0.038	0.004	0.004	0.026	0.015	0.004	0.022	0.027
41.618	83.198	0.032	0.007	0.001	0.003	0.030	0.003	0.007	0.002	0.014	0.003	0.003	0.010	0.012	0.015	0.012	0.005
45.662	81.316	0.435	0.058	0.002	0.003	0.290	0.001	0.734	0.005	0.559	0.004	0.003	0.055	0.113	0.154	0.044	0.016
48.885	80.318	0.241	0.009	0.013	0.017	0.227	0.079	0.226	0.033	0.150	0.003	0.033	0.107	0.093	0.037	0.004	0.065
50.201	80.112	0.203	0.008	0.006	0.009	0.185	0.030	0.136	0.019	0.067	0.004	0.021	0.028	0.075	0.061	0.035	0.015
49.381	80.907	0.071	0.003	0.003	0.009	0.065	0.056	0.053	0.010	0.030	0.004	0.028	0.019	0.026	0.032	0.011	0.020
30.308	88.764	0.026	0.010	0.003	0.004	0.004	0.003	0.080	0.006	0.384	0.004	0.003	0.002	0.005	0.042	0.035	0.012
30.384	87.499	0.081	0.022	0.001	0.004	0.018	0.002	0.218	0.016	1.074	0.005	0.004	0.007	0.002	0.015	0.014	0.024
53.062	78.581	0.210	0.024	0.004	0.002	0.180	0.049	0.089	0.026	0.021	0.005	0.042	0.004	0.073	0.120	0.078	0.020
69.427	77.940	0.198	0.108	0.009	0.058	0.123	0.152	0.033	0.048	0.262	0.010	0.131	0.022	0.103	0.113	0.062	0.008
69.580	77.864	0.203	0.103	0.002	0.075	0.137	0.195	0.033	0.044	0.281	0.014	0.170	0.032	0.093	0.064	0.036	0.007
69.714	77.808	0.056	0.008	0.002	0.031	0.032	0.101	0.005	0.011	0.059	0.011	0.088	0.012	0.027	0.073	0.039	0.008
75.016	77.085	0.178	0.278	0.001	0.023	0.212	0.008	0.022	0.029	0.025	0.011	0.039	0.063	0.292	0.027	0.013	0.028
75.741	76.655	0.346	0.381	0.015	0.103	0.407	0.036	0.050	0.107	0.041	0.008	0.139	0.162	0.510	0.044	0.034	0.072
76.084	76.599	0.256	0.135	0.015	0.086	0.347	0.016	0.040	0.103	0.035	0.012	0.058	0.291	0.431	0.039	0.048	0.071
82.455	75.832	0.244	0.365	0.003	0.037	0.366	0.032	0.769	0.078	0.669	0.019	0.061	0.188	0.303	0.183	0.188	0.056
82.722	75.681	0.208	0.309	0.005	0.076	0.302	0.116	0.625	0.039	0.530	0.013	0.197	0.210	0.251	0.191	0.146	0.060
91.381	75.434	0.026	0.075	0.001	0.053	0.073	0.035	0.015	0.091	0.052	0.018	0.042	0.014	0.018	0.070	0.078	0.026
91.705	75.478	0.123	0.233	0.012	0.113	0.338	0.077	0.028	0.153	0.118	0.023	0.074	0.035	0.077	0.019	0.046	0.088
94.662	74.895	0.187	0.786	0.006	0.317	0.409	0.068	0.101	0.231	0.490	0.021	0.130	0.058	0.164	0.082	0.030	0.077
107.365	74.717	0.377	0.064	0.001	0.196	0.408	0.031	0.289	0.109	0.167	0.023	0.046	0.146	0.613	0.207	0.680	0.121
109.215	74.562	0.339	0.057	0.001	0.127	0.140	0.003	0.165	0.026	0.076	0.032	0.051	0.025	0.229	0.124	0.058	0.302
110.416	74.721	0.218	0.045	0.004	0.125	0.040	0.028	0.102	0.117	0.082	0.018	0.046	0.025	0.056	0.185	0.052	0.107
120.869	70.302	0.487	0.533	0.005	0.157	0.105	0.140	0.707	0.061	0.149	0.027	0.046	0.034	0.139	0.115	0.068	0.076
120.373	70.215	0.351	0.376	0.009	0.150	0.073	0.099	0.522	0.020	0.144	0.027	0.007	0.009	0.109	0.092	0.046	0.018
128.899	67.050	0.320	0.230	0.018	0.033	0.173	0.100	0.326	0.091	0.093	0.047	0.176	0.232	0.387	0.056	0.040	0.038
149.612	62.851	0.622	0.129	0.002	0.165	0.116	0.045	0.357	0.051	0.238	0.036	0.058	0.042	0.109	0.045	0.025	0.155
149.822	62.509	1.728	0.385	0.006	0.186	0.424	0.065	0.909	0.146	0.704	0.033	0.073	0.161	0.311	0.036	0.011	0.294
149.384	62.544	0.565	0.144	0.005	0.075	0.123	0.038	0.341	0.093	0.220	0.033	0.058	0.081	0.122	0.046	0.023	0.137
169.525	63.005	0.317	0.174	0.036	0.097	0.098	0.129	0.055	0.120	0.194	0.077	0.156	0.347	0.347	0.072	0.121	0.183
174.217	63.067	0.574	0.648	0.067	0.107	0.800	0.325	0.139	0.447	0.715	0.049	0.238	0.356	0.115	0.422	0.374	0.253
174.675	63.296	0.601	0.489	0.025	0.092	0.614	0.186	0.123	0.192	0.659	0.052	0.071	0.310	0.023	0.034	0.072	0.224
184.650	62.855	0.851	0.737	0.022	0.111	1.135	0.257	0.142	0.979	0.999	0.110	0.450	0.257	0.431	0.074	0.107	0.386
197.506	62.719	0.961	0.083	0.244	0.052	0.969	0.051	0.473	0.112	0.445	0.111	0.087	0.078	1.057	0.152	0.246	0.041
198.460	63.023	1.739	0.213	0.190	0.082	1.540	0.276	0.146	0.739	0.378	0.113	0.441	0.065	1.882	0.002	0.024	0.544
198.689	62.889	1.808	0.218	0.219	0.020	1.522	0.166	0.064	0.577	0.327	0.093	0.190	0.045	1.914	0.086	0.121	0.488
198.956	62.926	1.247	0.184	0.095	0.087	1.094	0.049	0.074	0.257	0.266	0.117	0.033	0.044	1.322	0.055	0.106	0.271
216.560	62.838	0.661	0.766	0.045	0.266	0.409	0.475	0.603	0.392	0.289	0.150	0.321	0.228	0.895	0.032	0.099	0.254
237.579	62.783	0.495	0.100	0.023	0.121	0.793	0.254	0.314	0.152	0.231	0.181	0.215	0.150	0.824	0.042	0.039	0.382
240.059	62.924	0.565	0.066	0.013	0.137	0.543	0.097	0.503	0.485	0.429	0.181	0.153	0.228	0.225	0.177	0.387	0.332

Table 7 Driving Point 7 Results

Frequency (Hz)	Point	DP1	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716
	Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
18.673		104.854	0.003	0.007	0.088	0.068	0.005	0.414	0.296	0.012	0.122	0.315	0.004	0.002	0.031	0.198	0.009	0.017
19.035		103.776	0.002	0.004	0.399	0.233	0.004	0.360	0.262	0.008	0.148	0.276	0.003	0.002	0.019	0.175	0.006	0.055
19.855		103.419	0.002	0.000	0.302	0.323	0.000	0.085	0.070	0.003	0.109	0.067	0.001	0.001	0.015	0.139	0.001	0.013
24.204		98.449	0.008	0.003	0.051	0.042	0.011	0.055	0.026	0.005	0.044	0.048	0.032	0.002	0.018	0.011	0.004	0.030
25.139		96.644	0.015	0.009	0.295	0.173	0.022	0.827	0.031	0.025	0.016	0.672	0.036	0.003	0.150	0.100	0.008	0.073
25.311		98.060	0.015	0.008	0.137	0.083	0.005	0.268	0.028	0.007	0.122	0.217	0.006	0.008	0.082	0.028	0.010	0.120
27.256		95.312	0.022	0.007	0.390	0.186	0.032	0.215	0.432	0.009	0.069	0.114	0.033	0.013	0.049	0.046	0.007	0.070
30.956		93.706	0.008	0.002	0.889	0.531	0.008	0.199	0.092	0.169	0.525	0.158	0.007	0.004	0.052	0.052	0.047	0.064
31.128		93.382	0.006	0.002	0.599	0.359	0.008	0.043	0.042	0.065	0.335	0.033	0.006	0.002	0.042	0.028	0.018	0.043
32.558		92.517	0.005	0.002	0.093	0.077	0.016	0.131	0.103	0.054	0.016	0.094	0.019	0.041	0.006	0.012	0.016	0.010
42.171		88.089	0.010	0.043	0.031	0.010	0.017	0.009	0.007	0.066	0.011	0.002	0.075	0.031	0.019	0.008	0.026	0.010
45.414		87.011	0.032	0.023	0.044	0.003	0.012	0.037	0.020	0.118	0.006	0.025	0.017	0.004	0.007	0.010	0.030	0.007
45.776		86.793	0.121	0.042	0.100	0.012	0.085	0.019	0.010	0.366	0.009	0.012	0.162	0.005	0.011	0.012	0.044	0.001
47.855		85.886	0.031	0.003	0.023	0.007	0.074	0.007	0.005	0.075	0.019	0.003	0.137	0.053	0.018	0.017	0.005	0.003
48.580		85.712	0.039	0.014	0.005	0.002	0.167	0.011	0.003	0.084	0.004	0.007	0.297	0.034	0.012	0.006	0.002	0.004
48.866		85.521	0.033	0.011	0.018	0.014	0.090	0.017	0.010	0.101	0.029	0.009	0.181	0.639	0.018	0.042	0.028	0.007
63.286		81.584	0.003	0.006	0.054	0.007	0.032	0.021	0.031	0.028	0.078	0.022	0.038	0.118	0.006	0.037	0.017	0.014
64.526		81.251	0.130	0.036	0.171	0.102	0.060	0.006	0.026	0.332	0.017	0.019	0.009	0.030	0.002	0.021	0.020	0.003
64.697		81.126	0.169	0.033	0.190	0.127	0.078	0.015	0.038	0.420	0.026	0.031	0.019	0.018	0.007	0.039	0.059	0.008
65.250		80.858	0.062	0.017	0.057	0.045	0.035	0.009	0.020	0.075	0.006	0.012	0.003	0.034	0.011	0.023	0.031	0.009
74.348		78.556	0.144	0.067	0.062	0.049	0.365	0.098	0.050	0.227	0.045	0.018	0.130	0.026	0.030	0.021	0.138	0.041
75.035		78.893	0.071	0.145	0.021	0.022	0.056	0.045	0.055	0.033	0.002	0.005	0.048	0.041	0.036	0.016	0.273	0.048
74.711		78.771	0.157	0.228	0.072	0.024	0.189	0.008	0.012	0.175	0.005	0.004	0.084	0.023	0.009	0.005	0.462	0.019
75.417		78.794	0.051	0.181	0.066	0.016	0.044	0.087	0.015	0.085	0.102	0.025	0.108	0.054	0.128	0.081	0.353	0.146
91.877		76.305	1.067	1.441	0.109	0.063	0.213	0.058	0.066	1.546	0.018	0.009	0.045	0.264	0.031	0.009	0.783	0.017
92.087		76.289	0.624	0.837	0.064	0.069	0.140	0.106	0.096	1.040	0.035	0.017	0.204	0.214	0.011	0.015	0.580	0.040
92.239		76.108	0.365	0.439	0.189	0.048	0.079	0.094	0.069	0.387	0.051	0.024	0.167	0.185	0.059	0.012	0.205	0.047
108.089		73.956	0.872	0.123	0.039	0.005	1.596	0.014	0.010	0.120	0.043	0.008	0.346	0.161	0.008	0.009	0.778	0.021
108.719		74.238	1.220	1.029	0.074	0.070	1.766	0.099	0.105	0.442	0.740	0.052	0.429	0.209	0.014	0.418	0.596	0.086
108.967		74.080	0.865	0.697	0.092	0.041	0.880	0.090	0.102	0.267	0.711	0.054	0.408	0.028	0.032	0.497	0.898	0.041
135.250		71.725	1.231	0.495	0.412	0.186	0.743	0.049	0.164	2.308	0.047	0.105	0.331	0.033	0.024	0.035	0.696	0.034
135.460		71.719	0.868	0.255	0.152	0.074	1.109	0.102	0.072	1.375	0.191	0.046	0.349	0.146	0.035	0.003	0.394	0.043
137.424		71.822	0.538	0.058	0.041	0.008	0.140	0.009	0.005	0.596	0.073	0.009	0.109	0.082	0.017	0.043	0.961	0.010
140.209		71.305	1.299	0.204	0.204	0.108	0.074	0.126	0.079	1.011	0.107	0.090	0.043	0.019	0.015	0.024	0.784	0.019
145.493		70.918	0.965	1.096	0.197	0.052	0.095	0.357	0.201	0.355	0.160	0.181	0.050	0.020	0.077	0.067	0.694	0.251
145.702		70.554	0.970	1.027	0.206	0.042	0.112	0.379	0.311	0.223	0.138	0.197	0.063	0.090	0.036	0.043	0.692	0.122
169.811		69.386	1.014	0.866	0.135	0.106	0.157	0.537	0.422	0.730	0.052	0.125	0.387	0.099	0.006	0.080	0.567	0.033
158.958		70.005	0.557	0.037	0.100	0.028	0.032	0.061	0.060	0.395	0.165	0.024	0.015	0.092	0.014	0.089	0.128	0.049
169.563		69.473	1.151	1.233	0.112	0.129	0.341	0.052	0.208	0.769	0.066	0.050	0.727	0.053	0.019	0.125	1.053	0.061
184.116		68.877	0.969	0.266	0.061	0.059	0.133	0.146	0.072	0.460	0.085	0.090	0.134	0.161	0.014	0.065	0.396	0.074
184.803		68.676	0.556	0.201	0.218	0.066	0.053	0.102	0.040	0.397	0.042	0.054	0.096	0.071	0.006	0.067	0.319	0.028
194.492		68.017	2.090	0.261	0.159	0.068	0.365	0.057	0.054	0.678	0.014	0.075	0.789	0.157	0.017	0.002	0.585	0.051
195.961		68.013	1.200	0.550	0.100	0.037	0.196	0.135	0.055	0.221	0.073	0.086	0.834	0.084	0.006	0.112	0.626	0.061
197.144		67.991	0.863	0.322	0.147	0.073	0.080	0.150	0.052	0.151	0.058	0.117	0.426	0.019	0.020	0.030	0.424	0.037
197.868		68.026	0.598	0.252	0.067	0.006	0.044	0.105	0.039	0.106	0.027	0.148	0.214	0.051	0.012	0.024	0.245	0.043
199.738		67.963	0.571	0.267	0.214	0.112	0.218	0.081	0.026	0.190	0.159	0.078	0.369	0.138	0.003	0.073	0.552	0.019
221.424		67.242	0.604	0.375	0.102	0.019	0.059	0.025	0.041	0.034	0.017	0.022	0.045	0.166	0.025	0.024	0.144	0.015
200.787		59.620	0.245	0.166	0.206	0.072	0.031	0.110	0.192	0.164	0.052	0.147	0.224	0.042	0.039	0.073	0.431	0.029
234.528		66.854	0.518	0.114	0.098	0.070	0.172	0.010	0.074	0.507	0.027	0.017	0.071	0.113	0.038	0.043	0.173	0.019
38.052		87.579	0.013	0.012	0.045	0.015	0.007	0.013	0.009	0.003	0.017	0.014	0.014	0.015	0.010	0.013	0.019	0.004

Table 8 Driving Point 8 Results

Frequency (Hz)	Point	DP8	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816
	Units	N	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)	g (rms)
11.959		164.086	0.001	0.001	0.004	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.002	0.001	0.001
12.531		159.011	0.001	0.002	0.005	0.002	0.000	0.001	0.001	0.002	0.001	0.001	0.000	0.000	0.001	0.003	0.001	0.001
25.158		138.392	0.026	0.013	0.262	0.449	0.032	0.008	0.340	0.010	0.008	0.009	0.035	0.025	0.010	0.403	0.012	0.083
25.921		174.834	0.002	0.001	0.018	0.022	0.001	0.010	0.019	0.002	0.005	0.005	0.000	0.001	0.002	0.007	0.001	0.012
27.313		172.355	0.006	0.009	0.113	0.277	0.012	0.015	0.285	0.004	0.010	0.008	0.013	0.005	0.006	0.100	0.008	0.105
29.202		166.716	0.015	0.002	0.757	1.118	0.013	0.013	0.958	0.123	0.049	0.037	0.010	0.009	0.005	0.055	0.018	0.632
30.975		164.473	0.005	0.002	0.654	0.108	0.011	0.012	0.099	0.335	0.001	0.001	0.007	0.004	0.007	0.006	0.009	0.499
32.768		164.582	0.008	0.001	0.040	0.972	0.005	0.016	0.146	0.020	0.006	0.005	0.004	0.006	0.032	0.009	0.021	0.011
39.845		157.722	0.156	0.024	0.034	0.301	0.052	0.035	0.112	0.018	0.103	0.082	0.034	0.066	0.032	0.002	0.009	0.013
40.016		156.824	0.184	0.019	0.089	0.033	0.047	0.043	0.041	0.013	0.063	0.054	0.033	0.069	0.040	0.002	0.025	0.045
43.373		156.890	1.039	0.001	0.017	0.021	0.007	0.032	0.009	0.009	0.016	0.017	0.007	0.024	0.010	0.001	0.038	0.070
48.027		155.043	0.018	0.003	0.028	1.270	0.006	0.039	0.713	0.054	0.193	0.199	0.007	0.010	0.075	0.072	0.010	0.042
50.030		151.365	1.019	0.003	0.029	0.023	0.008	0.043	0.015	0.033	0.014	0.011	0.008	0.338	0.192	0.005	0.065	0.028
50.945		150.051	0.064	0.003	0.003	0.018	0.002	0.040	0.008	0.009	0.011	0.009	0.004	0.005	0.046	0.001	0.019	0.018
53.329		148.866	0.015	0.007	0.118	0.325	0.008	0.042	0.258	0.027	0.005	0.006	0.011	0.006	0.033	0.020	0.013	0.141
58.937		146.253	0.025	0.005	0.081	0.153	0.013	0.054	0.042	0.011	0.007	0.030	0.006	0.015	0.015	0.006	0.089	0.043
62.675		143.430	0.092	0.007	0.017	0.005	0.015	0.031	0.002	0.062	0.024	0.031	0.018	0.044	0.058	0.003	0.167	0.069
65.155		143.559	0.093	0.019	0.126	0.383	0.009	0.073	0.060	0.439	0.051	0.123	0.010	0.040	0.007	0.002	0.855	0.025
74.387		139.879	0.014	0.080	0.005	0.053	0.055	0.087	0.043	0.052	0.003	0.072	0.024	0.014	0.003	0.000	0.016	0.027
76.466		139.515	0.033	0.048	0.085	0.257	0.076	0.110	0.072	0.071	0.009	0.015	0.037	0.055	0.018	0.001	0.004	0.011
88.291		137.025	0.130	1.969	0.003	0.052	0.140	0.387	0.038	0.015	0.115	0.046	0.013	0.010	0.188	0.004	0.105	0.036
88.520		140.670	0.243	5.272	0.126	0.130	0.688	0.540	0.095	0.056	0.084	0.047	0.035	0.023	0.189	0.009	0.017	0.020
88.959		139.540	0.400	3.686	0.283	0.052	0.199	0.469	0.239	0.190	0.074	0.093	0.034	0.052	0.326	0.012	0.108	0.030
93.403		137.935	0.340	0.530	0.203	0.474	0.793	2.282	0.175	0.167	0.046	0.035	0.043	0.371	0.111	0.027	0.284	0.043
93.842		138.054	0.390	0.225	0.024	0.208	0.170	1.954	0.067	0.092	0.024	0.014	0.016	0.365	0.028	0.014	0.103	0.023
109.406		134.822	0.047	1.463	0.057	0.063	0.099	0.076	0.063	0.452	0.035	0.023	0.204	0.027	0.020	0.001	0.036	0.058
115.051		134.609	0.111	0.732	0.130	0.319	0.520	0.295	0.477	0.323	0.063	0.019	0.272	0.018	0.352	0.012	0.150	0.136
115.395		134.329	0.819	0.377	0.063	0.098	0.441	0.424	0.193	0.196	0.065	0.069	0.248	0.073	0.239	0.004	0.168	0.084
127.983		135.363	1.352	0.271	0.091	0.165	0.135	12.098	0.163	0.061	0.049	0.031	0.729	0.742	0.030	0.025	0.285	0.141
125.885		134.567	1.180	0.084	0.449	0.194	0.107	1.874	0.114	0.024	0.020	0.098	0.265	1.113	0.041	0.108	0.158	0.028
130.272		133.921	0.122	1.085	0.072	0.192	1.698	1.941	0.172	0.400	0.041	0.225	0.301	0.423	0.225	0.058	0.055	0.303
144.234		133.471	1.426	0.013	0.076	0.206	0.082	1.386	0.027	0.029	0.069	0.047	0.104	0.491	0.053	0.107	0.017	0.105
151.176		131.213	0.976	0.924	0.317	0.209	0.145	0.402	0.068	0.117	0.029	0.032	0.966	0.026	0.231	0.179	0.206	0.155
155.849		130.485	0.058	1.150	0.104	0.078	0.270	0.177	0.079	0.105	0.026	0.056	0.224	0.055	0.235	0.096	0.048	0.327
174.675		130.051	0.093	0.911	0.439	0.135	0.810	0.058	0.047	0.346	0.049	0.035	0.496	0.128	0.118	0.088	0.007	0.183
179.977		129.801	0.073	0.387	0.488	0.186	0.669	0.303	0.007	0.201	0.038	0.044	0.587	0.256	0.252	0.070	0.239	0.303
171.032		130.135	0.454	0.825	0.855	0.184	0.535	0.088	0.065	0.254	0.063	0.051	0.051	0.848	0.087	0.180	0.152	0.024
189.095		128.533	1.602	0.655	0.213	0.579	0.129	2.314	0.271	0.051	0.055	0.241	0.222	0.498	0.065	0.058	0.383	0.130
199.451		128.458	1.667	0.819	0.582	0.739	0.225	1.614	0.505	0.052	0.065	0.071	0.405	2.413	0.024	0.266	0.827	0.470
204.964		127.869	0.947	0.634	0.911	0.265	1.142	1.340	0.158	0.080	0.059	0.020	0.274	0.166	0.167	0.051	0.184	0.149
205.326		128.570	1.094	0.463	0.658	0.640	1.902	1.259	0.181	0.230	0.148	0.018	0.350	0.182	0.546	0.218	0.318	0.106
215.569		127.069	0.999	2.283	0.159	0.313	0.952	6.245	0.110	0.297	1.023	0.732	0.352	0.331	0.082	0.085	0.118	0.153
231.209		126.964	0.397	0.123	0.080	0.143	0.108	2.756	0.118	0.219	0.170	0.122	0.203	2.571	0.144	0.028	0.404	0.037
239.162		126.451	0.032	0.184	0.249	0.738	0.132	10.509	0.670	1.184	0.073	0.399	1.599	0.682	0.489	0.316	0.801	0.006
247.459		125.598	0.041	2.676	0.327	0.113	1.014	3.184	0.228	0.018	0.203	0.113	4.346	3.716	0.138	0.134	0.127	0.338
247.746		125.552	0.033	2.572	0.587	0.191	1.147	3.767	0.220	0.111	0.161	0.182	2.222	1.657	0.208	0.082	0.173	0.091
254.345		125.773	0.027	1.794	0.273	0.424	0.196	3.740	0.122	0.080	0.821	0.349	0.748	1.179	0.058	0.064	0.692	0.009
17.414		99.210	0.001	0.000	0.006	0.111	0.000	0.003	0.093	0.000	0.001	0.001	0.000	0.001	0.000	0.066	0.000	0.002
18.692		97.596	0.004	0.001	0.060	0.179	0.005	0.002	0.238	0.005	0.001	0.001	0.005	0.004	0.002	0.004	0.002	0.101
19.054		138.862	0.002	0.002	0.167	0.250	0.002	0.003	0.265	0.003	0.001	0.001	0.003	0.001	0.002	0.050	0.002	0.087

Temperatures

Upper Thermocouple (°F)

Driving Point	1	2	3	4	5	6	7	8
Pre Test	77.5	76.8	75.2	75.6	74.9	75.1	77.5	74.8
Post Test	76.0	75.6	76.1	77.6	75.4	76.8	77.8	76.8

Lower Thermocouple (°F)

Driving Point	1	2	3	4	5	6	7	8
Pre Test	74.4	72.2	69.6	72.6	68.9	67.6	74.5	67.3
Post Test	72.3	70.9	71.2	76.0	72.5	72.6	71.8	72.2

Appendix A – Sensor Specifications

Manufacturer	PCB Piezotronics
Model	352C68
Type	ICP Accelerometer
Sensitivity (Nom.)	100mV/g
Measurement range	50g
Frequency range (5% Amplitude)	0.5 to 10,000Hz
Broadband resolution	0.00016g rms
Mass	0.07 oz

Manufacturer	PCB Piezotronics
Model	208A03
Coupling type	ICP Load Cell
Sensitivity (Nom)	10 mV/lb
Measurement range	500 lb
Frequency range (5% Amplitude)	0.0003 to 36 kHz
Broadband resolution	0.005 lb rms

Appendix B – Calibration Certificates

Report number: **2589**

Certificate of Calibration and Conformance

for

PIMENTO

Customer	: **Larson Davis**
Contact person	: **Chad Walber**
Calibration performed at	: **Larson Davis**
Location	: **Provo, Utah**
System	: **Pimento P103**
Serial number	: **002204**
Calibration date	: **23MAR2006**
Certified and signed by	: **Sean Childs**

LMS Instruments has developed a calibration software program, which eliminates handling errors and verifies that a LMS Instruments product meets its full specifications.

This verification is compliant with the ISO 9001-2000 standards.

LMS Instruments recommends a calibration interval of every twelve (12) months.

System calibrated by Larson Davis, Inc.

ISO 9001-2000 Registered Company

1681 West 820 North
Provo, Utah 84601
Telephone – (801) 375-0177

Test Technician: .....

LMS Instruments BV
Druivenstraat 47, NL-4816 KB Breda
The Netherlands
Phone: +31 76 5736363
Fax: +31 76 5736373

Report number: **2589**

Environmental Conditions

Temperature: **24° C** **Humidity:** **24%**

System configuration

Item	*Quantity*	*Description*
1	1	PDTACH
1	1	ASP824C

Equipment used for calibration

Instrument	Model	Serial Number	Cal Certificate	Due Date
Digital multimeter	HP 34401A	US36033460	277736	05/27/06
Signal generator	HP 33120A	US36003253	286223	01/04/07

This Certificate attests that this instrument has been verified under the stated conditions with Measurement and Test Equipment (M&TE) standards traceable to the National Institute of Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Larson Davis corporate headquarters. An acceptable accuracy ratio between the standard(s) and the system verified has been maintained. This system meets or exceeds the manufacturers' published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the instrument and/or characteristics that were verified. Calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of Larson Davis.

 Test Technician: .....

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Fax: +31 76 5736373

Report number: **2589**

Calibration Test Report

RPM Accuracy Test

Input	Target	Value	Result
1000.000	0.200	1000.2Hz	OK
500.000	0.200	500.1Hz	OK
100.000	0.200	100.0Hz	OK
50.000	0.200	50.0Hz	OK
10.000	0.200	10.0Hz	OK
5.000	0.200	5.0Hz	OK

Test Technician: .....

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The Netherlands
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Fax: +31 76 5736373

Report number: **2589**

Module A ASP824 501085

Offset Test

Input	0.000
Target	0.003
CH1	0.6mV
CH2	0.2mV
CH3	0.6mV
CH4	0.5mV
CH5	1.2mV
CH6	0.8mV
CH7	0.5mV
CH8	0.8mV
Result	OK

DC/SE Gain Test

Range	10.0V	3.16V	1.0V	0.316V
Input	5.000	2.000	0.500	0.200
Target	0.200	0.200	0.500	0.500
CH1	5003.8mV	2001.6mV	500.5mV	200.3mV
CH2	5003.4mV	2001.5mV	500.5mV	200.3mV
CH3	5003.4mV	2001.5mV	500.5mV	200.3mV
CH4	5003.5mV	2001.5mV	500.6mV	200.3mV
CH5	5003.8mV	2001.7mV	500.5mV	200.3mV
CH6	5003.9mV	2001.6mV	500.5mV	200.3mV
CH7	5003.5mV	2001.6mV	500.6mV	200.3mV
CH8	5003.2mV	2001.6mV	500.6mV	200.3mV
Result	OK	OK	OK	OK

AC/SE Gain Test

Range	10.0V	3.16V	1.0V	0.316V
Input	5.000	1.500	0.500	0.150
Target	0.200	0.200	0.500	0.500
CH1	5004.8mV	1501.4mV	500.4mV	150.1mV
CH2	5004.6mV	1501.3mV	500.4mV	150.1mV
CH3	5004.7mV	1501.3mV	500.4mV	150.1mV
CH4	5004.6mV	1501.3mV	500.4mV	150.1mV
CH5	5004.9mV	1501.4mV	500.4mV	150.1mV
CH6	5004.5mV	1501.3mV	500.4mV	150.1mV
CH7	5004.7mV	1501.3mV	500.4mV	150.1mV
CH8	5004.3mV	1501.2mV	500.3mV	150.1mV
Result	OK	OK	OK	OK

Test Technician: .....

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Report number: **2589**

DAC DC test

10.000	1.000	0.100	0.000	-0.500	-5.000	-10.000
0.200	0.200	0.300	0.002	0.200	0.200	0.200
10000.0mV	1000.5mV	100.1mV	-0.0mV	-500.2mV	-5002.2mV	-10000.0mV
OK	OK	OK	OK	OK	OK	OK

DAC AC Test

10.000	5.000	1.000	0.500	0.100
0.200	0.200	0.200	0.200	0.300
10000.0mV	5002.2mV	1000.4mV	500.2mV	100.1mV
OK	OK	OK	OK	OK

Test Technician: .....

LMS Instruments BV
Druivenstraat 47, NL-4816 KB Breda
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CALIBRATION CERTIFICATE

Model: 208A03
Serial #: 7784
Description: Force Sensor
Type: ICP

Date: 11/16/2007
By: Ron Stevens, Jr., Cal.Tech.
Station: 0-1,000 lb Load Cell (Test Procedure AT-501-2)

Sensitivity*: 10.59 mV/LBF
2.381 mV/N

Temp: 75 deg F [24deg C]
Humidity: 31 %

Linearity*: 0.3% FS
Uncertainty:** +/- 1 %

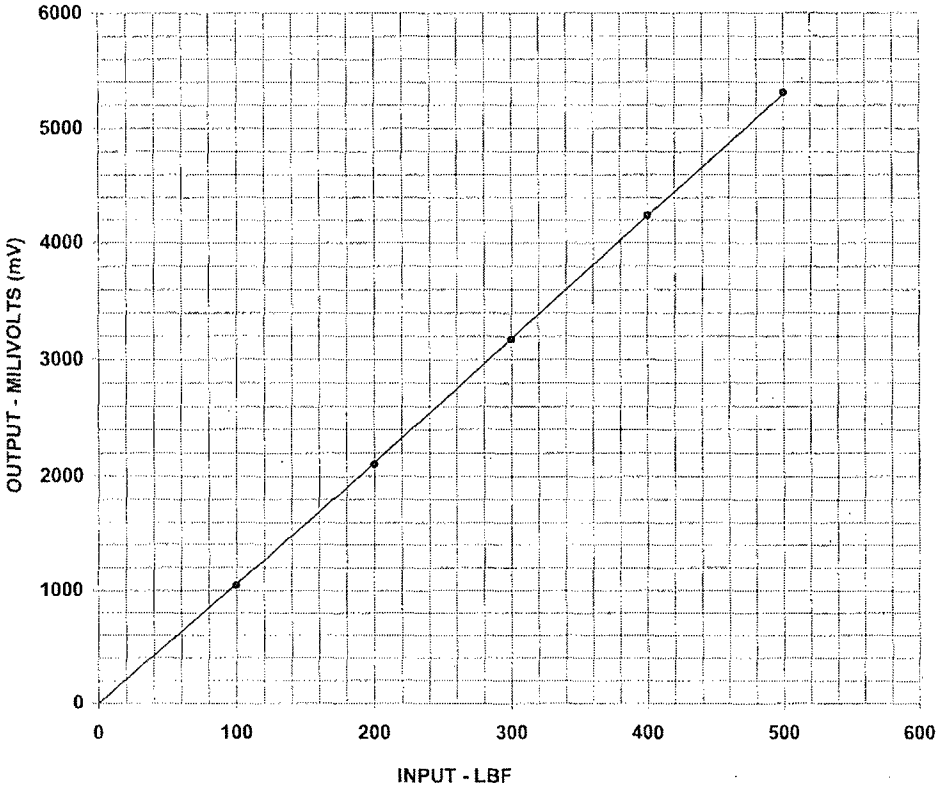
Cert #: 277905

Bias: 10.92 VDC

* Zero based, least-squares straight line.

** Measurement uncertainty represented using a coverage factor of k=2 which provides a level of confidence of approximately 95 %.

Condition of Unit:
As Found: In tolerance
As Left: In tolerance



TEST DATA

INPUT (LBF)	OUTPUT (mV)
100	1046
200	2103
300	3169
400	4238
500	5310

Notes:
1 FCS-1
2 Standard calibration is supplied in compression mode.
3 Calibration is traceable to NIST and is accredited to ISO 17025 and ANSI/NCSL Z540-1-1994.
4 NIST traceability through PCB control # KE104.
5 This certificate may not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.

ACCREDITED
Cert. No. 1862.01

PCB PIEZOTRONICS INC.

Tel: 716-684-0001 Fax: 716-684-0987 Email: sales@pcb.com
3425 Walden Avenue, Depew NY 14043

ISO 9001 CERTIFIED

~Calibration Certificate~

THE MODAL SHOP INC.
A PCB GROUP CO.

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

Sensor Information

Model Number:	352C68
Serial Number:	55998
Manufacturer:	PCB
ID Number:	31339
Description:	ICP® Accelerometer

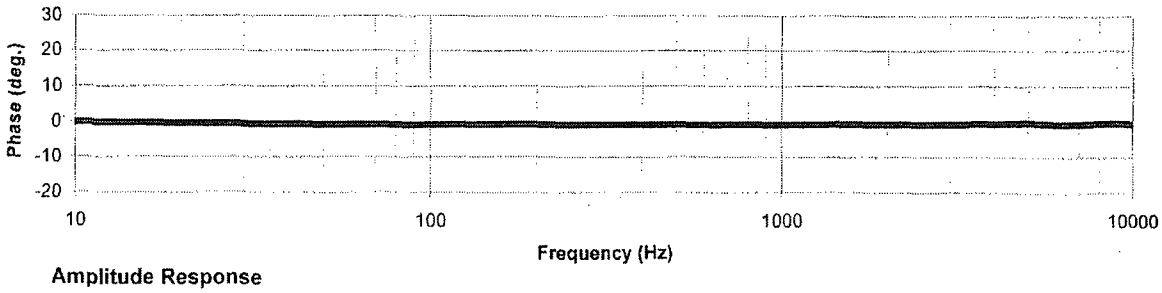
Calibration Data

Sensitivity @ 100 Hz:	96.1241	mV/g
Phase @ 100 Hz:	-0.7214	deg.
Test Level:	1.00	g

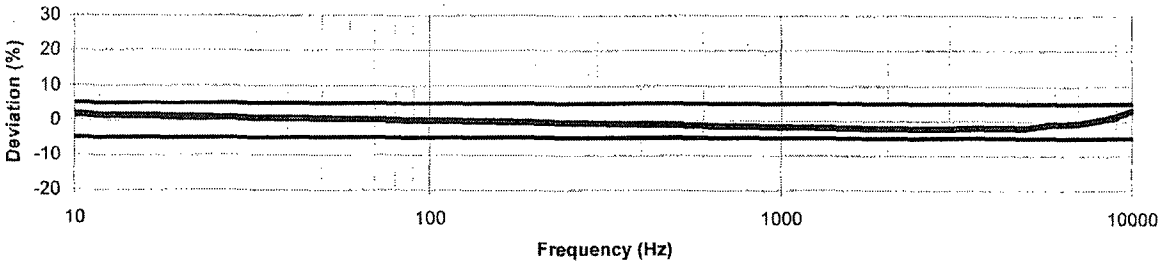
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.7189	-0.0491
30	0.8581	-0.5769
50	0.4945	-0.7126
100	0.0000	-0.7214
300	-0.7989	-0.7002
500	-1.1911	-0.7966
1000	-1.7783	-0.7147
2000	-2.1920	-0.6639
3000	-2.2000	-0.6369
4000	-1.9378	-0.5963
5000	-2.0114	-0.2700
6000	-0.9002	-0.7224
7000	-0.6227	-0.5413
8000	0.2681	-0.3940
9000	1.3560	-0.3609
10000	2.9770	-0.5888

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	76 (25)	°F (°C)
Humidity:	46	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11031

THE MODAL SHOP INC.
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~Calibration Certificate~

Sensor Information

Model Number	352C68
Serial Number	55998
Manufacturer	PCB
ID Number	31339

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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A PCB GROUP CO.

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www.modalshop.com

Sensor Information

Model Number:	352C68
Serial Number:	55986
Manufacturer:	PCB
ID Number:	31337
Description:	ICP® Accelerometer

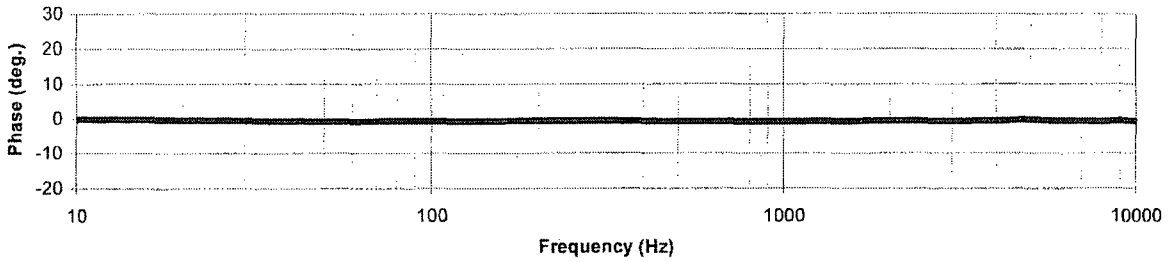
Calibration Data

Sensitivity @ 100 Hz:	100.5466	mV/g
Phase @ 100 Hz:	-0.6946	deg.
Test Level:	1.00	g

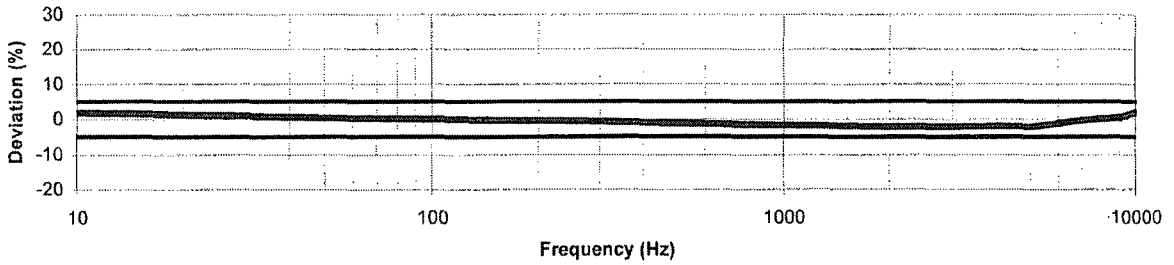
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.8174	-0.0533
30	0.8999	-0.5956
50	0.4421	-0.7064
100	0.0000	-0.6946
300	-0.6849	-0.5862
500	-1.1671	-0.7196
1000	-1.7688	-0.7074
2000	-2.1429	-0.6073
3000	-2.1467	-0.6174
4000	-1.9732	-0.5642
5000	-2.1060	-0.2590
6000	-1.2668	-0.5805
7000	-0.3535	-0.5766
8000	0.1640	-0.7679
9000	0.4448	-0.5293
10000	1.9021	-0.5714

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 76 (25) °F (°C)
Humidity: 46 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11030

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NPC GROUP CO.

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~Calibration Certificate~

Sensor Information

Model Number	352C68
Serial Number	55986
Manufacturer	PCB
ID Number	31337

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

Cal ID: 11030

~Calibration Certificate~

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Cincinnati, OH 45241
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Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number:	352C68
Serial Number:	55985
Manufacturer:	PCB
ID Number:	31336
Description:	ICP® Accelerometer

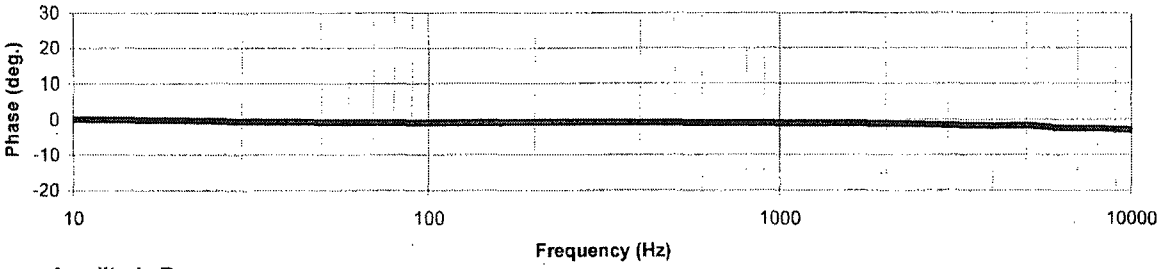
Calibration Data

Sensitivity @ 100 Hz:	104.09	mV/g
Phase @ 100 Hz:	-0.80	deg.
Test Level:	1.00	g

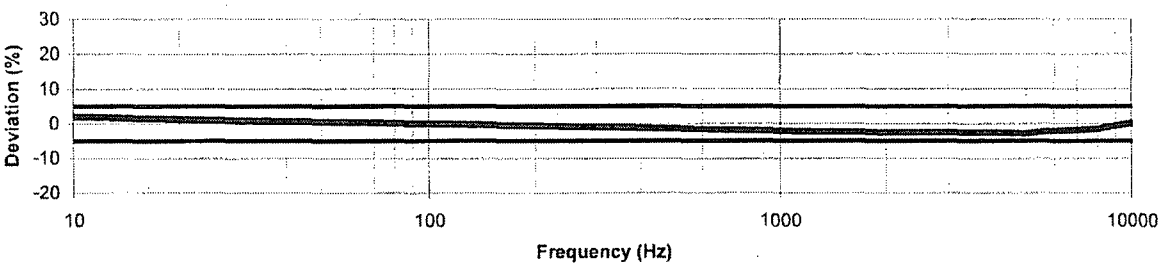
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.85	0.08
30	0.84	-0.58
50	0.46	-0.76
100	0.00	-0.80
300	-0.98	-0.73
500	-1.44	-1.03
1000	-2.14	-1.05
2000	-2.56	-1.22
3000	-2.61	-1.54
4000	-2.56	-1.77
5000	-2.88	-1.73
6000	-2.12	-2.28
7000	-1.87	-2.56
8000	-1.57	-2.56
9000	-0.63	-2.80
10000	0.16	-3.00

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	42	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10845

~Calibration Certificate~

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Cincinnati, OH 45241
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Sensor Information

Model Number	352C68
Serial Number	55985
Manufacturer	PCB
ID Number	31336

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Cincinnati, OH 45241
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www.modalshop.com

Sensor Information

Model Number: 352C68
Serial Number: 73732
Manufacturer: PCB
ID Number: 34206
Description: ICP® Accelerometer

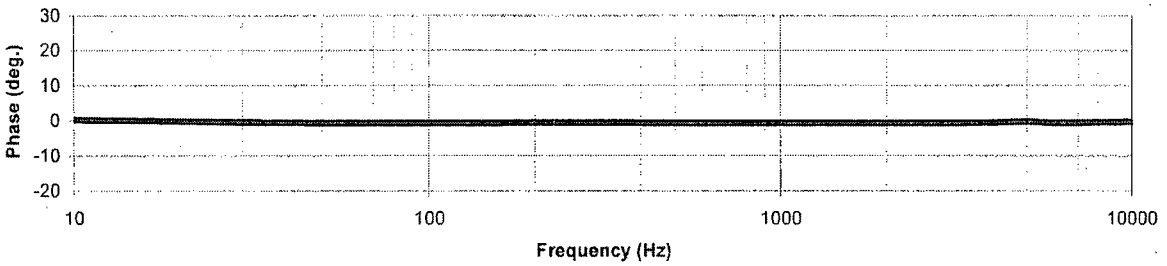
Calibration Data

Sensitivity @ 100 Hz:	100.60	mV/g
Phase @ 100 Hz:	-0.66	deg.
Test Level:	1.00	g

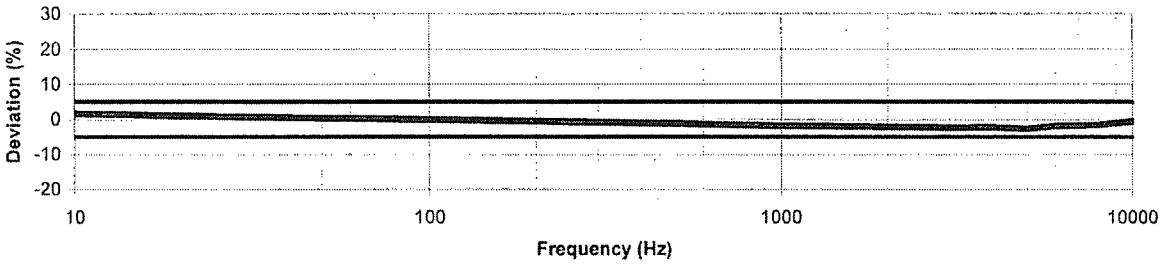
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.64	0.22
30	0.76	-0.50
50	0.42	-0.63
100	0.00	-0.66
300	-0.74	-0.59
500	-1.21	-0.68
1000	-1.81	-0.66
2000	-2.11	-0.64
3000	-2.31	-0.65
4000	-2.28	-0.61
5000	-2.65	-0.33
6000	-1.95	-0.62
7000	-1.76	-0.67
8000	-1.65	-0.49
9000	-0.99	-0.47
10000	-0.50	-0.42

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 73 (23) °F (°C)
Humidity: 42 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10856

~Calibration Certificate~

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Sensor Information

Model Number	352C68
Serial Number	73732
Manufacturer	PCB
ID Number	34206

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

Cal ID: 10856

~Calibration Certificate~

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Cincinnati, OH 45241
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Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number:	352C68
Serial Number:	73735
Manufacturer:	PCB
ID Number:	34209
Description:	ICP® Accelerometer

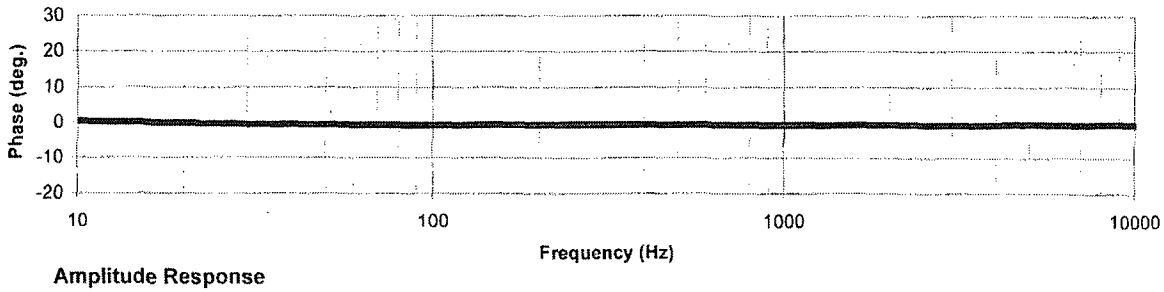
Calibration Data

Sensitivity @ 100 Hz:	99.77	mV/g
Phase @ 100 Hz:	-0.63	deg.
Test Level:	1.00	g

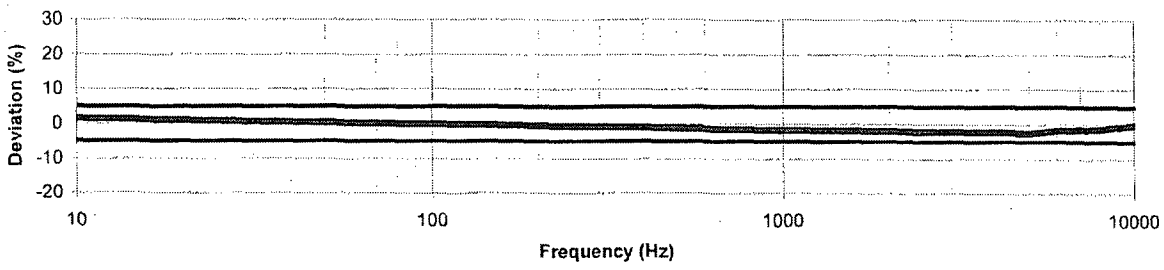
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.56	0.32
30	0.67	-0.43
50	0.36	-0.60
100	0.00	-0.63
300	-0.74	-0.52
500	-1.15	-0.61
1000	-1.76	-0.62
2000	-2.04	-0.57
3000	-2.17	-0.63
4000	-2.17	-0.58
5000	-2.50	-0.30
6000	-1.81	-0.58
7000	-1.58	-0.60
8000	-1.41	-0.42
9000	-0.74	-0.44
10000	-0.25	-0.39

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 74 (24) °F (°C)
Humidity: 43 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10851

~Calibration Certificate~

THE MODAL SHOP INC.
A PCB GROUP CO

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

Sensor Information

Model Number	352C68
Serial Number	73735
Manufacturer	PCB
ID Number	34209

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

Cal ID: 10851

~Calibration Certificate~

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

Sensor Information

Model Number: 352C68
Serial Number: 65438
Manufacturer: PCB
ID Number: 32631
Description: ICP® Accelerometer

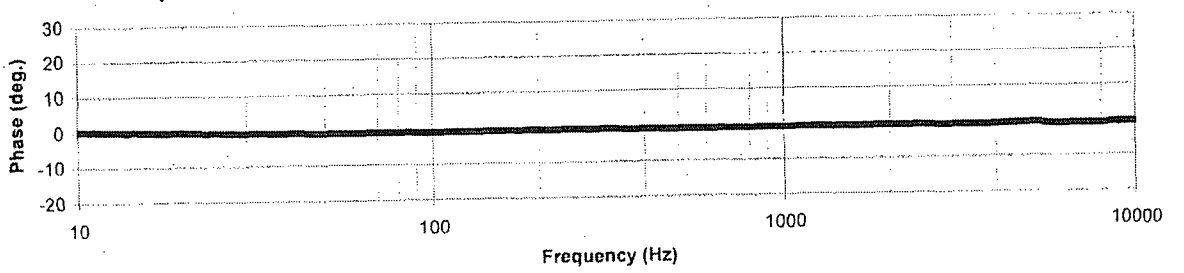
Calibration Data

Sensitivity @ 100 Hz:	94.88	mV/g
Phase @ 100 Hz:	-0.71	deg.
Test Level:	1.00	g

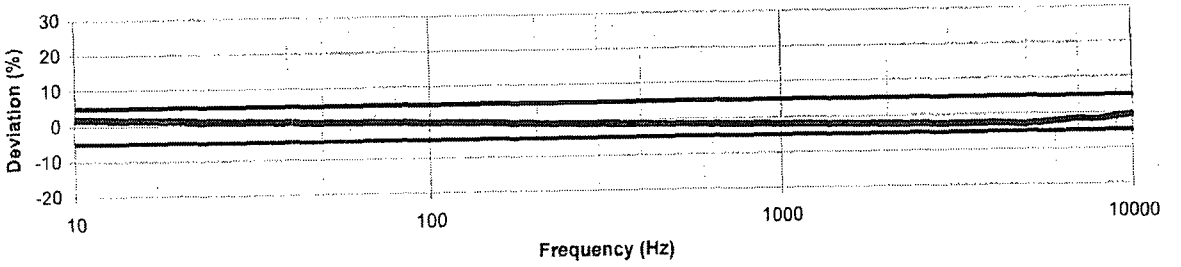
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.89	0.22
30	0.77	-0.56
50	0.40	-0.70
100	0.00	-0.71
300	-1.11	-0.69
500	-1.52	-0.78
1000	-1.97	-0.77
2000	-2.44	-0.61
3000	-2.58	-0.68
4000	-2.54	-0.66
5000	-2.94	-0.33
6000	-2.18	-0.61
7000	-1.78	-0.64
8000	-1.82	-0.66
9000	-1.21	-0.52
10000	-0.64	-0.38

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 75 (24) °F (°C)
Humidity: 42 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10843

~Calibration Certificate~

THE MODAL SHOP INC.
APCB GROUP CO

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

Sensor Information

Model Number	352C68
Serial Number	65438
Manufacturer	PCB
ID Number	32631

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 5/10/2007

Due Date:

~Calibration Certificate~

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

Sensor Information

Model Number:	352C68
Serial Number:	73736
Manufacturer:	PCB
ID Number:	34210
Description:	ICP® Accelerometer

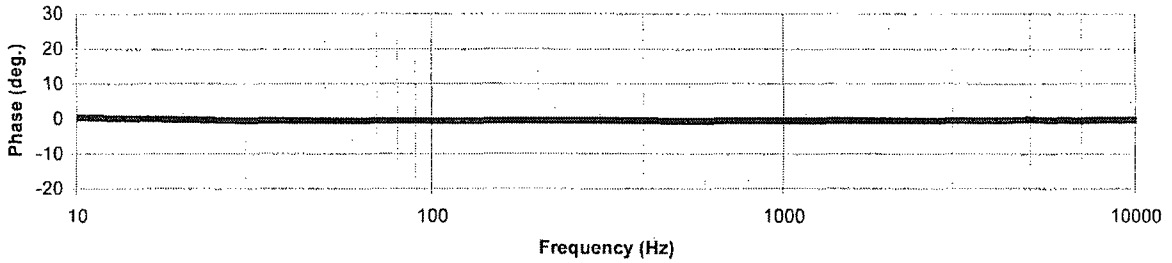
Calibration Data

Sensitivity @ 100 Hz:	101.65	mV/g
Phase @ 100 Hz:	-0.60	deg.
Test Level:	1.00	g

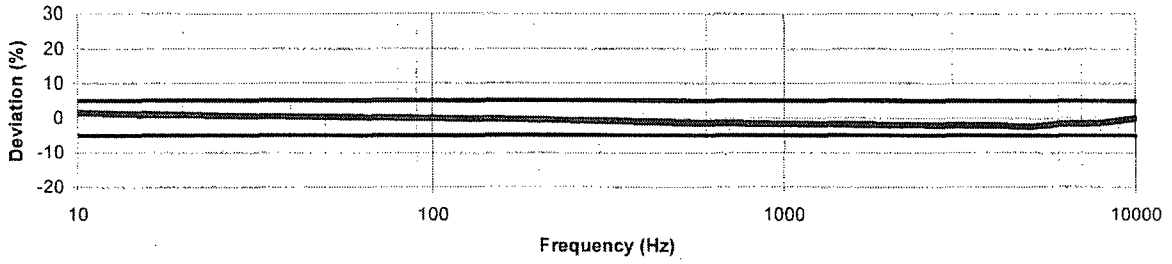
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.50	0.26
30	0.58	-0.45
50	0.31	-0.59
100	0.00	-0.60
300	-0.73	-0.48
500	-1.28	-0.67
1000	-1.71	-0.60
2000	-2.03	-0.55
3000	-2.11	-0.61
4000	-2.06	-0.58
5000	-2.44	-0.30
6000	-1.70	-0.59
7000	-1.57	-0.66
8000	-1.40	-0.41
9000	-0.64	-0.38
10000	-0.10	-0.32

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	74 (24)	°F (°C)
Humidity:	43	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10849

~Calibration Certificate~

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

Sensor Information

Model Number	352C68
Serial Number	73736
Manufacturer	PCB
ID Number	34210

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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A PCB GROUP CO.

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Cincinnati, OH 45241
Ph: 513-351-9919
Fax: 513-458-2172
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Sensor Information

Model Number:	352C68
Serial Number:	74959
Manufacturer:	PCB
ID Number:	34330
Description:	ICP® Accelerometer

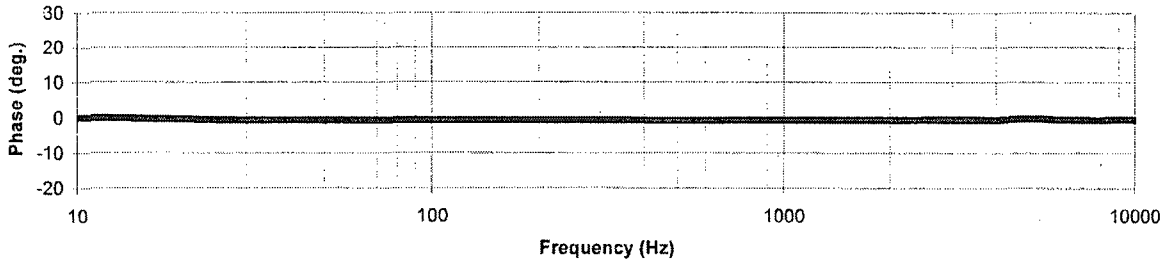
Calibration Data

Sensitivity @ 100 Hz:	98.8067	mV/g
Phase @ 100 Hz:	-0.6086	deg.
Test Level:	1.00	g

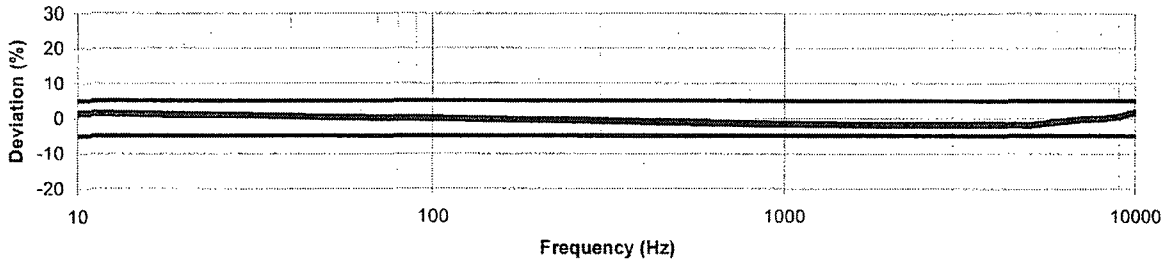
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.4740	0.0609
30	0.8172	-0.5355
50	0.3685	-0.5873
100	0.0000	-0.6086
300	-0.7284	-0.5833
500	-1.1236	-0.6426
1000	-1.5781	-0.5933
2000	-1.9301	-0.5497
3000	-1.9097	-0.5100
4000	-1.8017	-0.4561
5000	-1.9906	-0.1472
6000	-0.9809	-0.3772
7000	-0.3460	-0.5086
8000	-0.2274	-0.5370
9000	0.5194	-0.3254
10000	1.7229	-0.4459

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	46	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11028

~Calibration Certificate~

THE MODAL SHOP INC.
A PCB GROUP CO.

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

Sensor Information

Model Number	352C68
Serial Number	74959
Manufacturer	PCB
ID Number	34330

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Cincinnati, OH 45241
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Fax: 513-458-2172
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Sensor Information

Model Number:	352C68
Serial Number:	39593
Manufacturer:	PCB
ID Number:	29359
Description:	ICP® Accelerometer

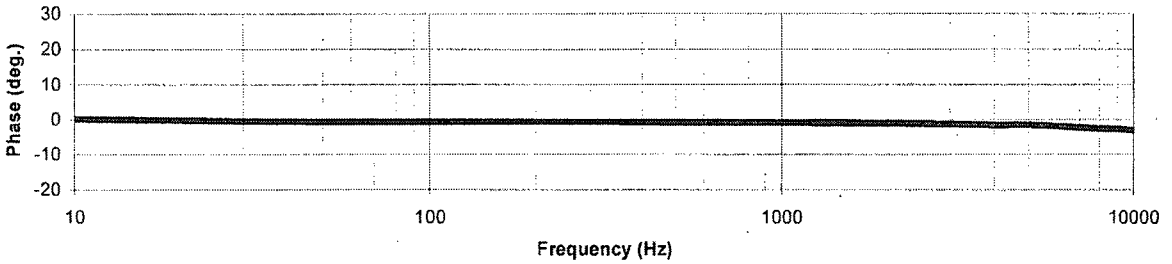
Calibration Data

Sensitivity @ 100 Hz:	100.5548	mV/g
Phase @ 100 Hz:	-0.6445	deg.
Test Level:	1.00	g

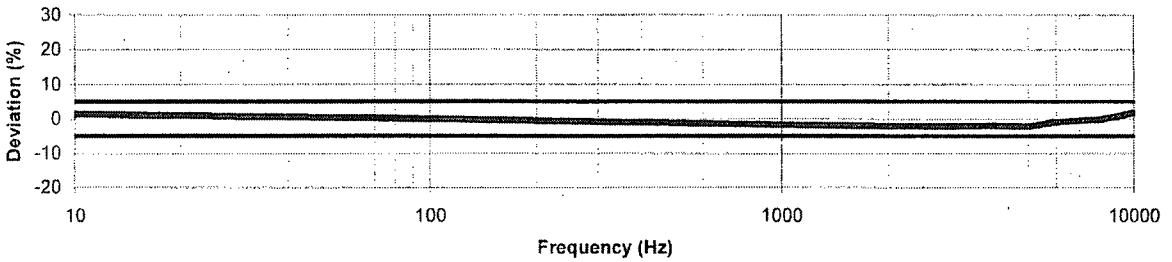
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.4538	0.1031
30	0.6954	-0.4805
50	0.4247	-0.6473
100	0.0000	-0.6445
300	-0.7809	-0.6942
500	-1.2419	-0.8097
1000	-1.7051	-0.9256
2000	-2.0733	-1.1525
3000	-2.1093	-1.3303
4000	-1.9862	-1.5507
5000	-2.2081	-1.4781
6000	-1.0069	-1.8948
7000	-0.4736	-2.3179
8000	-0.1980	-2.6035
9000	0.6887	-2.7025
10000	1.8337	-3.1474

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11021

~Calibration Certificate~

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

Sensor Information

Model Number	352C68
Serial Number	39593
Manufacturer	PCB
ID Number	29359

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
Std Sig Conditioner	PCB	442A102	173	12/12/2007
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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A PCB GROUP CO.

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Ph: 513-351-9919
Fax: 513-458-2172
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Sensor Information

Model Number:	352C68
Serial Number:	74957
Manufacturer:	PCB
ID Number:	34353
Description:	ICP® Accelerometer

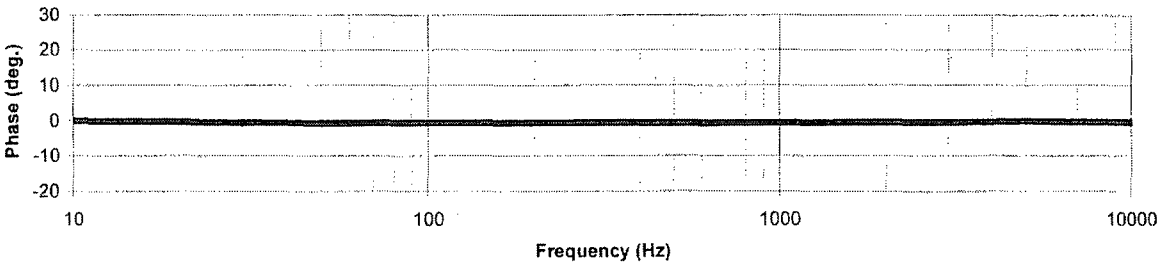
Calibration Data

Sensitivity @ 100 Hz:	100.2896	mV/g
Phase @ 100 Hz:	-0.5966	deg.
Test Level:	1.00	g

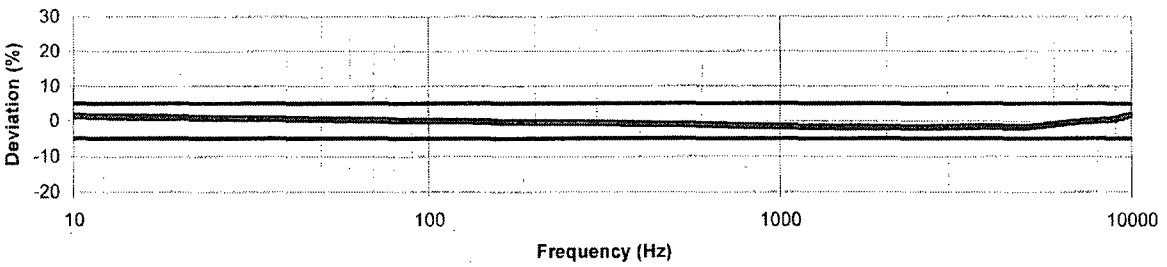
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.4374	0.0084
30	0.6982	-0.4677
50	0.4431	-0.6188
100	0.0000	-0.5966
300	-0.5717	-0.6043
500	-1.0026	-0.6172
1000	-1.5463	-0.5780
2000	-1.8584	-0.5207
3000	-1.8651	-0.4938
4000	-1.7120	-0.4438
5000	-1.9291	-0.1194
6000	-0.9445	-0.3530
7000	-0.3165	-0.4448
8000	0.1369	-0.5278
9000	0.5700	-0.3831
10000	1.7314	-0.4619

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	46	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11025

~Calibration Certificate~

THE MODAL SHOP INC.
APCHGROUPCO

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

Sensor Information

Model Number	352C68
Serial Number	74957
Manufacturer	PCB
ID Number	34353

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

Cal ID: 11025

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A PCB GROUP CO.

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Cincinnati, OH 45241
Ph: 513-351-9919
Fax: 513-458-2172
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~Calibration Certificate~

Sensor Information

Model Number:	352C68
Serial Number:	65474
Manufacturer:	PCB
ID Number:	32672
Description:	ICP® Accelerometer

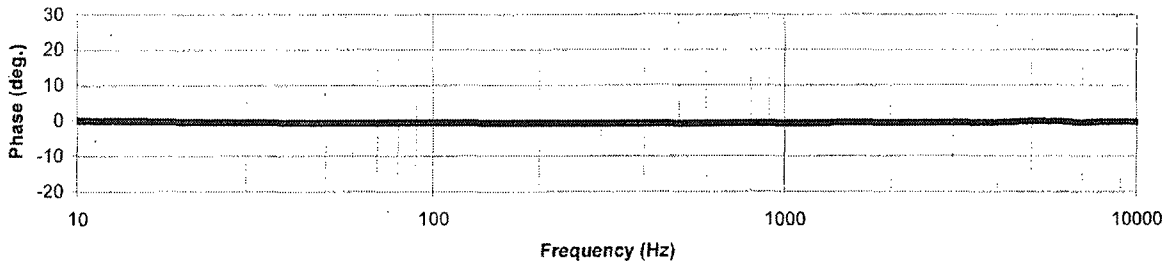
Calibration Data

Sensitivity @ 100 Hz:	90.6032	mV/g
Phase @ 100 Hz:	-0.6090	deg.
Test Level:	1.00	g

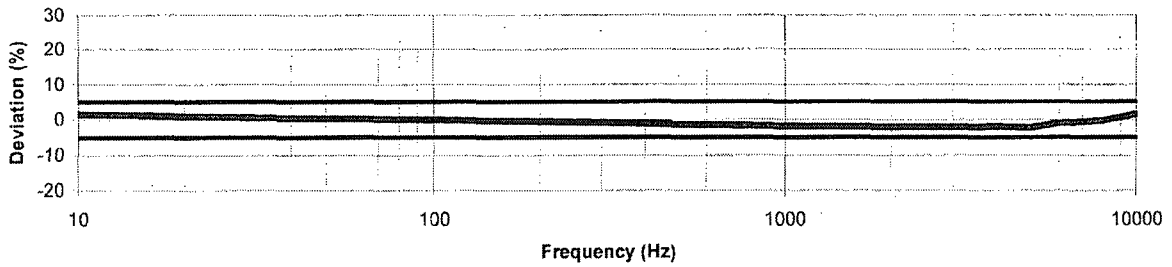
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.5595	0.0329
30	0.6873	-0.5163
50	0.3753	-0.6510
100	0.0000	-0.6090
300	-0.7830	-0.7334
500	-1.3192	-0.7154
1000	-1.8120	-0.6414
2000	-2.0898	-0.5726
3000	-2.1398	-0.5170
4000	-2.0082	-0.4519
5000	-2.2248	-0.1269
6000	-0.9912	-0.2443
7000	-0.5998	-0.6067
8000	-0.3478	-0.3623
9000	0.7062	-0.3570
10000	1.5911	-0.4097

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11023

~Calibration Certificate~

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3149 East Kemper Rd.
Cincinnati, OH 45241
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Fax: 513-458-2172
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Sensor Information

Model Number	352C68
Serial Number	65474
Manufacturer	PCB
ID Number	32672

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Cincinnati, OH 45241
Ph: 513-351-9919
Fax: 513-458-2172
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Sensor Information

Model Number:	352C68
Serial Number:	65470
Manufacturer:	PCB
ID Number:	32670
Description:	ICP® Accelerometer

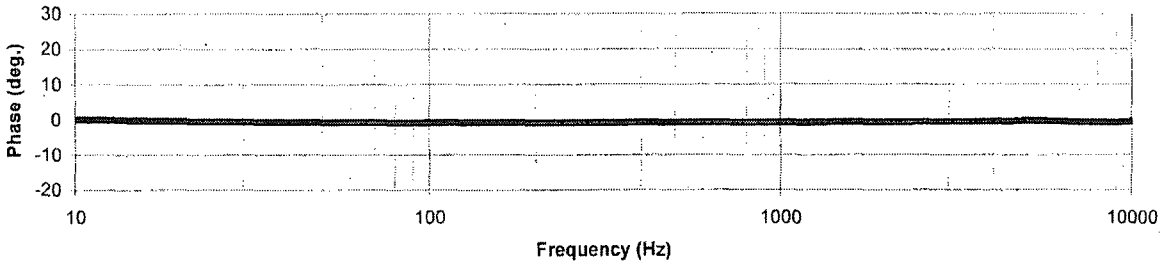
Calibration Data

Sensitivity @ 100 Hz:	96.2716	mV/g
Phase @ 100 Hz:	-0.7075	deg.
Test Level:	1.00	g

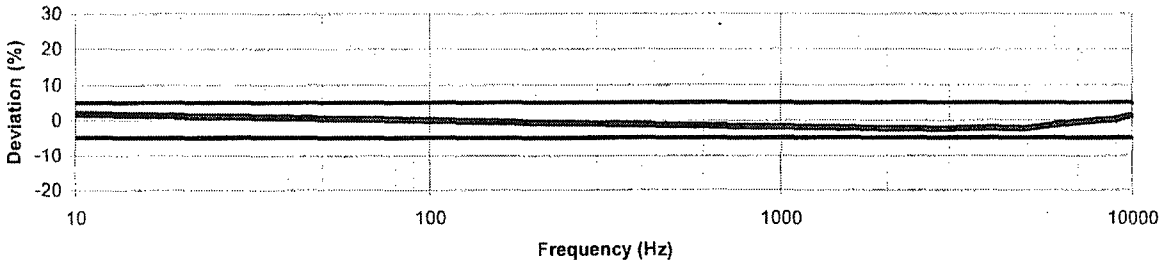
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.8367	0.0764
30	0.8128	-0.5874
50	0.5249	-0.6733
100	0.0000	-0.7075
300	-0.9720	-0.7231
500	-1.3997	-0.7262
1000	-1.8984	-0.7256
2000	-2.2773	-0.6267
3000	-2.3512	-0.5993
4000	-2.1545	-0.5511
5000	-2.3403	-0.2303
6000	-1.2508	-0.4411
7000	-0.5267	-0.5517
8000	-0.0034	-0.6861
9000	0.2378	-0.6995
10000	1.4332	-0.5296

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%. 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	46	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11026

~Calibration Certificate~

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Sensor Information

Model Number	352C68
Serial Number	65470
Manufacturer	PCB
ID Number	32670

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

Cal ID: 11026

~Calibration Certificate~

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Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number:	352C68
Serial Number:	65469
Manufacturer:	PCB
ID Number:	32673
Description:	ICP® Accelerometer

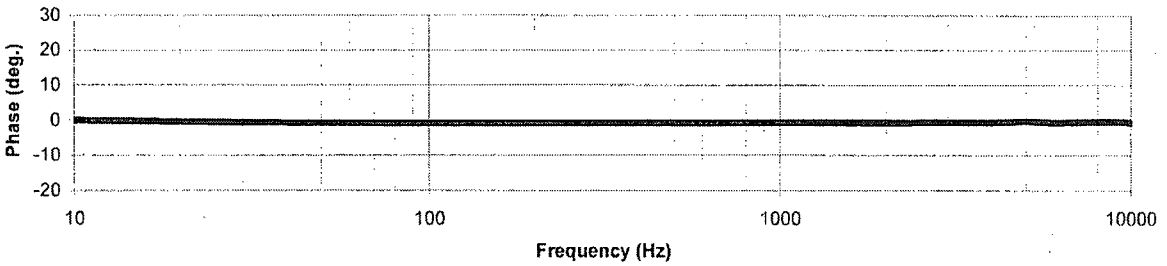
Calibration Data

Sensitivity @ 100 Hz:	92.1601	mV/g
Phase @ 100 Hz:	-0.7019	deg.
Test Level:	1.00	g

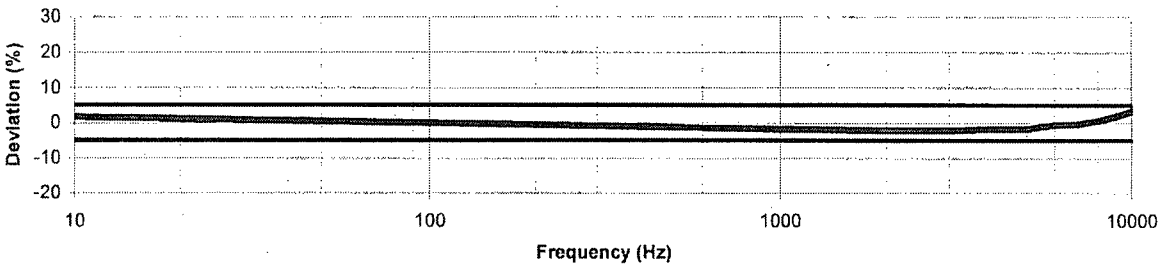
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.6561	-0.0128
30	0.8552	-0.5840
50	0.4769	-0.6903
100	0.0000	-0.7019
300	-0.7804	-0.7471
500	-1.2225	-0.7386
1000	-1.7990	-0.6744
2000	-2.1277	-0.6217
3000	-2.1037	-0.5569
4000	-1.8038	-0.5333
5000	-1.8468	-0.2010
6000	-0.5412	-0.5667
7000	-0.4116	-0.4889
8000	0.5886	-0.2918
9000	1.8359	-0.3154
10000	3.2482	-0.4544

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11018

~Calibration Certificate~

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Cincinnati, OH 45241
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Sensor Information

Model Number	352C68
Serial Number	65469
Manufacturer	PCB
ID Number	32673

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 6/27/2007

Due Date:

Cal ID: 11018

~Calibration Certificate~

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Sensor Information

Model Number:	352C68
Serial Number:	65430
Manufacturer:	PCB
ID Number:	32624
Description:	ICP® Accelerometer

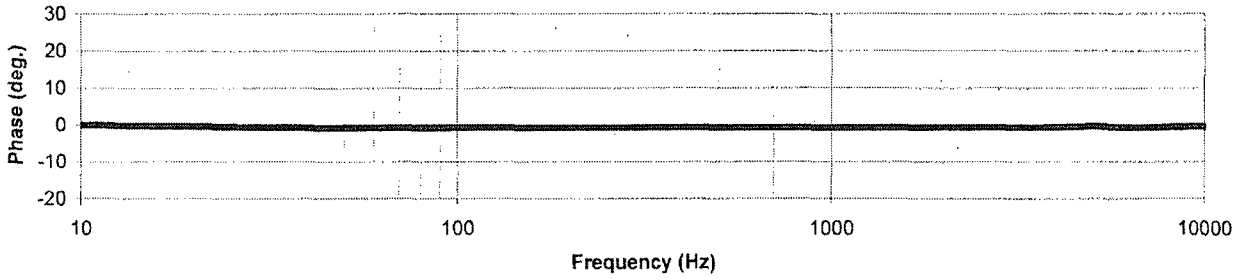
Calibration Data

Sensitivity @ 100 Hz:	97.48	mV/g
Phase @ 100 Hz:	-0.78	deg.
Test Level:	1.00	g

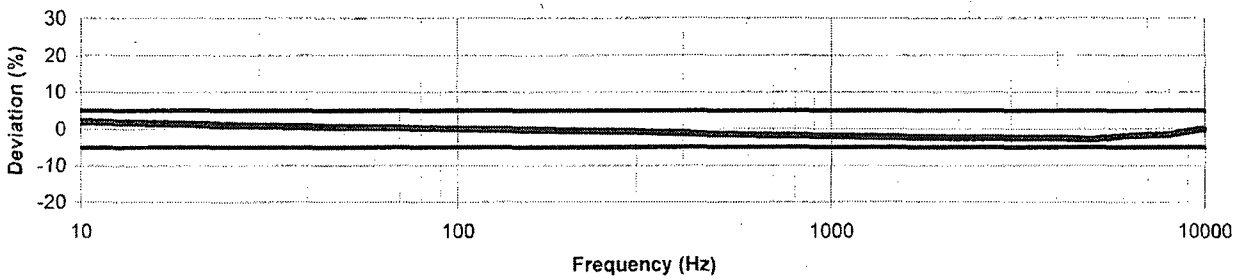
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.94	0.03
30	0.85	-0.63
50	0.50	-0.78
100	0.00	-0.78
300	-0.78	-0.76
500	-1.48	-0.77
1000	-2.00	-0.72
2000	-2.42	-0.63
3000	-2.52	-0.72
4000	-2.50	-0.66
5000	-2.83	-0.35
6000	-2.03	-0.62
7000	-1.68	-0.70
8000	-1.59	-0.47
9000	-0.70	-0.41
10000	0.00	-0.30

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	42	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10841

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~Calibration Certificate~

Sensor Information

Model Number	352C68
Serial Number	65430
Manufacturer	PCB
ID Number	32624

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Sensor Information

Model Number:	352C68
Serial Number:	65427
Manufacturer:	PCB
ID Number:	32622
Description:	ICP® Accelerometer

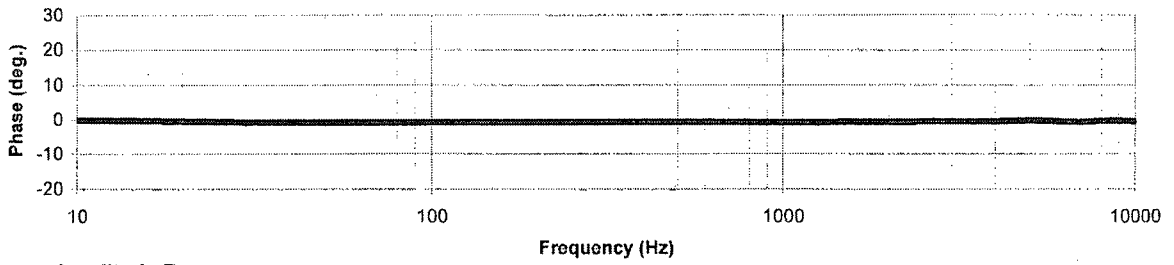
Calibration Data

Sensitivity @ 100 Hz:	92.3009	mV/g
Phase @ 100 Hz:	-0.7458	deg.
Test Level:	1.00	g

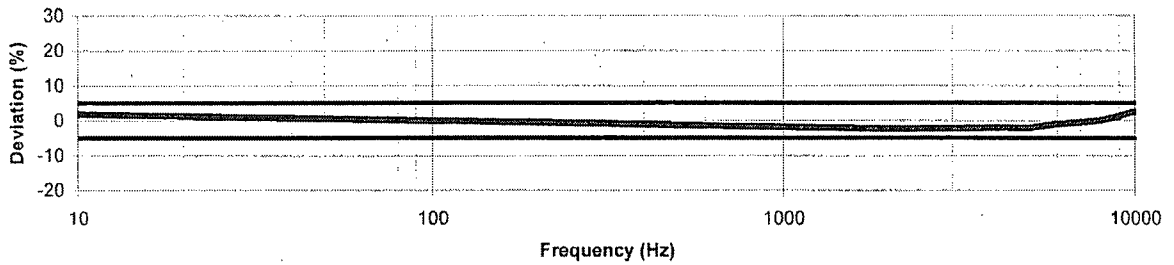
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.8033	-0.1747
30	0.8463	-0.7335
50	0.5145	-0.7374
100	0.0000	-0.7458
300	-0.8112	-0.7389
500	-1.3107	-0.7579
1000	-1.9057	-0.7420
2000	-2.2733	-0.6268
3000	-2.2619	-0.6116
4000	-2.0586	-0.5656
5000	-2.1803	-0.2483
6000	-1.0276	-0.5198
7000	-0.5683	-0.7099
8000	0.0187	-0.3792
9000	1.2089	-0.3435
10000	2.5734	-0.4566

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	46	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11029

~Calibration Certificate~

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Sensor Information

Model Number	352C68
Serial Number	65427
Manufacturer	PCB
ID Number	32622

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Cincinnati, OH 45241
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Fax: 513-458-2172
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Sensor Information

Model Number:	352C68
Serial Number:	65441
Manufacturer:	PCB
ID Number:	32634
Description:	ICP® Accelerometer

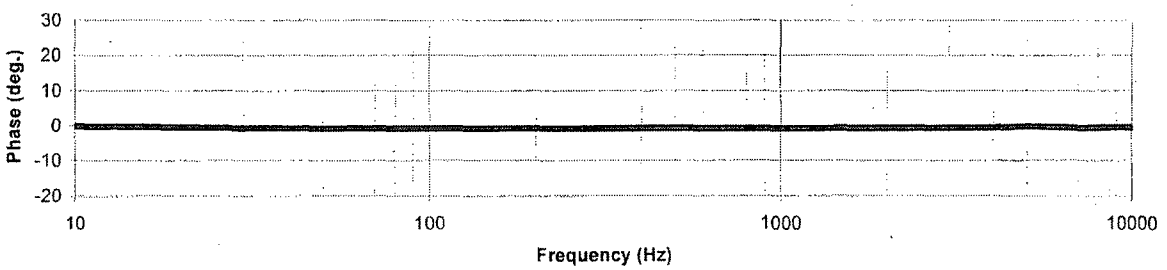
Calibration Data

Sensitivity @ 100 Hz:	96.5064	mV/g
Phase @ 100 Hz:	-0.7192	deg.
Test Level:	1.00	g

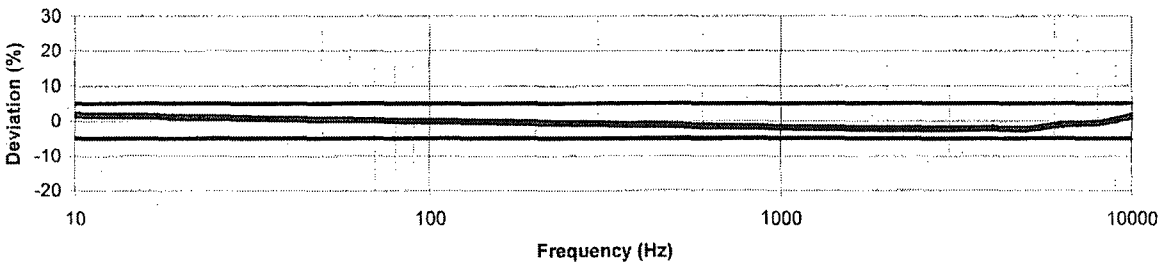
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.7277	-0.1656
30	0.8517	-0.6809
50	0.4580	-0.7414
100	0.0000	-0.7192
300	-0.7776	-0.7040
500	-1.2683	-0.7602
1000	-1.8793	-0.7164
2000	-2.2773	-0.6355
3000	-2.2971	-0.6002
4000	-2.1645	-0.5348
5000	-2.3657	-0.1998
6000	-1.3190	-0.4288
7000	-0.7198	-0.6228
8000	-0.6158	-0.5382
9000	0.3063	-0.3823
10000	1.4011	-0.4698

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 75 (24) °F (°C)
Humidity: 46 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11024

THE MODAL SHOP INC.

~Calibration Certificate~

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

Sensor Information

Model Number	352C68
Serial Number	65441
Manufacturer	PCB
ID Number	32634

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 6/27/2007

Due Date:

Cal ID: 11024

~Calibration Certificate~

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

Sensor Information

Model Number:	352C68
Serial Number:	65436
Manufacturer:	PCB
ID Number:	32630
Description:	ICP® Accelerometer

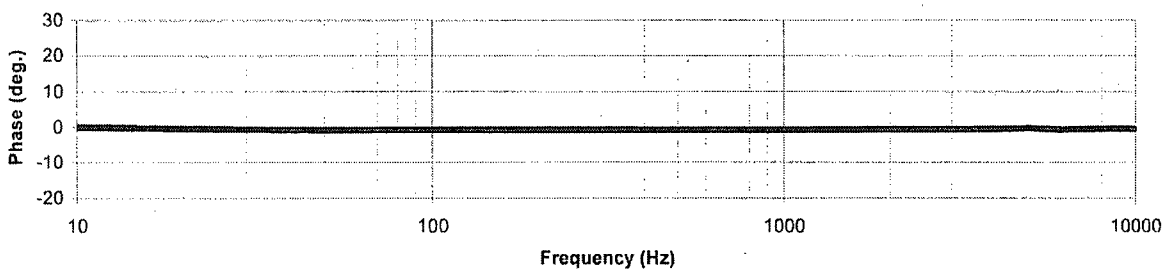
Calibration Data

Sensitivity @ 100 Hz:	94.6039	mV/g
Phase @ 100 Hz:	-0.6961	deg.
Test Level:	1.00	g

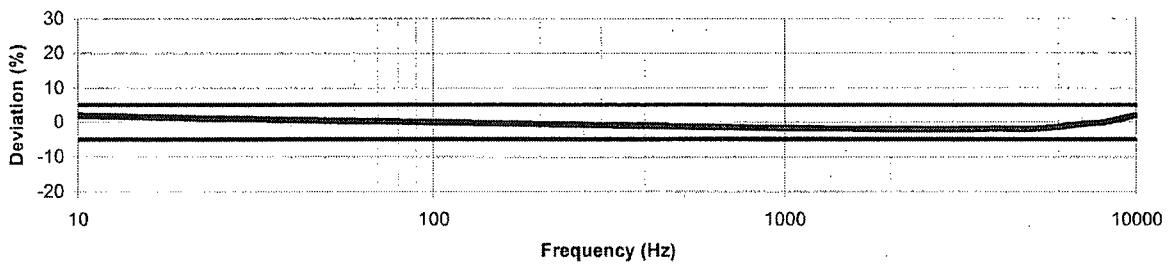
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.9668	0.0079
30	0.8626	-0.5989
50	0.4691	-0.7058
100	0.0000	-0.6961
300	-0.9453	-0.6839
500	-1.2734	-0.7628
1000	-1.8469	-0.7169
2000	-2.1697	-0.5816
3000	-2.1921	-0.5819
4000	-1.9861	-0.5100
5000	-2.1477	-0.2058
6000	-1.3694	-0.6763
7000	-0.6719	-0.5843
8000	-0.1941	-0.3929
9000	0.8137	-0.3421
10000	2.0354	-0.4127

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11019

~Calibration Certificate~

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A PCB GROUP CO

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

Sensor Information

Model Number	352C68
Serial Number	65436
Manufacturer	PCB
ID Number	32630

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 6/27/2007

Due Date:

Cal ID: 11019

~Calibration Certificate~

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A PCB GROUP CO.

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

Sensor Information

Model Number:	352C68
Serial Number:	65428
Manufacturer:	PCB
ID Number:	32623
Description:	ICP® Accelerometer

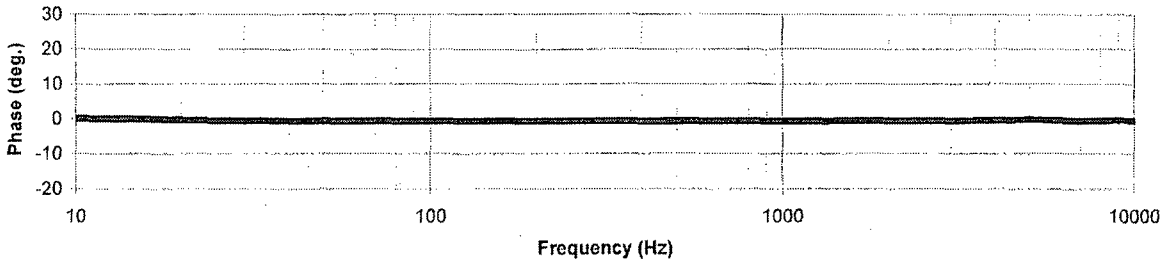
Calibration Data

Sensitivity @ 100 Hz:	90.2237	mV/g
Phase @ 100 Hz:	-0.6725	deg.
Test Level:	1.00	g

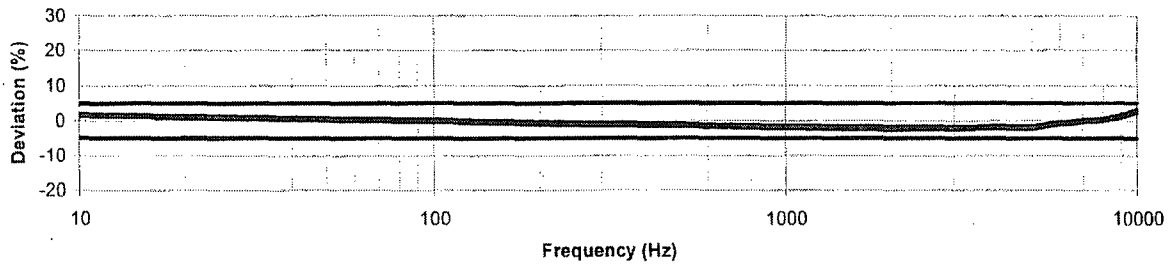
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.6865	-0.0153
30	0.7715	-0.5737
50	0.3980	-0.6807
100	0.0000	-0.6725
300	-0.9438	-0.6555
500	-1.2378	-0.6954
1000	-1.8555	-0.6947
2000	-2.1407	-0.5803
3000	-2.1521	-0.5966
4000	-1.9114	-0.5173
5000	-1.9956	-0.1933
6000	-0.8308	-0.4332
7000	0.0039	-0.6175
8000	0.2883	-0.5646
9000	1.3774	-0.4227
10000	2.8345	-0.4611

Notes

Results relate only to the items calibrated.

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

Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11022

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SPECIALISTS

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~Calibration Certificate~

Sensor Information

Model Number	352C68
Serial Number	65428
Manufacturer	PCB
ID Number	32623

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Cincinnati, OH 45241
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Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number:	352C68
Serial Number:	65434
Manufacturer:	PCB
ID Number:	32628
Description:	ICP® Accelerometer

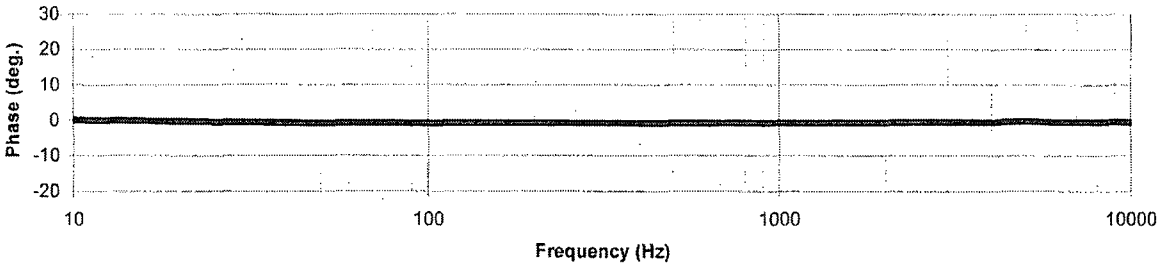
Calibration Data

Sensitivity @ 100 Hz:	92.9406	mV/g
Phase @ 100 Hz:	-0.7300	deg.
Test Level:	1.00	g

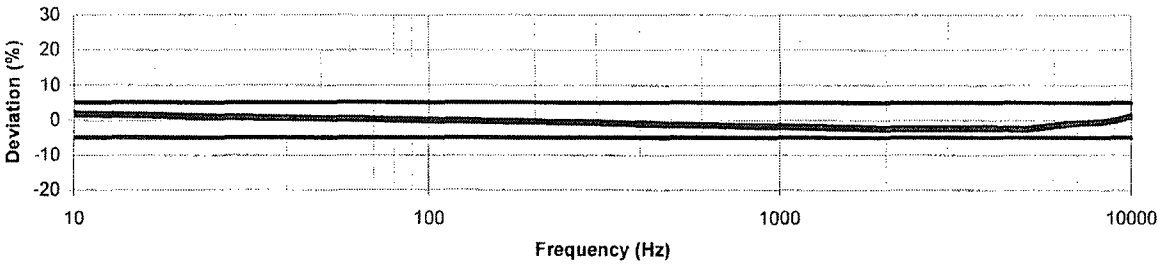
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.7820	0.0540
30	0.8723	-0.6085
50	0.5452	-0.7251
100	0.0000	-0.7300
300	-0.7384	-0.7463
500	-1.3434	-0.7883
1000	-1.8868	-0.7258
2000	-2.3792	-0.6518
3000	-2.3855	-0.6129
4000	-2.2756	-0.5660
5000	-2.5206	-0.2264
6000	-1.6076	-0.4877
7000	-0.9382	-0.5184
8000	-0.6463	-0.6142
9000	-0.0605	-0.3843
10000	1.1306	-0.5692

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	47	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 6/27/2007
Due Date:

Cal ID: 11020

~Calibration Certificate~

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Sensor Information

Model Number	352C68
Serial Number	65434
Manufacturer	PCB
ID Number	32628

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifer	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 6/27/2007

Customer: TMS Rental

Due Date:

Cal ID: 11020

~Calibration Certificate~

Sensor Information

Model Number:	352C68
Serial Number:	49027
Manufacturer:	PCB
ID Number:	30736
Description:	ICP® Accelerometer

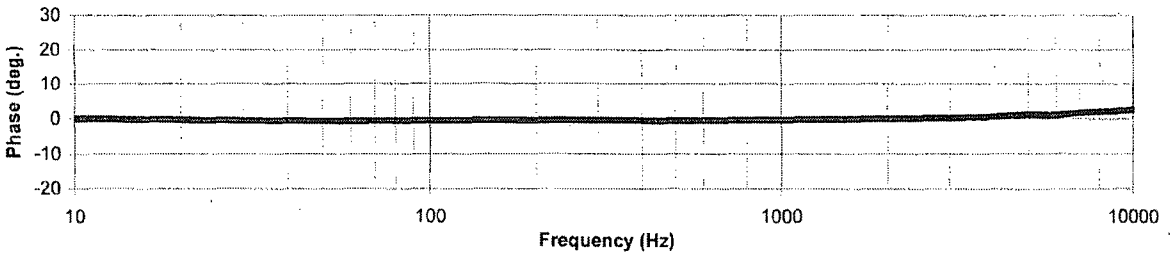
Calibration Data

Sensitivity @ 100 Hz:	99.61	mV/g
Phase @ 100 Hz:	-0.61	deg.
Test Accel.:	1.00	g

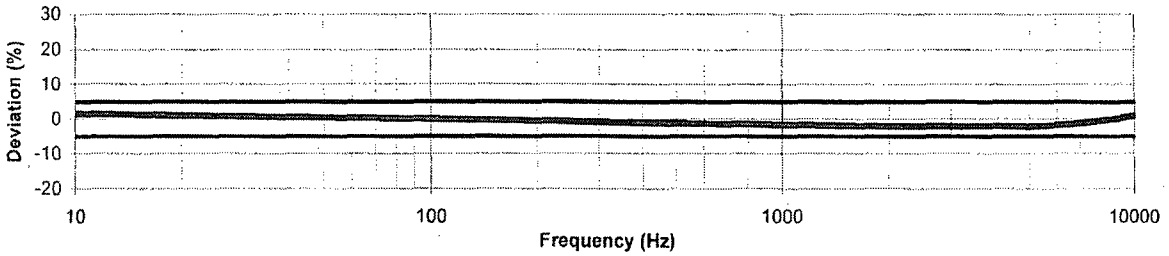
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.55	0.03
30	0.74	-0.51
50	0.45	-0.62
100	0.00	-0.61
300	-0.81	-0.43
500	-1.16	-0.47
1000	-1.72	-0.36
2000	-2.07	-0.02
3000	-2.09	0.28
4000	-2.02	0.61
5000	-2.25	1.21
6000	-1.77	1.06
7000	-1.21	1.60
8000	-0.51	2.09
9000	0.21	2.27
10000	0.91	2.56

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; +/- 1.35%, 100 Hz; +/- 1.25%, 101-920 Hz; 1.35%, 921-5000 Hz; 1.6%, 5001-10,000 Hz; 2.0%.

Procedure Used: PRD-P220

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	24	°C
	75	°F
Humidity:	22	%

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

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 3/6/2007
Due Date:

Cal ID: 10626

~Calibration Certificate~

TMS 9155C Sensor Calibration System

Sensor Information

Model Number	352C68
Serial Number	49027
Manufacturer	PCB
ID Number	30736

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
TUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 3/6/2007

Customer:

Due Date:

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Cal ID: 10626

~Calibration Certificate~

Sensor Information

Model Number:	352C68
Serial Number:	73232
Manufacturer:	PCB
ID Number:	33862
Description:	ICP® Accelerometer

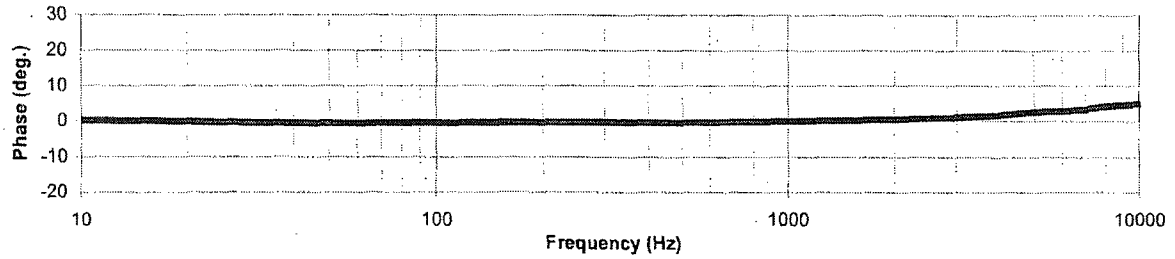
Calibration Data

Sensitivity @ 100 Hz:	99.68	mV/g
Phase @ 100 Hz:	-0.60	deg.
Test Accel.:	1.00	g

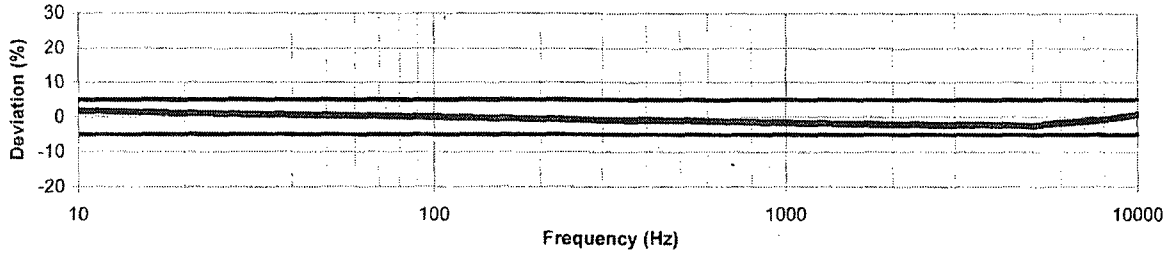
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.77	0.10
30	0.73	-0.47
50	0.52	-0.62
100	0.00	-0.60
300	-0.95	-0.35
500	-1.11	-0.41
1000	-1.67	-0.12
2000	-2.18	0.51
3000	-2.23	1.05
4000	-2.18	1.65
5000	-2.47	2.53
6000	-1.67	2.81
7000	-1.22	3.35
8000	-0.84	4.16
9000	0.05	4.48
10000	0.65	4.94

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; +/- 1.35%, 100 Hz; +/- 1.25%, 101-920 Hz; 1.35%, 921-5000 Hz; 1.6%, 5001-10,000 Hz; 2.0%.

Procedure Used: PRD-P220

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	21	°C
	70	°F
Humidity:	25	%

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A PCB GROUP CO.
3149 East Kemper Rd.
Cincinnati, OH 45241
Ph: 513-351-9919
Fax: 513-458-2172
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Approval Information

Technician: Ed Devlin

Approval:

Cal Date: 3/19/2007

Due Date:

Cal ID: 10673

~Calibration Certificate~

TMS 9155C Sensor Calibration System

Sensor Information

Model Number	352C68
Serial Number	73232
Manufacturer	PCB
ID Number	33862

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
TUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 3/19/2007

Customer: TMS Rental

Due Date:

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Cal ID: 10673

~Calibration Certificate~

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Sensor Information

Model Number: 352C68
Serial Number: 29431
Manufacturer: PCB
ID Number: 27526
Description: ICP® Accelerometer

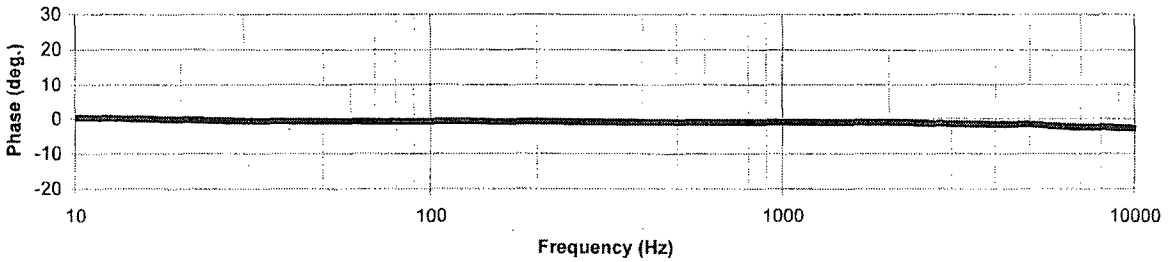
Calibration Data

Sensitivity @ 100 Hz:	106.08	mV/g
Phase @ 100 Hz:	-0.65	deg.
Test Level:	1.00	g

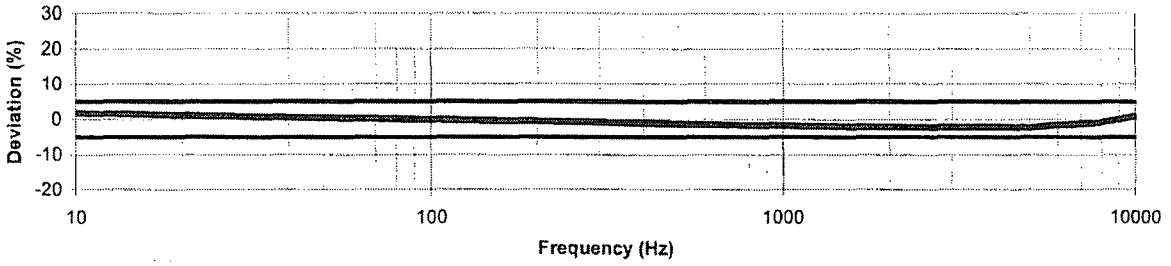
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.72	0.29
30	0.79	-0.55
50	0.37	-0.62
100	0.00	-0.65
300	-0.81	-0.78
500	-1.24	-0.87
1000	-1.84	-0.94
2000	-2.16	-1.04
3000	-2.21	-1.37
4000	-2.12	-1.54
5000	-2.37	-1.48
6000	-1.54	-2.03
7000	-1.22	-2.27
8000	-0.83	-2.30
9000	0.08	-2.56
10000	0.80	-2.70

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Lab Conditions

Temperature: 74 (24) °F (°C)
Humidity: 43 %

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10847

~Calibration Certificate~

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APCB GROUP PLC

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Sensor Information

Model Number	352C68
Serial Number	29431
Manufacturer	PCB
ID Number	27526

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 5/10/2007

Due Date:

~Calibration Certificate~

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

Sensor Information

Model Number:	352C68
Serial Number:	55999
Manufacturer:	PCB
ID Number:	31340
Description:	ICP® Accelerometer

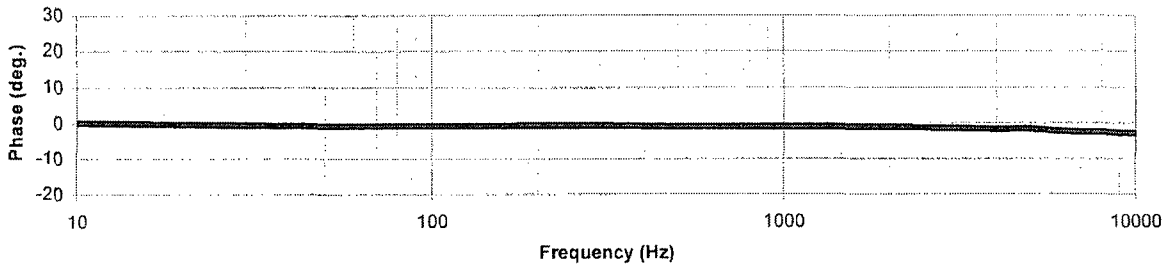
Calibration Data

Sensitivity @ 100 Hz:	103.75	mV/g
Phase @ 100 Hz:	-0.73	deg.
Test Level:	1.00	g

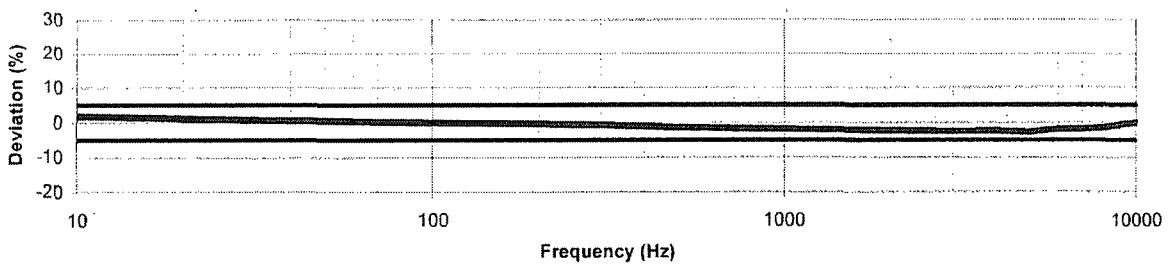
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.80	0.05
30	0.77	-0.57
50	0.48	-0.73
100	0.00	-0.73
300	-0.76	-0.62
500	-1.42	-0.87
1000	-1.92	-1.03
2000	-2.34	-1.16
3000	-2.49	-1.47
4000	-2.43	-1.71
5000	-2.76	-1.67
6000	-1.94	-2.21
7000	-1.81	-2.54
8000	-1.54	-2.50
9000	-0.69	-2.75
10000	0.02	-2.91

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	42	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10842

~Calibration Certificate~

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Cincinnati, OH 45241
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Sensor Information

Model Number	352C68
Serial Number	55999
Manufacturer	PCB
ID Number	31340

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Cal Date: 5/10/2007

Customer: TMS Rental

Due Date:

~Calibration Certificate~

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Sensor Information

Model Number:	352C68
Serial Number:	55983
Manufacturer:	PCB
ID Number:	31334
Description:	ICP® Accelerometer

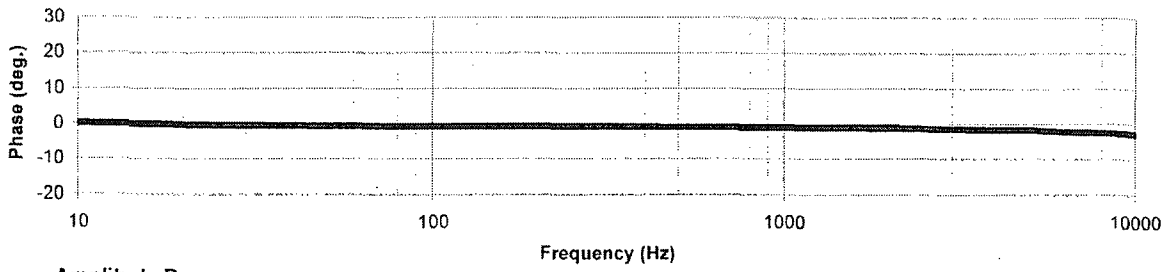
Calibration Data

Sensitivity @ 100 Hz:	98.36	mV/g
Phase @ 100 Hz:	-0.70	deg.
Test Level:	1.00	g

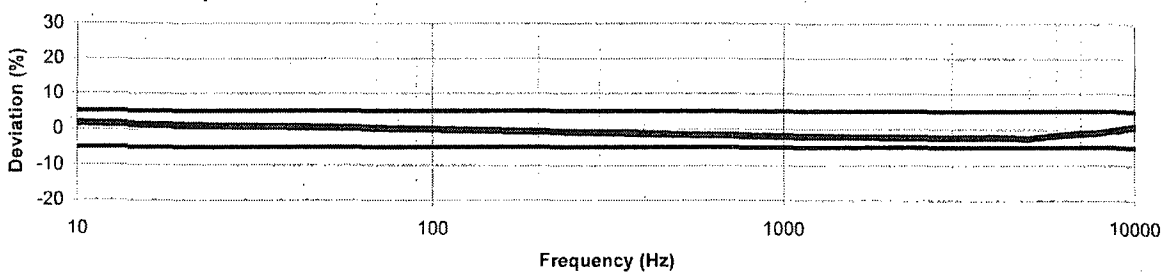
Transducer Specifications

Amp. Range:	± 50	g
Resolution:	0.00016	g
Resonant Freq:	≥ 35000	Hz
Temp. Range:	-54 to 93	°C
	-65 to 200	°F
Axis:	Uni-Axial	

Phase Response



Amplitude Response



Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
10	1.68	0.12
30	0.76	-0.52
50	0.49	-0.68
100	0.00	-0.70
300	-1.02	-0.73
500	-1.47	-0.86
1000	-1.89	-0.99
2000	-2.26	-1.23
3000	-2.39	-1.44
4000	-2.28	-1.67
5000	-2.55	-1.63
6000	-1.70	-2.10
7000	-1.19	-2.44
8000	-0.94	-2.52
9000	-0.02	-2.70
10000	0.82	-2.86

Notes

Results relate only to the items calibrated.

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Method: Calibration is performed in compliance with ISO 9001 and ISO 17025

This calibration was performed with TMS 9155C Calibration Workstation version 4.5.2

Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO16063-21

Procedure Used: PRD-P220

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 10-99 Hz; ± 1.35%, 100 Hz; ± 1.25%. 101-920 Hz; ± 1.35%, 921-5000 Hz; ± 1.60%, 5001-10,000 Hz; ± 2.00%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Unit Condition

As Found:	In Tolerance
As Left:	In Tolerance

Lab Conditions

Temperature:	75 (24)	°F (°C)
Humidity:	42	%

Approval Information

Technician: Ed Devlin
Approval:

Cal Date: 5/10/2007
Due Date:

Cal ID: 10844

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~Calibration Certificate~

Sensor Information

Model Number	352C68
Serial Number	55983
Manufacturer	PCB
ID Number	31334

Note

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Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
SUT Signal Conditioner	PCB	443B101	373	8/17/2007
Power Amplifier	TMS	2050E02	218529	n/a
Shaker	PCB	396C11	603	n/a
Data Aquisition Card	NI	4461	15004324	7/13/2007
Std Accelerometer	PCB	080A200	110553	12/12/2007
Std Sig Conditioner	PCB	442A102	173	12/12/2007

Technician: Ed Devlin

Customer: TMS Rental

Cal Date: 5/10/2007

Due Date:

Cal ID: 10844

~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 393B04

Serial Number: C9181

Description: ICP® Accelerometer Method: Back-to-Back Comparison Calibration

Manufacturer: PCB

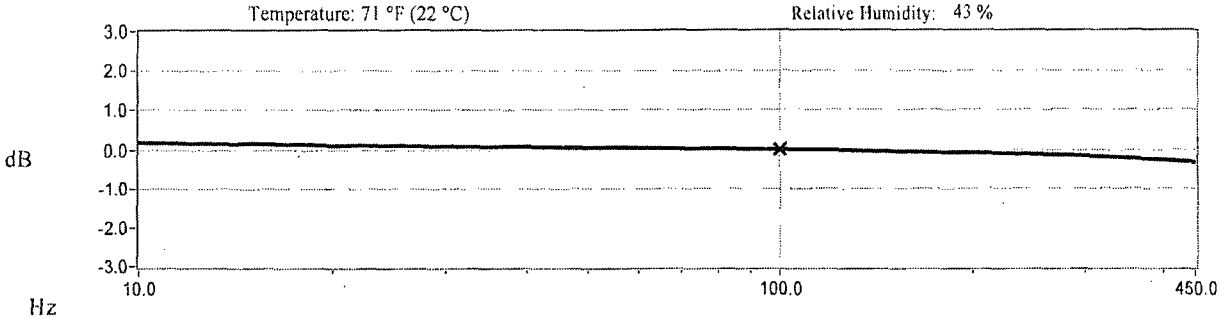
ACS-1, ACS-4

Calibration Data

Sensitivity @ 100.0 Hz	**999**	**mV/g**	Output Bias	11.5	VDC
	(101.9	**mV/m/s²)**	Transverse Sensitivity	2.5	%
Discharge Time Constant	8.9	seconds	Resonant Frequency	3000.0	Hz

Sensitivity Plot

Temperature: 71 °F (22 °C) Relative Humidity: 43 %



Data Points

Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)
10.0	2.1	300.0	-1.9
15.0	1.9	450.0	-3.8
30.0	1.0		
50.0	0.7		
REF. FREQ.	0.0		

Mounting Surface: Stainless Steel w/Silicone Grease Coating Fastener: Stud Mount Fixture Orientation: Vertical

Acceleration Level (rms)[1]: 1.00 g (9.81 m/s²)[4]

[1]The acceleration level may be limited by shaker displacement at low frequencies. If the listed level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude; Acceleration Level (g) = 0.010 x (freq)². [4]The gravitational constant used for calculations by the calibration system is: 1 g = 9.80665 m/s².

Condition of Unit

As Found: In Tolerance, No Adjustment Necessary

As Left: In Tolerance

Notes

1. Calibration is NIST Traceable thru Project 822/274086 and PTB Traceable thru Project 1060.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540-1-1994 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; +/- 2.0%, 10-99 Hz; +/- 1.5%, 100-1999 Hz; +/- 1.0%, 2-10 kHz; +/- 2.5%.

Technician: Al Sturniolo Date: 11/16/07

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Cert No 1662.01

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CAL3 - 3278069001.06

~ Calibration Certificate - Phase ~

Per ISO 16063-21

Model Number: 393B04

Serial Number: C9181

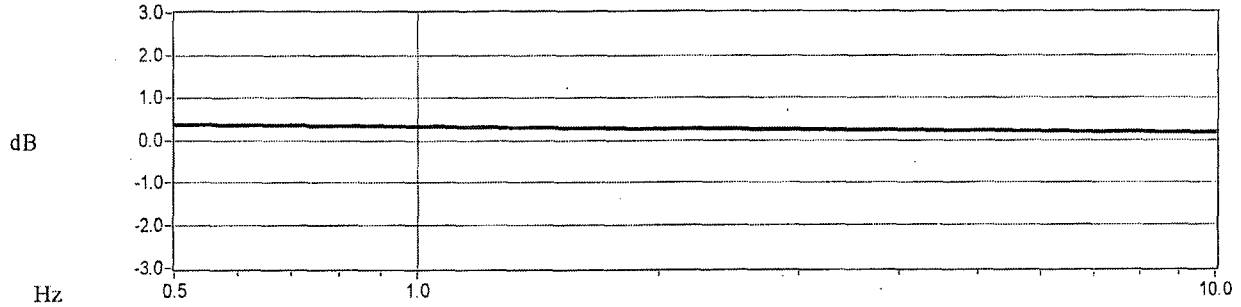
Description: ICP® Accelerometer Method: Back-to-Back Comparison Calibration

Manufacturer: PCB

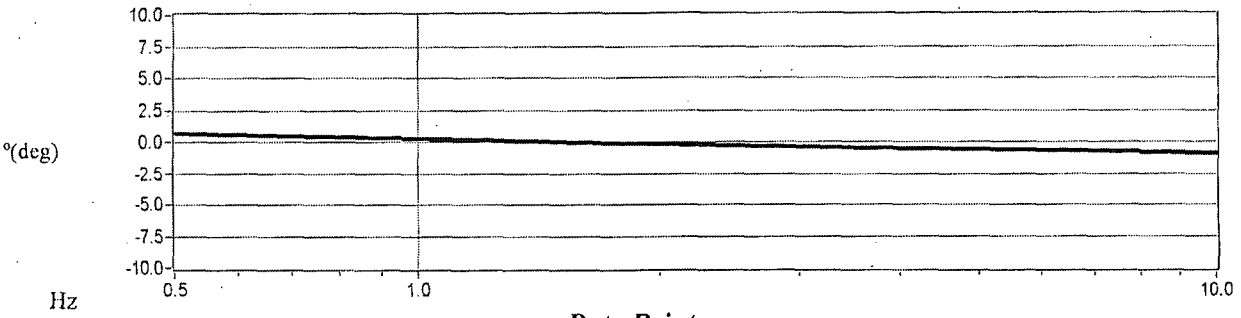
Calibration Data

Sensitivity @ 100.0 Hz 999 mV/g (101.9 mV/m/s²)

Magnitude Plot



Phase Plot



Data Points

Frequency (Hz)	Deviation (%)	Phase (°)
0.5	4.3	0.7
1.0	3.7	0.3
2.0	3.2	-0.2
5.0	2.6	-0.6
7.0	2.4	-0.7
10.0	2.1	-0.9

Notes

1. Calibration is traceable to one or more of the following report numbers; PTB 5399, PTB 5400 and NIST 822/271196.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540-1-1994 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 0.5-0.99 Hz; +/- 1.8%, 1-30 Hz; +/- 1.0%, 30.01-199 Hz; +/- 1.5%, 200-1 kHz; +/- 3.0%.

Technician: Al Sturniolo Date: 11/16/07

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~ Calibration Certificate ~

Per ISO 16063-21

Model Number: 393B04

Serial Number: 11092

Description: ICP® Accelerometer

Method: Back-to-Back Comparison Calibration

Manufacturer: PCB

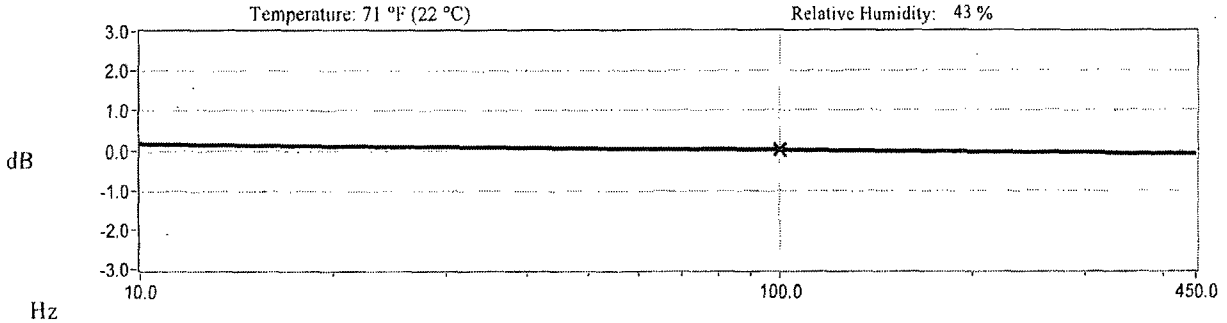
ACS-1, ACS-4

Calibration Data

Sensitivity @ 100.0 Hz	**962**	**mV/g**	Output Bias	11.7	VDC
	(98.1	**mV/m/s²)**	Transverse Sensitivity	1.6	%
Discharge Time Constant	6.6	seconds	Resonant Frequency	3000.0	Hz

Sensitivity Plot

Temperature: 71 °F (22 °C) Relative Humidity: 43 %



Data Points

Frequency (Hz)	Dev. (%)	Frequency (Hz)	Dev. (%)
10.0	2.0	300.0	-0.7
15.0	1.4	450.0	-1.2
30.0	0.9		
50.0	0.6		
REF. FREQ.	0.0		

Mounting Surface: Stainless Steel w/Silicone Grease Coating Fastener: Stud Mount Fixture Orientation: Vertical
Acceleration Level (rms)[1]: 1.00 g (9.81 m/s²)[2]
[1]The acceleration level may be limited by shaker displacement at low frequencies. If the listed level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude: Acceleration Level (g) = 0.010 x (freq)².
[2]The gravitational constant used for calculations by the calibration system is: 1 g = 9.80665 m/s².

Condition of Unit

As Found: In Tolerance, No Adjustment Necessary

As Left: In Tolerance

Notes

1. Calibration is NIST Traceable thru Project 822/274086 and PTB Traceable thru Project 1060.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540-1-1994 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 5-9 Hz; +/- 2.0%, 10-99 Hz; +/- 1.5%, 100-1999 Hz; +/- 1.0%, 2-10 kHz; +/- 2.5%.

Technician: Al Sturniolo Date: 11/16/07

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CAL3 - 3278070331.32

~ Calibration Certificate - Phase ~

Per ISO 16063-21

Model Number: 393B04

Serial Number: 11092

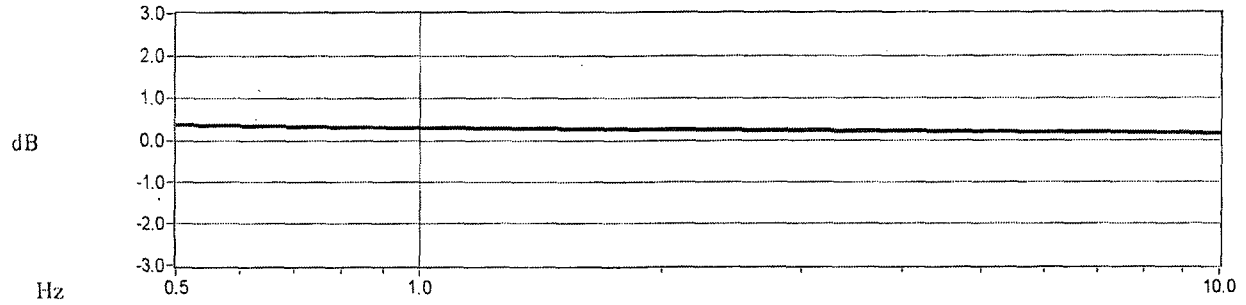
Description: ICP® Accelerometer Method: Back-to-Back Comparison Calibration

Manufacturer: PCB

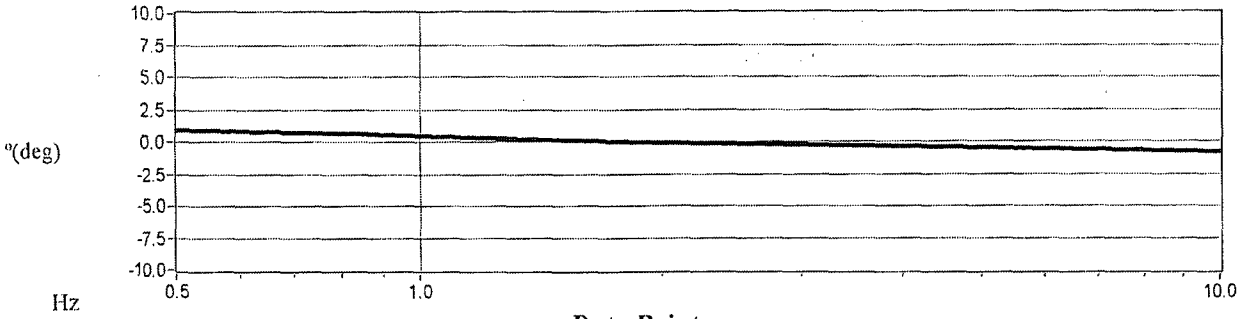
Calibration Data

Sensitivity @ 100.0 Hz 962 mV/g (98.1 mV/m/s²)

Magnitude Plot



Phase Plot



Data Points

Frequency (Hz)	Deviation (%)	Phase (°)
0.5	4.4	0.9
1.0	3.5	0.4
2.0	3.0	-0.1
5.0	2.4	-0.5
7.0	2.2	-0.6
10.0	2.0	-0.8

Notes

1. Calibration is traceable to one or more of the following report numbers; PTB 5399, PTB 5400 and NIST 822/271196.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540-1-1994 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Measurement uncertainty (95% confidence level with coverage factor of 2) for frequency ranges tested during calibration are as follows: 0.5-0.99 Hz; +/- 1.8%, 1-30 Hz; +/- 1.0%, 30.01-199 Hz; +/- 1.5%, 200-1 kHz; +/- 3.0%.

Technician: Al Sturniolo Date: 11/16/07

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