CHATSWORTH PRODUCTS
An Employee-Owned Company

Corporate Office
31425 Agoura Road
Westlake Village, CA 91361
818-735-6100 FAX 818-735-6199

Customer Service/Technical Support
800-849-4969
www.chatsworth.com

August 15, 2014

The attached document is the property of Chatsworth Products (CPI). It should not be modified.
It should not be reproduced or redistributed in any way without the express permission of CPI.

The attached TCG NEBS COMPLIANCE REPORT is provided on request specifically to you and specifically for use in evaluating and specifying the Z4-Series SeismicFrame Cabinet.

- The Z4-Series SeismicFrame Cabinet features an industry-leading 1500 lb (680 kg) seismic equipment load with additional 100 lb (45 kg) top load for cabling.

- The Z4-Series SeismicFrame Cabinet was tested by a Telecommunication Carrier Group and ISO 17025 certified independent Testing Laboratory (ITL) to meet the requirements of Telcordia Technologies GR-63-CORE, Issue 4, April 2012, Sections 4.4 per Zone 4 requirements. Testing evaluates the cabinet per Sections 4.4.1 Earthquake Environment and Criteria, 4.4.2 Framework and Anchor Criteria, and 5.4.1 Earthquake Test Methods.

- The attached document is a test performance report. NEBS COMPLIANCE testing is a physical test of product performance under simulated earthquake conditions. The testing process is standardized and may only be performed by ITL labs that are certified to conduct GR-63-CORE testing. Results are uniform and are documented in a standard report format.

- The attached TCG NEBS COMPLIANCE REPORT documents the testing and results, qualifying the 1500 lb (680 kg) seismic equipment load for Z4-Series SeismicFrame Cabinet P/N Z4-22U-113C-C12. This cabinet is the tallest and deepest 31.5”W (800 mm) frame. These results cover all 31.5”W (800 mm) Z4-Series SeismicFrame Cabinets, CPI P/Ns Z4-X**2**X-1X3X-X1X (Download Data Sheet)

Thank you for your interest in Chatsworth Products.

If you have further questions or concerns, please contact CPI Technical Support, techsupport@chatsworth.com.

TCG NEBS COMPLIANCE REPORT

Customer Name: Chatsworth Products, Inc.
3004 South Austin Avenue
Georgetown, TX 78627

Product Name: Z4-22U-113C-C12 Cabinet With 1,500 lb Load

Tested/Evaluated To:

Telcordia Technologies GR-63-CORE, Issue 4, April 2012
Sections 4.4

Date: September 2014
Project: 18195.01
Report: 18.18195.01.101.FR1
Issue: 3

TCG Independent Testing Laboratory:
Southwest Research Institute®
6220 Culebra Road
San Antonio, TX 78238

This report is for the information of the client. It may be used in its entirety for the purpose of securing product acceptance from duly constituted approval authorities. This report shall not be reproduced, except in full, without the written approval of SwRI. Neither this report nor the name of the Institute shall be used in publicity or advertising.

Authored By:

Mark Orlowski
Research Engineer,
Structural Dynamics & Product Assurance Section

Approved By:

Jenny Ferren
Manager,
Structural Dynamics & Product Assurance Section

0 RELEASE CONTROL RECORD

Below is a table documenting the various changes recorded in this report. Each issuance of the report is clearly marked with the revision number and date of issue.

Table 0.1: Revision Table

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
1	Original Release	February 28, 2014
2	Product Referred to by Part Number	April 22, 2014
3	Fix Bookmark Error	September 18, 2014

1 EARTHQUAKE VIBRATION

TCG NEBS COMPLIANCE TEST REPORT FOR:

Chatsworth Products, Inc.
3004 South Austin Avenue
Georgetown, TX 78627

PRODUCT:

Z4-22U-113C-C12 Cabinet

TESTED TO:

Telcordia Technologies GR-63-CORE, Issue 4, April 2012
Section 4.4

Date: September 2014
Project: 18195.01
Report: 18.18195.01.101.FR1, Issue 3

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Table 1.1: Summary of Test Results for Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

Section	Section Name	Criteria	Complies?			Page	Comment
			Yes	No	N/A		
Section 4.4	***Earthquake, Office Vibration, and Transportation Vibration***						
4.4.1	Earthquake Environment and Criteria	R4-83 [110]	✓			9	
		R4-84 [111]	✓			9	
		R4-85 [112]	✓			9	
		O4-86 [113]	✓			10	
		R4-87 [114]			✓	10	
		O4-88 [115]			✓	10	
4.4.2	Framework and Anchor Criteria	O4-89 [116]	✓			32	
		R4-90 [117]	✓				
		O4-91 [118]	✓				Although the static pull test was not performed, the results from the dynamic test fall with the required parameters.
		R4-92 [119]	✓				
		O4-93 [120]	✓				
		O4-94 [121]	✓				

1.1 OVERVIEW

PROJECT OBJECTIVE

Testing was performed to determine whether the Z4-22U-113C-C12 Cabinet supplied by Chatsworth Products, Inc. met the tested requirements of Section 4.4, *Earthquake, Office Vibration, and Transportation Vibration* of GR-63-CORE, Issue 4, April 2012 with a 1,500 lb load.

EQUIPMENT CONFIGURATION AND TEST CONDITIONS

The equipment under test (EUT) was the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet.

EQUIPMENT OPERATING CONDITIONS

The Z4-22U-113C-C12 Cabinet was configured for normal operation for its intended use within telco-owned facilities.

PASS/ FAIL CRITERIA

The EUT was to endure the relevant testing with no physical or structural damage.

1.2 EARTHQUAKE ENVIRONMENT AND CRITERIA (4.4.1)

TEST LOCATION: Mark Orlowski supervised the following evaluation on February 4 through February 5, 2014, at Southwest Research Institute in San Antonio, Texas.

PHYSICAL PERFORMANCE CRITERIA (4.4.1.2)

During frame-level testing, the physical performance of the equipment shelves, framework, and fastening hardware are considered. Permanent structural or mechanical damage of any of these elements constitutes a test failure.

Permanent structural damage is defined as deformation of any load-bearing element of the equipment being tested, or any connection failure. Typical examples of permanent structural damage are bent or buckled uprights, deformed bases, cracks, and failed anchors or fastening hardware.

Mechanical damage is defined as any dislocation or separation of components. Examples of mechanical damage are disengaged cards and modules, and opened (including partially) doors, drawers, or covers.

R4-83

REQUIREMENT: [110] All equipment shall be constructed to sustain the waveform testing of Section 5.4.1 of GR-63-CORE without permanent structural or mechanical damage.

TEST PROCEDURE: See test procedure described later in this section.

RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-83 [106]. See detailed results in the Physical Performance Criteria Results section.

R4-84

REQUIREMENT: [111] Frame-level equipment shall be constructed so that during the waveform testing of Section 5.4.1 of GR-63-CORE, the maximum single-amplitude deflection at the top of the framework, relative to the base, does not exceed 75 mm (3 in).

TEST PROCEDURE: See test procedure described later in this section.

RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-84 [111]. See detailed results in the Physical Performance Criteria Results section.

R4-85

REQUIREMENT: [112] Frame-level equipment shall have a natural mechanical frequency greater than 2.0 Hz as determined by the swept sine survey of Section 5.4.1 of GR-63-CORE.

TEST PROCEDURE: See test procedure described later in this section.

RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-85 [112]. See detailed results in the Physical Performance Criteria Results section.

O4-86

OBJECTIVE: [113] Frame-level equipment should have a natural mechanical frequency greater than 6.0 Hz as determined by the swept sine survey of Section 5.4.1 of GR-63-CORE.

TEST PROCEDURE: See test procedure described later in this section.

RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **meets** O4-86 [113]. See detailed results in the Physical Performance Criteria Results section.

FUNCTIONAL PERFORMANCE CRITERIA (4.4.1.3)

R4-87

REQUIREMENT: [114] All equipment shall be constructed to meet applicable functionality requirements immediately before and after each axis of waveform testing of Section 5.4.1 of GR-63-CORE. The equipment shall sustain operation without replacement of components, manual rebooting, or human intervention.

RESULTS: R4-87 [114] is **not applicable** to the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet. The cabinet's purpose is strictly structural.

O4-88

OBJECTIVE: [115] All equipment should be constructed to meet applicable functionality requirements continuously during waveform testing of Section 5.4.1 of GR-63-CORE. These functionality criteria shall demonstrate that the equipment has sustained operation without loss of service during the testing.

RESULTS: O4-88 [115] is **not applicable** to the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet. The cabinet's purpose is strictly structural.

EARTHQUAKE ENVIRONMENT AND PHYSICAL PERFORMANCE CRITERIA

Earthquake Environment

Zone 4 criteria (worst-case) were selected for earthquake testing to comply with the requirements of the equipment manufacturer. The item under test is a Z4-22U-113C-C12 Cabinet containing 1,500 lb of weight.

Physical Performance Criteria

Permanent structural damage is defined as deformation of any load-bearing element of the equipment being tested, or any connection failure. Typical examples of permanent structural damage are bent or buckled uprights, deformed bases, cracks, and failed anchors or fastening hardware.

Mechanical damage is defined as any dislocation or separation of components. Examples of mechanical damage are disengaged cards and modules, and opened (including partially) doors, drawers, or covers.

WAVEFORM TESTING OF SECTION 5.4.1 OF GR-63-CORE

Waveform

Waveforms obtained from Telcordia on computer diskette in ASCII code were programmed into the SwRI control equipment. There are three waveforms: one for Zones 1 and 2 testing, one for Zone 3 testing, and one for Zone 4 testing. The appropriate waveform for the Earthquake Zone test to be performed (Zone 4) was used.

Transfer functions have been calculated to account for the unique response of each of SwRI's shaker tables. Each transfer function relates the shaker table's input (typically in displacement) to the shaker table's output in g's. For any shaker table, a transfer function can be found by dividing the table's output by the table's input (in the frequency domain). The inverse of this transfer function is multiplied by the appropriate waveform (in the frequency domain). The resulting frequency domain drive signal is then converted for use in the time domain. This process is employed to generate the drive signal for each test run of the shaker table.

Accelerometers

Response accelerometers were placed at the top and middle of the structure for each axis of testing. The response accelerometer locations are shown in Figure 1.1 through Figure 1.6. The control accelerometers were mounted directly to the shaker table.

Response Spectrum Analyzer

The Test Response Spectrum (TRS) is generated from the shaker table acceleration data via a Response Spectrum Analyzer using 2% damping. The reproduction of the Telcordia waveforms was verified by analyzing the TRS at sixth octave (logarithmically spaced) frequencies from 0.5 to 50 Hz. Figure 5-18 of GR-63-CORE lists the response spectrum analyzer frequencies.

Deflection Measurement Equipment

A method of measuring the deflection at the top of the framework relative to its base is provided. String potentiometers were used for this purpose.

Table Equipment and Specifications

Two seismic tables, one for horizontal motion and one for vertical motion, are used for earthquake testing. Both tables have mounting surfaces of up to 8 by 8 feet and can be excited with sine or random motion. Maximum table payload capacity is 10,000 lb. deadweight for each table.

All calibrated test equipment used to perform the tests and acquire data during this qualification program is listed in

Table 1.2. Drive mechanisms are servo controlled, electro hydraulic and have the capabilities listed in Table 1.3.

Table 1.2: Calibrated Test Equipment for Seismic Testing

ITEM	MAKE	MODEL	ASSET	CAL DUE*
Accelerometer	CEC	4-202-0017	011336	07/22/14
Accelerometer	CEC	4-202-0001	010182	07/23/14
Transducer	MDTotco	1850-020	011604	09/06/14
Accelerometer	PCB	A353B17	005372	12/06/14
Accelerometer	PCB	A353B17	010055	12/06/14
Shaker Control	Dactron	LASER	011488	02/14/14
Torque Wrench	Armstrong	64-046	011395	07/10/14

*Unless otherwise specified, calibration is performed on an annual cycle.

Table 1.3: Seismic Table Specifications

	HORIZONTAL	VERTICAL
Frequency Range	0-100 Hz	0-100 Hz
Dynamic Force Capacity	50,000 lb.	50,000 lb.
Maximum Stroke	12 in.	10 in.
Payload	10,000 lb.	10,000 lb.

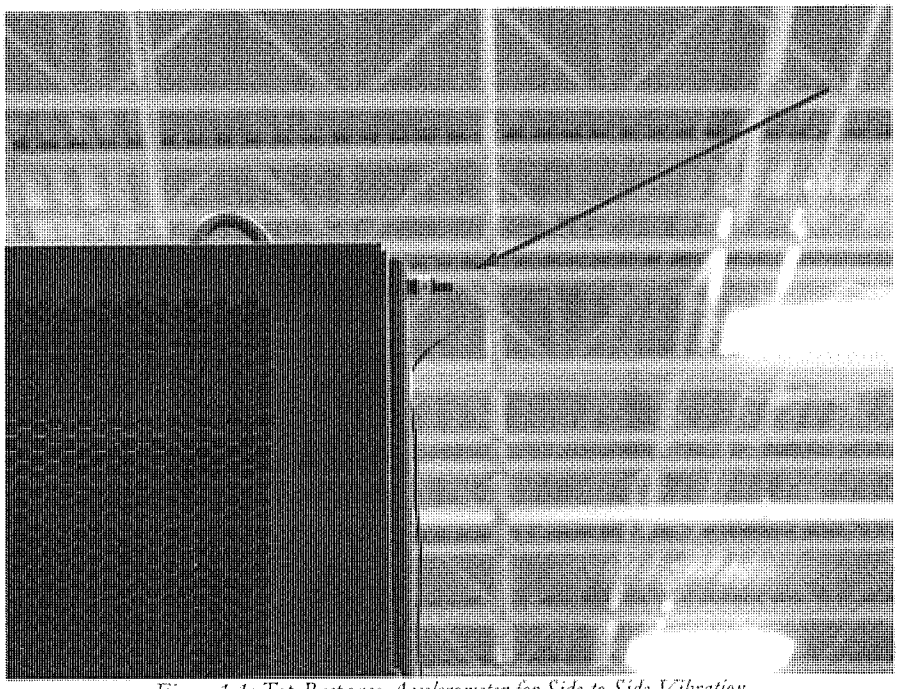


Figure 1.1: Top Response Accelerometer for Side to Side Vibration

Figure 1.2: Middle Response Accelerometer for Side to Side Vibration

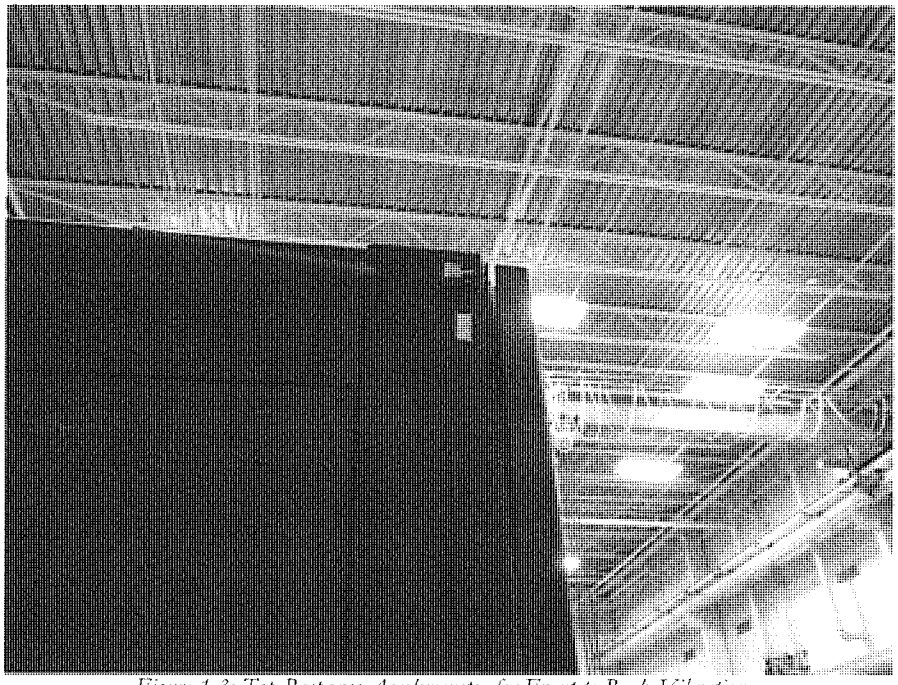


Figure 1.3: Top Response Accelerometer for Front to Back Vibration

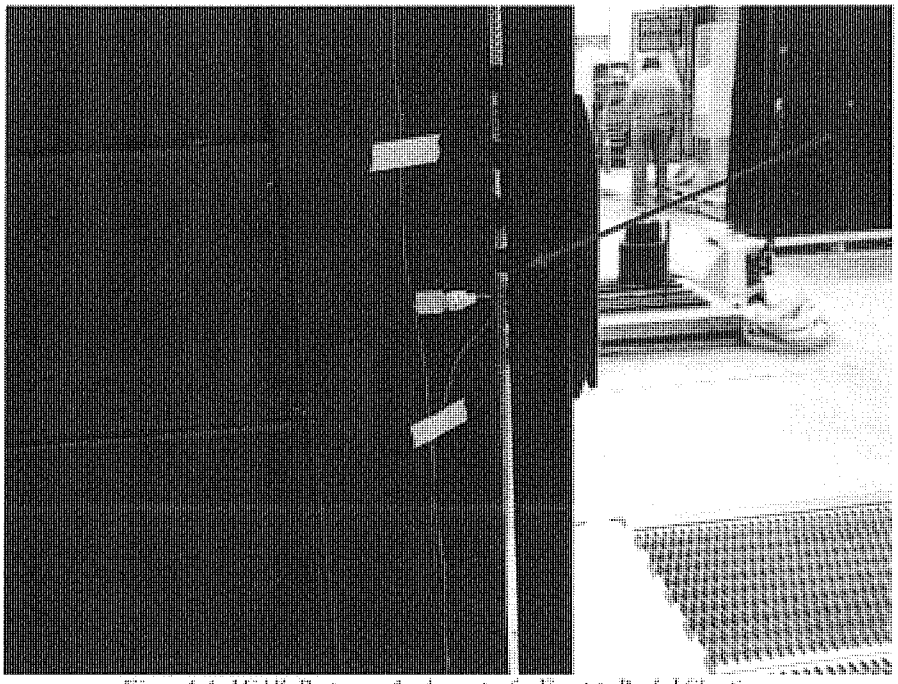


Figure 1.4: Middle Response Accelerometer for Front to Back Vibration

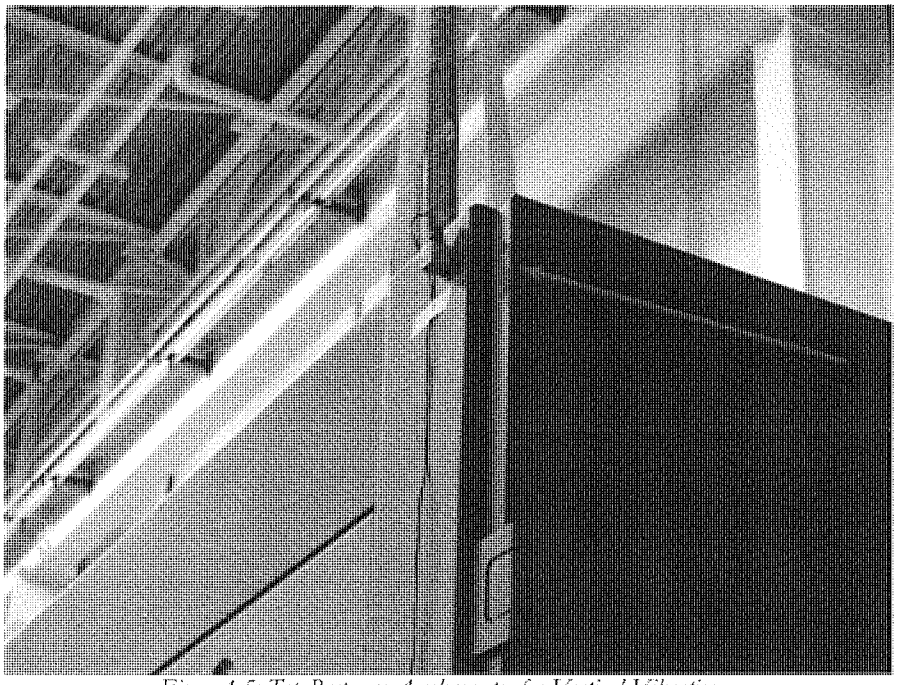


Figure 1.5: Top Response Accelerometer for Vertical Vibration

Figure 1.6: Middle Response Accelerometer for Vertical Vibration

TEST METHOD

Frame-Level Mounting Procedure

The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet was attached to a 4' x 6' x 6"-thick concrete slab using four 12 mm diameter bolts with an embedment depth of 3.5 in. Total weight of the empty rack was approximately 563.5 pounds. The added payload weight was 1,500 pounds. The added load was mounted via shelves shown in Figure 1.7. An additional 100 pounds was attached to the top of the rack as shown in Figure 1.8 to simulate overhead cabling.

The Cartesian coordinate system is used to define the test axes during the earthquake testing as follows:

- X Axis; Horizontal; Side to Side
- Y Axis; Horizontal; Front to Back
- Z Axis; Vertical

Pictures of the equipment mounted for testing is each axis are shown in Figure 1.9 through Figure 1.11 below.

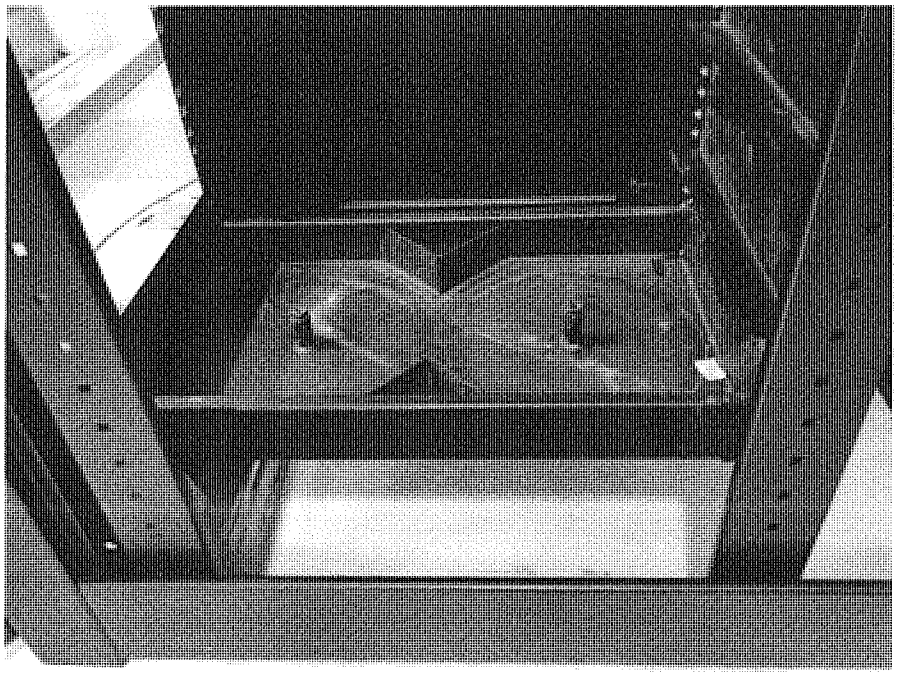


Figure 1.7: Shelving for Added Load

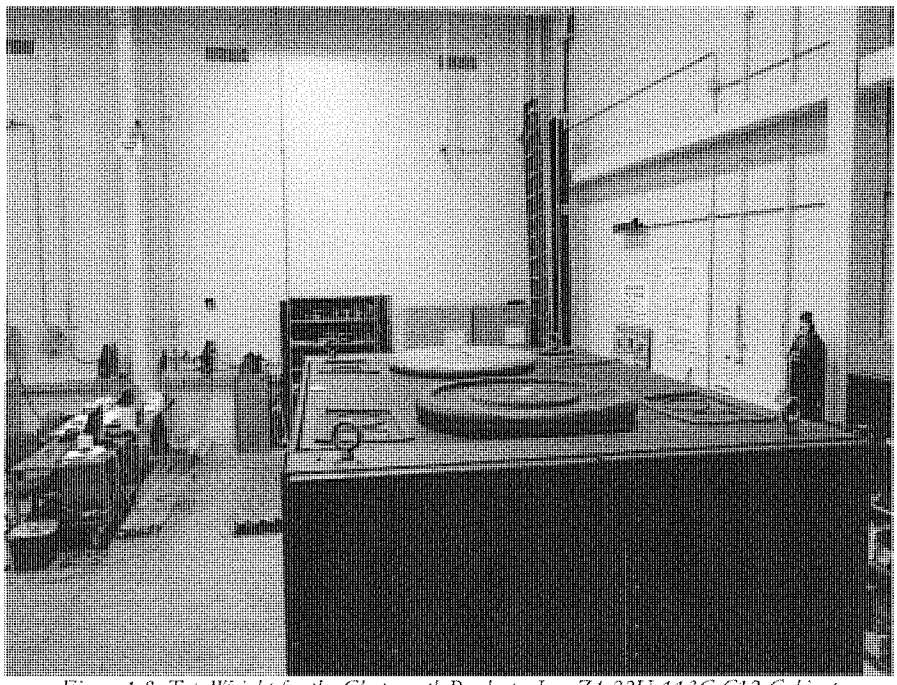


Figure 1.8: Top Weight for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

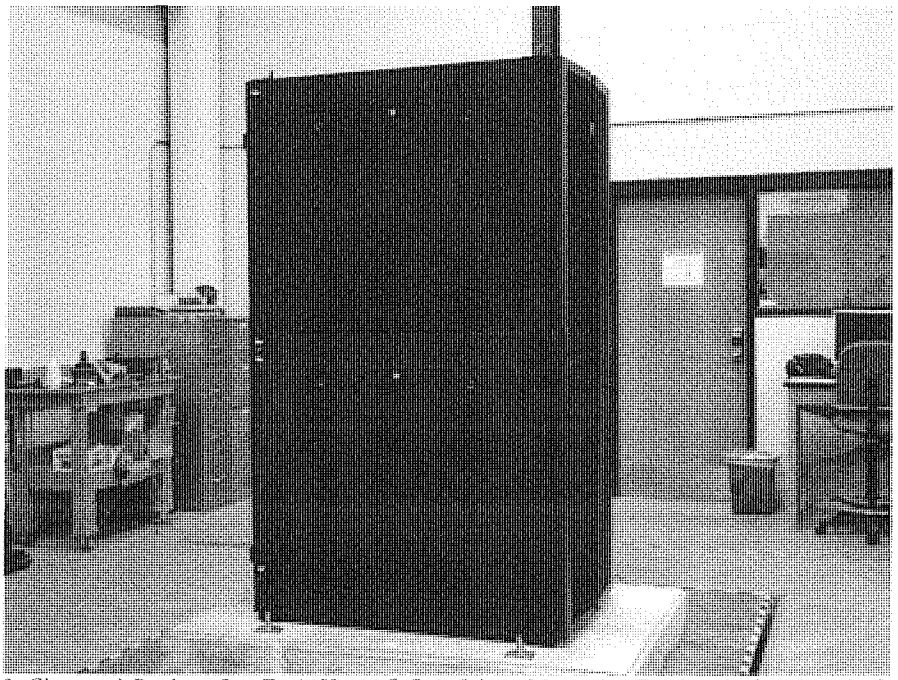


Figure 1.9: Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet Mounted to Earthquake Simulator for Side to Side Vibration

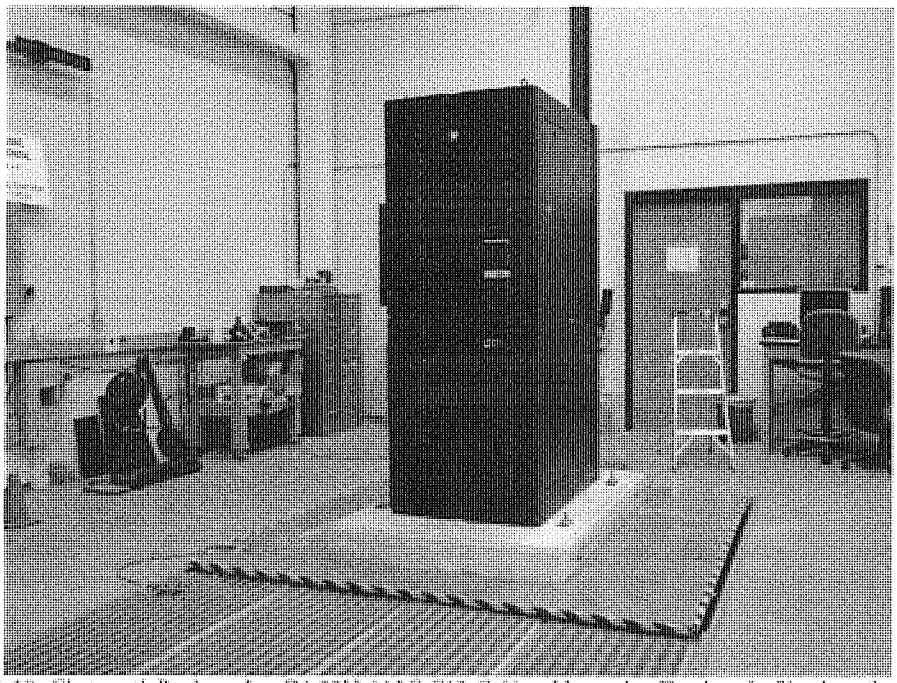


Figure 1.10: Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet Mounted to Earthquake Simulator for Front to Back Vibration

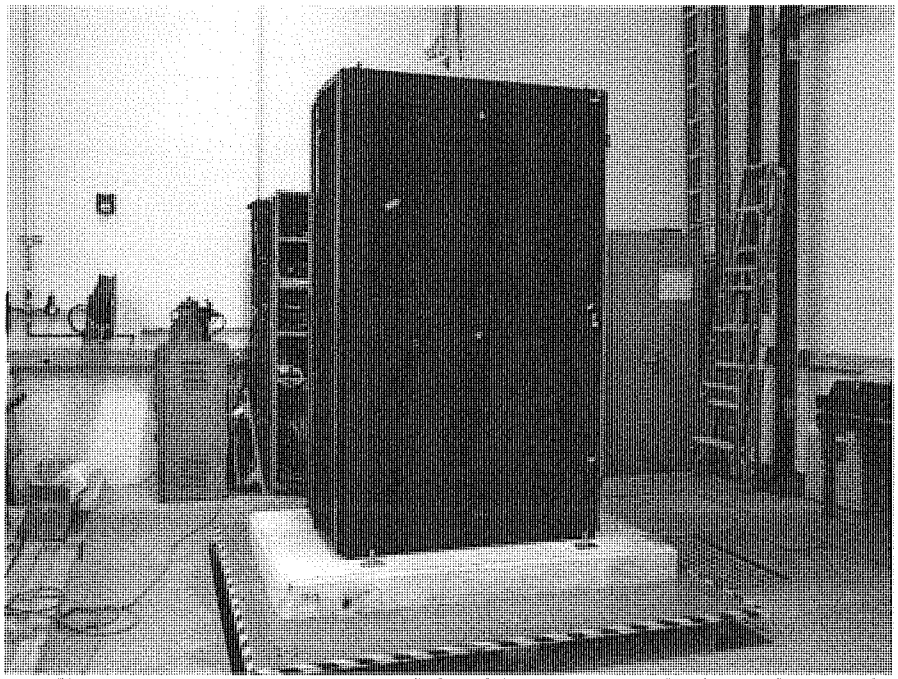


Figure 1.11: Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet Mounted to Earthquake Simulator for Vertical Vibration

Sine Survey Tests

The Sine Survey is a swept sine waveform test used to determine critical frequencies of the framework. Swept sine surveys were performed for horizontal and vertical axes. The sine surveys were generally performed prior to earthquake testing in that axis. The sine surveys were performed by inputting uniaxial sinusoidal excitation of 0.2 g peak into the equipments' axis of interest. The frequency range covered during the sine surveys was 1-50 Hz at a sweep rate of 1.0 octave per minute.

Two response accelerometers were used on the equipment under test in each axis. The locations of the accelerometers for each test configuration are given in Figure 1.1 through Figure 1.6. Accelerometers are indicated by arrows in the photographs. The control accelerometers were mounted directly to the shaker tables during the testing.

The response and control accelerations were monitored and recorded during the sine surveys using the uniaxial accelerometers mounted in the direction of the input excitation. Transmissibility plots of response acceleration to input acceleration were obtained for the response accelerometer locations, with a resonance defined as a peak of greater than two times the input excitation. A summary of the sine survey testing is included in Table 1.5.

Earthquake Qualification Tests

The Zone 4 Simulated Earthquakes were performed on the SwRI seismic simulator using the uni-axial VERTEQII time history of the NEBS document.

Uniaxial earthquake tests of 30 seconds duration were conducted on each axis of the Z4-22U-113C-C12 Cabinet. The Required Response Spectra used are given in Telcordia GR-63-CORE. The test items were tested at the NEBS Zone 4 level. The digital analyzer has a digitizing rate of 320 samples per second per channel for 32 seconds and analyzes the data at the frequencies listed in Telcordia GR-63-CORE. Response Spectra plots out to 50 Hz for all TRSs with 2% damping values are given later in this section.

During each earthquake event, multiple channels of data were digitized at 320 samples per second. The data channels are from the following:

- Response Acceleration: Top of Structure & Middle of Structure
- Shaker Table Acceleration
- Displacement, Top of Structure (Horizontal Tests Only)
- Displacement, Shaker Table (Horizontal Tests Only)

The response accelerometer locations were the same as were used for the sine survey responses. Acceleration time history plots are given in the Test Results section. The displacement data was used to calculate the displacement of the top of the structure relative to the base of the structure. Relative displacement measurements were made for the horizontal directions only. The relative displacement plots are shown in Figure 1.30 and Figure 1.31.

TEST RESULTS

The test item was inspected visually after each earthquake event for mechanical and structural damage, and the anchor torques were checked and adjusted, if necessary. Notes about the visual inspections and functional performance are contained in the laboratory data logs in Appendix 1-A. The sections below provide a summary of the earthquake testing performed. Response spectra and acceleration time histories are presented in Figure 1.18 through Figure 1.29.

Mechanical and Structural Damage Criteria

The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-83 [110]. The Z4-22U-113C-C12 Cabinet was inspected for mechanical or structural damage following earthquake testing in each axis. There was no mechanical or structural damage noted for the Z4-22U-113C-C12 Cabinet after the earthquake testing.

Displacement Criteria

The deflection at the top of the test item, relative to the base, was monitored and recorded during the seismic events using string potentiometers attached to the equipment. Relative displacement plots were obtained for the side-to-side and front-to-back seismic events. The Dactron LASER controller was used to produce the relative displacement plots. The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-84 [111]. The displacement data acquired during testing is summarized in Table 1.4. The maximum relative displacements of the test item did not exceed the 3-inch displacement limit. Time histories of displacement are given in Figure 1.30 and Figure 1.31 below.

Table 1.4: Displacement Summary for Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

Test Axis	Maximum Displacement, Inches	Top Residual Displacement, Inches
Side to Side	1.40	0.05
Front to Back	0.75	0.01

Natural Mechanical Frequency Criteria

The response and control accelerations were monitored and recorded during the sweeps using the uniaxial accelerometers mounted on the item. Response accelerometer locations are shown in Figure 1.1 through Figure 1.6. Transfer function plots of response to input were obtained for the response accelerometer locations with a resonance defined as a peak of greater than two times the input excitation. The Dactron LASER controller was used to produce the transfer function plots. The transfer function plots and details of the results are shown later in this section of this report. The transmissibility plots can be seen in Figure 1.12 through Figure 1.17.

The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-85 [112]. Detailed results are presented in Table 1.5.

The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **meets** O4-86 [113]. All natural frequencies are above 6.0 Hz. Detailed results are presented in Table 1.5.

There was no mechanical or structural damage to the test item after the sine surveys at 0.2 g input.

Table 1.5: Natural Mechanical Frequency Criteria Summary for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

Test Axis	Response Location	First Mode Frequency, HZ
Side to Side	Top	8.66
	Middle	8.60
Front to Back	Top	7.10
	Middle	7.04
Vertical	Top	>50
	Middle	>50

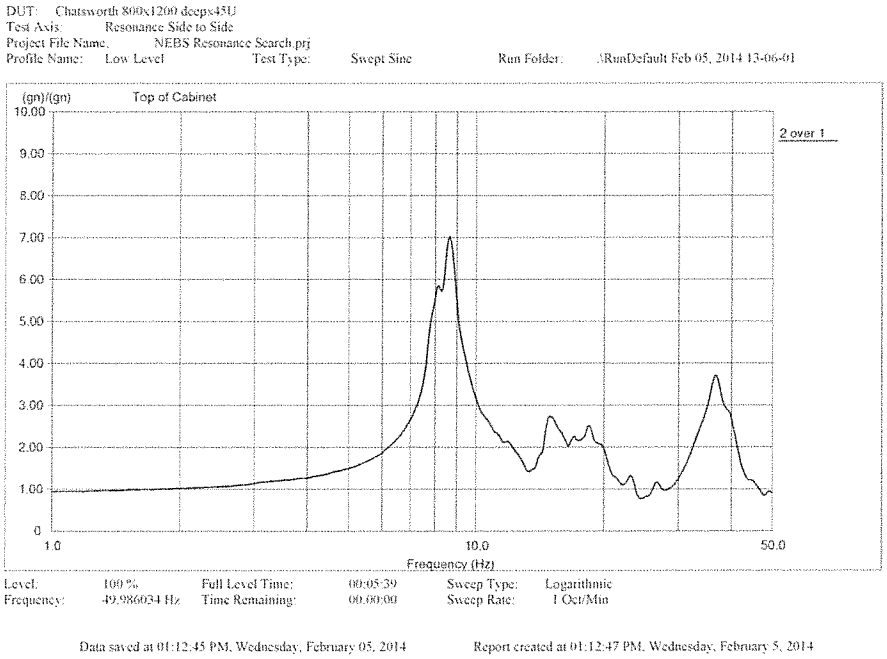


Figure 1.12: Side to Side, Zone 4, Transmissibility Plot, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

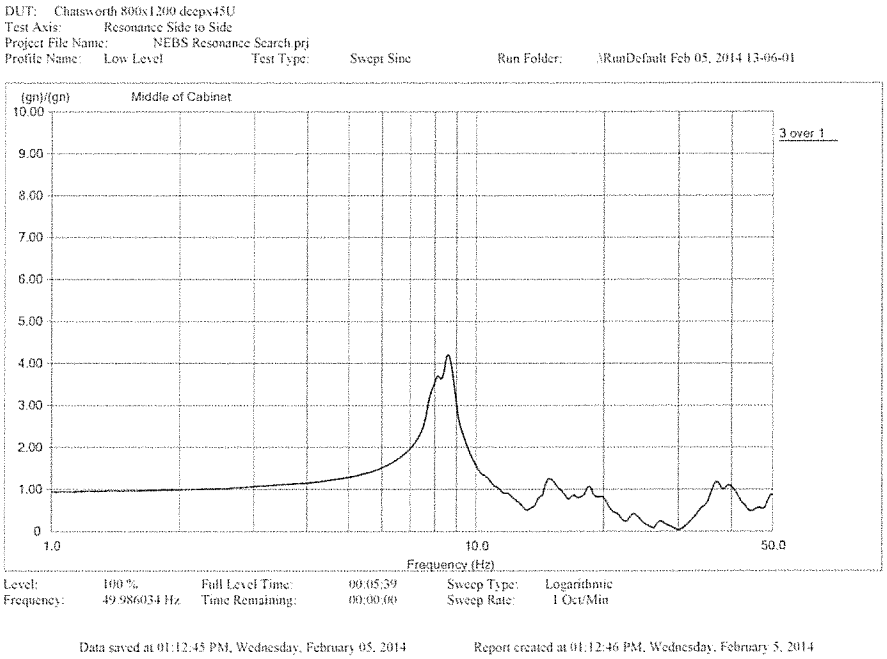


Figure 1.13: Side to Side, Zone 4, Transmissibility Plot, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

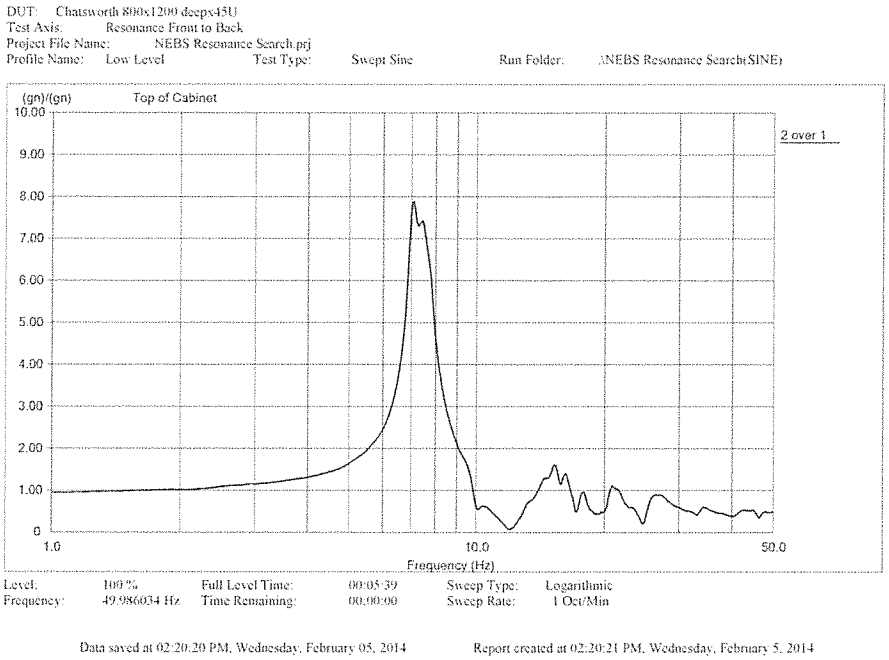


Figure 1.14: Front to Back, Zone 4, Transmissibility Plot, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

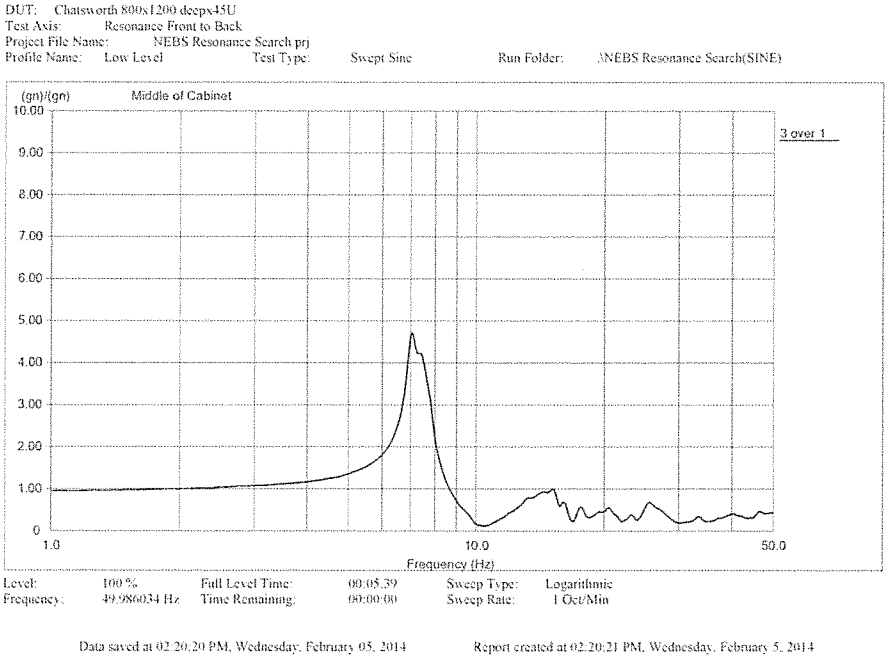


Figure 1.15: Front to Back, Zone 4, Transmissibility Plot, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

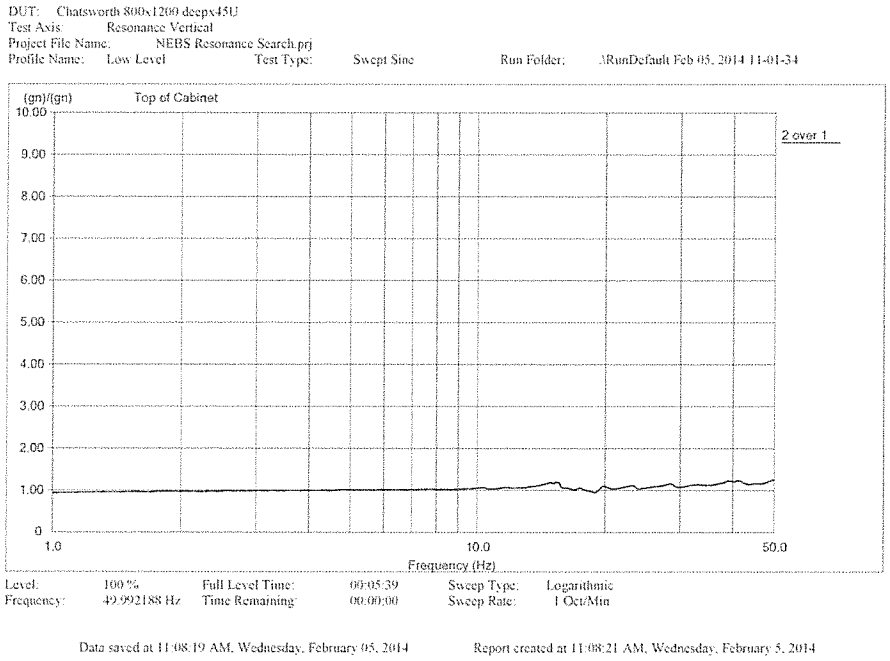


Figure 1.16: Vertical, Zone 4, Transmissibility Plot, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

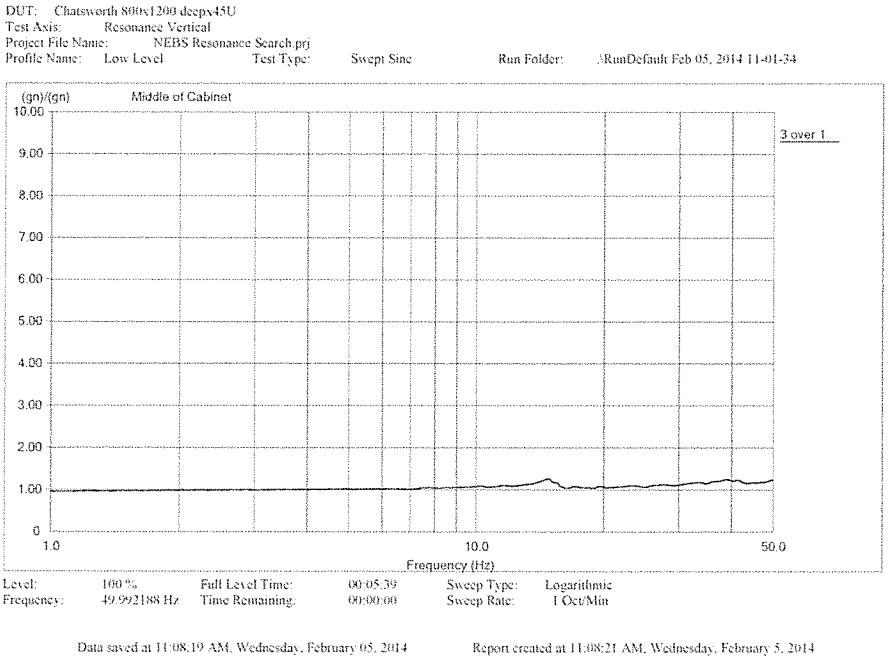


Figure 1.17: Vertical, Zone 4, Transmissibility Plot, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

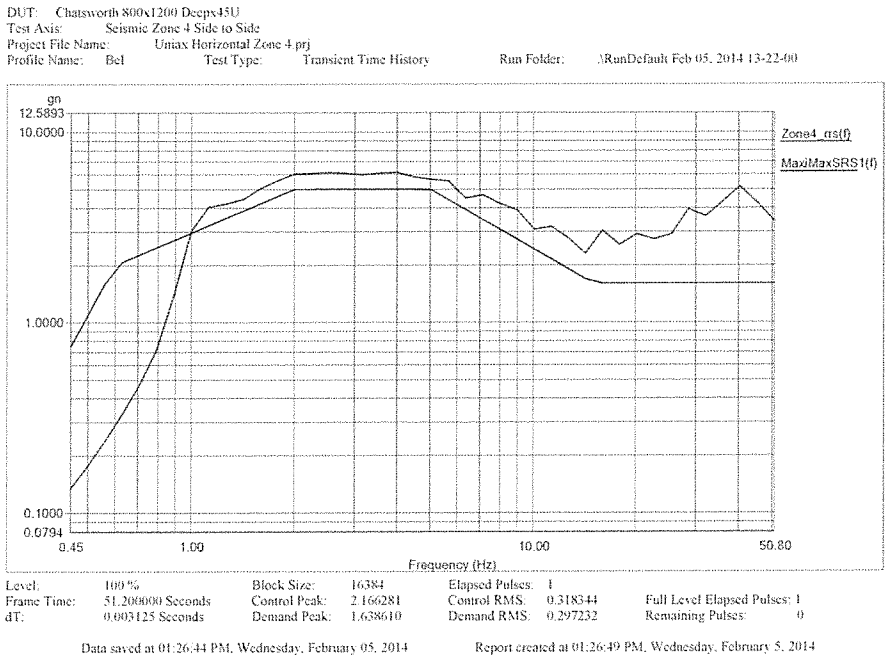


Figure 1.18: Side to Side, Zone 4, Response Spectra for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

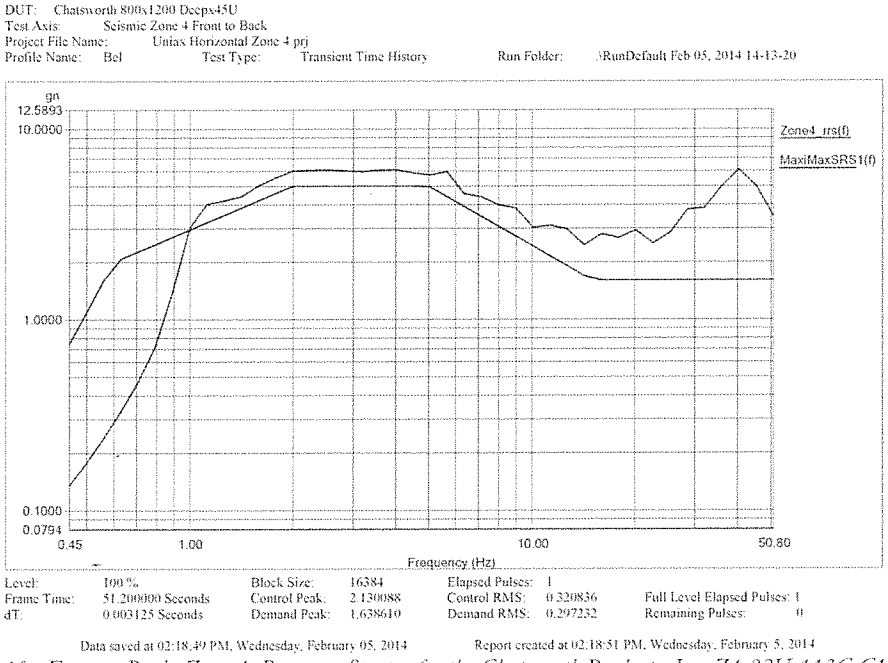


Figure 1.19: Front to Back, Zone 4, Response Spectra for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

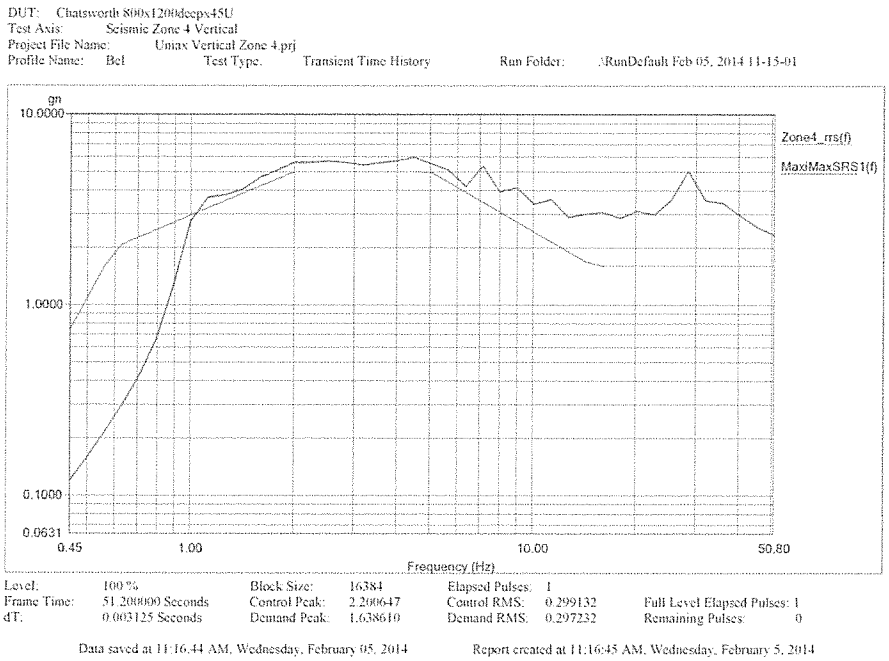


Figure 1.20: Vertical, Zone 4, Response Spectra for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

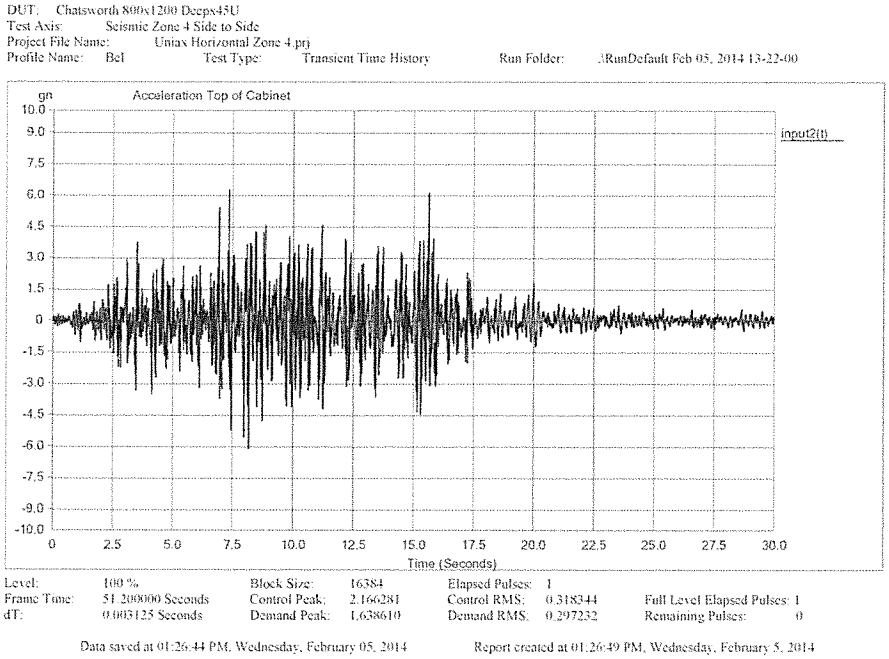


Figure 1.21: Side to Side, Zone 4, Acceleration Time History, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

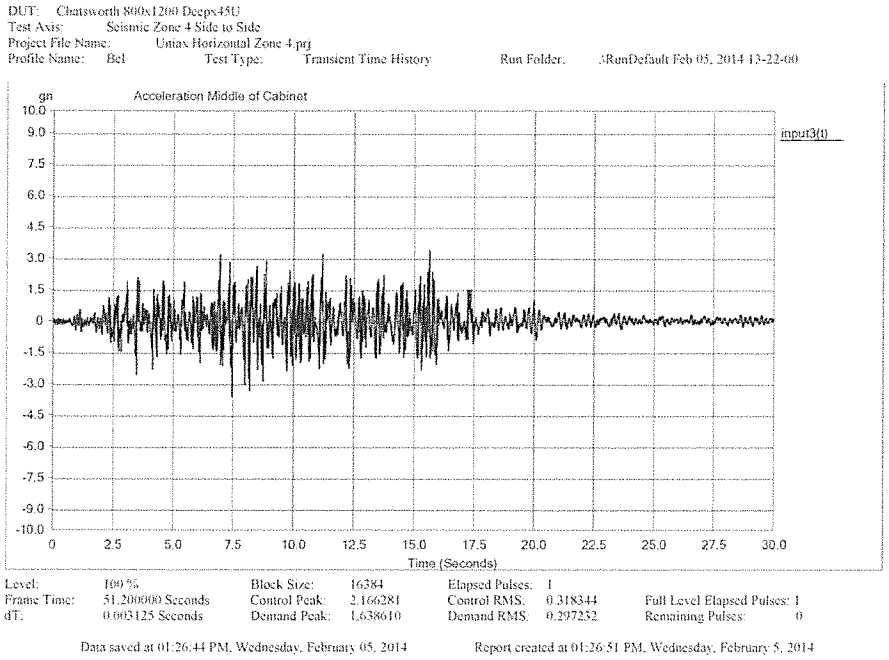


Figure 1.22: Side to Side, Zone 4, Acceleration Time History, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

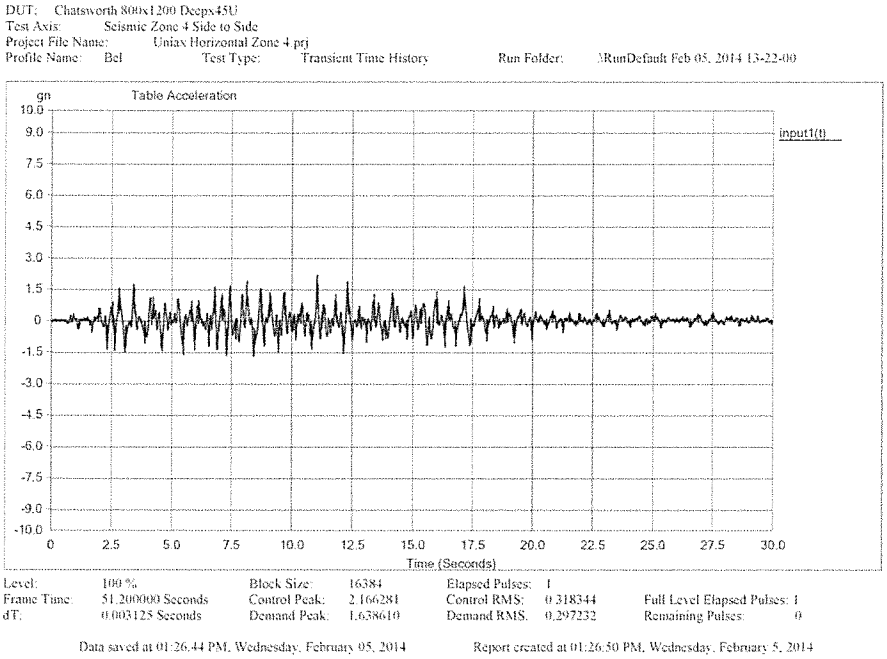


Figure 1.23: Side to Side, Zone 4, Acceleration Time History, Table for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

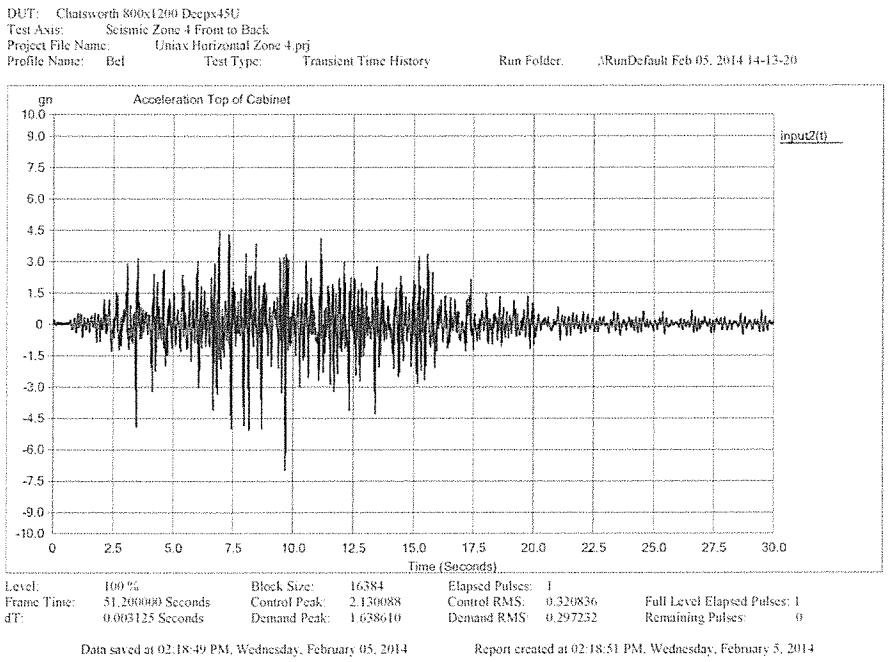


Figure 1.24: Front to Back, Zone 4, Acceleration Time History, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

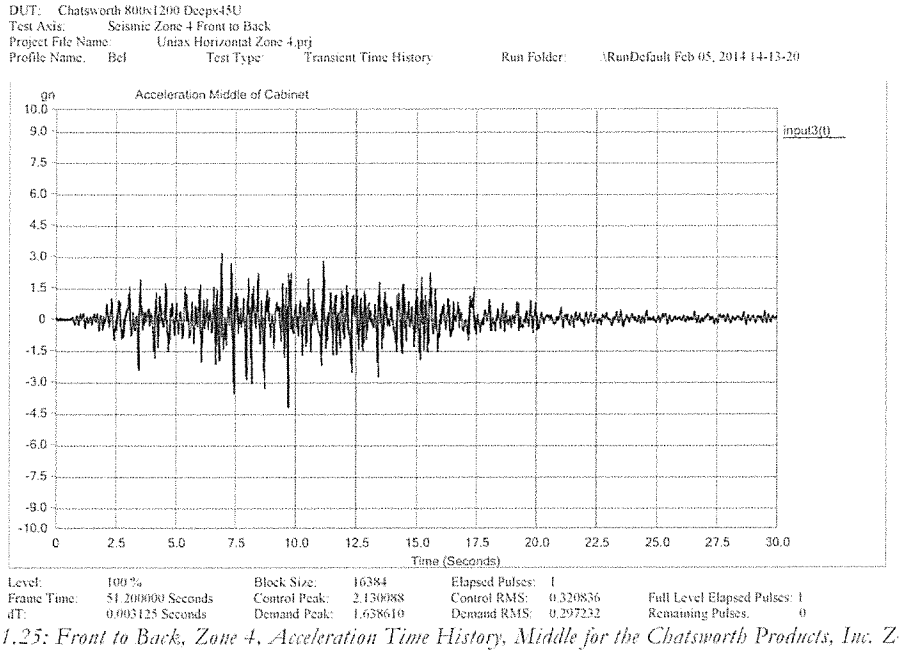


Figure 1.25: Front to Back, Zone 4, Acceleration Time History, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

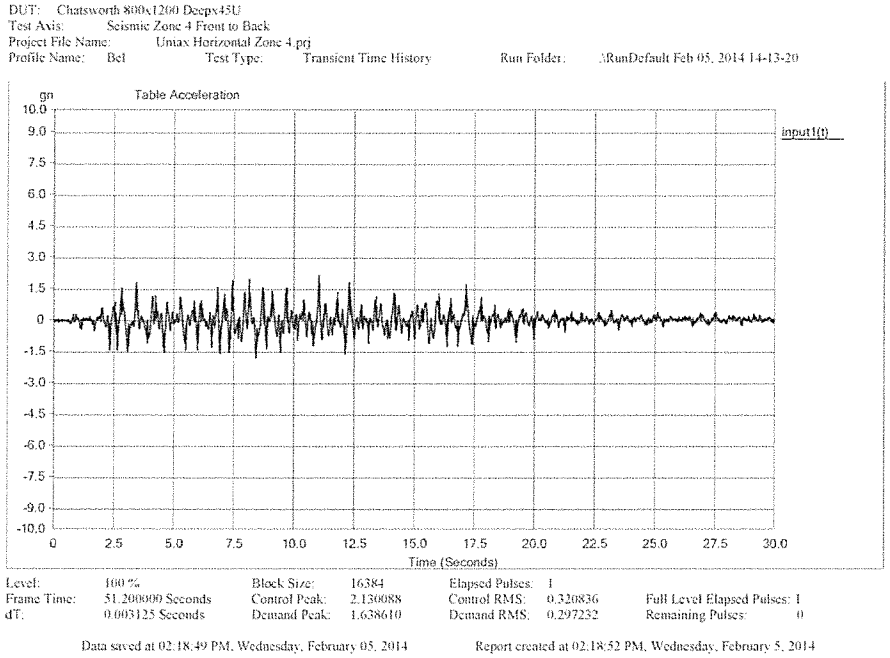


Figure 1.26: Front to Back, Zone 4, Acceleration Time History, Table for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

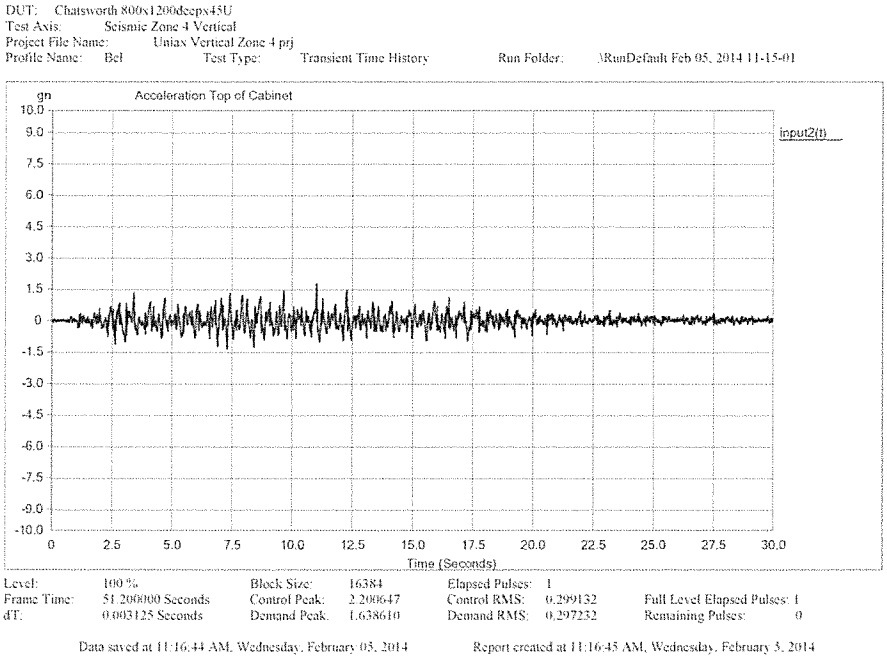


Figure 1.27: Vertical, Zone 4, Acceleration Time History, Top for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

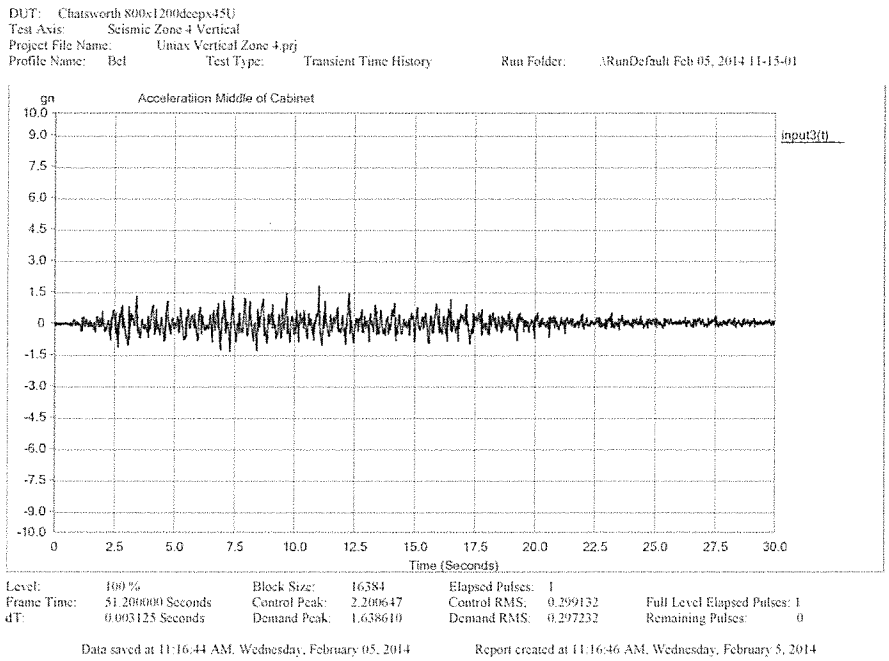


Figure 1.28: Vertical, Zone 4, Acceleration Time History, Middle for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

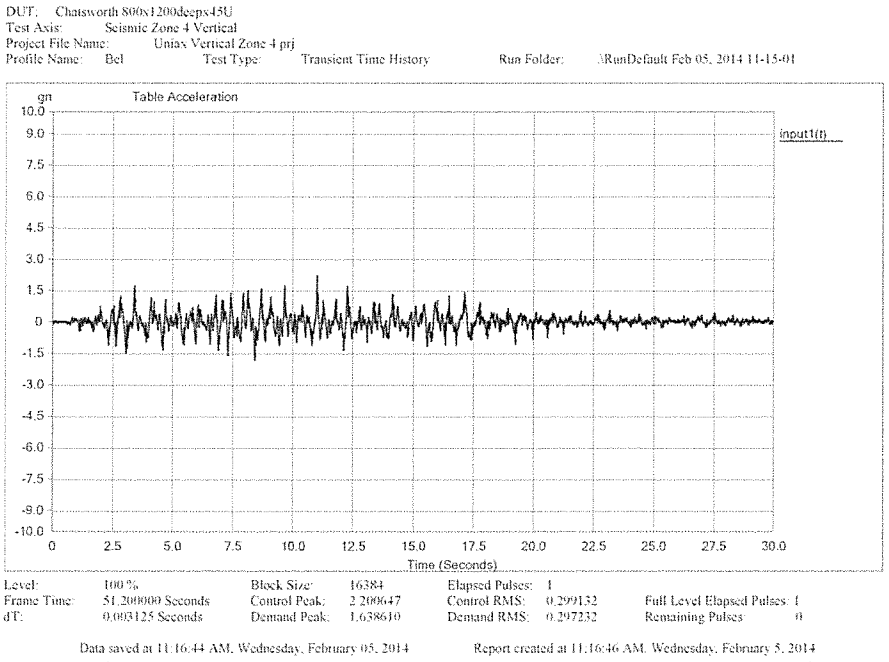


Figure 1.29: Vertical, Zone 4, Acceleration Time History, Table for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

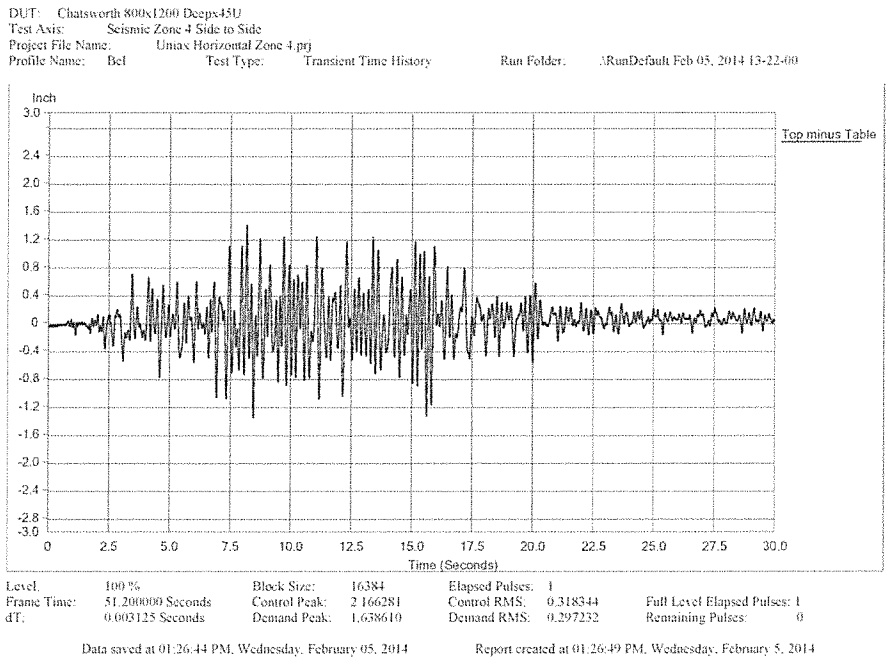


Figure 1.30: Side to Side, Zone 4, Displacement Time History for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

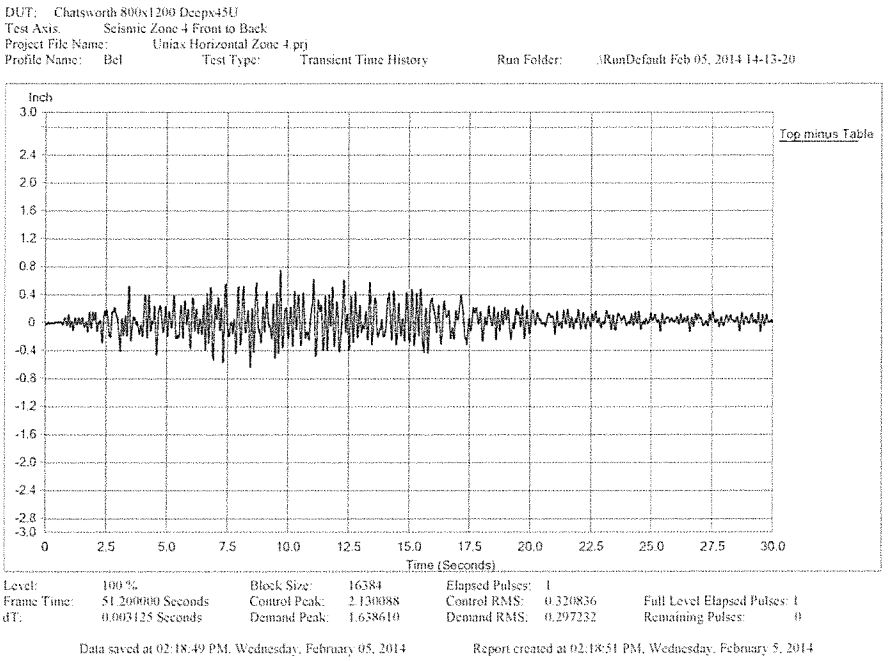


Figure 1.31: Front to Back, Zone 4, Displacement Time History for the Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet

1.3 FRAMEWORK AND ANCHOR CRITERIA (4.4.2)

The following criteria apply to all framework and concrete expansion anchors used in network facilities. They are intended to ensure minimum limits for structural performance in earthquake environments are met.

O4-89

REQUIREMENT: [116] Framework should be of welded construction.

TEST RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **meets** O4-89 [116]. The frame is of welded construction.

R4-90

REQUIREMENT: [117] Framework shall be constructed for base mounting to the floor without auxiliary support or bracing from the building walls or ceilings.

TEST RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **complies** with R4-90 [117]. The frame did not have any support or bracing.

O4-91

REQUIREMENT: [118] For framework used in earthquake risk zones, the static pull testing procedures of Section 5.4.1.4, "Static Test Procedure," of GR-63-CORE should be followed, meeting these objectives:

- The maximum single amplitude deflection at the top of the framework should not exceed 75 mm (3 in).
- The top of the framework should return to its original position, within 6 mm (0.24 in) when the load is removed.
- The framework should sustain no permanent structural damage during static framework testing.

TEST RESULTS: The Chatsworth Products, Inc. Z4-22U-113C-C12 Cabinet **meets** O4-91 [118]. The static pull objective, O4-91 [118], was not performed since the loaded framework had been synthesized waveform tested per GR-63-CORE Section 5.4.1.5, "Waveform Test Procedure." However, all parameters measured during the dynamic testing were within the limits set by O4-91 [118].

R4-92

REQUIREMENT: [119] Concrete expansion anchors used to base mount framework to the floor shall meet the following requirements:

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

TEST RESULTS: The hardware used to secure the Z4-22U-113C-C12 Cabinet to the floor **complies** with R4-92 [119]. The embedment depth was 3.5 inches and the bolt diameter was 12 mm.

O4-93

REQUIREMENT: [120] Concrete expansion anchors used to base mount the framework to the floor should be suitable for earthquake (dynamic) applications, as specified by the manufacturer.

TEST RESULTS: The hardware used to secure the Z4-22U-113C-C12 Cabinet to the floor **meets** O4-93 [120]. The concrete expansion anchors were suitable for earthquake applications.

O4-94

REQUIREMENT: [121] Concrete expansion anchors should use steel construction to minimize creep.

TEST RESULTS: The hardware used to secure the Z4-22U-113C-C12 Cabinet to the floor **meets** O4-94 [121]. The anchors were made of steel construction.

APPENDIX 1-A LABORATORY DATA LOGS

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 800X1200deepX45U Page 1 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14	815	MG	
	815	MG	**Purpose of test:** Operational / (Mechanical / Structural)
	816	MG	**Type of test:** Shelf level / (Frame level)
			Pre-Test Inspection:
			inspect: all hardware for externally observable anomalies shelves for deformation, loose or pulled rivets/screws, etc. frame for cracked or poor welds, deformed base, bent uprights, etc.
			Any anomalies noted? YES / (NO)
			Was Project Manager and/or client notified of any anomalies? YES / NO / (NA)
			Noted anomalies:
	8:14	MG	**Frame Information:**
			Identification: 800X1200deepX45U
			Welded construction? ~~YES / NO~~ WELDED + BOLTED
			Top or side support used? YES / (NO)
			Weight of equipment: 543.5 EMPTY
			Top mass added: 100
	8:17	MG	**Mounting Information:**
			Slab dimensions: 4X4X6" Slab I.D. P9
			Type of anchor: HILTI Qty: 4
			Anchor designed for dynamic applications per manufacturer? (YES) / NO
			Anchors of steel construction? (YES) / NO
			Anchor bolt diameter: 12 mm
			Embedment depth: 3.5 in
			Anchor torque value: 60 ft-lb
			Anchor selection, location and mounting as per client instruction? (YES) / NO
			Alternate anchor mounting locations available? YES / (NO)
			Alternate locations used? YES / (NO)
			Are anchors accessible without interrupting service? (YES) / NO
			If no, explain:

Reviewed By: Mark O Nelson **Anomalies:** YES / (NO)

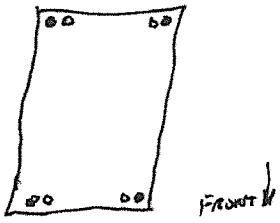
F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 800 x 1200deep x45U Page 2 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14	8:19	MG	Diagram of frame footprint with mounting and anchor locations: 
	2:19	MG	Additional mounting hardware used? YES (NO) If so, diagram additional mounting hardware including critical dimensions and composition:

Reviewed By: Mark O Yandell Anomalies: YES / NO

F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 800 x 1200 4cp X45" Page 7 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14			Diagram shelf locations (include weight / size / dummy shelves, etc.):
		MO	See photo
	8:20	MC	Equipment Operation:
			Operation / functionality monitored by: CHATSWORTH
			Details:
		MO	N/A cabinet is structural only.

Reviewed By: Mark Olenski Anomalies: YES / NO

F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 200 x 1000 deep x 45U Page 4 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14	8:21	MC	

Identification of Test Equipment Used: Uniaxial Tables

ITEM	MAKE	MODEL	ASSET	ID	CAL DUE
Accelerometer	CEC	4-202-0017	011386	Horz	Jul 22,14
Accelerometer	CEC	4-202-0001	010182	Vert	Jul 28,14
Amplifier	Moog	NF123-211 A1		-	
Transducer	MTS	RHT0120UD601A01		Horz	N.R.
Transducer	MTS	RHT0120UD601A01		Vert	N.R.
Servo Amp	Moog	NF122-001		Vert	N.R.
Servo Amp	Moog	NF122-001		Horz	N.R.
Controller	Dactron	Laser – Slave		-	
Controller	Dactron	Laser - Master		-	
Accelerometer	PCB	A353B17		A1	
Accelerometer	PCB	A353B17	010065	A2	Dec 4, 14
Accelerometer	PCB	A353B17	006373	A3	Dec 4, 14
Accelerometer	PCB	A353B17		A4	
Accelerometer	PCB	A353B17		A5	
Accelerometer	PCB	A353B17		A6	
Transducer	MD Totco	1850-		SP1	
Transducer	MD Totco	1850-		SP2	
Transducer	MD Totco	1850-030		SP3	
Transducer	MD Totco	1850-020	011604	T	Sept 4, 14
Transducer	MD Totco	1850-	012355	B	Jul 6, 14
Torque Wrench	Armstrong	64-046	011395	-	Jul 10, 14

8:31 MC

Details of accelerometers, string pots and additional instrumentation used:

ID#	Input#	Location
A	2	TOP OF CABINET
2	3	MIDDLE OF CABINET
A3		TOP OF CABINET
SPT	7	
SPB	8	FRAME

Reviewed By: Mark O. Morris Anomalies: YES (NO)

F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 800 x 1200 deep x 45U Page 5 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14	11:01	MG	SINE SURVEY VERTICAL
	11:15	MG	SEISMIC ZONE 4 VERTICAL NO DAMAGE ANCHORS OK
	1306	MG	SINE SURVEY SIDE TO SIDE
	1322	MG	SEISMIC ZONE 4 SIDE TO SIDE DISP. 1.40 INCH P.D. .05 INCH NO DAMAGE ANCHORS OK
	1405	MG	SINE SURVEY FRONT TO BACK ~~DISP. .75 INCH MG P.D. .01 INCH MG~~
	1413	MG	SEISMIC ZONE 4 FRONT TO BACK DISP .75 INCH P.D. .01 INCH ANCHORS OK NO DAMAGE

Reviewed By: Mark Orlando Anomalies: YES / NO

F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 800 x 1200 deep X 45U — Page 6 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 — PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/5/14			

Resonance Data

Location and association of accelerometers:

	A2		A8					
	Freq	Ampl	Freq	Ampl	Freq	Ampl	Freq	Ampl
Side to Side	8.66	7.03	8.60	4.20				
Front to Back	7.10	7.88	7.04	4.70				
Vertical	>	50	7	520				

1306 ML
1405 ML
1101 ML

Displacement/Deflection Data

Location and association of displacement transducers:

	Top - Bottom							
	Displ	PD	Displ	PD	Displ	PD	Displ	PD
Side to Side	1.40	.05						
Front to Back	.75	.01						

1322 ML
1413 ML

Reviewed By: _____ Anomalies: YES / NO

F-NEBS Earthquake, Rev 3

Southwest Research Institute®
Mechanical Engineering Division
Structural Dynamics and Product Assurance Section

TEST ITEM IDEN: CHATSWORTH 600 x 1200 deep x 45U — Page 7 of 7

TEST PROCEDURE REF: GR-63-CORE, Issue 4 — PROJECT NO: 18.18195.01.101

TEST NAME: 5.4.1 Earthquake Test

DATE	TIME	INITIAL	OBSERVATIONS
2/6/14	1415	MC	Photographic Log

Location & Image #:

View	*Top*	*Mid*				
Side to Side Accelerometers	3247	3248				
Vertical Accelerometers	3243	3244				
Front to Back Accelerometers	3283	3254				
View						
Side to Side (& Vertical)	3249	VERT 3245				
Front to Back (& Vertical)	3255					
Mounting Pattern	3240 3241					
Mounting Hardware						
Top Mass	3256					
Equipment Loading	3258					
String Pot Location	*Top*	*Base*				
SS	3261	3252				
FB	3257	3256				

1445 MC

Test Information:

Video record of seismic tests? (YES) / NO

Copies of test logs given to client at time of testing? YES (NO)

Pictures and Data transferred to the File Server? (YES) NO

Additional Notes:

Reviewed By: Mark O'Neill — **Anomalies:** YES / (NO)

F-NEBS Earthquake, Rev 3