# Vibration & Shock Test Report
# SeaTraceR Class B
# AIS Transponder

On behalf of Sevenstar Electronics Ltd

Peter J Forey
Director

20 June 2007

# Contents

# 1. Overview

## 1.1. Introduction

The Equipment Under Test (EUT), as described within this document, was submitted for Vibration and Shock testing as agreed with the customer.

## 1.2. Objective

The purpose of the test was to verify the performance of the equipment when subjected to vibration and shock tests as requested and listed in section 2 Test Summary.

## 1.3. Product Modifications

None to samples submitted.

## 1.4. Conclusion

The EUT met the performance criteria defined in section 2 Test Summary.

# 2. Test Summary

## 2.1. Summary

The EUT was tested to extended vibration tests and shock tests as defined below.

The EUT met the performance requirements when subjected to the vibration test of EN 60945:2000 but with the sweep rate reduced to 0.2 octaves per minute and with the EUT operational throughout the test.

The results showed no resonances, so in each orientation the EUT was subjected to a 2 hour vibration test at 30Hz., 7m/sec, in accordance with EN 60945. The EUT met the performance requirements throughout the resonance test.

The EUT met the performance requirements before and after subjection to a shock test consisting of three vertical half sine wave shocks with duration 25msecs and peak acceleration 100m/s2.

## 2.2. Performance criteria

The EUT was monitored to verify reception of position reports from an approved Class A AIS transponder. The Class A transponder was monitored to verify reception of position reports from the EUT according to the nominal schedule.

# 3. Equipment and Test Details

## 3.1. General

| | |
|---|---|
| EUT: | Class B Automatic Identification System (AIS) Transponder |
| | Manufacturer: Sevenstar Electronics Ltd |
| | Model: SeaTraceR, S/N 287010 |
| Customer: | Mr Colin Watts |
| | Sevenstar Electronics Ltd |
| | 7 Richards Close |
| | Wootton Bassett |
| | Wilts SN4 7LE |
| | Tel: 01793 852829 |
| Test date(s): | June 5-14 2007 |
| Measurement site: | Sartech Engineering Ltd |
| | 13 Trowers Way |
| | Holmethorpe Industrial Estate |
| | Redhill, Surrey RH1 2LH |

## 3.2. EUT Description

The EUT is an AIS Transponder for maritime use. The AIS Transponder transmits and receives position, bearing and other key data from surrounding shipping fitted with a similar AIS Transponder. The AIS Transponder is also fitted with a GPS receiver to give its own position. The AIS data is transposed into electronic nautical charts to provide key information on surrounding shipping.

## 3.3. EUT Support

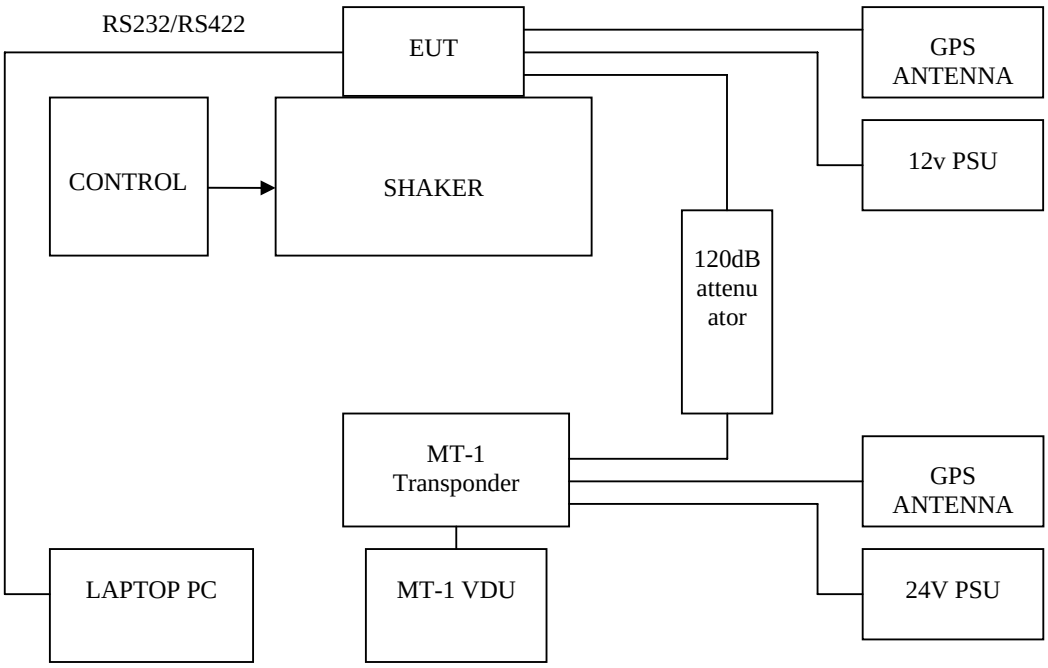
- 12V power supply Manson Model EP-603, s/n 6035908
- GPS antenna SM-66, s/n 7094123
- 24V power supply EHQ Model PS3003L, s/n 10001
- McMurdo MT-1 Display (VDU) , s/n 89072013
- McMurdo MT-1 Class A Transponder, s/n 89072013
- Toshiba Laptop PC, model T8200, S/N 61287094G
- 120dB attenuator
- Data communication USB to Serial Interface, s/n VT130200
- ACE Technology GA-1575N GPS Antenna, s/n 04000251

## 3.4. EUT Test Exerciser

The Toshiba PC continuously monitored the activity of the Class B AIS Transponder over the RS232 and RS422 interface. Once every 180 seconds the message changed to indicate a transmission had occurred. The McMurdo MT-1 VDU displayed a message

had been received from the Class B AIS Transponder and displayed a counter in seconds for the time to the next message; the count between each message was 180 seconds. The Toshiba PC and the MT-1 VDU were monitored for data interruption or unintended transmissions.

### *3.5. EUT Test Configuration*




Note: GPS antennas sited outside on extension cables.

### 3.6. Environmental test conditions

Normal office conditions. Ambient temperature 20-25 degC.

### 3.7. Vibration and shock test equipment

| Manufacturer | Model | Serial Number | Description | Calibration status |
|---|---|---|---|---|
| LDS | V830-185 | SP9184-005 | Air Cooled Vibrator | N/A |
| LDS | SPAK32K | SP9184-0071 | 32kW Amplifier | N/A |
| Dactron | Comet COM200 | 12107947 | Shaker Control System | Calibrated |
| PCB | 353B34 | 108267 | Control accelerometer | Calibrated |
| PCB | 353B03 | 108361 | Monitor accelerometer | Calibrated |
| Benq | ePC408006UK | 5K81567 | PC | N/A |

# 4. Vibration and Shock Results

**Note: Due to occasional transients picked up by the accelerometers, the system automatically paused the test several times during some of the following runs. In each case, testing was resumed by user input.**

## *4.1. EN60945:2000 Para 8.7Swept Sine Test*

**Test 1**

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : Front facing - horizontal

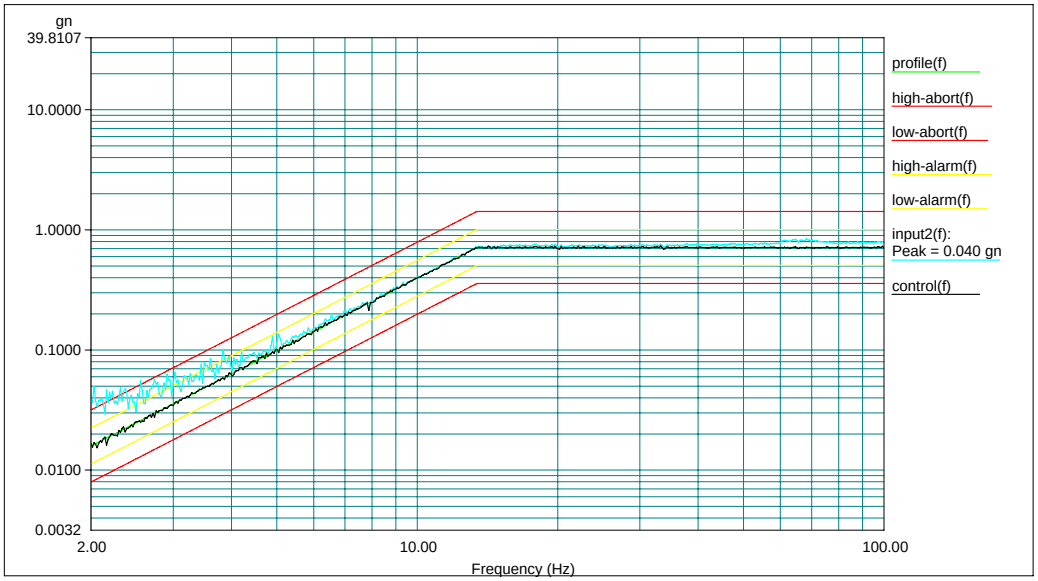
Notes : Test 1

Ambient Temp. : 21.8

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 12:16:58, Tuesday, June 05, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 12:16:58, Jun 05, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 12:17:07, Jun 05, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Sweep 1 at this entry |
| 12:17:07, Jun 05, 07 | 2.00 | 0.006/ 0.016 gn | Controller | RMS low, |
| 12:17:07, Jun 05, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Paused in scheduled test |
| 12:17:08, Jun 05, 07 | 2.00 | | User Command | Resume the Drive output |
| 00:00:10 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 12:45:37, Jun 05, 07 | 100.00 | 0.713/ 0.714 gn | Controller | Sweep 2 at this entry |
| 13:09:14, Jun 05, 07 | 3.75 | 0.022/ 0.056 gn | Controller | RMS low, |
| 13:09:14, Jun 05, 07 | 3.75 | 0.022/ 0.056 gn | Controller | Paused in scheduled test |
| 13:09:41, Jun 05, 07 | 3.75 | | User Command | Resume the Drive output |
| 00:52:43 | 3.75 | | Controller | Start a new sweep/dwell entry |
| 13:14:18, Jun 05, 07 | 2.00 | Controller | 'control(f),drive(f),' Saved Signals | |
| 13:14:18, Jun 05, 07 | 2.00 | | Controller | All Panes saved to the disk. |
| 13:14:20, Jun 05, 07 | 0.00 | 0.017/ 0.016 gn | Controller | End of Test |
| 13:14:20, Jun 05, 07 | 0.00 | | Full level elapsed 00:56:30 | |
| 13:14:20, Jun 05, 07 | 0.00 | | Full level elapsed sine cycles: 84925.0 | |




Result: EUT performed normally throughout the test.

**Test 2**

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : Left facing - horizontal

Notes : Test 2

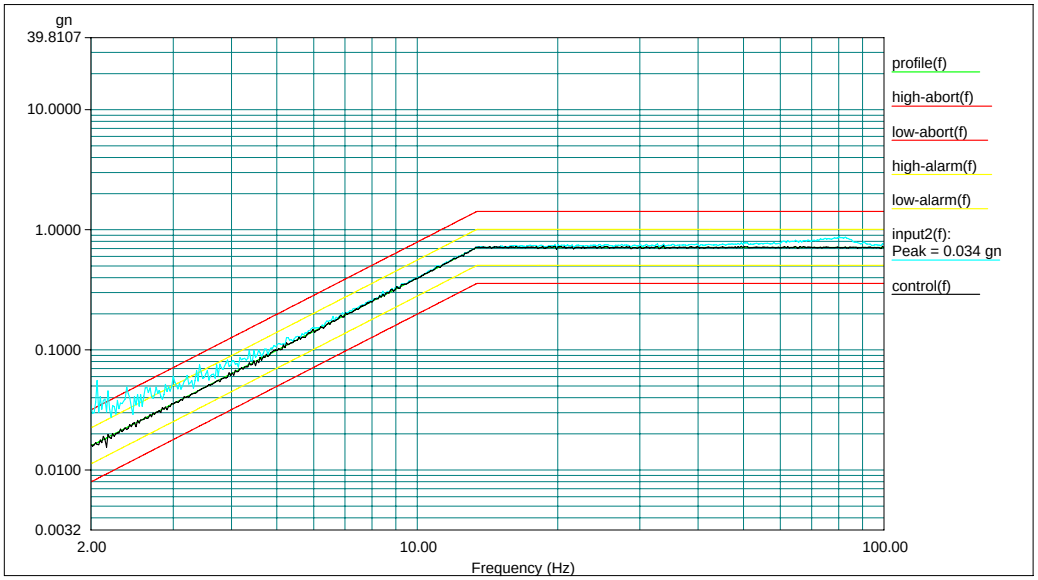
Ambient Temp. : 22.3

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 09:53:15, Thursday, June 07, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 09:53:15, Jun 07, 07 | 0.00 | | User Command | Start the Test |
| 09:53:17, Jun 07, 07 | 0.00 | | Controller | Demand level changed |
| 00:00:02 2.00 | | Controller | Start a new sweep/dwell entry | |
| 09:53:24, Jun 07, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Sweep 1 at this entry |
| 09:53:24, Jun 07, 07 | 2.00 | 0.006/ 0.016 gn | Controller | RMS low, |
| 09:53:24, Jun 07, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Paused in scheduled test |
| 09:53:25, Jun 07, 07 | 2.00 | | User Command | Resume the Drive output |
| 00:00:10 2.00 | | Controller | Start a new sweep/dwell entry | |
| 10:21:56, Jun 07, 07 | 100.00 | 0.716/ 0.714 gn | Controller | Sweep 2 at this entry |
| 10:45:34, Jun 07, 07 | 3.75 | 0.021/ 0.056 gn | Controller | RMS low, |

| | | | | |
|---|---|---|---|---|
| 10:45:34, Jun 07, 07 | 3.75 | 0.021/ 0.056 gn | Controller | Paused in scheduled test |
| 10:45:35, Jun 07, 07 | 3.75 | | User Command | Resume the Drive output |
| 00:52:20 | 3.75 | | Controller | Start a new sweep/dwell entry |
| 10:50:12, Jun 07, 07 | 2.00 | | Controller | All Panes saved to the disk. |
| 10:50:12, Jun 07, 07 | 2.00 | | Controller | 'control(f),drive(f),' Saved Signals |
| 10:50:14, Jun 07, 07 | 0.00 | 0.016/ 0.016 gn | Controller | End of Test |
| 10:50:14, Jun 07, 07 | 0.00 | | Full level elapsed 00:56:30 | |
| 10:50:14, Jun 07, 07 | 0.00 | | Full level elapsed sine cycles: 84925.0 | |




Result: EUT performed normally throughout the test.

## Test 3

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : LH facing - LH side to top

Notes : Test 3

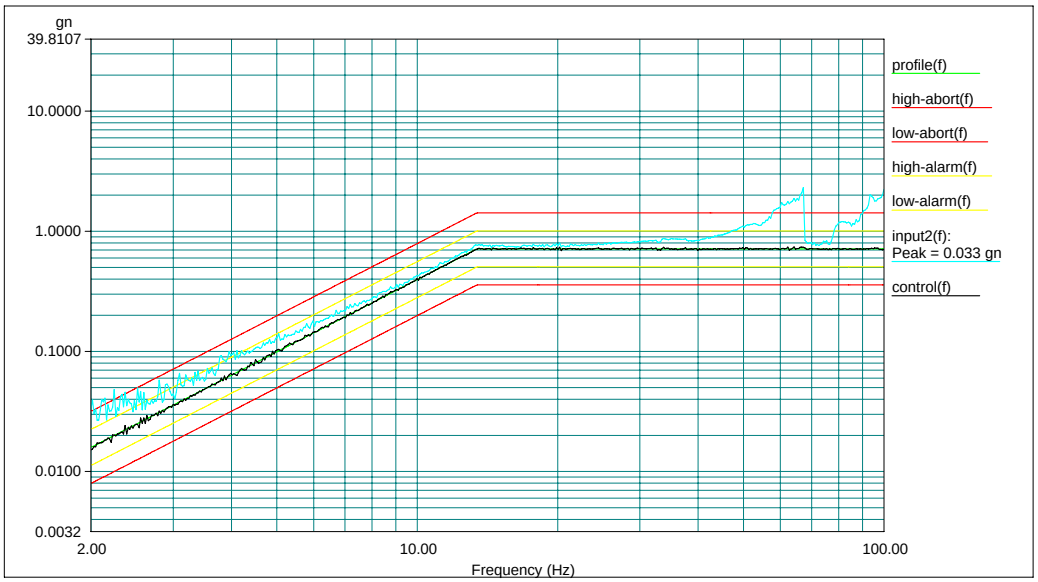
Ambient Temp. : 22.7

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 09:52:26, Tuesday, June 12, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 09:52:26, Jun 12, 07 | 0.00 | | User Command | Start the Test |
| 09:52:28, Jun 12, 07 | 0.00 | | Controller | Demand level changed |

| | | | | |
|---|---|---|---|---|
| 00:00:02 2.00 | Controller | Start a new sweep/dwell entry | | |
| 09:52:35, Jun 12, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Sweep 1 at this entry |
| 09:52:35, Jun 12, 07 | 2.00 | 0.006/ 0.016 gn | Controller | RMS low, |
| 09:52:35, Jun 12, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Paused in scheduled test |
| 09:52:37, Jun 12, 07 | 2.00 | User Command | Resume the Drive output | |
| 00:00:11 2.00 | Controller | Start a new sweep/dwell entry | | |
| 10:21:09, Jun 12, 07 | 100.00 | 0.727/ 0.714 gn | Controller | Sweep 2 at this entry |
| 10:44:46, Jun 12, 07 | 3.75 | 0.022/ 0.056 gn | Controller | RMS low, |
| 10:44:46, Jun 12, 07 | 3.75 | 0.022/ 0.056 gn | Controller | Paused in scheduled test |
| 10:47:11, Jun 12, 07 | 3.75 | User Command | Resume the Drive output | |
| 00:54:45 3.75 | Controller | Start a new sweep/dwell entry | | |
| 10:51:48, Jun 12, 07 | 2.00 | Controller | All Panes saved to the disk. | |
| 10:51:48, Jun 12, 07 | 2.00 | Controller | 'control(f),drive(f),' Saved Signals | |
| 10:51:50, Jun 12, 07 | 0.00 | 0.015/ 0.016 gn | Controller | End of Test |
| 10:51:50, Jun 12, 07 | 0.00 | Full level elapsed 00:56:30 | | |
| 10:51:50, Jun 12, 07 | 0.00 | Full level elapsed sine cycles: 84925.0 | | |




Result: EUT performed normally throughout the test.

## Test 4

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : Front facing - LH side to top

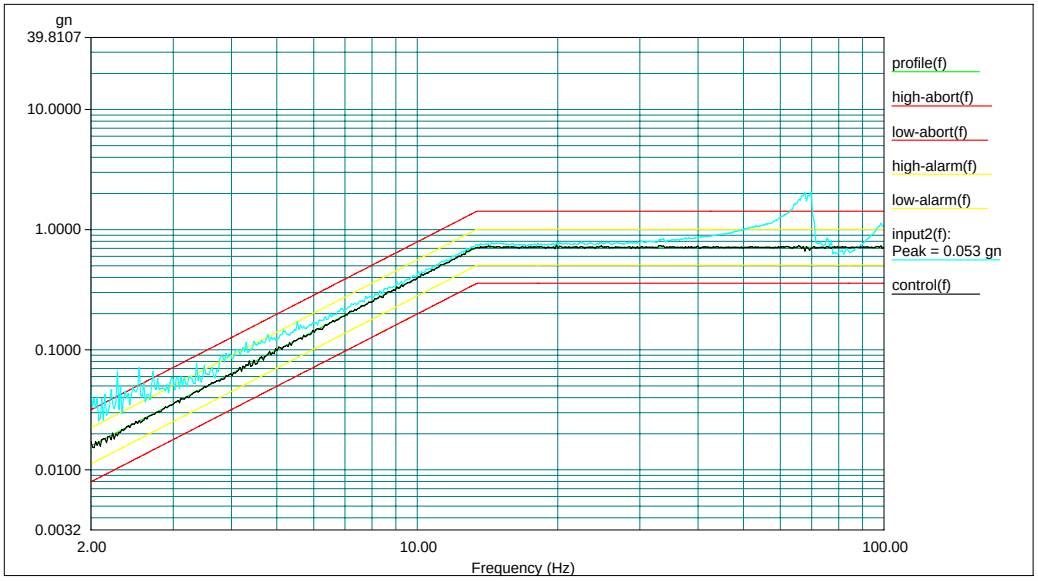
Notes : Test 4

Ambient Temp. : 26.3

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 13:35:26, Tuesday, June 12, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 13:35:26, Jun 12, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 13:35:32, Jun 12, 07 | 2.00 | 0.002/ 0.016 gn | Controller | open, |
| 13:35:32, Jun 12, 07 | 2.00 | 0.002/ 0.016 gn | Controller | Paused in scheduled test |
| 13:35:38, Jun 12, 07 | 2.00 | | User Command | Resume the Drive output |
| 00:00:12 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 13:35:41, Jun 12, 07 | 2.00 | 0.003/ 0.016 gn | Controller | Sweep 1 at this entry |
| 14:04:10, Jun 12, 07 | 100.00 | 0.720/ 0.714 gn | Controller | Sweep 2 at this entry |
| 14:27:47, Jun 12, 07 | 3.75 | 0.024/ 0.056 gn | Controller | RMS low, |
| 14:27:47, Jun 12, 07 | 3.75 | 0.024/ 0.056 gn | Controller | Paused in scheduled test |
| 14:29:01, Jun 12, 07 | 3.75 | | User Command | Resume the Drive output |
| 00:53:35 | 3.75 | | Controller | Start a new sweep/dwell entry |
| 14:33:38, Jun 12, 07 | 2.00 | Controller | | 'control(f),drive(f),' Saved Signals |
| 14:33:38, Jun 12, 07 | 2.00 | | Controller | All Panes saved to the disk. |
| 14:33:40, Jun 12, 07 | 0.00 | 0.017/ 0.016 gn | Controller | End of Test |
| 14:33:40, Jun 12, 07 | 0.00 | | Full level elapsed 00:56:30 | |
| 14:33:40, Jun 12, 07 | 0.00 | | Full level elapsed sine cycles: 84925.0 | |




Result: EUT performed normally throughout the test.

## Test 5

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : Front facing down - top to front

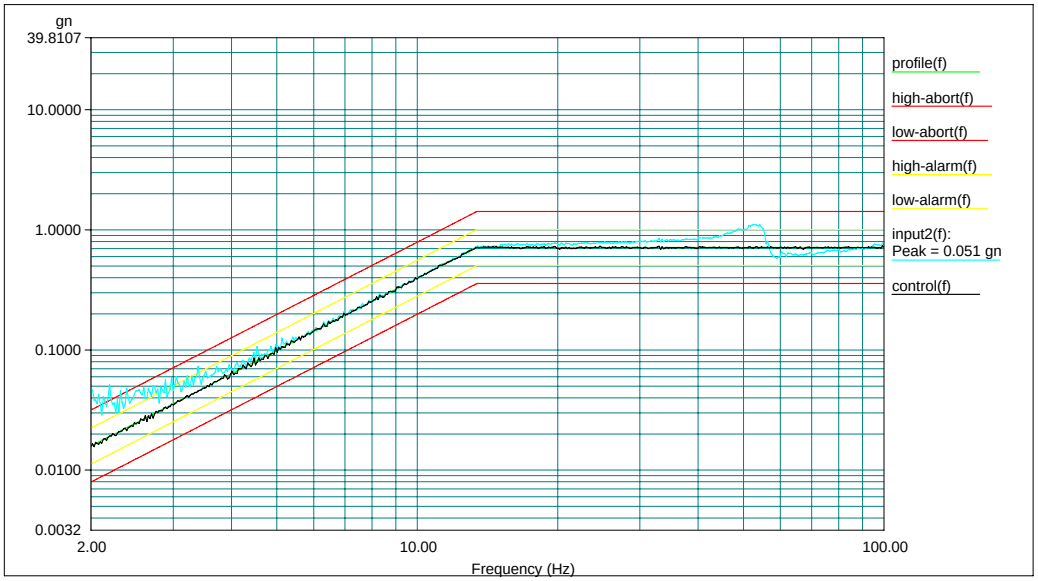
Notes : Test 5

Ambient Temp. : 21.9

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 08:41:05, Thursday, June 14, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 08:41:05, Jun 14, 07 | 0.00 | | User Command | Start the Test |
| 00:00:03 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 08:41:15, Jun 14, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Sweep 1 at this entry |
| 08:41:15, Jun 14, 07 | 2.00 | 0.006/ 0.016 gn | Controller | RMS low, |
| 08:41:15, Jun 14, 07 | 2.00 | 0.006/ 0.016 gn | Controller | Paused in scheduled test |
| 08:41:16, Jun 14, 07 | 2.00 | | User Command | Resume the Drive output |
| 00:00:11 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 09:09:44, Jun 14, 07 | 99.99 | 0.714/ 0.714 gn | Controller | Sweep 2 at this entry |
| 09:33:21, Jun 14, 07 | 3.75 | 0.055/ 0.056 gn | Controller | open, |
| 09:33:21, Jun 14, 07 | 3.75 | 0.055/ 0.056 gn | Controller | Paused in scheduled test |
| 09:33:52, Jun 14, 07 | 3.75 | | User Command | Resume the Drive output |
| 00:52:47 | 3.75 | | Controller | Start a new sweep/dwell entry |
| 09:38:30, Jun 14, 07 | 2.00 | Controller | | 'control(f),drive(f),' Saved Signals |
| 09:38:30, Jun 14, 07 | 2.00 | | Controller | All Panes saved to the disk. |
| 09:38:32, Jun 14, 07 | 0.00 | 0.016/ 0.016 gn | Controller | End of Test |
| 09:38:32, Jun 14, 07 | 0.00 | | Full level elapsed 00:56:30 | |
| 09:38:32, Jun 14, 07 | 0.00 | | Full level elapsed sine cycles: 84925.0 | |




Result: EUT performed normally throughout the test.

**Test 6**

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec (0.2oct/min)

Orientation : Font facing down - top to RH side

Notes : Test 6

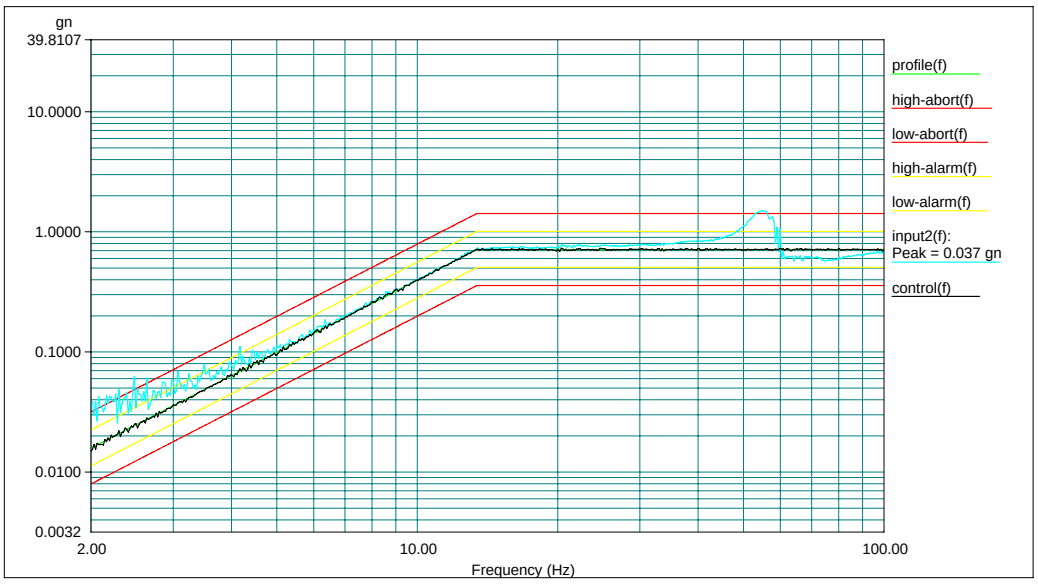
Ambient Temp. : 25.7

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 12:07:10, Thursday, June 14, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 12:07:10, Jun 14, 07 | 0.00 | | User Command | Start the Test |
| 00:00:03 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 12:07:20, Jun 14, 07 | 2.00 | 0.004/ 0.016 gn | Controller | Sweep 1 at this entry |
| 12:07:20, Jun 14, 07 | 2.00 | 0.004/ 0.016 gn | Controller | RMS low, |
| 12:07:20, Jun 14, 07 | 2.00 | 0.004/ 0.016 gn | Controller | Paused in scheduled test |
| 12:07:21, Jun 14, 07 | 2.00 | | User Command | Resume the Drive output |
| 00:00:11 | 2.00 | | Controller | Start a new sweep/dwell entry |
| 12:07:27, Jun 14, 07 | 2.01 | 0.008/ 0.016 gn | Controller | RMS low, |
| 12:07:27, Jun 14, 07 | 2.01 | 0.008/ 0.016 gn | Controller | Paused in scheduled test |
| 12:07:30, Jun 14, 07 | 2.01 | | User Command | Resume the Drive output |

| | | | | | |
|---|---|---|---|---|---|
| 00:00:20 2.01 | | | Controller | Start a new sweep/dwell entry | |
| 12:35:59, Jun 14, 07 | 99.99 | 0.712/ 0.714 gn | Controller | Sweep 2 at this entry | |
| 12:59:36, Jun 14, 07 | 3.75 | 0.056/ 0.056 gn | Controller | open, | |
| 12:59:36, Jun 14, 07 | 3.75 | 0.056/ 0.056 gn | Controller | Paused in scheduled test | |
| 13:05:13, Jun 14, 07 | 3.75 | | User Command | Resume the Drive output | |
| 00:58:03 3.75 | | | Controller | Start a new sweep/dwell entry | |
| 13:09:49, Jun 14, 07 | 2.00 | Controller | | 'control(f),drive(f),' Saved Signals | |
| 13:09:49, Jun 14, 07 | 2.00 | | Controller | All Panes saved to the disk. | |
| 13:09:51, Jun 14, 07 | 0.00 | 0.015/ 0.016 gn | Controller | End of Test | |
| 13:09:51, Jun 14, 07 | 0.00 | | Full level elapsed 00:56:30 | | |
| 13:09:51, Jun 14, 07 | 0.00 | | Full level elapsed sine cycles: 84925.1 | | |




Result: EUT performed normally throughout the test.

## *4.2. 30Hz 2Hr Resonance Tests*

**Test 1**

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : Front facing - horizontal

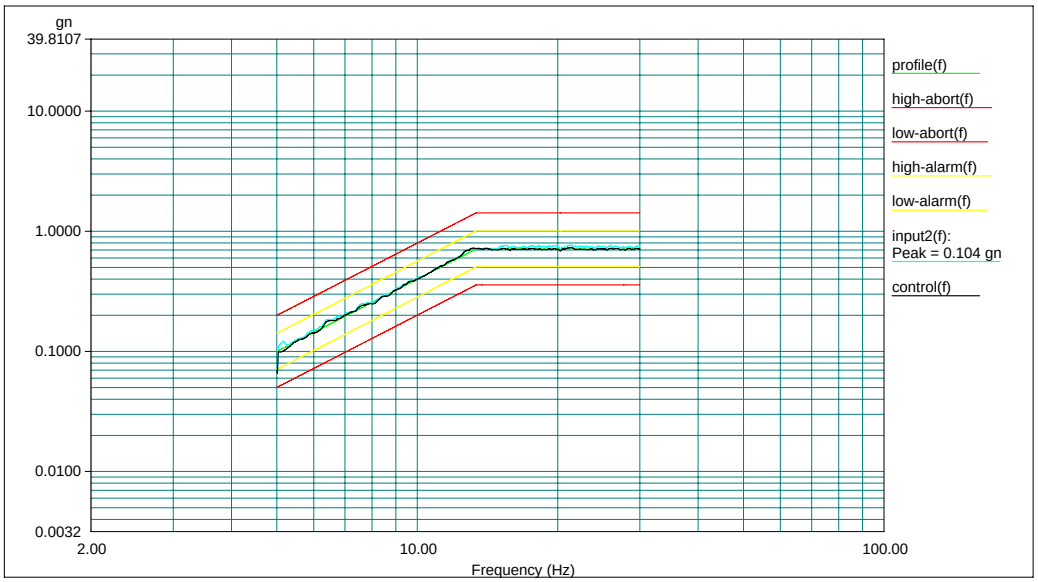
Notes : Test 1

Ambient Temp. : 25.2

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 14:15:26, Tuesday, June 05, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 14:15:26, Jun 05, 07 | 0.00 | | User Command | Start the Test |
| 00:00:03 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 14:15:34, Jun 05, 07 | 5.00 | 0.069/ 0.101 gn | Controller | Sweep 1 at this entry |
| 14:15:34, Jun 05, 07 | 5.09 | 0.057/ 0.103 gn | Controller | Paused in scheduled test |
| 14:15:37, Jun 05, 07 | 5.09 | | User Command | Resume the Drive output |
| 00:00:11 | 5.09 | | Controller | Start a new sweep/dwell entry |
| 15:53:34, Jun 05, 07 | 30.00 | 0.899/ 0.714 gn | Controller | open, |
| 15:53:34, Jun 05, 07 | 30.00 | 0.899/ 0.714 gn | Controller | Paused in scheduled test |
| 15:54:53, Jun 05, 07 | 30.00 | | User Command | Resume the Drive output |
| 01:39:27 | 30.00 | | Controller | Start a new sweep/dwell entry |
| 16:18:10, Jun 05, 07 | 5.03 | Controller | 'control(f),drive(f),' Saved Signals | |
| 16:18:10, Jun 05, 07 | 5.03 | | Controller | All Panes saved to the disk. |
| 16:18:12, Jun 05, 07 | 0.00 | 0.099/ 0.101 gn | Controller | End of Test |
| 16:18:12, Jun 05, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 16:18:12, Jun 05, 07 | 0.00 | | Full level elapsed sine cycles: 216843.8 | |




Result: EUT performed normally throughout the test.

## Test 2

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : Left facing - horizontal

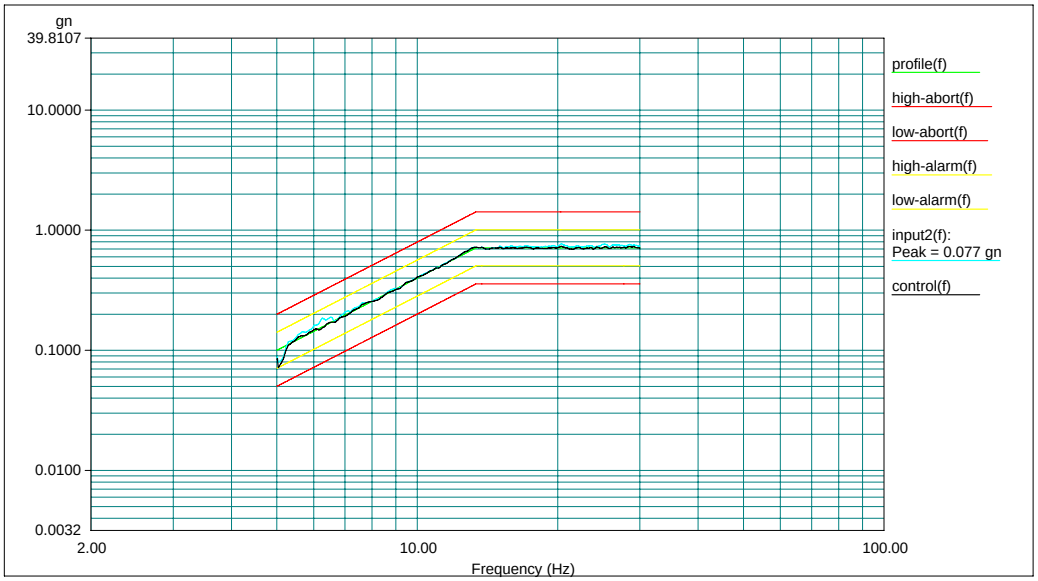
Notes : Test 2

Ambient Temp. : 24.6

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 10:55:18, Thursday, June 07, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 10:55:18, Jun 07, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 5.00 | | Controller | | Start a new sweep/dwell entry |
| 10:55:26, Jun 07, 07 | 5.02 | 0.085/ 0.101 gn | Controller | Sweep 1 at this entry |
| 10:55:27, Jun 07, 07 | 5.48 | 0.051/ 0.120 gn | Controller | Paused in scheduled test |
| 10:55:30, Jun 07, 07 | 5.49 | | User Command | Resume the Drive output |
| 00:00:12 5.49 | | Controller | | Start a new sweep/dwell entry |
| 12:56:41, Jun 07, 07 | 5.03 | Controller | | 'control(f),drive(f),' Saved Signals |
| 12:56:41, Jun 07, 07 | 5.03 | | Controller | All Panes saved to the disk. |
| 12:56:41, Jun 07, 07 | 0.00 | 0.072/ 0.101 gn | Controller | End of Test |
| 12:56:41, Jun 07, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 12:56:41, Jun 07, 07 | 0.00 | | Full level elapsed sine cycles: 216842.7 | |




Result: EUT performed normally throughout the test.

## Test 3

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : LH facing - LH side to top

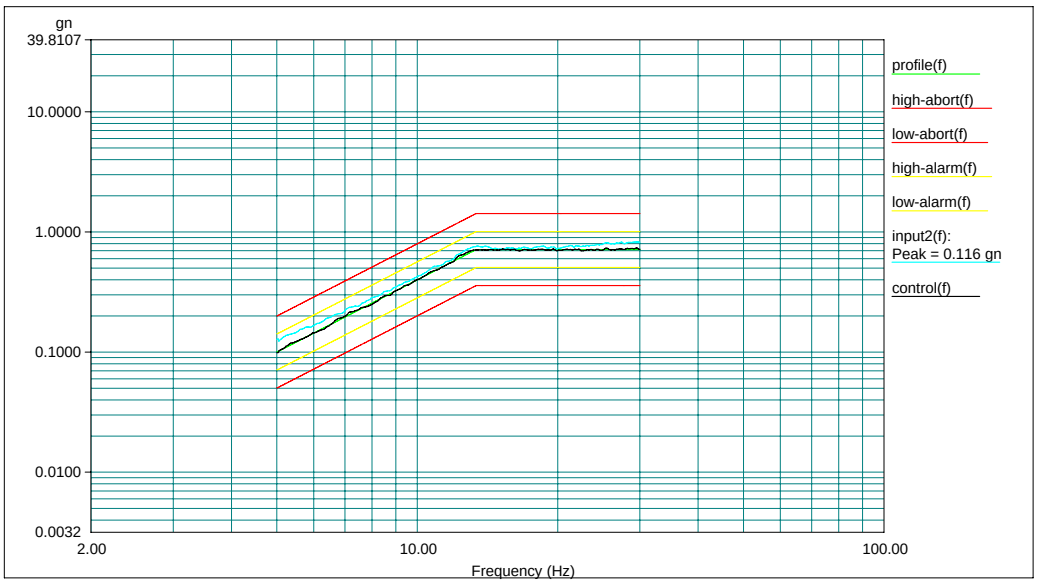
Notes : Test 3

Ambient Temp. : 24.2

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 10:55:09, Tuesday, June 12, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 10:55:09, Jun 12, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 10:55:15, Jun 12, 07 | 5.00 | 0.055/ 0.003 gn | Controller | open, |
| 10:55:15, Jun 12, 07 | 5.00 | 0.055/ 0.003 gn | Controller | Paused in scheduled test |
| 10:55:16, Jun 12, 07 | 5.00 | | User Command | Resume the Drive output |
| 00:00:07 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 10:55:17, Jun 12, 07 | 5.00 | 0.048/ 0.101 gn | Controller | Sweep 1 at this entry |
| 12:56:24, Jun 12, 07 | 5.04 | Controller | 'control(f),drive(f),' Saved Signals | |
| 12:56:24, Jun 12, 07 | 5.04 | | Controller | All Panes saved to the disk. |
| 12:56:25, Jun 12, 07 | 0.00 | 0.102/ 0.101 gn | Controller | End of Test |
| 12:56:25, Jun 12, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 12:56:25, Jun 12, 07 | 0.00 | | Full level elapsed sine cycles: 216843.8 | |




Result: EUT performed normally throughout the test.

## Test 4

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : LH facing front - LH side to top

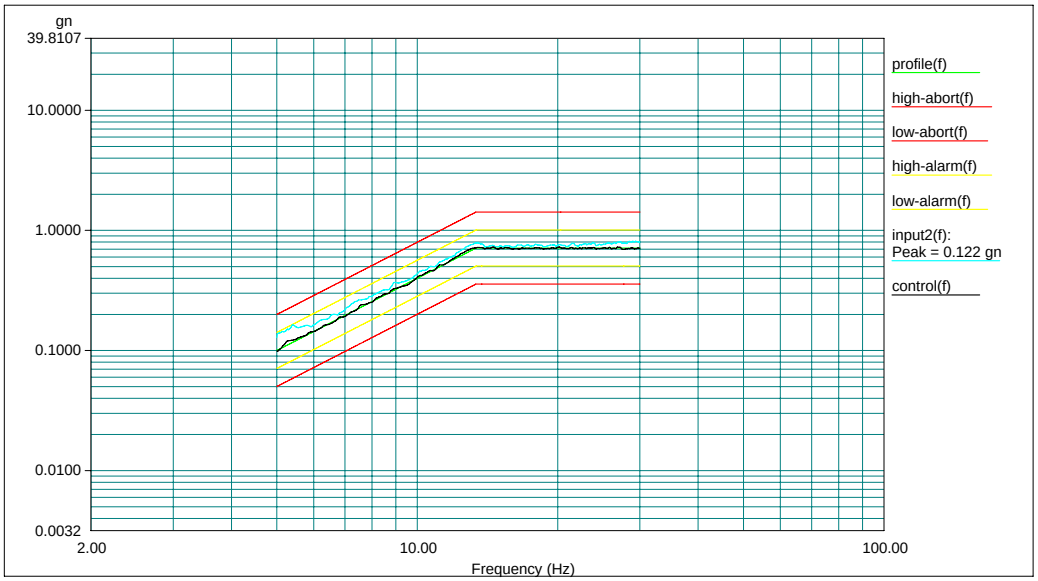
Notes : Test 4

Ambient Temp. : 26.5

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 14:34:34, Tuesday, June 12, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 14:34:34, Jun 12, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 5.00 | | Controller | | Start a new sweep/dwell entry |
| 14:34:39, Jun 12, 07 | 5.00 | 0.053/ 0.004 gn | Controller | open, |
| 14:34:39, Jun 12, 07 | 5.00 | 0.053/ 0.004 gn | Controller | Paused in scheduled test |
| 14:34:42, Jun 12, 07 | 5.00 | | User Command | Resume the Drive output |
| 00:00:08 5.00 | | Controller | | Start a new sweep/dwell entry |
| 14:34:43, Jun 12, 07 | 5.00 | 0.044/ 0.101 gn | Controller | Sweep 1 at this entry |
| 16:26:39, Jun 12, 07 | 30.00 | 0.920/ 0.714 gn | Controller | open, |
| 16:26:39, Jun 12, 07 | 30.00 | 0.920/ 0.714 gn | Controller | Paused in scheduled test |
| 16:27:44, Jun 12, 07 | 30.00 | | User Command | Resume the Drive output |
| 01:53:10 30.00 | | Controller | | Start a new sweep/dwell entry |
| 16:36:57, Jun 12, 07 | 5.01 | Controller | | 'control(f),drive(f),' Saved Signals |
| 16:36:57, Jun 12, 07 | 5.01 | | Controller | All Panes saved to the disk. |
| 16:36:58, Jun 12, 07 | 0.00 | 0.098/ 0.101 gn | Controller | End of Test |
| 16:36:58, Jun 12, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 16:36:58, Jun 12, 07 | 0.00 | | Full level elapsed sine cycles: 216843.8 | |




Result: EUT performed normally throughout the test.

## Test 5

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : Front facing down - top facing front

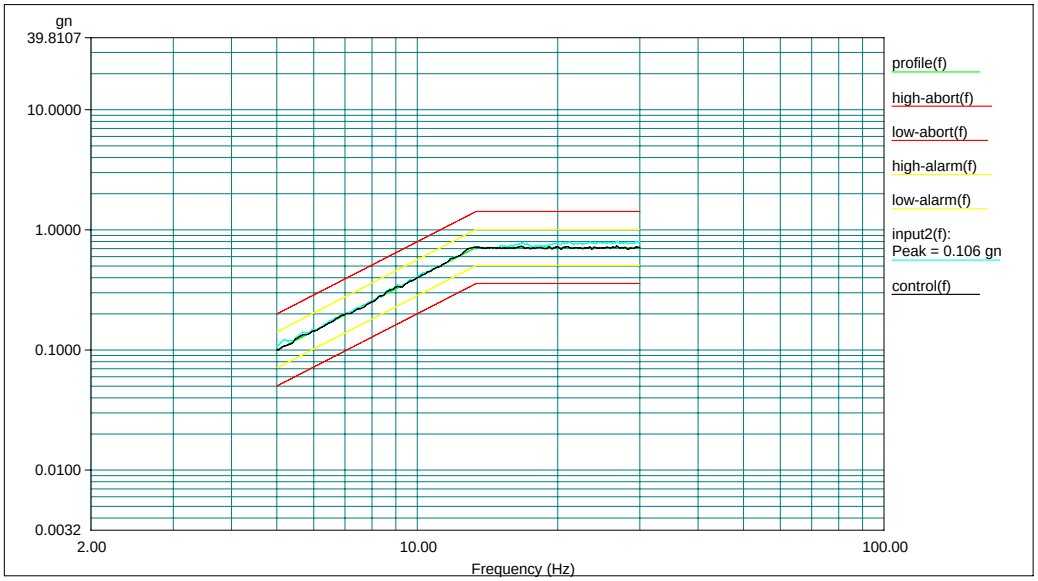
Notes : Test 5

Ambient Temp. : 26.5

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 09:41:42, Thursday, June 14, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 09:41:42, Jun 14, 07 | 0.00 | | User Command | Start the Test |
| 00:00:03 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 09:41:48, Jun 14, 07 | 5.00 | 0.061/ 0.003 gn | Controller | open, |
| 09:41:48, Jun 14, 07 | 5.00 | 0.061/ 0.003 gn | Controller | Paused in scheduled test |
| 09:41:50, Jun 14, 07 | 5.00 | | User Command | Resume the Drive output |
| 00:00:08 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 09:41:51, Jun 14, 07 | 5.00 | 0.055/ 0.101 gn | Controller | Sweep 1 at this entry |
| 09:51:00, Jun 14, 07 | 30.00 | 0.870/ 0.714 gn | Controller | open, |
| 09:51:00, Jun 14, 07 | 30.00 | 0.870/ 0.714 gn | Controller | Paused in scheduled test |
| 10:01:58, Jun 14, 07 | 30.00 | | User Command | Resume the Drive output |
| 00:20:16 | 30.00 | | Controller | Start a new sweep/dwell entry |
| 11:54:08, Jun 14, 07 | 5.04 | Controller | 'control(f),drive(f),' | Saved Signals |
| 11:54:08, Jun 14, 07 | 5.04 | | Controller | All Panes saved to the disk. |
| 11:54:09, Jun 14, 07 | 0.00 | 0.100/ 0.101 gn | Controller | End of Test |
| 11:54:09, Jun 14, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 11:54:09, Jun 14, 07 | 0.00 | | Full level elapsed sine cycles: 216843.8 | |




Result: EUT performed normally throughout the test.

**Test 6**

DUT : Sea Tracer Sartech 2 123456002

Serial Number : 287010

Test Protocol : Marine Spec 30Hz 2H test

Orientation : Front facing down - top to RH side

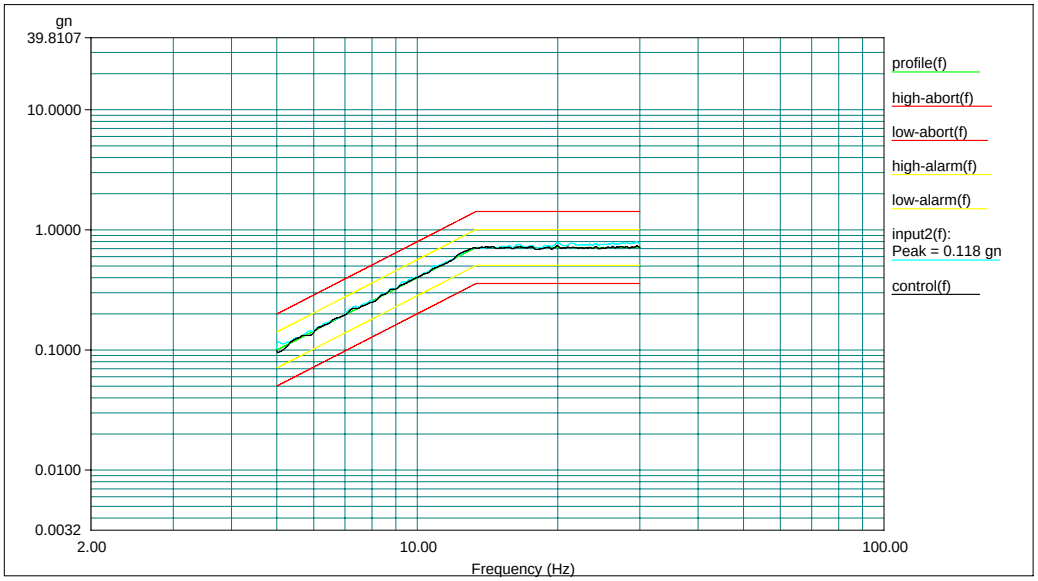
Notes : Test 6

Ambient Temp. : 26.6

Dactron Dual DSP Shaker Control System

Swept Sine Test Run Log 13:11:00, Thursday, June 14, 2007

| ENTRY TIME | FREQ(Hz) | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 13:11:00, Jun 14, 07 | 0.00 | | User Command | Start the Test |
| 00:00:02 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 13:11:05, Jun 14, 07 | 5.00 | 0.057/ 0.003 gn | Controller | Paused in scheduled test |
| 13:11:07, Jun 14, 07 | 5.00 | | User Command | Resume the Drive output |
| 00:00:07 | 5.00 | | Controller | Start a new sweep/dwell entry |
| 13:11:09, Jun 14, 07 | 5.00 | 0.047/ 0.101 gn | Controller | Sweep 1 at this entry |
| 15:12:16, Jun 14, 07 | 5.02 | | Controller | All Panes saved to the disk. |
| 15:12:16, Jun 14, 07 | 5.02 | Controller | | 'control(f),drive(f),' Saved Signals |
| 15:12:17, Jun 14, 07 | 0.00 | 0.095/ 0.101 gn | Controller | End of Test |
| 15:12:17, Jun 14, 07 | 0.00 | | Full level elapsed 02:01:02 | |
| 15:12:17, Jun 14, 07 | 0.00 | | Full level elapsed sine cycles: 216843.8 | |




Result: EUT performed normally throughout the test.

## 4.3. Half sine wave shock test

**Test 1**

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : Front facing - horizontal

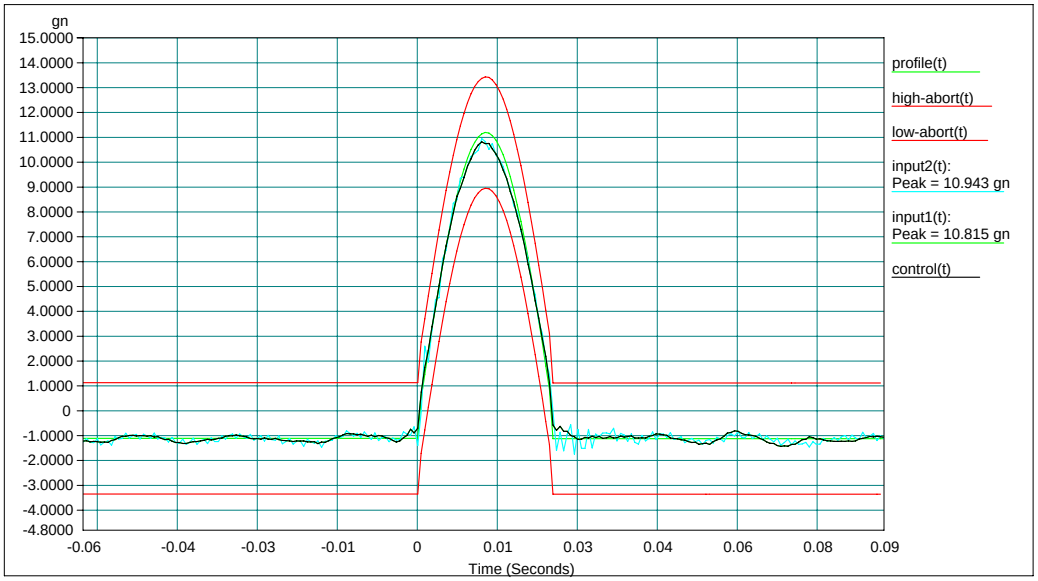
Notes : Test 1

Ambient temp. : 21.9

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log 09:32:21, Thursday, June 07, 2007

| ENTRY TIME /ELAPSED | LEVEL | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 09:32:21, Jun 07, 07/ | 0 | 0.00 % | User Command | Start the Test |
| 09:32:26, Jun 07, 07/ | 1 | 18.10 % 2.023/ 4.476 gn | Controller | Running in pre-test |
| 09:32:28, Jun 07, 07/ | 2 | 40.00 % 3.908/ 4.476 gn | Controller | |
| 09:32:29, Jun 07, 07/ | 3 | 40.00 % 4.352/ 4.476 gn | Controller | |
| 09:32:31, Jun 07, 07/ | 4 | 40.00 % 4.464/ 4.476 gn | Controller | System paused after pre-test |
| 09:32:36, Jun 07, 07/ | 4 | 40.00 % | User Command | Run Scheduled Test |
| 09:32:38, Jun 07, 07/ | 5 | 50.00 % 5.567/ 5.595 gn | Controller | Running in scheduled test |
| 09:32:39, Jun 07, 07/ | 6 | 50.00 % 5.566/ 5.595 gn | Controller | |
| 09:32:41, Jun 07, 07/ | 7 | 75.00 % 8.023/ 8.392 gn | Controller | |
| 09:32:42, Jun 07, 07/ | 8 | 100.00 % 9.577/11.190 gn | Controller | |
| 09:32:44, Jun 07, 07/ | 9 | 100.00 % 10.199/11.190 gn | Controller | |
| 09:32:45, Jun 07, 07/ | 10 | 100.00 % 10.815/11.190 gn | Controller | |
| 09:32:45, Jun 07, 07 | | 100.00 % | Controller | 'control(t),drive(t),' Saved Signals |
| 09:32:45, Jun 07, 07/ | 10 | 100.00 % | Controller | All Panes saved to the disk. |
| 09:32:46, Jun 07, 07/ | 10 | 100.00 % 10.815/11.190 gn | Controller | End of Test |
| 09:32:46, Jun 07, 07/ | 10 | 100.00 % | | Full level elapsed 3 |
| 09:32:46, Jun 07, 07/ | 10 | 100.00 % | | Total elapsed 10 |




Result: EUT performed normally before and after shock test

## Test 2

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : Left facing - horizontal

Notes : Test 2

Ambient temp. : 24.4

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log 13:00:03, Thursday, June 07, 2007

| ENTRY TIME /ELAPSED | LEVEL | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 13:00:03, Jun 07, 07/ | 0 | 0.00 % | User Command | Start the Test |
| 13:00:08, Jun 07, 07/ | 1 | 18.12 % 2.026/ 4.476 gn | Controller | Running in pre-test |
| 13:00:10, Jun 07, 07/ | 2 | 40.00 % 4.218/ 4.476 gn | Controller | |
| 13:00:11, Jun 07, 07/ | 3 | 40.00 % 4.523/ 4.476 gn | Controller | |
| 13:00:13, Jun 07, 07/ | 4 | 40.00 % 4.402/ 4.476 gn | Controller | System paused after pre-test |
| 13:00:18, Jun 07, 07/ | 4 | 40.00 % | User Command | Run Scheduled Test |
| 13:00:20, Jun 07, 07/ | 5 | 50.00 % 5.499/ 5.595 gn | Controller | Running in scheduled test |
| 13:00:22, Jun 07, 07/ | 6 | 50.00 % 5.677/ 5.595 gn | Controller | |
| 13:00:23, Jun 07, 07/ | 7 | 75.00 % 7.913/ 8.392 gn | Controller | |
| 13:00:25, Jun 07, 07/ | 8 | 100.00 % 9.781/11.190 gn | Controller | |
| 13:00:26, Jun 07, 07/ | 9 | 100.00 % 10.409/11.190 gn | Controller | |

13:00:28, Jun 07, 07/ 10 100.00 % 10.846/11.190 gn Controller

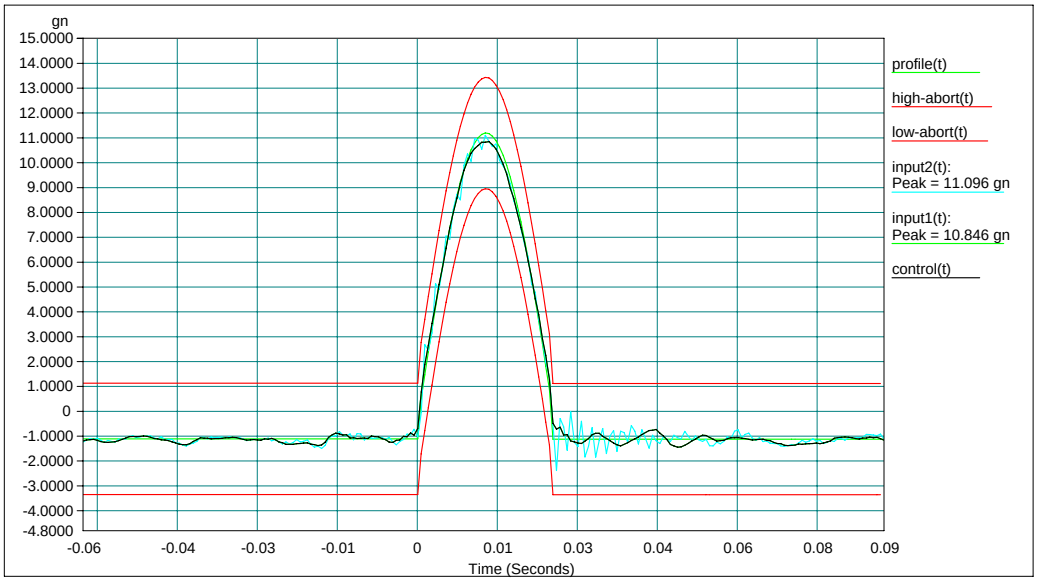
13:00:28, Jun 07, 07 100.00 % Controller 'control(t),drive(t),' Saved Signals

13:00:28, Jun 07, 07/ 10 100.00 % Controller All Panes saved to the disk.

13:00:28, Jun 07, 07/ 10 100.00 % 10.846/11.190 gn Controller End of Test

13:00:28, Jun 07, 07/ 10 100.00 % Full level elapsed 3

13:00:28, Jun 07, 07/ 10 100.00 % Total elapsed 10




Result: EUT performed normally before and after shock test

## Test 3

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : LH facing - LH side to top

Notes : Test 3

Ambient temp. : 26.5

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log 13:06:58, Tuesday, June 12, 2007

ENTRY TIME LEVEL CTL/DEMAND(Peak) SOURCE DESCRIPTION

/ELAPSED

13:06:58, Jun 12, 07/ 0 0.00 % User Command Start the Test

13:07:03, Jun 12, 07/ 1 19.54 % 2.185/ 4.476 gn Controller Running in pre-test

13:07:05, Jun 12, 07/ 2 40.00 % 4.323/ 4.476 gn Controller

13:07:07, Jun 12, 07/ 3 40.00 % 4.563/ 4.476 gn Controller

13:07:08, Jun 12, 07/ 4 40.00 % 4.550/ 4.476 gn Controller System paused after pre-test

13:07:11, Jun 12, 07/ 4 40.00 % User Command Run Scheduled Test

13:07:13, Jun 12, 07/ 5 50.00 % 5.574/ 5.595 gn Controller Running in scheduled test

13:07:14, Jun 12, 07/ 6 50.00 % 5.565/ 5.595 gn Controller

13:07:16, Jun 12, 07/ 7 75.00 % 7.795/ 8.392 gn Controller

13:07:17, Jun 12, 07/ 8 100.00 % 10.248/11.190 gn Controller

13:07:19, Jun 12, 07/ 9 100.00 % 10.588/11.190 gn Controller

13:07:20, Jun 12, 07/ 10 100.00 % 10.908/11.190 gn Controller

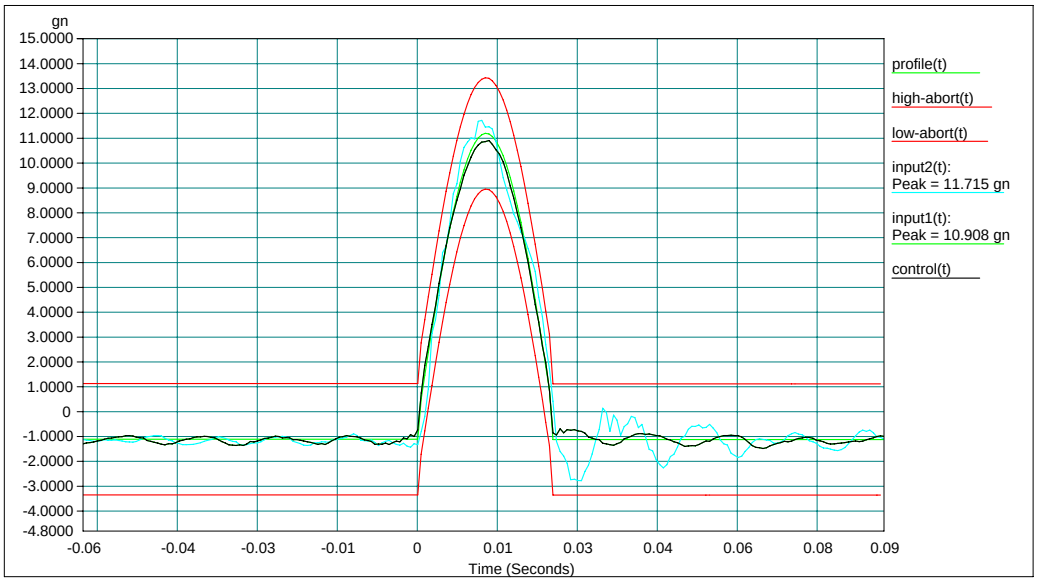
13:07:20, Jun 12, 07 100.00 % Controller 'control(t),drive(t),' Saved Signals

13:07:20, Jun 12, 07/ 10 100.00 % Controller All Panes saved to the disk.

13:07:20, Jun 12, 07/ 10 100.00 % 10.908/11.190 gn Controller End of Test

13:07:20, Jun 12, 07/ 10 100.00 % Full level elapsed 3

13:07:20, Jun 12, 07/ 10 100.00 % Total elapsed 10




Result: EUT performed normally before and after shock test

## Test 4

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : Front facing - LH side to top

Notes : Test 4

Ambient temp. : 21.8

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log 08:04:57, Thursday, June 14, 2007

ENTRY TIME LEVEL CTL/DEMAND(Peak) SOURCE DESCRIPTION

/ELAPSED

08:04:57, Jun 14, 07/ 0 0.00 % User Command Start the Test

08:05:02, Jun 14, 07/ 1 17.80 % 1.990/ 4.476 gn Controller Running in pre-test

08:05:04, Jun 14, 07/ 2 40.00 % 3.981/ 4.476 gn Controller

08:05:06, Jun 14, 07/ 3 40.00 % 4.424/ 4.476 gn Controller

08:05:07, Jun 14, 07/ 4 40.00 % 4.573/ 4.476 gn Controller System paused after pre-test

08:05:13, Jun 14, 07/ 4 40.00 % User Command Run Scheduled Test

08:05:14, Jun 14, 07/ 5 50.00 % 5.501/ 5.595 gn Controller Running in scheduled test

08:05:16, Jun 14, 07/ 6 50.00 % 5.616/ 5.595 gn Controller

08:05:17, Jun 14, 07/ 7 75.00 % 7.671/ 8.392 gn Controller

08:05:19, Jun 14, 07/ 8 100.00 % 9.416/11.190 gn Controller

08:05:21, Jun 14, 07/ 9 100.00 % 10.212/11.190 gn Controller

08:05:22, Jun 14, 07/ 10 100.00 % 10.728/11.190 gn Controller

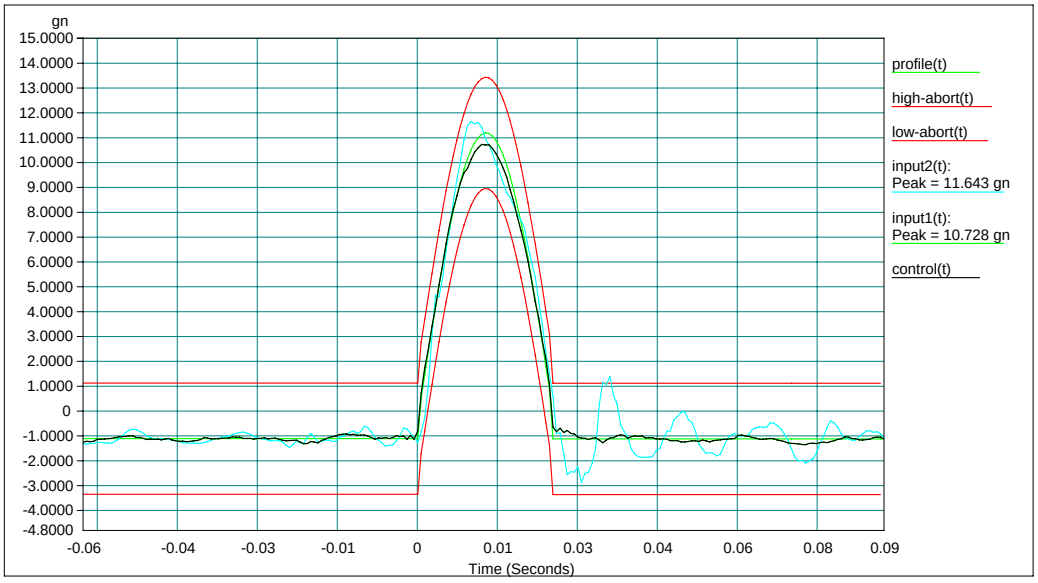
08:05:22, Jun 14, 07 100.00 % Controller 'control(t),drive(t),' Saved Signals

08:05:22, Jun 14, 07/ 10 100.00 % Controller All Panes saved to the disk.

08:05:22, Jun 14, 07/ 10 100.00 % 10.728/11.190 gn Controller End of Test

08:05:22, Jun 14, 07/ 10 100.00 % Full level elapsed 3

08:05:22, Jun 14, 07/ 10 100.00 % Total elapsed 10




Result: EUT performed normally before and after shock test

## Test 5

DUT : Sea Tracer Sartech Test 2 123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : Front facing down - top to front

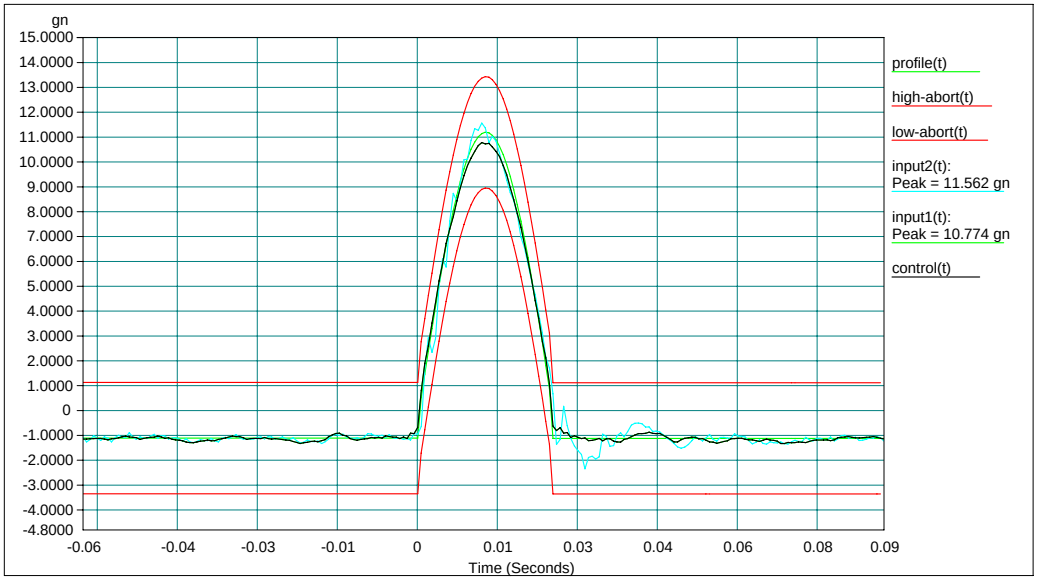
Notes : Test 5

Ambient temp. : 25.6

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log 11:58:22, Thursday, June 14, 2007

| ENTRY TIME /ELAPSED | LEVEL | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 11:58:22, Jun 14, 07/ | 0 | 0.00 % | User Command | Start the Test |
| 11:58:27, Jun 14, 07/ | 1 | 18.45 % 2.063/ 4.476 gn | Controller | Running in pre-test |
| 11:58:29, Jun 14, 07/ | 2 | 40.00 % 4.256/ 4.476 gn | Controller | |
| 11:58:30, Jun 14, 07/ | 3 | 40.00 % 4.550/ 4.476 gn | Controller | |
| 11:58:32, Jun 14, 07/ | 4 | 40.00 % 4.462/ 4.476 gn | Controller | System paused after pre-test |
| 11:58:38, Jun 14, 07/ | 4 | 40.00 % | User Command | Run Scheduled Test |
| 11:58:40, Jun 14, 07/ | 5 | 50.00 % 5.555/ 5.595 gn | Controller | Running in scheduled test |
| 11:58:41, Jun 14, 07/ | 6 | 50.00 % 5.536/ 5.595 gn | Controller | |
| 11:58:43, Jun 14, 07/ | 7 | 75.00 % 7.945/ 8.392 gn | Controller | |
| 11:58:44, Jun 14, 07/ | 8 | 100.00 % 9.740/11.190 gn | Controller | |
| 11:58:46, Jun 14, 07/ | 9 | 100.00 % 10.284/11.190 gn | Controller | |
| 11:58:47, Jun 14, 07/ | 10 | 100.00 % 10.774/11.190 gn | Controller | |
| 11:58:47, Jun 14, 07 | | 100.00 % | Controller | 'control(t),drive(t),' Saved Signals |
| 11:58:47, Jun 14, 07/ | 10 | 100.00 % | Controller | All Panes saved to the disk. |
| 11:58:47, Jun 14, 07/ | 10 | 100.00 % 10.774/11.190 gn | Controller | End of Test |
| 11:58:47, Jun 14, 07/ | 10 | 100.00 % | | Full level elapsed 3 |
| 11:58:47, Jun 14, 07/ | 10 | 100.00 % | | Total elapsed 10 |




Result: EUT performed normally before and after shock test

## Test 6

DUT : Sea Tracer Sartech Test 2  123456002

Serial Number : 287010

Test Protocol : 100m/s2 half sine 25ms

Orientation : Front facing down - top to RH side

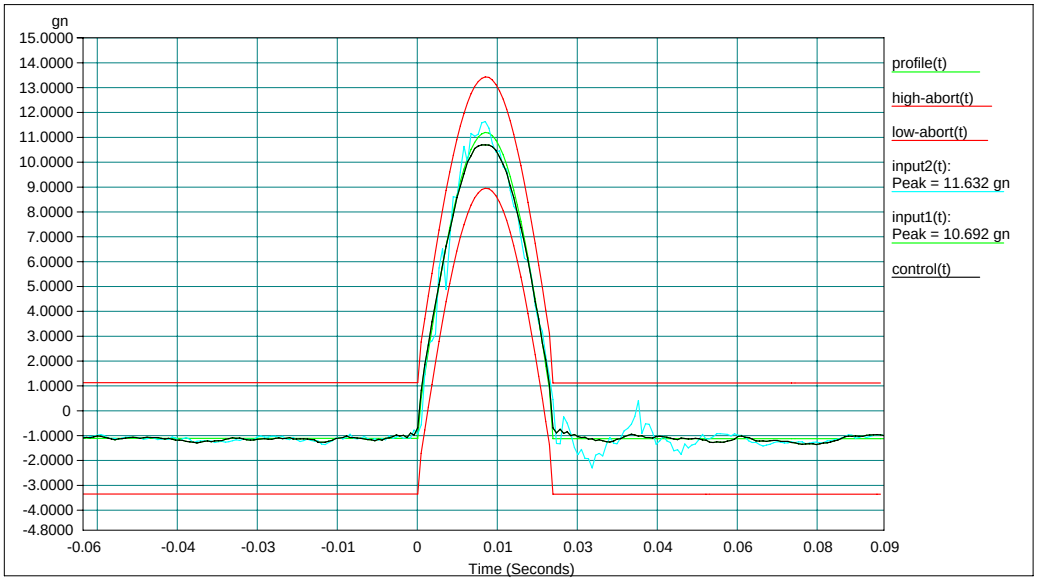
Notes : Test 6

Ambient temp. : 26.5

Dactron Dual DSP Shaker Control System

Classical Shock Test Run Log  15:16:43, Thursday, June 14, 2007

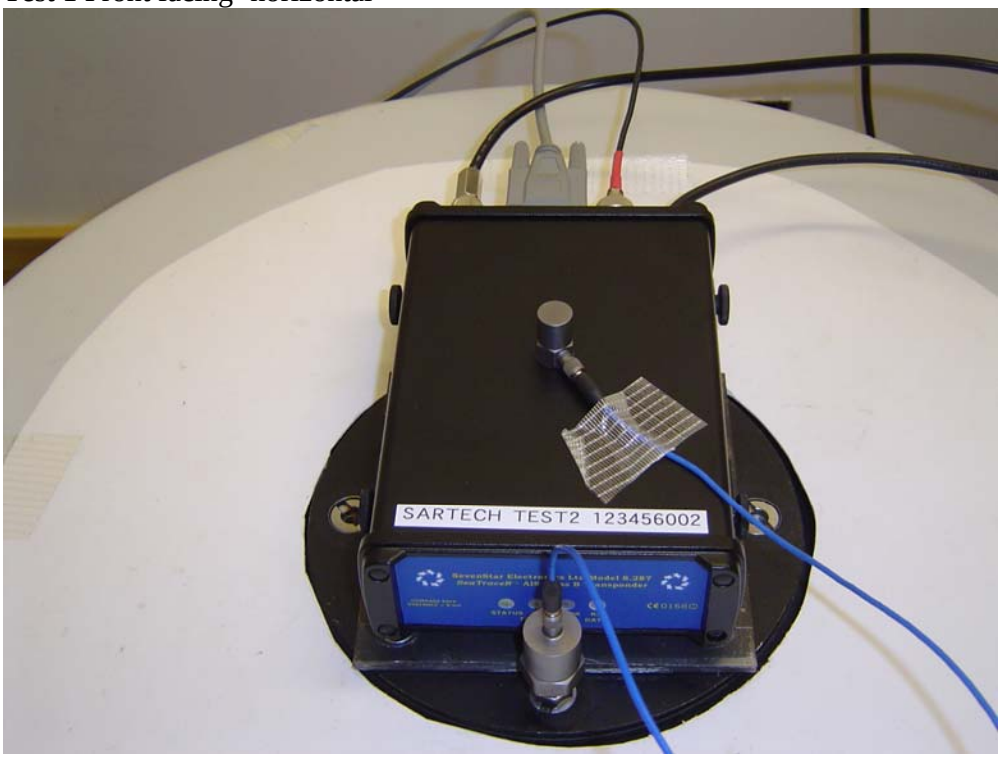
| ENTRY TIME /ELAPSED | LEVEL | CTL/DEMAND(Peak) | SOURCE | DESCRIPTION |
|---|---|---|---|---|
| 15:16:43, Jun 14, 07/ | 0 | 0.00 % | User Command | Start the Test |
| 15:16:48, Jun 14, 07/ | 1 | 18.91 % 2.114/ 4.476 gn | Controller | Running in pre-test |
| 15:16:50, Jun 14, 07/ | 2 | 40.00 % 4.268/ 4.476 gn | Controller | |
| 15:16:51, Jun 14, 07/ | 3 | 40.00 % 4.536/ 4.476 gn | Controller | |
| 15:16:53, Jun 14, 07/ | 4 | 40.00 % 4.449/ 4.476 gn | Controller | System paused after pre-test |
| 15:16:55, Jun 14, 07/ | 4 | 40.00 % | User Command | Run Scheduled Test |
| 15:16:56, Jun 14, 07/ | 5 | 50.00 % 5.318/ 5.595 gn | Controller | Running in scheduled test |
| 15:16:58, Jun 14, 07/ | 6 | 50.00 % 5.877/ 5.595 gn | Controller | |
| 15:16:59, Jun 14, 07/ | 7 | 75.00 % 7.964/ 8.392 gn | Controller | |
| 15:17:01, Jun 14, 07/ | 8 | 100.00 % 9.954/11.190 gn | Controller | |
| 15:17:02, Jun 14, 07/ | 9 | 100.00 % 10.324/11.190 gn | Controller | |
| 15:17:04, Jun 14, 07/ | 10 | 100.00 % 10.692/11.190 gn | Controller | |
| 15:17:04, Jun 14, 07 | | 100.00 % | Controller | 'control(t),drive(t),' Saved Signals |
| 15:17:04, Jun 14, 07/ | 10 | 100.00 % | Controller | All Panes saved to the disk. |
| 15:17:04, Jun 14, 07/ | 10 | 100.00 % 10.692/11.190 gn | Controller | End of Test |
| 15:17:04, Jun 14, 07/ | 10 | 100.00 % | | Full level elapsed 3 |
| 15:17:04, Jun 14, 07/ | 10 | 100.00 % | | Total elapsed 10 |



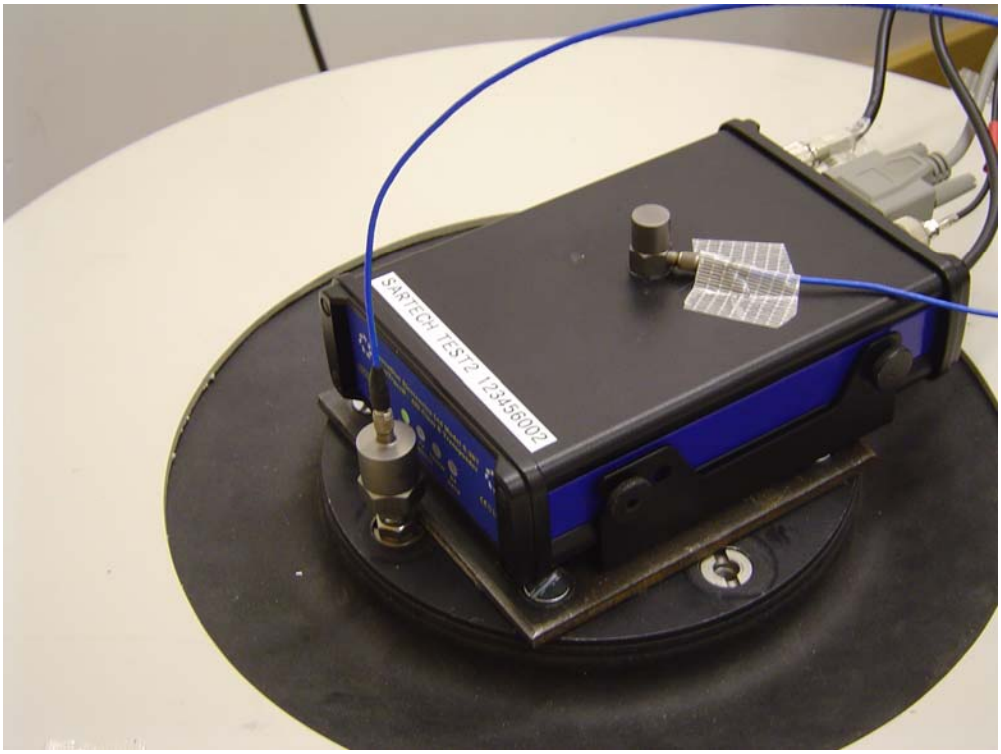

Result: EUT performed normally before and after shock test

# 5. Photo log

Test 1 Front facing- horizontal

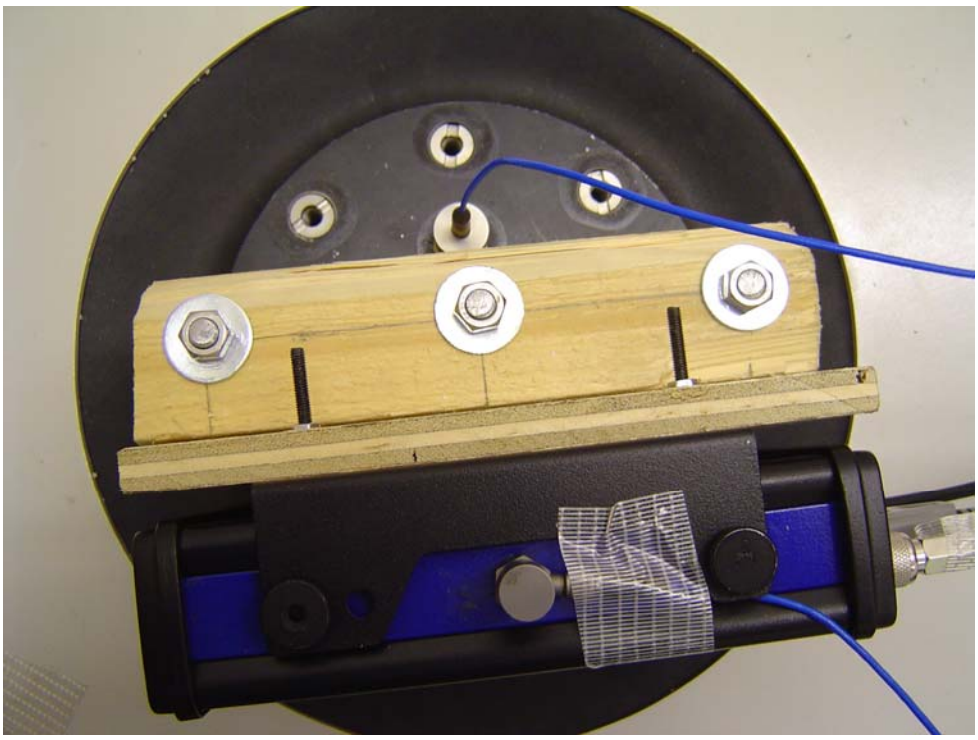



Test 2 LH side facing horizontal

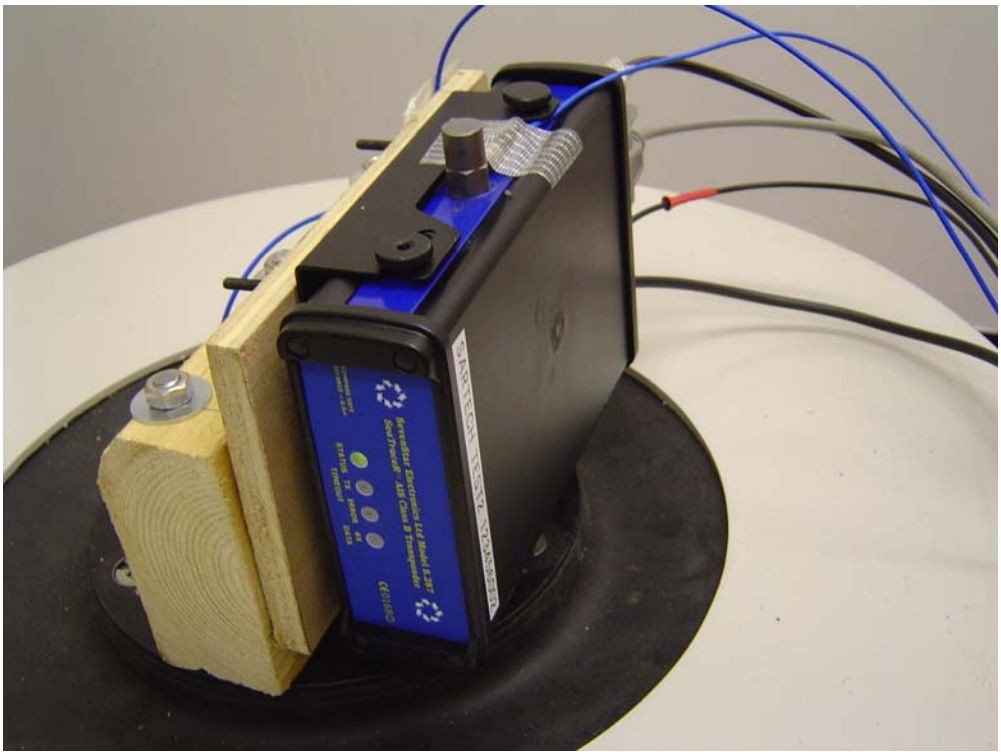


Test 3 LH side facing – side to top (a)

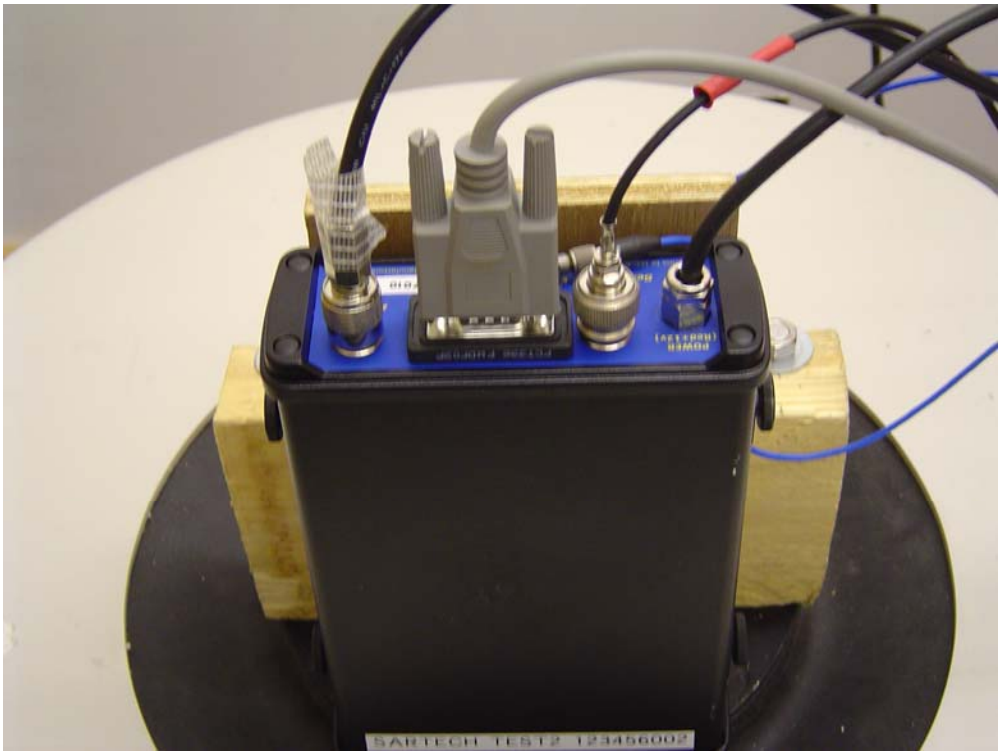

Test 3 LH side facing – side to top (b)



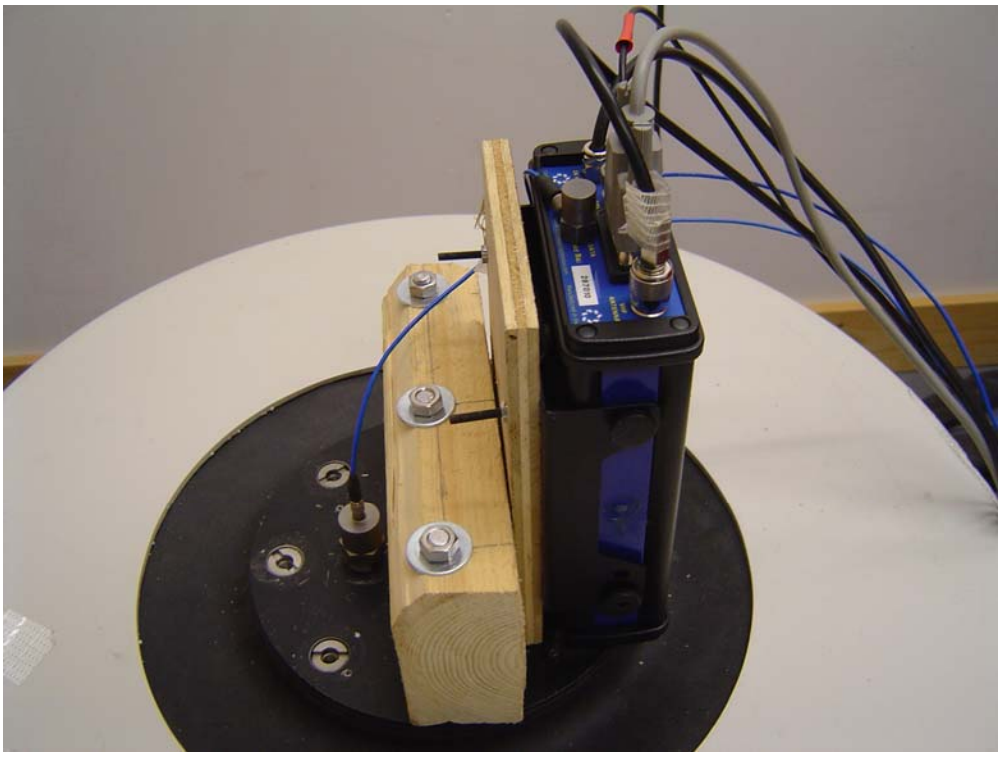
Test 4 Front facing – LH side to top



Test 5 Front facing down – top facing down



Test 6 Front facing down – top facing right



V830-185 Vibrator

MT-1 Transponder with its power supply and VDU.  Laptop monitoring EUT.

# 6. Calibration records

## 6.1. Shaker controller

Calibration Report for COMET-USB front end DSP box serial number: 12107947

Calibration software libray version: 5.520

FEB major version: 1.00, minor version: 13.00

Time And Date of Calibration: Tuesday, December 19, 2006 08:45:55

| | |
|---|---|
| Calibrated by: | T Compton |
| Voltage Meter Brand: | Thurlby Thandar |
| Voltage Meter Model Number: | 1705 |
| Voltage Meter Serial Number: | 103851 |
| Voltage Meter Traceability Certificate Number: | 1002738 |
| Voltage Meter Certificate Date: | 26 January 2006 |
| Voltage Meter Certificate Due Date: | 26 January 2008 |

| | |
|---|---|
| Front end DSP box Serial Number | = 12107947 |
| Number of Settings to Test for Output Channels | = 3 |
| Number of Output Channels | = 1 |
| Number of Settings to Test for Input Channels | = 3 |
| Number of Input Channels | = 8 |

**********

Initial(uncalibrated) Output Channel Offsets (volts)

| Channel | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| Drive | -0.005110 | -0.004420 | -0.004340 |

Initial(uncalibrated) Output Channel Gain Error (percentage)

| Channel | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| Drive | 0.180321 | -0.159747 | -2.496097 |

Final (calibrated) Output Channel Offsets (volts)

| Channel | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|
| Drive | -0.000010 | -0.000020 | -0.000010 | Pass |

Final (calibrated) Output Channel Gain Error (percentage)

| Channel | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Drive | 0.000000 | -0.019999 | -0.019993 | Pass |

**********

Initial(uncalibrated) Input Channel Offsets (volts)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| 1 | -0.043062 | -0.011703 | -0.010643 |
| 2 | -0.041773 | -0.014741 | -0.010717 |

Initial(uncalibrated) Input Channel Gain Error (percentage)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| 1 | 0.421407 | -0.519671 | -2.331968 |
| 2 | -0.092604 | -0.935302 | -2.844666 |

Final (calibrated) Input Channel Offsets (in volts)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|
| 1 | 0.000301 | -0.000064 | -0.000251 | Pass |
| 2 | 0.000089 | -0.000138 | -0.000310 | Pass |

Final (calibrated) Input Channel Gain Error (percentage)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|
| 1 | 0.008983 | 0.003647 | -0.000755 | Pass |
| 2 | 0.008306 | 0.004824 | 0.002599 | Pass |

**********

Initial(uncalibrated) Input Channel Offsets (AC Coupling) (volts)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| 1 | -0.030059 | -0.000281 | 0.000449 |
| 2 | -0.030007 | -0.004562 | -0.000887 |

Initial(uncalibrated) Input Channel Gain Error (AC Coupling) (percentage)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range |
|---|---|---|---|
| 1 | 0.410426 | -0.530587 | -2.343082 |
| 2 | -0.103979 | -0.945706 | -2.854307 |

Final (calibrated) Input Channel Offsets (AC Coupling) (in volts)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | -0.000152 | 0.000034 | 0.000079 | Pass |
| 2 | -0.000324 | -0.000011 | 0.000034 | Pass |

Final (calibrated) Input Channel Gain Error (AC Coupling) (percentage)

| Channel Number | 10.0 Volt Range | 1.0 Volt Range | 0.1 Volt Range | Results |
|---|---|---|---|---|
| 1 | 0.013418 | 0.005722 | -0.000534 | Pass |
| 2 | 0.013361 | 0.006819 | 0.002443 | Pass |

Overall calibration result: Pass

********* end of calibration report *********

## 6.2. Reference DMM

# CERTIFICATE OF CALIBRATION

Issued by: RS Components Ltd.

Date Issued. 30 Apr 2007 Certificate No. 1053748

**RS Calibration**
*Calibration and Repair Service*
Venture Close, Lammas Rd
Corby, Northants NN17 5EX

Tel: 01536 405545
Fax: 01536 401590

Page 1 of 2 Pages

Steven Macleod

| | |
|---|---|
| Client | SARTECH ENGINEERING LTD<br>REDHILL<br>RH1 2LH |
| Instrument | Testo 905-1 Temperature Indicator |
| Serial No. | 060900040944 |
| Client Reference | N/A |
| Procedure ID. | 327.0606 Rev. P2 |
| Probe Stock No. | N/A |
| Date Received | N/A |
| Date of Calibration | 30 Apr 2007 |
| Performance Status | Pass |

| Equipment Used to Carry Out Calibration | Equipment ID. |
|---|---|
| ASL F200 Precision Thermometer | Cal 895 |
| Platinum Resistance Probe | Cal 898 |
| Platinum Resistance Probe | Cal 901 |
| ASL F200 Precision Thermometer | Cal 896 |
| Platinum Resistance Probe | Cal 907 |
| Platinum Resistance Probe | Cal 908 |

The measurements reported in this certificate were carried out using equipment whose values are traceable to national standards.

All procedures employed and results reported are in compliance with the requirements of the International Standard ISO/IEC 17025:2005.

The management controls of the RS Calibration Laboratory are registered under the British Standard BS EN ISO 9001 : 2000 No. RS 00362.

**Uncertainties**
The reported expanded uncertainties are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

This is a new instrument therefore no adjustment was necessary.

# CERTIFICATE OF CALIBRATION

Certificate No.

1053748

RS Calibration
*Calibration and Repair Service*



Environment
The ambient temperature during the calibration was (20 ± 3) °C .

Method
The instrument was calibrated by comparison with reference resistance probes in suitable mediums at various controlled temperatures.
The reference resistance probes were measured with resistance bridges to determine the true temperature of the test medium.

Prior to the calibration the instrument was allowed to stabilise in the laboratory for a period of not less than 30 minutes.

The immersion depth of the probe was not less than: 150 mm

| | Reference Temperature | Instrument Indicated | UUT L.S.D Stability |
|---|---|---|---|
| °C Range | -19.93 °C | -20.7 °C | 1 |
| | 0.00 °C | -0.7 °C | 1 |
| | 99.98 °C | 99.8 °C | 1 |
| | 194.28 °C | 193.9 °C | 1 |
| °F Range | 32.00 °F | 30.8 °F | 2 |
| | 211.96 °F | 211.3 °F | 3 |

Measurement uncertainties of the recorded values:

-20 °C to 250 °C ± 0.15 °C
-4 °F to 482 °F ± 0.27 °F

Reported values
The uncertainties quoted refer to the recorded values, which include any identified contribution of the instrument under test and not to the ability of the instrument to maintain it's calibration.

When in use due allowance should be made for the stability of the instrument as found in the UUT L.S.D Stability column.

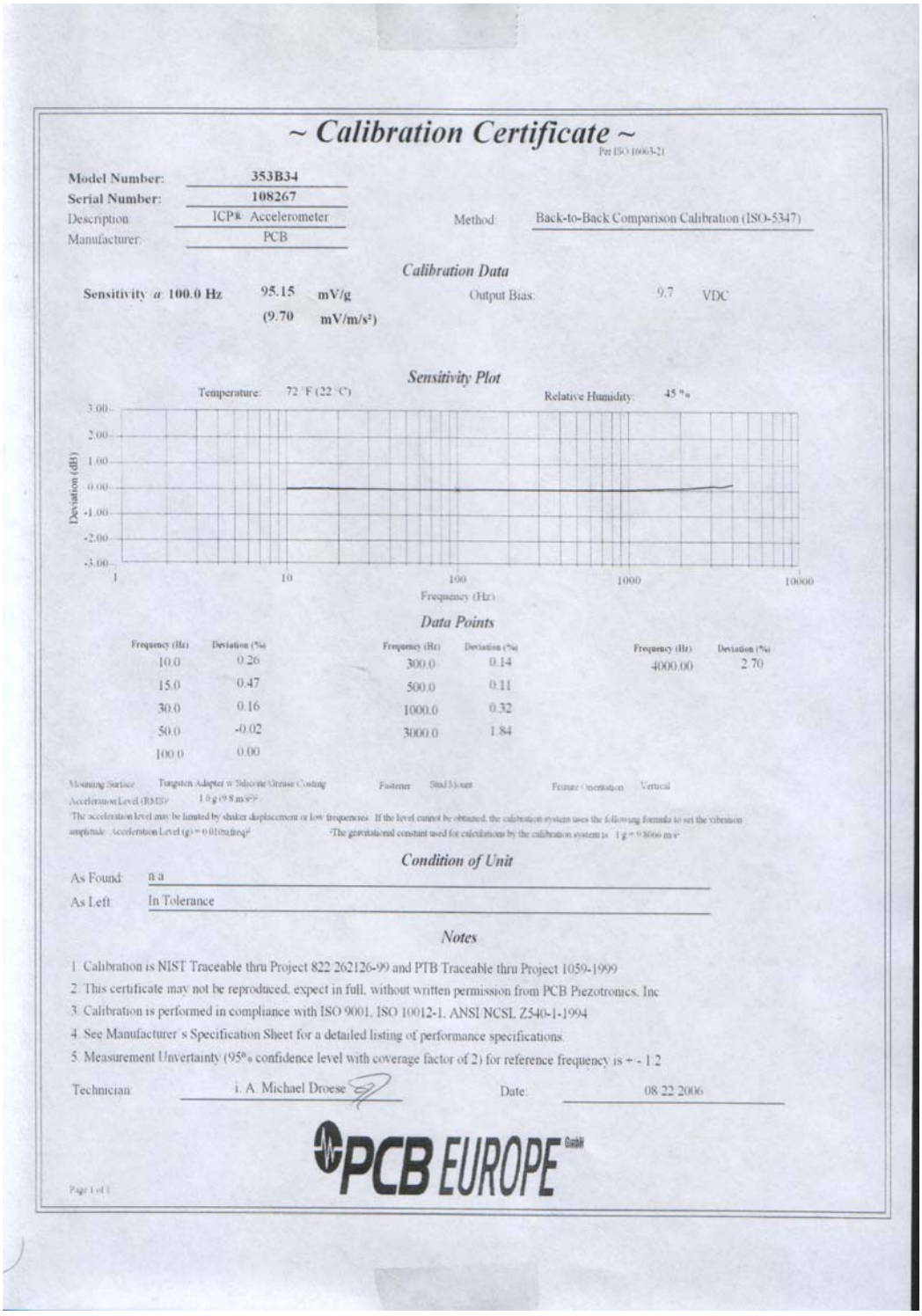
The L.S.D component of the above measurement uncertainties refers to the display resolution of the instrument under test.

**END OF CALIBRATION** **CALIBRATED BY:- SPM**

Compliance to Specification

The specification published by the manufacturer and found in the instrument's handbook has been used to determine performance at the measured points.

## 6.3. Accelerometer 1



# ~ Calibration Certificate ~

Per ISO 16063-21

| | |
|---|---|
| **Model Number:** | **353B34** |
| **Serial Number:** | **108267** |
| Description: | ICP® Accelerometer |
| Manufacturer: | PCB |

Method: Back-to-Back Comparison Calibration (ISO-5347)

### Calibration Data

**Sensitivity @ 100.0 Hz** 95.15 mV/g (9.70 mV/m/s²)

Output Bias: 9.7 VDC

### Sensitivity Plot

Temperature: 72 °F (22 °C) Relative Humidity: 45 %




### Data Points

| Frequency (Hz) | Deviation (%) | Frequency (Hz) | Deviation (%) | Frequency (Hz) | Deviation (%) |
|---|---|---|---|---|---|
| 10.0 | 0.26 | 300.0 | 0.14 | 4000.00 | 2.70 |
| 15.0 | 0.47 | 500.0 | 0.11 | | |
| 30.0 | 0.16 | 1000.0 | 0.32 | | |
| 50.0 | -0.02 | 3000.0 | 1.84 | | |
| 100.0 | 0.00 | | | | |

Mounting Surface: Tungsten Adapter w Silicone Grease Coating Fastener: Stud Mount Feature Orientation: Vertical

Acceleration Level (RMS)*: 1.0 g (9.8 m/s²)

The acceleration level may be limited by shaker displacement at low frequencies. If the level cannot be obtained, the calibration system uses the following formula to set the vibration amplitude: Acceleration Level (g) = 0.010*freq²

*The gravitational constant used for calculations by the calibration system is: 1 g = 9.8066 m/s²

### Condition of Unit

As Found: n.a

As Left: In Tolerance

### Notes

1. Calibration is NIST Traceable thru Project 822.262126-99 and PTB Traceable thru Project 1059-1999
2. This certificate may not be reproduced, except in full, without written permission from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540-1-1994
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 reference frequency is +/- 1.2

Technician: i. A. Michael Droese Date: 08.22.2006

PCB EUROPE GmbH

Page 1 of 1

## 6.4. Accelerometer 2

# CERTIFICATE OF CALIBRATION

ISSUED BY: **CALIBRATION MAINTENANCE & REPAIR LTD**

DATE OF ISSUE: 24 April 2007 CERTIFICATE NUMBER: 118773

0654

CMR

Home Farm Industrial Park
Norwich Road
Marsham
Norfolk
NR10 5PQ
Tel: +44 1603 279557
Fax: +44 1603 278008

Page 1 of 3

Approved Signatory

P.K.Clark
M.A.Frost
R.J.Wade

| | |
|---|---|
| **CUSTOMER** | |
| LDS Test & Measurement Ltd | |
| Heath Works | |
| Baldock Road | |
| Royston | |
| Herts | |
| SG8 5BQ | |
| **MANUFACTURER** | PCB Piezotronics |
| **DESCRIPTION** | Accelerometer |
| **MODEL** | 353B03 |
| **SERIAL No** | 108361 |
| **IDENT No** | Not Known |
| **DATE RECEIVED** | 23 April 2007 |
| **DATE OF CALIBRATION** | 23 April 2007 |
| **ORDER No** | 4500005564 |

**ENVIRONMENT**
The instrument was placed in the Vibration Laboratory environment and allowed to stabilise prior to calibration. Measurements were made in ambient conditions 25°C ± 5°C, relative humidity <60%.

**STABILITY**
The results contained in this certificate refer to the measurements made at the time of test and not to the accelerometer's ability to maintain calibration.

**PROCEDURE**
Measurements were performed in accordance with the in house Laboratory procedure No. EP046. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

| Instruments Used | Serial No. | Certificate No. |
|---|---|---|
| Bruel & Kjaer 2626 | 918344 | M1503 |
| Constant Current Source | 241 | M1518 |
| Reference Accelerometer | A0202 | 557329 |
| Reference Accelerometer | 1103 | 10015488 |
| Northstar | 1142X3-414 | M1515 |
| Keithley 2001 | 0938461 | 37876/M1522 |

| Accelerometer Data | |
|---|---|
| Nominal sensitivity @ 160 Hz | 9.9110 mV/g |

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be produced other than in full, except with prior written approval of the issuing laboratory.

# CERTIFICATE OF CALIBRATION

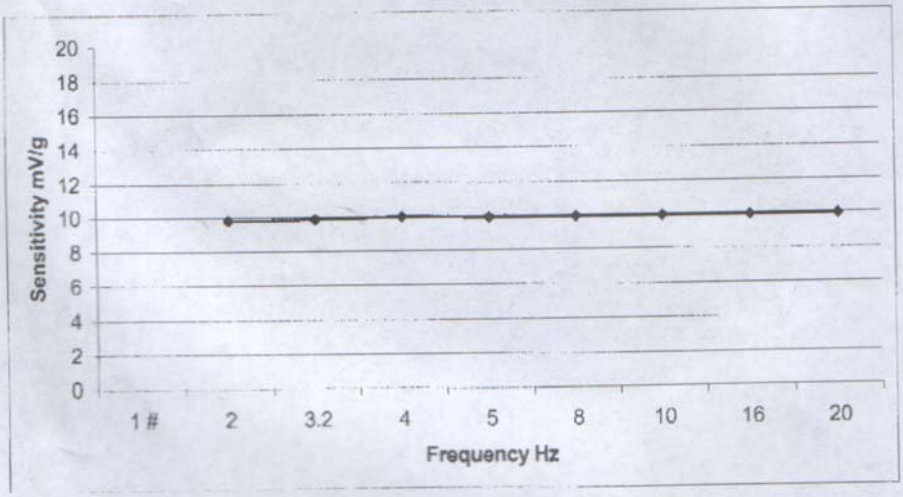
ISSUED BY: **CALIBRATION MAINTENANCE & REPAIR LTD**

UKAS ACCREDITED CALIBRATION LABORATORY No. 0654

CERTIFICATE NUMBER
**118773**

**Page 2 of 3**

| Frequency Hz | Sensitivity mV/g | Sensitivity mV/ms$^{-2}$ | Frequency Hz | Sensitivity mV/g | Sensitivity mV/ms$^{-2}$ |
|---|---|---|---|---|---|
| 1 # | | 0.0000 | 8 | 9.8861 | 1.0081 |
| 2 | 9.7919 | 0.9985 | 10 | 9.9013 | 1.0097 |
| 3.2 | 9.8213 | 1.0015 | 16 | 9.9117 | 1.0107 |
| 4 | 9.9364 | 1.0132 | 20 | 9.9253 | 1.0121 |
| 5 | 9.8681 | 1.0063 | | | |




The curve is for guidance only and does not represent the sensitivity at the frequencies other than those measured.

The reported expanded uncertainty for the frequency range 2Hz-10Hz is estimated to be ±1.9% and 10Hz-20Hz is estimated to be ±2.7% based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.

Calibrations marked with # are not UKAS Accredited in this Certificate and have been included for completeness.

# CERTIFICATE OF CALIBRATION

ISSUED BY: **CALIBRATION MAINTENANCE & REPAIR LTD**

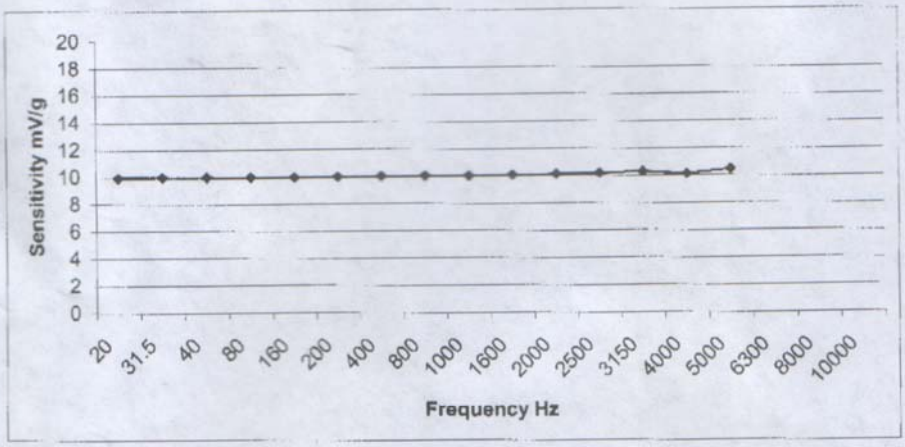
UKAS ACCREDITED CALIBRATION LABORATORY No. 0654

CMR

CERTIFICATE NUMBER
**118773**



| Frequency Hz | Sensitivity mV/g | Sensitivity mV/ms$^{-2}$ | Frequency Hz | Sensitivity mV/g | Sensitivity mV/ms$^{-2}$ |
|---|---|---|---|---|---|
| 20 | 9.8928 | 1.0088 | 1600 | 10.0367 | 1.0235 |
| 31.5 | 9.9513 | 1.0148 | 2000 | 10.0837 | 1.0283 |
| 40 | 9.9398 | 1.0136 | 2500 | 10.1593 | 1.0360 |
| 80 | 9.9440 | 1.0140 | 3150 | 10.2531 | 1.0455 |
| 160 | 9.9110 | 1.0106 | 4000 | 10.0804 | 1.0279 |
| 200 | 9.9573 | 1.0154 | 5000 | 10.4330 | 1.0639 |
| 400 | 9.9700 | 1.0167 | 6300 | | 0.0000 |
| 800 | 9.9915 | 1.0188 | 8000 | | 0.0000 |
| 1000 | 9.9853 | 1.0182 | 10000 | | 0.0000 |




The curve is for guidance only and does not represent the sensitivity at the frequencies other than those measured.

The reported expanded uncertainty for the frequency range 20Hz-40Hz is estimated to be ±1.4%, 40Hz-5kHz is estimated to be ±1.0% and for the frequency range 5kHz-10kHz is estimated to be ±2.0% based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.

TEST ENGINEER: R J WADE

DATE: 23 April 2007