NEMA

TS 2-2003

SmartSensor Matrix

As contracted by Wavetronix, Tektronix Service Solutions performed NEMA testing in October 2010. The following report documents the results of the test and is unedited by Wavetronix.

Tester contact information:
Tektronix Service Solutions
6120 Hanging Moss Road
Orlando, Florida 32807

Tektronix
Service Solutions

6120 Hanging Moss Road, Orlando, Florida, 32807 (407) 678-6900, FAX (407) 671-0664

Customer: **WAVETRONIX**

P. O. No.: **PO0019046** Job No.: **282245 - 001**

Order Quantity: **2 Systems** Mfg. P/N

Customer P/N: **SS225, Click 112-114, 222, 204-205, 301**

Specification **Wavetronix Test Procedure (9/15/2010) & NEMA TS 2-2003**

Part Type:

Prepared By: **Eric Brentzel** Date Prepared: **10/28/2010**

Reviewed By: Date Reviewed: 10-28-10

CERTIFICATE OF COMPLIANCE

This is to certify that the referenced item was subjected to a testing program in accordance with your Procurement Document, as defined in the attached test plan. This plan specifies the test sequence, outlines the test conditions and provides a summary for each test.

Tektronix Service Solutions does not infer or imply that the test methods utilized in the body of this report have been granted suitability by the Defense Supply Center Columbus, (DSCC). A current listing of approved suitability methods is available upon request.

Mfr.: WAVETRONIX Date Code: - Accept: 2 SYSTEMS Reject: 0

SEE ATTACHED DOCUMENTATION

Approved By: Date Approved: 10-30-10

INCOMING INSPECTION

Quantity	Model Number	Serial Number	Device Type
2	SS225	N/A	SmartSensor Radar
1	Click 112	N/A	2 Channel Card
1	Click 114	N/A	4 Channel Card
2	Click 222	N/A	Surge Suppressor
1	Click 202	N/A	2 Amp Power Supply
1	Click 204	N/A	4 Amp Power Supply
2	Click 301	N/A	Serial to Ethernet Conv.

10-15-10 E.D.

OPERATIONAL VERIFICATION TEST

Documentation:
Wavetronix Test Procedure (9/15/2010) &
NEMA TS 2-2003, Paragraph 2.2.7.1 & 2.2.10

10-21-10 E.D.

Initial Setup and Verification:
Connect the test unit AC input to an AC Power Source, programmable for both voltage and frequency output.

Procedure:

1. Apply 120V, 60Hz +- 3Hz AC power to the AC inputs of the unit and verify system operation.
2. Vary input voltage from 89V to 135V, 60Hz +- 3Hz AC power to the AC inputs of the unit and verify system operation.
3. Confirm proper operation of equipment by exercising operating and communication mode functions, as appropriate.

Test Observations:

Two similarly configured WAVETRONIX SmartSensor Matrix systems were submitted for evaluation to the NEMA TS-2 Environmental Test Requirement.

The first system consisted of the Click 222, 112, 202, 301 and SS225 while the second system consisted of the Click 222, 114, 204, 301 and SS225.

The difference between the two configurations is power supply current rating (2 amp vs. 4 amp) and number of detector channels (2 channels vs. 4 channels). Noted differences aside, the configurations are outwardly identical in terms of setup and operation.

At initial setup the WAVETRONIX SmartSensor Matrix equipment was found to operate properly across the prescribed range of AC Voltages and Frequencies.

TRANSIENT TEST – (DC INPUT)

Documentation:
Wavetronix Test Procedure (9/15/2010), Section 4.2 &
NEMA TS 2-2003, Paragraph 2.8.1.3 Steps 1- 3, **(I/O Terminals Sampled)**

10-23-10 E.B.

Conditions:

Input Voltage Range:	**10.8 – 26.5 VDC**
Transient Amplitude:	**300 volts +- 5%**
Transient Polarity:	**Positive and Negative**
Pulse Width:	**10 µs**
Source Impedance:	**1,000 Ω**
Repetition:	**5 Pulses /Polarity – 1 per second**

Procedure:

1. Apply nominal input power and configure unit to cycle, as appropriate.
2. Superimpose high-repetition noise transients on the DC input of the unit under test ("5" pulses at rate of "1" per second in each polarity).
3. Confirm that test unit continues to operate without malfunction during test.

TRANSIENT TEST – (I/O TERMINALS)

10-23-10 E.B.

Conditions:

AC Input Voltage:	**120V, 60Hz +- 3Hz**
DC Input Voltage Range:	**10.8 – 26.5 VDC**
Transient Amplitude:	**300 volts +- 5%**
Transient Polarity:	**Positive and Negative**
Pulse Width:	**10 µs**
Source Impedance:	**1,000 Ω**
Repetition:	**5 Pulses /Polarity – 1 per second**

Procedure:

1. Apply nominal input power and configure unit to cycle, as appropriate.
2. With equipment configured per WAVETRONICS test procedure, apply transients to selected Input/Output (asserted and de-asserted as appropriate) of equipment under test, ("5" pulses at rate of "1" per second in each polarity).
3. Confirm that test unit continues to operate without malfunction during test.

Test Observations:

The WAVETRONIX SmartSensor Matrix equipment system powered normally following application of the High-Repetition /Low-Repetition Transient test conditions.

Communication with equipment and functional testing was performed without issue.

The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, Transient Testing requirements, as performed in this section.

TRANSIENT TEST – (HIGH REPETITION NOISE TRANSIENTS)

Documentation:
Wavetronix Test Procedure (9/15/2010), Section 4.2 &
NEMA TS 2-2003, Paragraph 2.2.7.2 Steps 1-5

10-23-10 E.B.

Conditions:

Line Input Voltage:	**120V, 60Hz +- 3Hz to AC inputs**
Transient Amplitude:	**300 volts +- 5%**
Transient Polarity:	**Positive and Negative**
Pulse Width:	**10 μs**
Peak Power:	**2,500 watts**
Duration:	**5 Minutes min. (each polarity)**

Procedure:

1. Apply nominal input power and configure unit to cycle, as appropriate.
2. Superimpose high-repetition noise transients on the AC input of the unit under test (1 pulse every other cycle, moving uniformly over the full wave to sweep across 360 degrees of the line cycle once every 3 seconds.).
3. Confirm that test unit continues to operate without malfunction during the entire test.

TRANSIENT TEST – (LOW REPETITION HIGH-ENERGY TRANSIENTS)

10-23-10 E.B.

Conditions:

Line Input Voltage:	**120V, 60Hz +- 3Hz to AC inputs**
Transient Amplitude:	**600 volts +- 5%**
Transient Polarity:	**Positive and Negative**
Repetitions:	**10 (each polarity)**
Energy Source:	**Capacitor, oil-filled (10 microfarads)**

Procedure:

1. Apply nominal input power and configure unit to cycle, as appropriate.
2. Charge capacitor to prescribed voltage and discharge into the AC input of the unit under test (1 discharge every 10 seconds for a total of 10 discharges per polarity.).
3. Confirm that test unit continues to operate without malfunction.

Test Observations:

The WAVETRONIX SmartSensor Matrix equipment system powered normally following application of the High- Repetition /Low-Repetition Transient test conditions.

Communication with equipment and functional testing was performed without issue.

The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, Transient Testing requirements, as performed in this section.

TRANSIENT TEST – (NON-DESTRUCT TRANSIENT IMMUNITY)	**Documentation:** Wavetronix Test Procedure (9/15/2010), Section 4.2 & NEMA TS 2-2003, Paragraph 2.2.7.2 Steps 8-13 **Conditions:** Line Input Voltage: **NO POWER APPLIED** Transient Amplitude: **1000 volts +- 5%** Transient Polarity: **Positive and Negative** Repetitions: **3 (each polarity)** Energy Source: **Capacitor, oil-filled (15 microfarads)** **Procedure:** 1. Apply **NO POWER** to unit. 2. Charge capacitor to prescribed voltage and discharge into the AC input of the unit under test, (1 discharge every 2 seconds for a total of 3 discharges per polarity.). 3. Upon completion of transient test, apply nominal "nominal" input power to unit and verify that device powers up and cycles through all functions normally. **Test Observations:** **The WAVETRONIX SmartSensor Matrix equipment system powered normally following application of the Non-Destruct Transient test conditions.** **Communication with equipment and functional testing was performed without issue.** **The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, Transient Testing requirements, as performed in this section.**	10-25-10	E.B.

TASK	CONDITIONS	Date Completed	Operator Stamp
LOW-TEMPERATURE – LOW-VOLTAGE TEST	**Documentation:** Wavetronix Test Procedure (9/15/2010), Section 4.3 & NEMA TS 2-2003 2.2.7.3 - 2.2.7.4 & Figure 2-1 **Conditions:** Applied Input Voltage: **89V 60Hz +- 3Hz to AC inputs** Temperature: **-34°C** Humidity: **Uncontrolled** Unit Status: **Powered & operating in chamber** **Procedure:** 1. Beginning at ambient conditions, set input voltage to specified level and confirm correct operation. 2. With unit operating, ramp chamber temperature to -34°C at a rate not exceeding 17°C per hour. 3. Allow unit to operate for a minimum of 5 hours before exercising functions to determine that unit is operable. 4. Remove power from unit for a minimum of 5 hours 5. Restore power to unit and perform Functional /Operational tests as applicable.	10-27-10	E.B.
LOW-TEMPERATURE – HIGH-VOLTAGE TEST	**Conditions:** Applied Input Voltage: **135V 60Hz +- 3Hz to AC inputs** Temperature: **-34°C** Humidity: **18% (not to exceed 95% as temperature "ramps" to +74°C)** Unit Status: **Powered & operating in chamber** **Procedure:** 1. With unit stabilized at -34°C, set input voltage to specified level and confirm correct operation. 2. Allow unit to operate for a minimum of 1 hour then exercise functions to determine that unit is operable. 3. Perform Functional /Operational tests as applicable. 4. Confirm that test unit functions normally in all modes. **Test Observations:** **The WAVETRONIX SmartSensor Matrix equipment system performed properly while operating with the specified "static" low-temperature and low/high voltage conditions applied.** **The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, Low-Temperature testing requirements, as performed in this section.**	10-27-10	E.B.

HIGH-TEMPERATURE – HIGH-VOLTAGE TEST

Documentation:
Wavetronix Test Procedure (9/15/2010), Section 4.3 &
NEMA TS 2-2003 2.2.7.5 – 2.2.7.6

Conditions:

Applied Input Voltage:	**135V 60Hz +- 3Hz to AC inputs**
Temperature:	**+74°C**
Humidity:	**18%**
Unit Status:	**Powered & operating in chamber**

Procedure:

1. With unit operating, ramp chamber temperature to +74°C at a rate not exceeding 17°C per hour with humidity at 18%.
2. Maintain temperature and humidity conditions and allow unit to operate for a minimum of 15 hours before exercising functions to determine that unit is operable.
3. Confirm that test unit functions normally in all modes.

Date Completed: 10-28-10 Operator Stamp: E.B.

HIGH-TEMPERATURE – LOW-VOLTAGE TEST

Conditions:

Applied Input Voltage:	**89V 60Hz +- 3Hz to AC inputs**
Temperature:	**+74°C**
Humidity:	**18%**
Unit Status:	**Powered & operating in chamber**

Procedure:

1. With unit stabilized at +74°C, set input voltage to specified level and confirm correct operation.
2. Perform Functional /Operational tests as applicable to confirm proper operation.
3. Ramp chamber temperature to room ambient at a rate not exceeding 17°C per hour.
4. Allow unit to stabilize at ambient condition for one hour before removing from chamber.
5. Confirm that test unit functions normally in all modes.

Date Completed: 10-28-10 Operator Stamp: E.B.

Test Observations:

The WAVETRONIX SmartSensor Matrix equipment system performed properly while operating with the specified "static" high-temperature and high/low voltage conditions applied.

The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, High-Temperature testing requirements, as performed in this section.

VIBRATION – (RESONANT SEARCH)

Documentation:
Wavetronix Test Procedure (9/15/2010), Section 4.1 &
NEMA TS 2-2003 2.2.8.1 – 2.2.8.4

Conditions:

Frequency Range:	**5 - 30Hz**
Displacement Level:	**0.015 inch DA**
Number of Sweeps:	**1**
Sweep Duration:	**12.5 minutes**
Number of axis:	**3 (X, Y & Z)**

Procedure:

1. Verify accelerometer operation
2. Attach unit to the vibration table.
3. Note resonant frequencies in a given plane and record the most severe
4. If resonances found are equally severe, record each frequency.
5. If no resonant frequency is found for a given plane, record 30Hz.

10-29-10 M.L.

VIBRATION – (ENDURANCE TEST)

Conditions:

Frequency Range:	**5 - 30Hz (Per results of Resonant Search)**
Acceleration Level:	**0.5g**
Dwell Duration:	**1 hour per each axis**
Number of axis:	**3 (X, Y & Z)**

Procedure:

1. Verify accelerometer operation
2. Attach unit to the vibration table.
3. Vibrate test unit in each plane for prescribed period of time.
4. If more than one resonant frequency was recorded, the test period shall be divided equally between resonant frequencies.
5. If no resonant frequencies were noted the test shall be performed at 30Hz.

Details:

- Examine for physical damage attributable to vibration testing.
- Verify that the unit powers up and is able to function normally in all modes.

Test Observations:

No Resonant Frequencies were noted in the frequency range of applied vibration. The Endurance test was consequently performed at the single frequency of 30Hz. Test units operated normally following exposure to the applied vibration test frequencies and levels.

10-29-10 M.L.

SHOCK

Documentation:
Wavetronix Test Procedure (9/15/2010), Section 4.4 &
NEMA TS 2-2003 2.2.9.1 – 2.2.9.4

Conditions:

Shock Amplitude:	**10 g's**
Shock Duration:	**10 msec**
Waveform:	**Half-sine**
Number of axis:	**3 (X, Y & Z)**
Number shocks per Orientation:	**2 (one in each direction)**
Total Shocks:	**6**

Procedure:

1. Verify accelerometer operation
2. Attach unit to the shock table.
3. Shock test unit in each plane in accordance with test requirement.

Details:

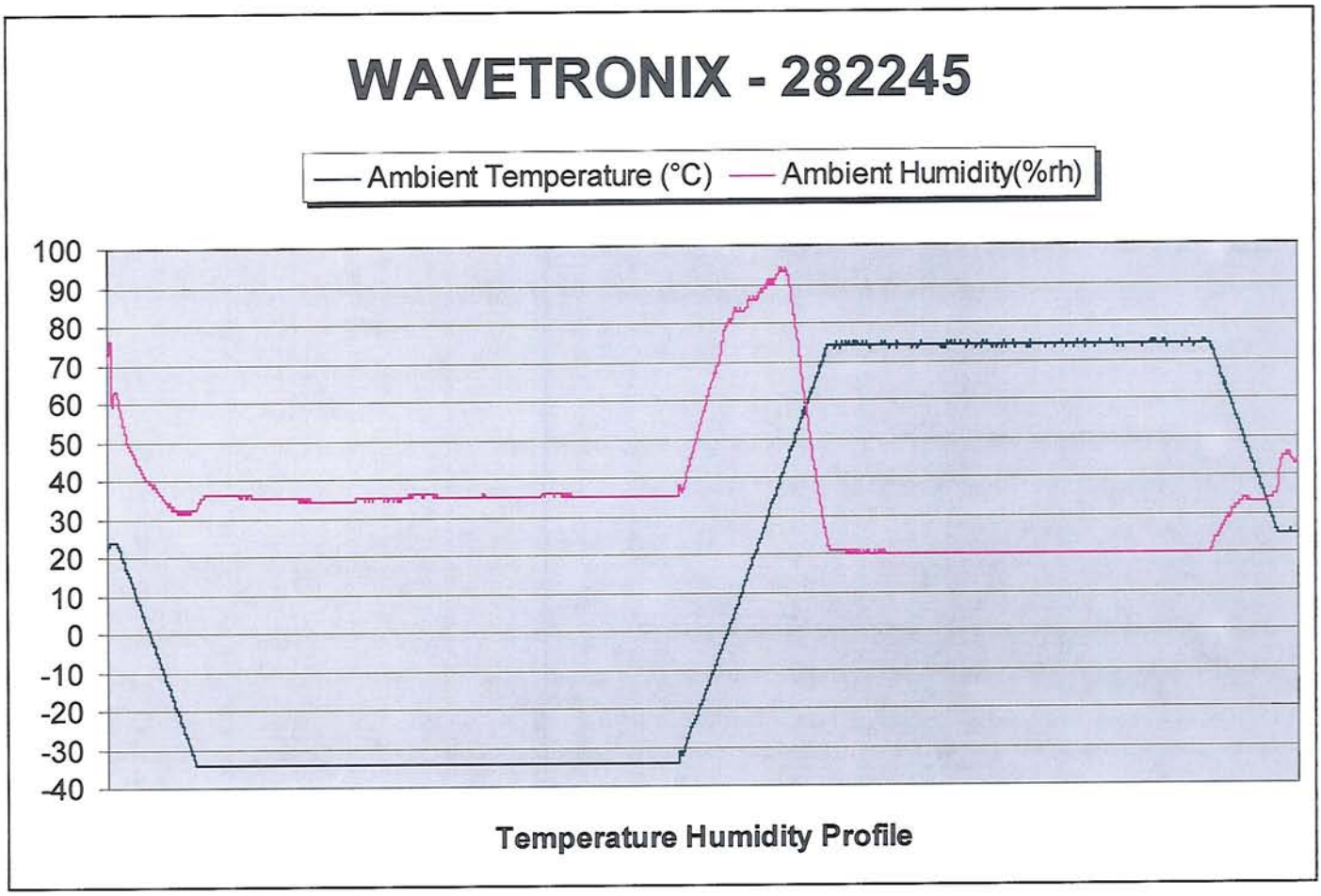
- Examine for physical damage attributable to shock testing.
- Verify that the unit powers up and is able to function normally in all modes.

Test Observations:

Post-shock test evaluation revealed no physical or cosmetic damage to the test units. Subsequent electrical testing showed proper operation of the WAVETRONIX SmartSensor Matrix equipment system.

The WAVETRONIX SmartSensor Matrix determined to be compliant to applicable NEMA TS-2, Vibration and Shock testing requirements, as performed in this and preceding section.

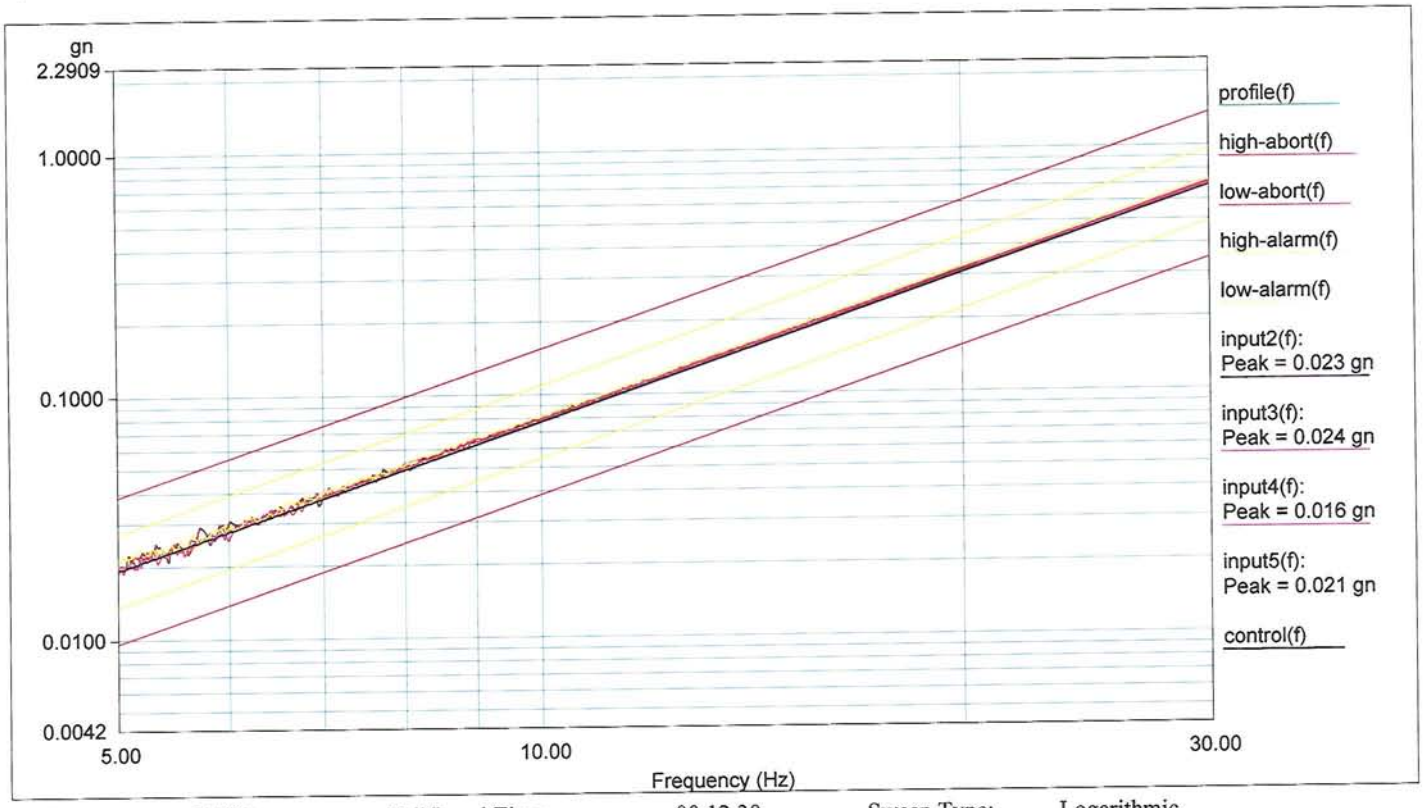
Date Completed: 10-29-10
Operator Stamp: M. L.


WAVETRONIX - 282245
Ambient Temperature (°C)
Ambient Humidity(%rh)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
Temperature Humidity Profile

DUT: RESONANT SEARCH - X-AXIS
Serial Number:
Project File Name: NEMA RES SEARCH.prj
Profile Name: NEMA Resonant Search
29, 2010 09-01-00

Test Type: Swept Sine

Run Folder: .\RunDefault Oct



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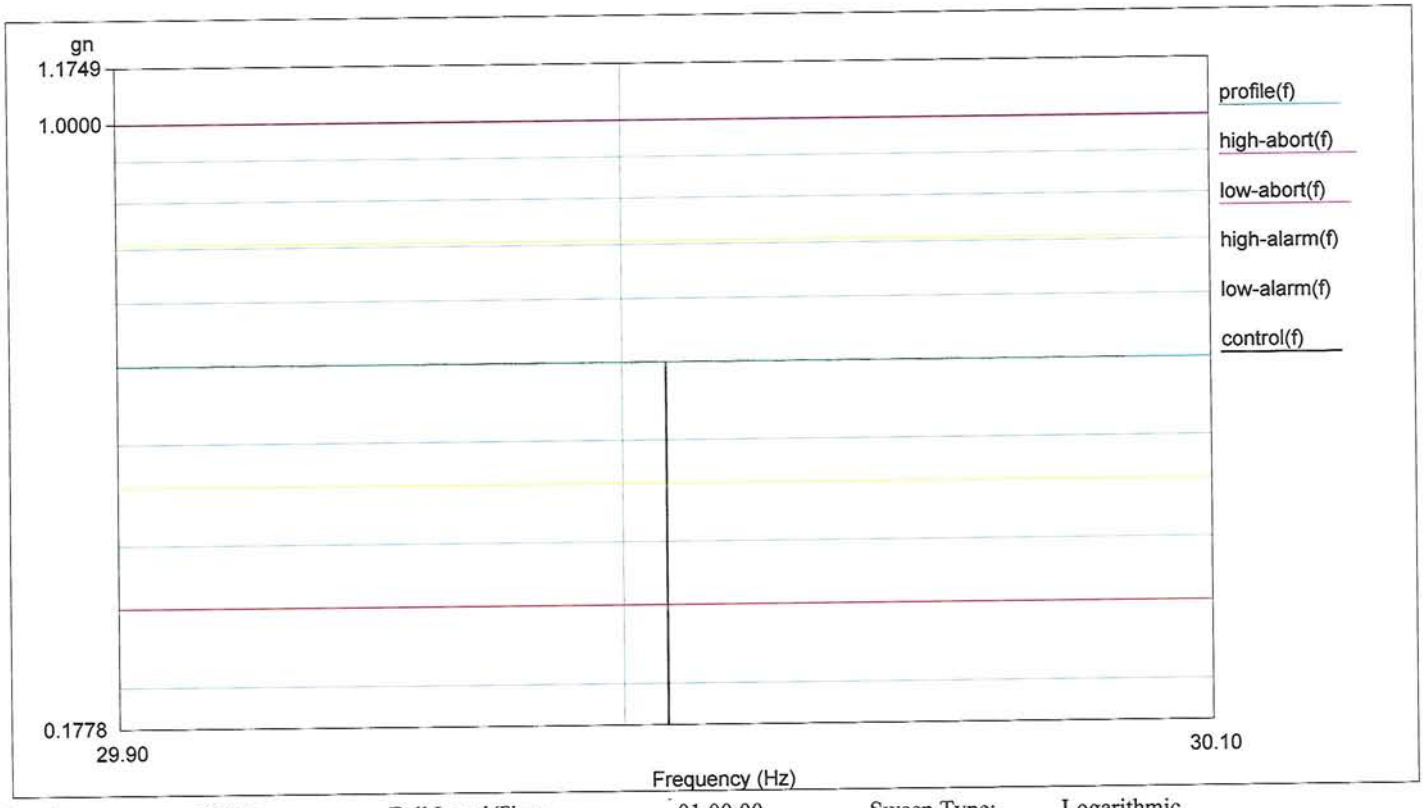
DUT: ENDURANCE DWELL - X-AXIS
Serial Number:
Project File Name: NEMA ENDURANCE.prj
Profile Name: NEMA Resonant Search
Test Type: Swept Sine
Run Folder: .\RunDefault Oct 29, 2010 09-15-56



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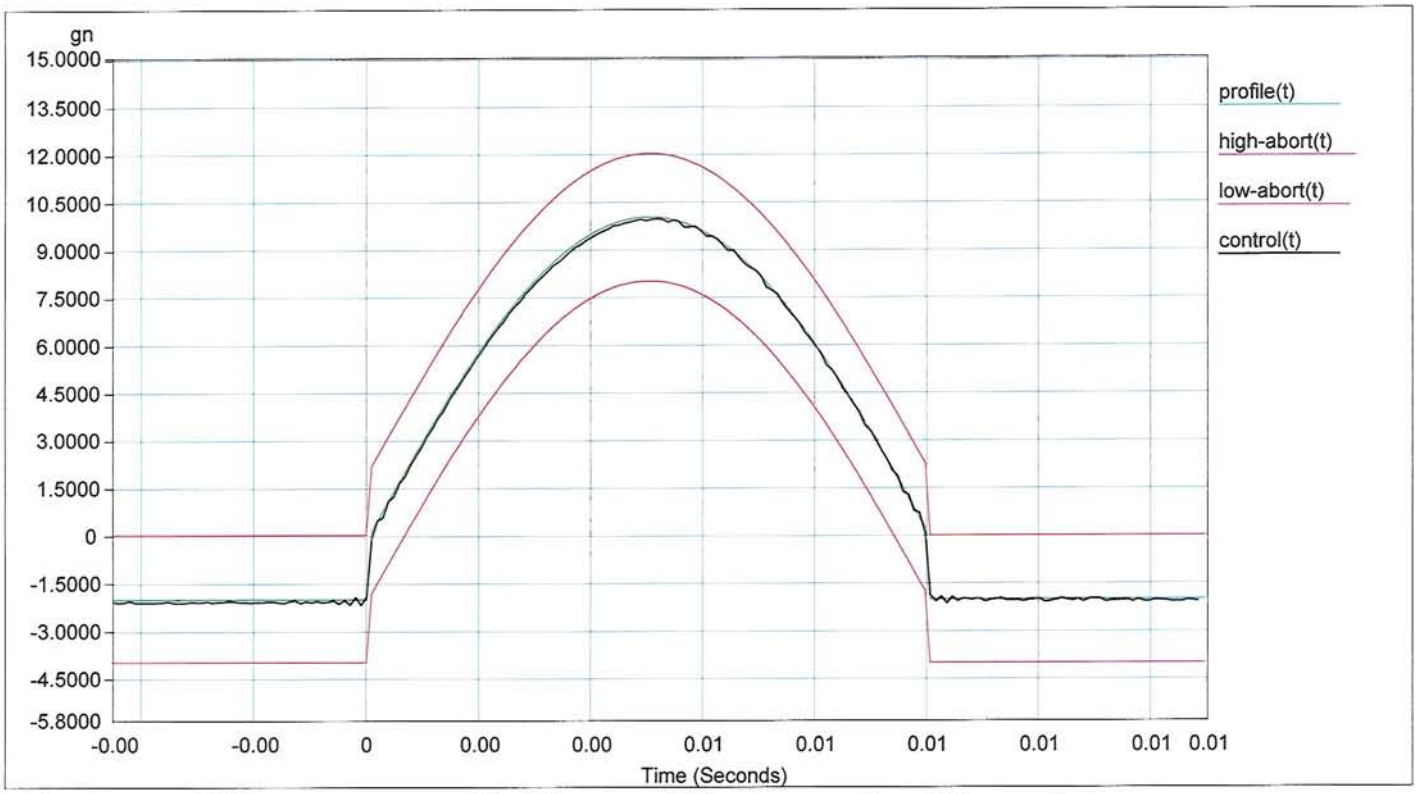
Frequency:	30.000000 Hz	Time Remaining:	00:00:00	Sweep Rate:	1 Oct/Min

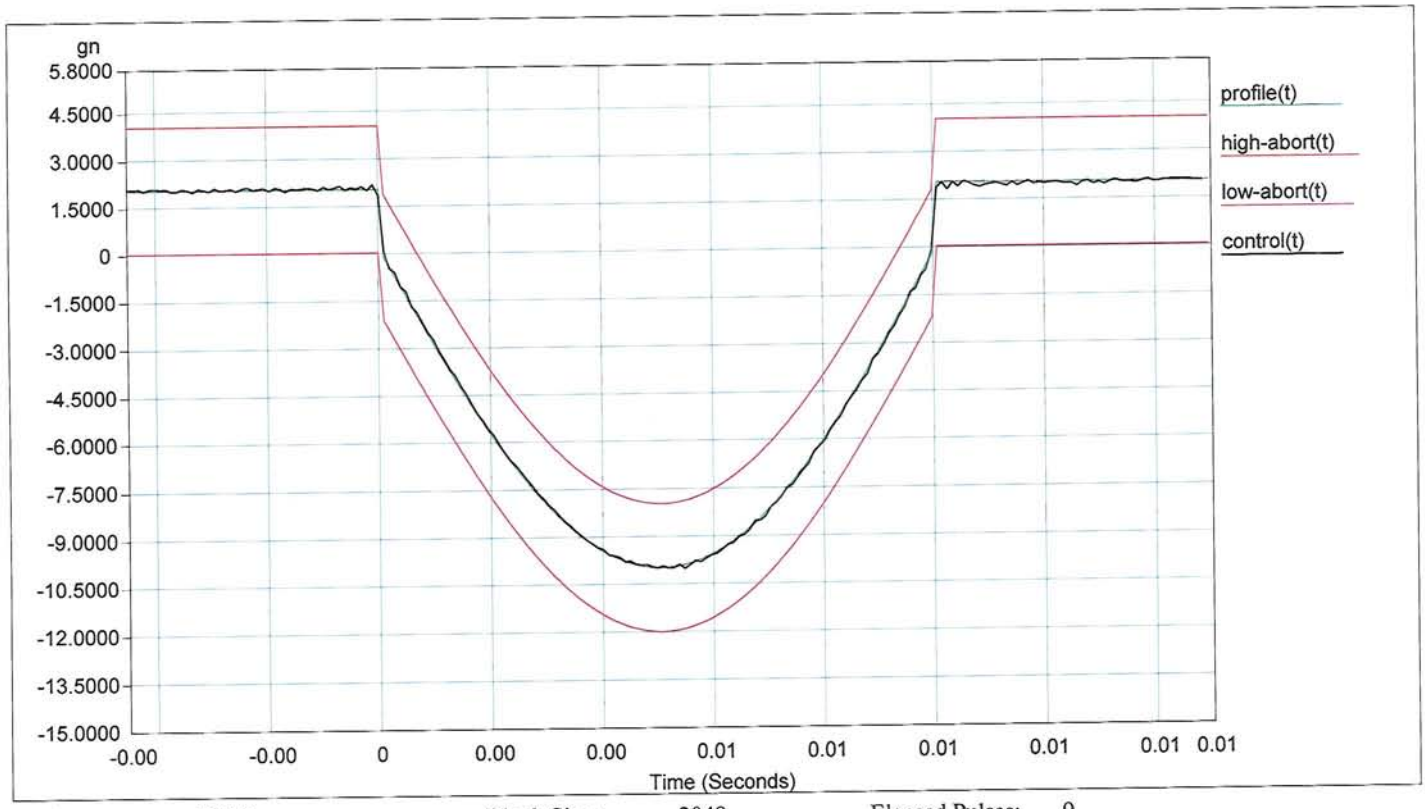
Data saved at 10:19:40 AM, Friday, October 29, 2010 Report created at 10:19:41 AM, Friday, October 29, 2010

DUT: SHOCK - X-AXIS
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec Test Type: Classical Shock Run Folder: .\RunDefault Oct 29, 2010
10-21-06



Level: 100 % Block Size: 2048 Elapsed Pulses: 9
Frame Time: 0.200000 Seconds Control Peak: 9.967143 Control RMS: 1.969124 Full Level Elapsed Pulses: 1
dT: 0.000098 Seconds Demand Peak: 10.000000 Demand RMS: 1.968571 Remaining Pulses: 0
Pulse Type: Half Sine Amplitude: 10.000000 Pulse Width: 10.000000 ms
Data saved at 10:21:26 AM, Friday, October 29, 2010 Report created at 10:21:26 AM, Friday, October 29, 2010

DUT: SHOCK - X-AXIS NEG
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec Test Type: Classical Shock Run Folder: .\RunDefault Oct 29, 2010
10-22-03



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dT: 0.000098 Seconds Demand Peak: 10.000000 Demand RMS: 1.968571 Remaining Pulses: 0
Pulse Type: Half Sine Amplitude: 10.000000 Pulse Width: 10.000000 ms
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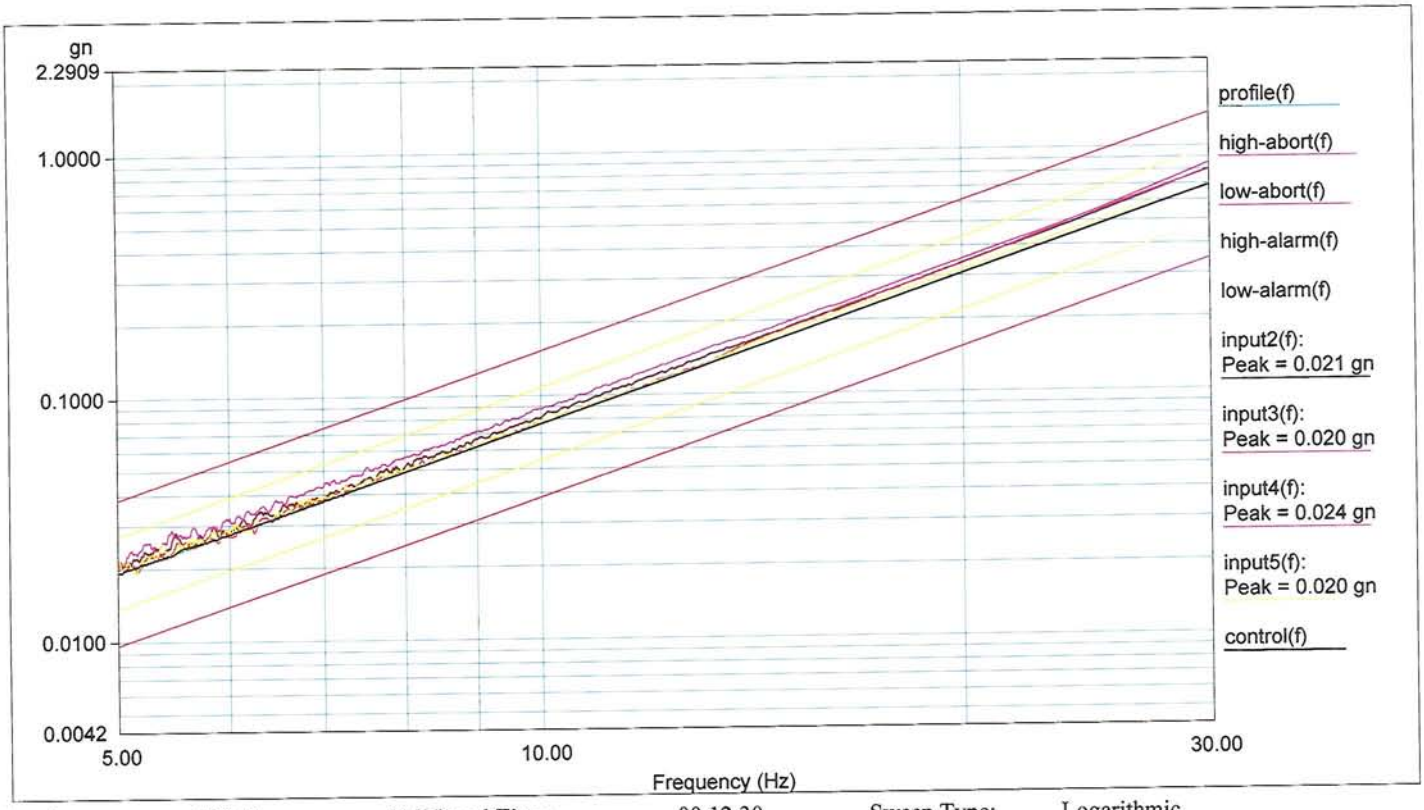
DUT: RESONANT SEARCH - Y-AXIS
Serial Number:
Project File Name: NEMA RES SEARCH.prj
Profile Name: NEMA Resonant Search
29, 2010 11-15-11

Test Type: Swept Sine

Run Folder: .\RunDefault Oct



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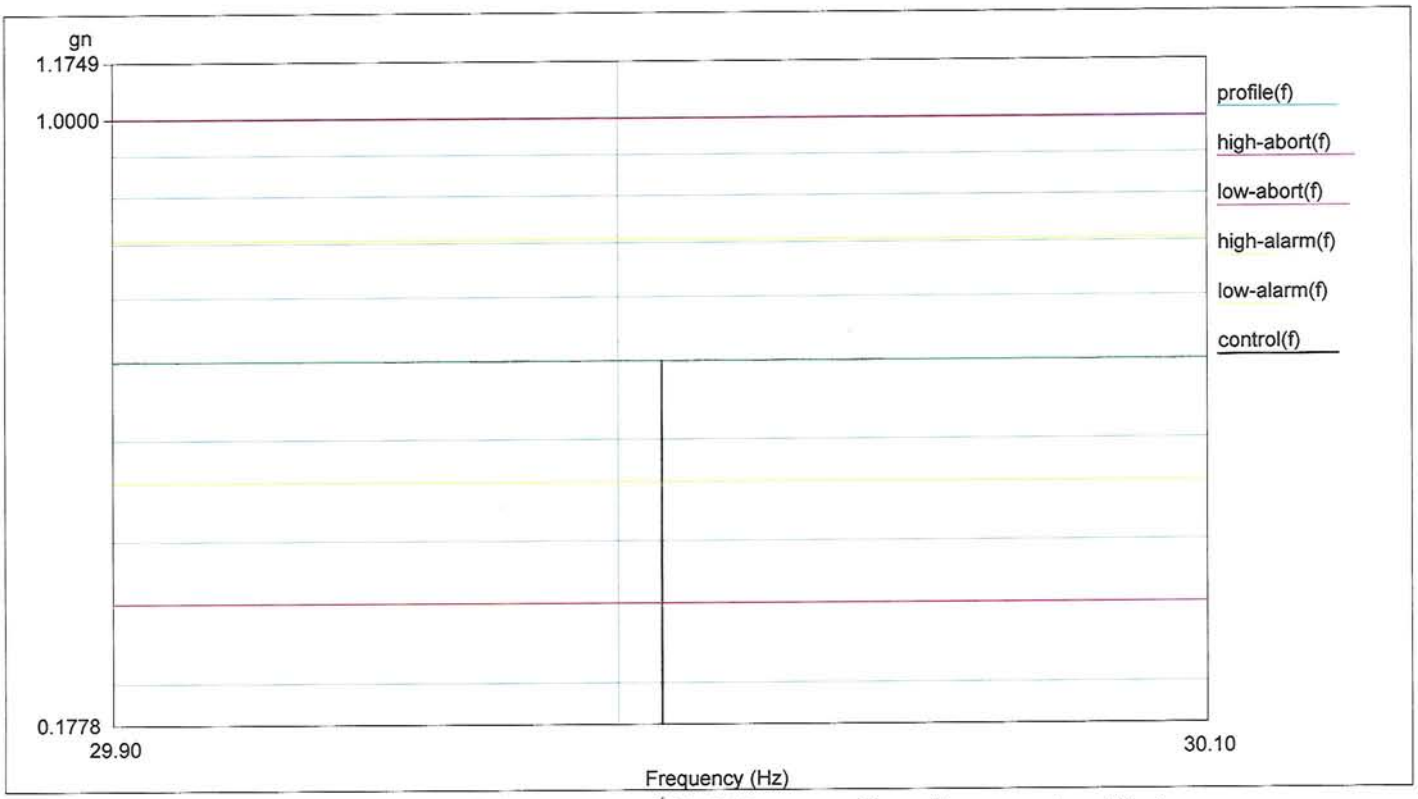
DUT: ENDURANCE DWELL - Y-AXIS
Serial Number:
Project File Name: NEMA ENDURANCE.prj
Profile Name: NEMA Resonant Search Test Type: Swept Sine Run Folder: .\RunDefault Oct 29, 2010 11-30-51



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Frequency:	30.000000 Hz	Time Remaining:	00:00:00	Sweep Rate:	1 Oct/Min

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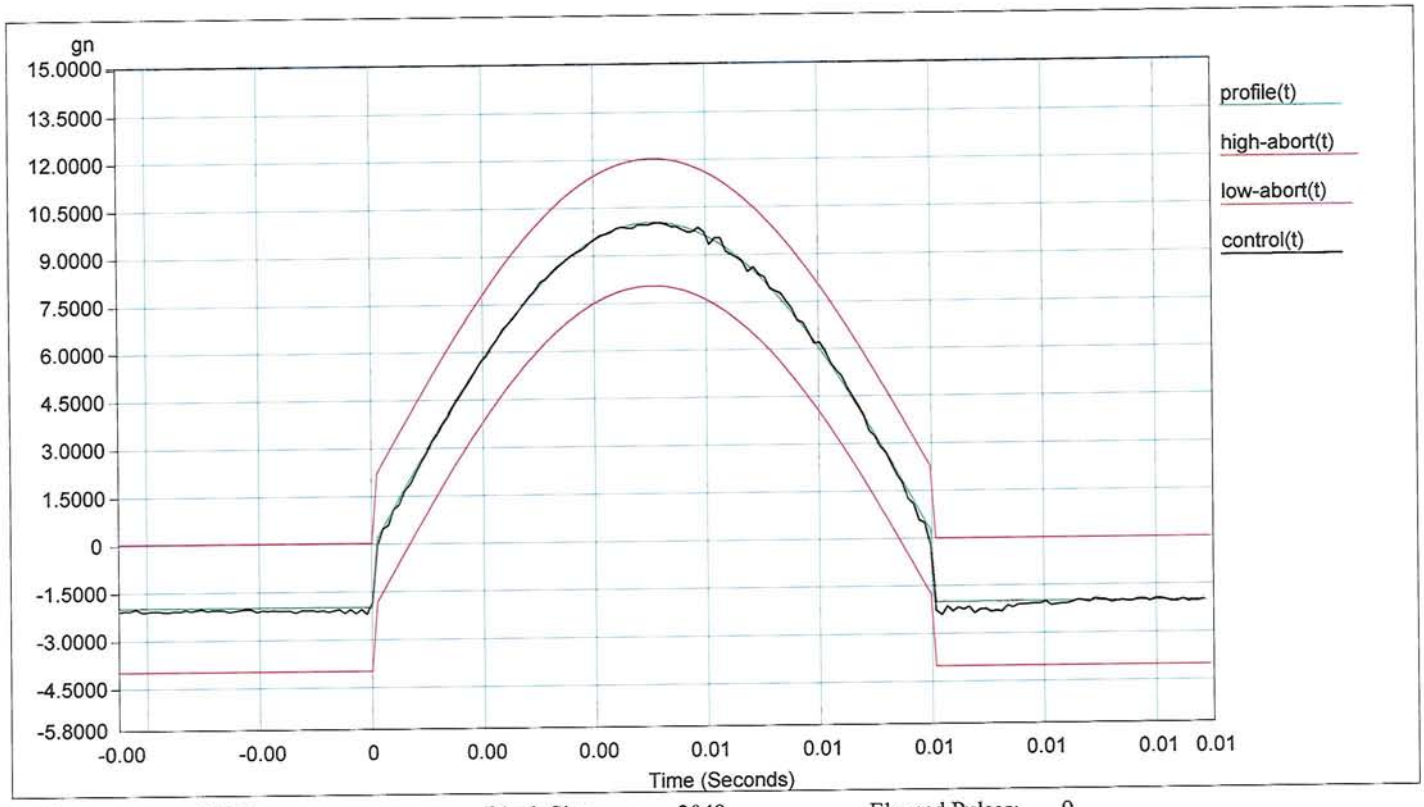
TASK	CONDITIONS	Date Completed	Operator Stamp

DUT: SHOCK - Y-AXIS POS
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec Test Type: Classical Shock Run Folder: .\RunDefault Oct 29, 2010
12-34-59



Level: 100 % Block Size: 2048 Elapsed Pulses: 9
Frame Time: 0.200000 Seconds Control Peak: 9.994732 Control RMS: 1.978429 Full Level Elapsed Pulses: 1
dT: 0.000098 Seconds Demand Peak: 10.000000 Demand RMS: 1.968571 Remaining Pulses: 0
Pulse Type: Half Sine Amplitude: 10.000000 Pulse Width: 10.000000 ms
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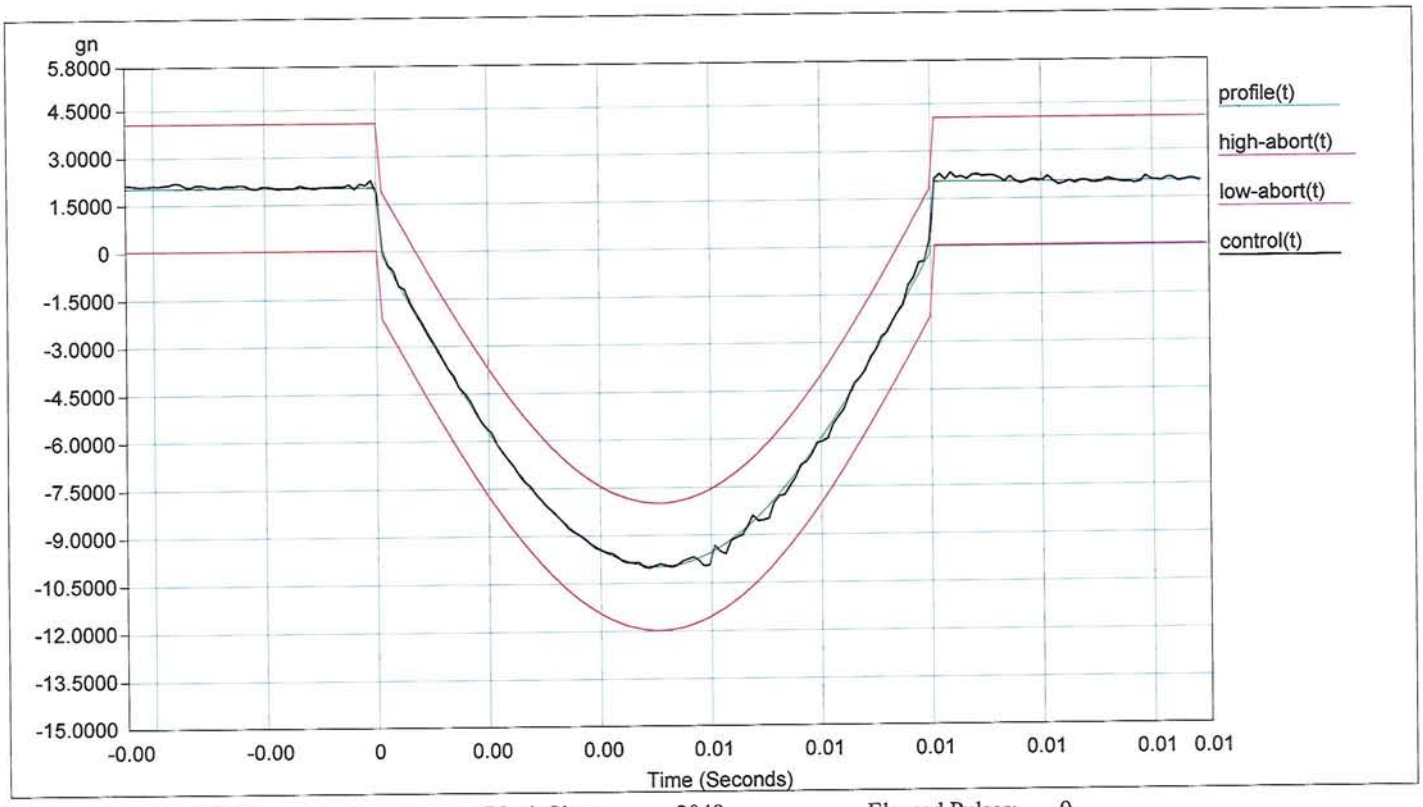
DUT: SHOCK - Y-AXIS NEG
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec
Test Type: Classical Shock
Run Folder: .\RunDefault Oct 29, 2010
12-35-52



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dT:	0.000098 Seconds	Demand Peak:	10.000000	Demand RMS:	1.968571	Remaining Pulses:	0
Pulse Type:	Half Sine	Amplitude:	10.000000	Pulse Width:	10.000000 ms		

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Report created at 12:36:08 PM, Friday, October 29, 2010

DUT: RESONANT SEARCH - Z-AXIS
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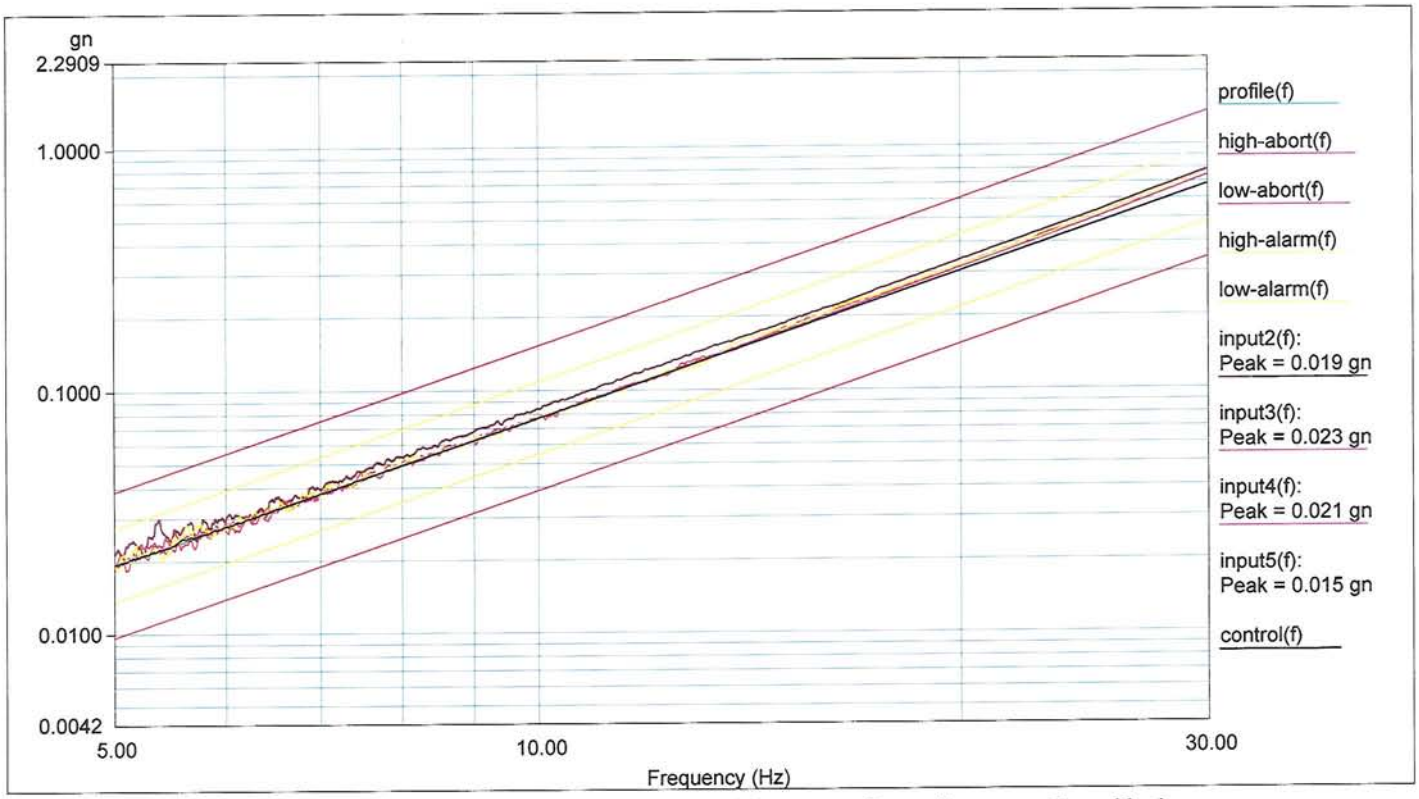
Project File Name: NEMA RES SEARCH.prj
Profile Name: NEMA Resonant Search Test Type: Swept Sine Run Folder: .\RunDefault Oct 29, 2010 12-58-38



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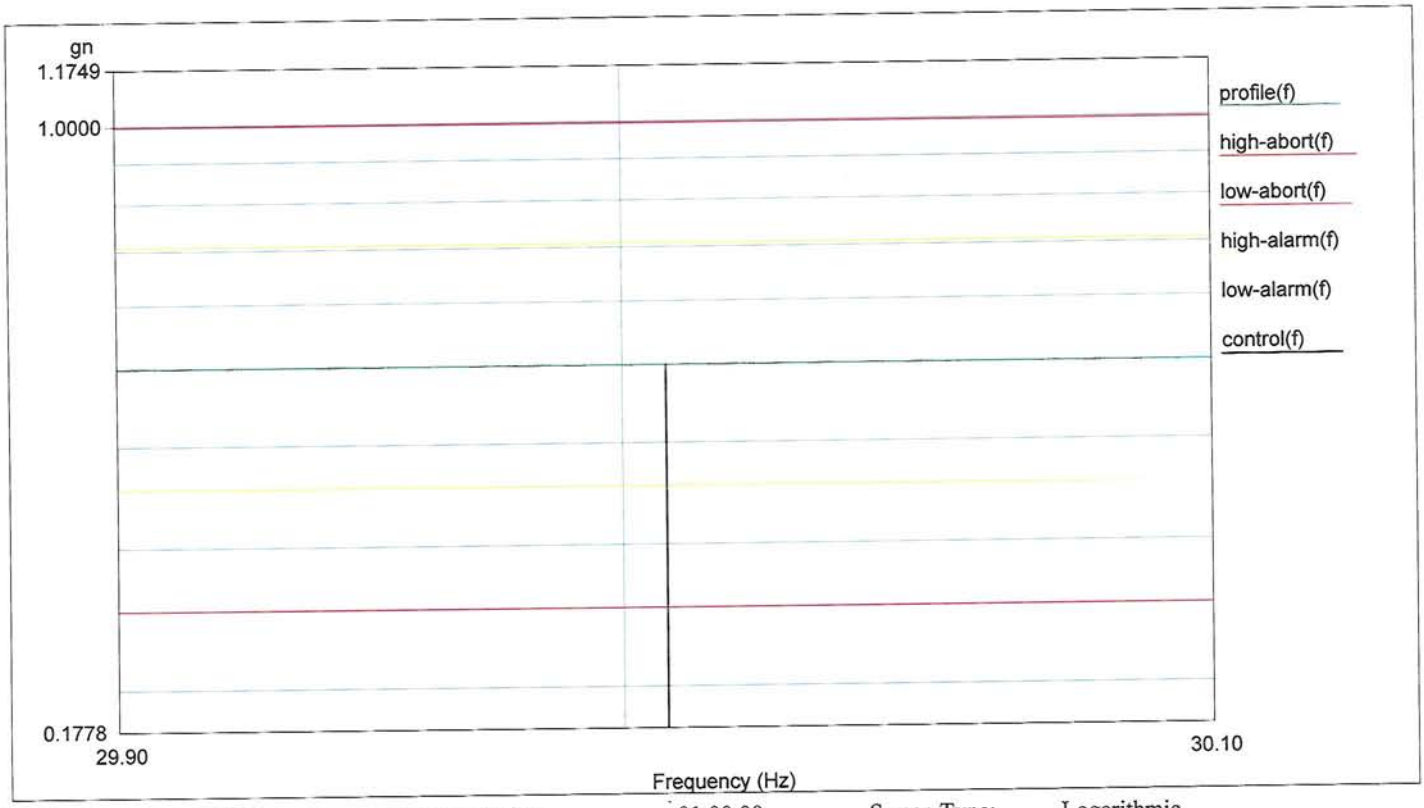
DUT: ENDURANCE DWELL - Z-AXIS
Serial Number:
Project File Name: NEMA ENDURANCE.prj
Profile Name: NEMA Resonant Search
29, 2010 13-14-07

Test Type: Swept Sine

Run Folder: .\RunDefault Oct



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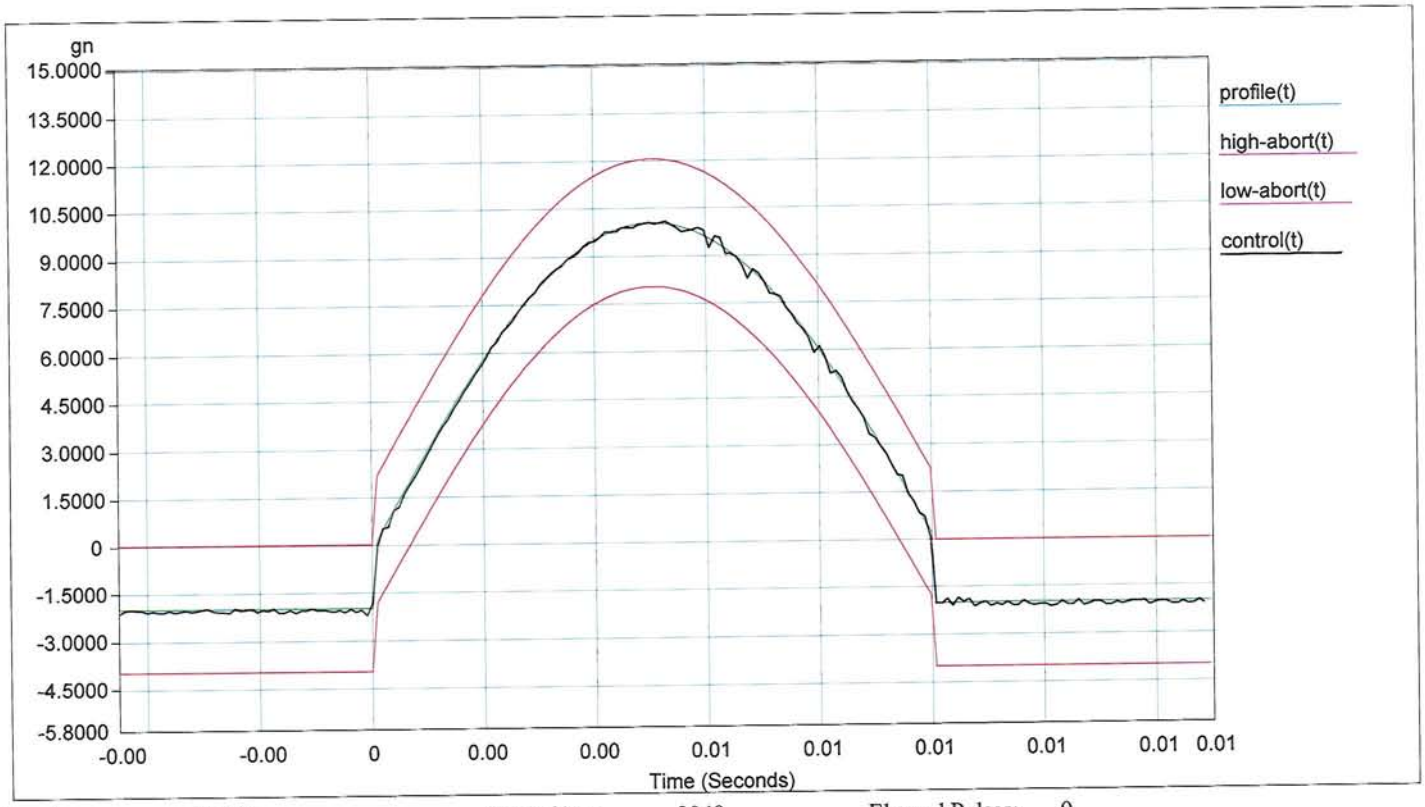
Report created at 02:14:20 PM, Friday, October 29, 2010

DUT: SHOCK - Z-AXIS POS
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec Test Type: Classical Shock Run Folder: .\RunDefault Oct 29, 2010
14-15-25



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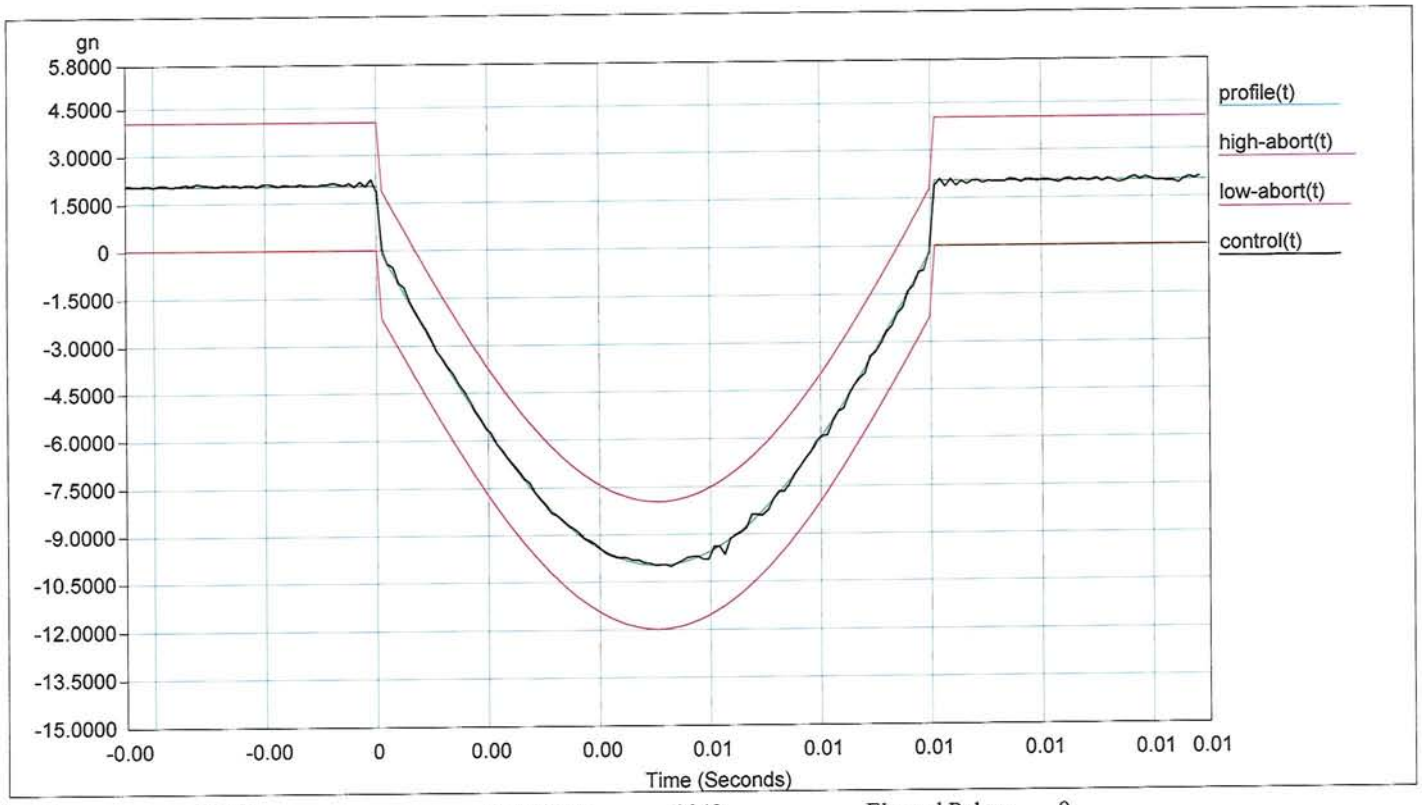
dT:	0.000098 Seconds	Demand Peak:	10.000000	Demand RMS:	1.968571	Remaining Pulses:	0
Pulse Type:	Half Sine	Amplitude:	10.000000	Pulse Width:	10.000000 ms		

Data saved at 02:15:58 PM, Friday, October 29, 2010 Report created at 02:15:58 PM, Friday, October 29, 2010

DUT: SHOCK - Z-AXIS NEG
Serial Number:
Project File Name: NEMA SHOCK 10G.prj
Profile Name: 10gn 10mSec Test Type: Classical Shock Run Folder: .\RunDefault Oct 29, 2010
14-16-16



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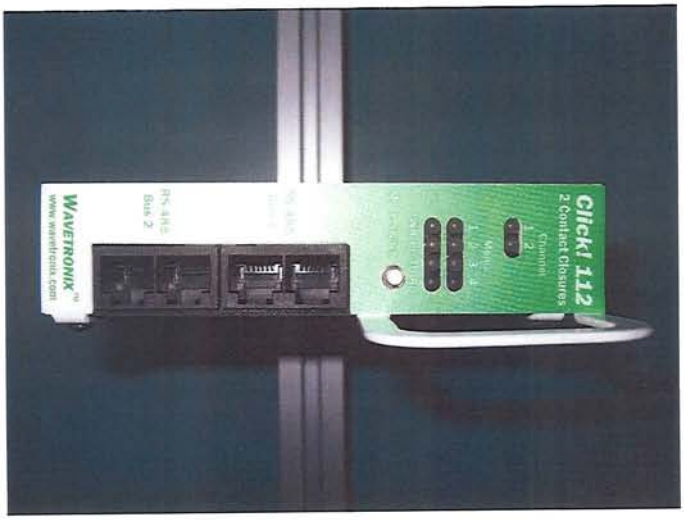
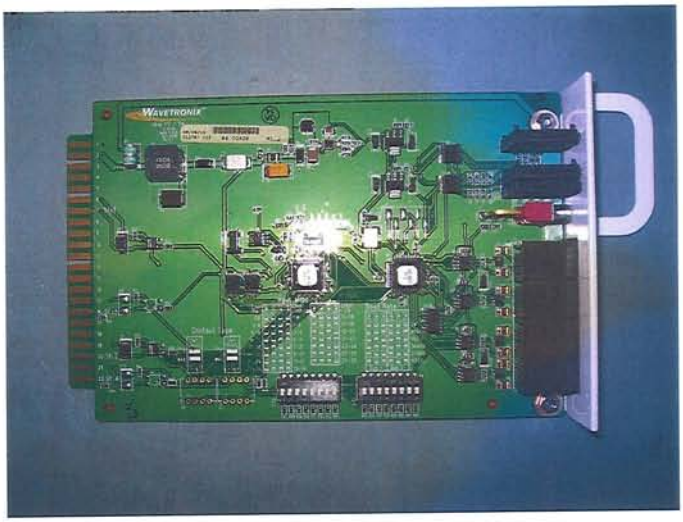
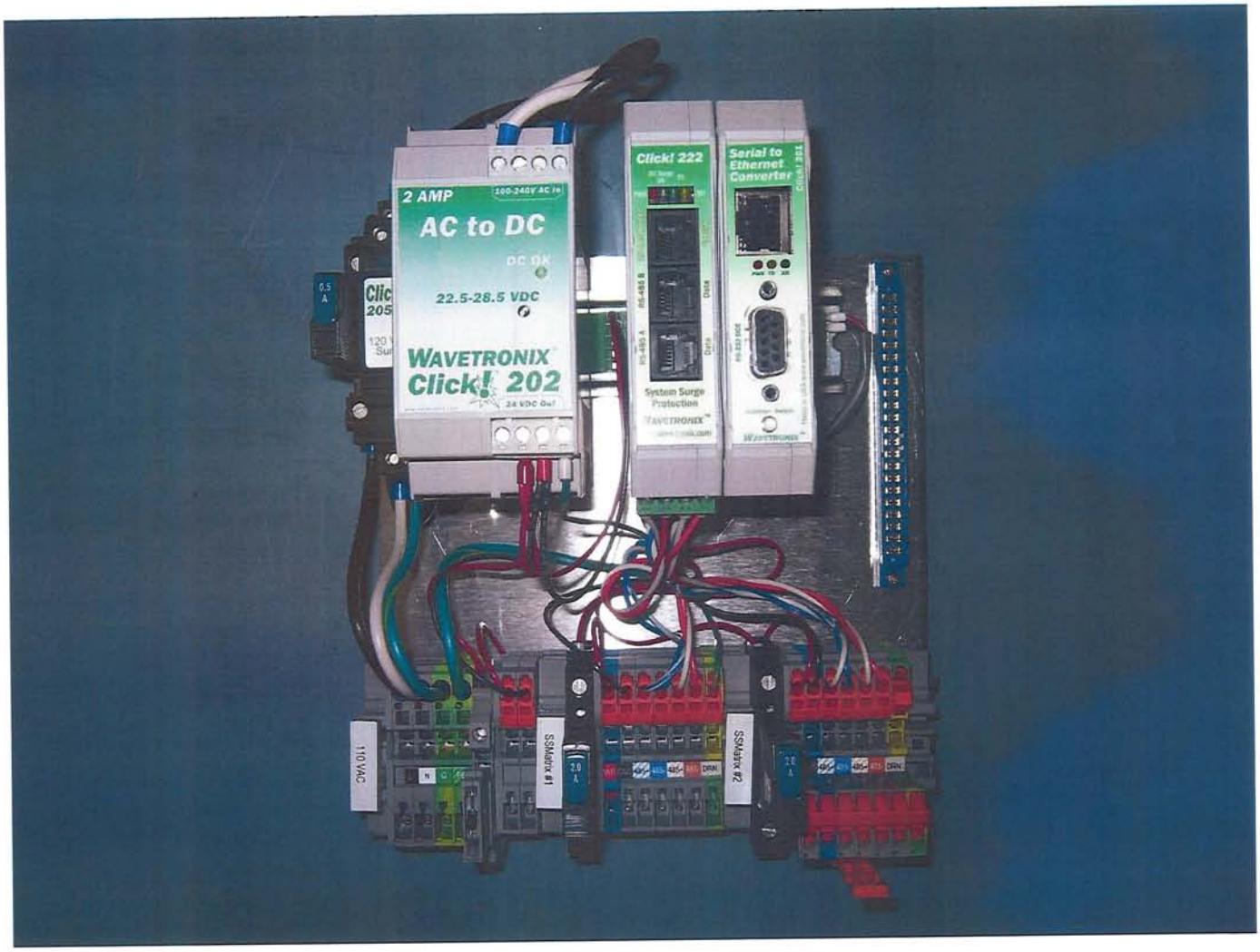
Frame Time:	0.200000 Seconds	Control Peak:	10.041819	Control RMS:	1.970819	Full Level Elapsed Pulses:	1
dT:	0.000098 Seconds	Demand Peak:	10.000000	Demand RMS:	1.968571	Remaining Pulses:	0
Pulse Type:	Half Sine	Amplitude:	10.000000	Pulse Width:	10.000000 ms		

Data saved at 02:16:44 PM, Friday, October 29, 2010 Report created at 02:16:44 PM, Friday, October 29, 2010

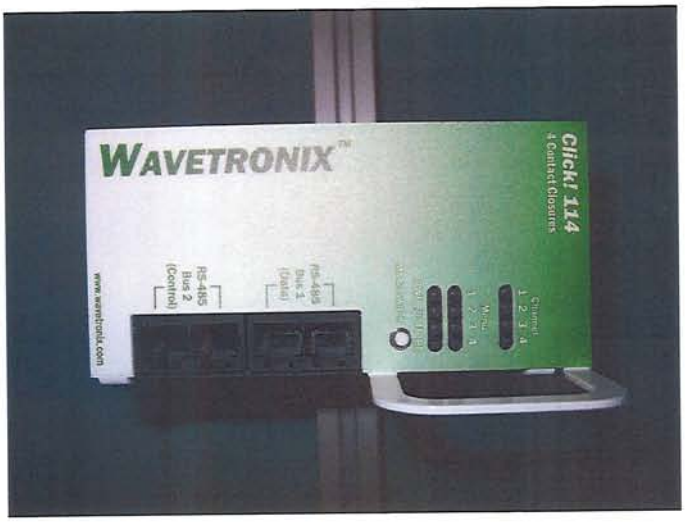
WAVETRONIX SmartSensor Matrix equipment, Click 112, 204, 222 & 301

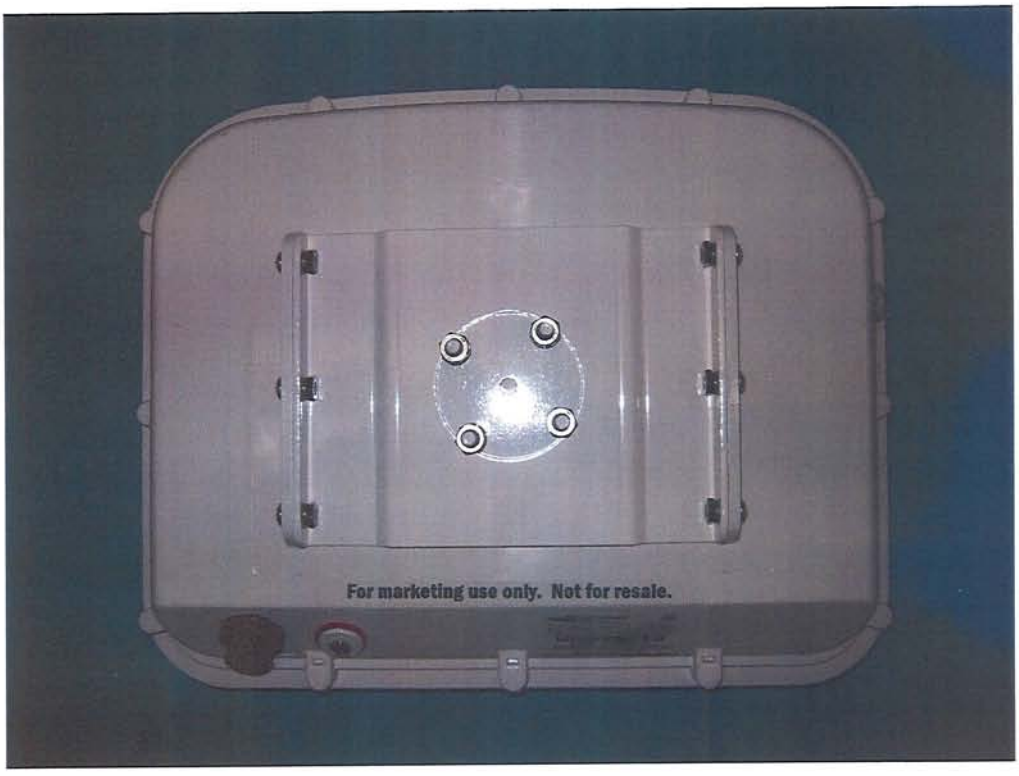




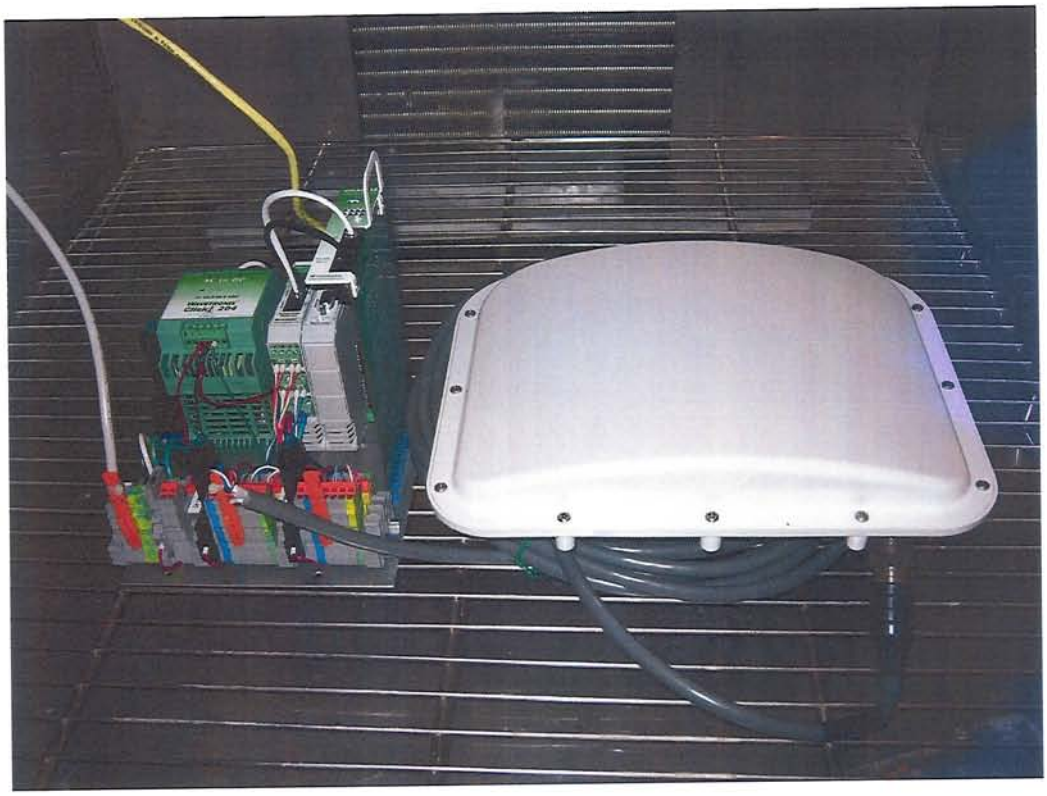


WAVETRONIX SmartSensor Matrix equipment, Click 114, 202, 222 & 301

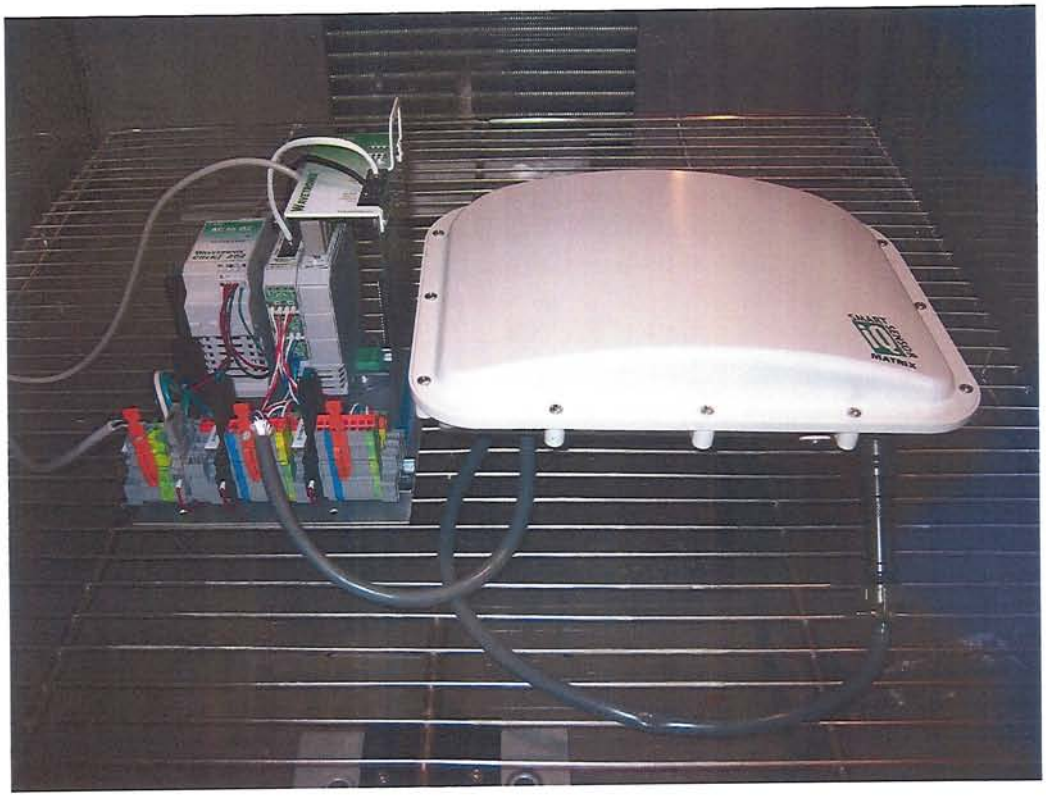


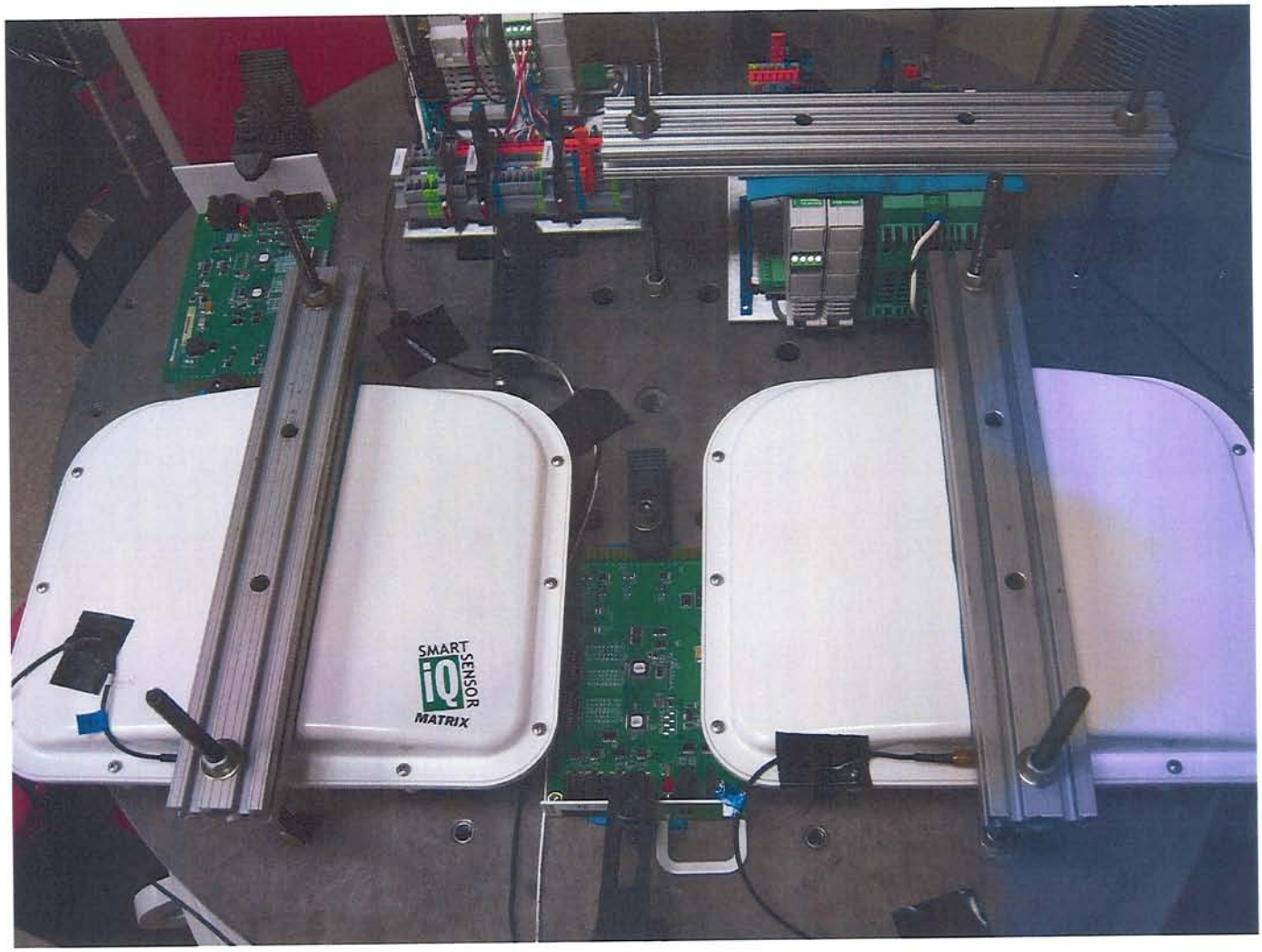


WAVETRONIX SmartSensor Matrix, SS225 Sensor



WAVETRONIX SmartSensor Matrix equipment configured for Temperature /Humidity.





WAVETRONIX SmartSensor Matrix equipment, configured for Vibration and Shock testing in X, Y & Z orientations.

WAVETRONIX mounted to LDS V8-440 Vibration Simulation System.

TASK	CONDITIONS	Date Completed	Operator Stamp

USAGE LOG

All Equipment Station Logs Completed.

Manufacturer	Model # / Function	Asset #	Cal. Due
Envirotronics	SH27-C	83-6402	10/14/11
LDS	V8 / Shaker	83-1120PT	11/5/10
Kistler	8704B500M1 /Accel	83-6365	1/4/11
Dytran	3023A / Accel	83-6374	3/31/11
Dytran	3023A / Accel	83-6393	4/19/11
Dytran	3023A / Accel	83-6395	4/19/11
Pacific Power	110-HE / AC Pwr. Sup.	83-6099	4/21/11
Tektronix	TDS3064B /Oscope	83-6340	10/7/11
HP	6634 /Power Supply	83-6218	3/5/11
Fluke	80K-40 HV /HV Probe	83-5419	3/19/11
Fluke	87 Series IV /DMM	83-6256	12/21/10

10-29-10 E.B.

PACK

Use original container or equivalent
One copy of test plan.

SHIP TO:

WAVETRONIX.
78 EAST 1700 SOUTH
BUILDING B
PROVO, UT 84606

SHIP VIA: