HIRDLS

TR-MMS-459
(3164-SA032-TRF)
Issue 1

HIGH RESOLUTION DYNAMICS LIMB SOUNDER

Originator: N Crossland Date: 17 April, 2013

Subject/Title: **FM SSH Vibration Test Report**

Description/Summary/Contents:

The Sunshield Subsystem (SSH) Flight Model (FM) has been successfully subjected to workmanship level vibration testing.

Keywords: SSH, FM, Vibration

Purpose of this Document: SSH Test Report

Reviewed/Approved by: Date (yy-mm-dd):			

Matra Marconi Space
Anchorage Road
Portsmouth
Hampshire PO3 5PU
England

EOS

SUNSHIELD SUBSYSTEM (SSH)
FLIGHT MODEL (FM)
VIBRATION TEST REPORT

Responsible Engineer: _____ Date: _____

Quality Assurance: _____ Date: _____

Project Manager: _____ Date: _____

© MATRA MARCONI SPACE UK LIMITED

THE COPYRIGHT IN THIS DOCUMENT IS THE PROPERTY OF MATRA MARCONI SPACE UK LIMITED. This document is supplied by Matra Marconi Space UK Limited on the express terms that it is to be treated as confidential and that it may not be copied, used or disclosed to others for any purpose except as expressly authorised under the terms of Contract No N2A 3R 0386.

Any person, other than the authorised holder, who finds or otherwise obtains possession of the document, should post it, together with his/her name and address, to the Registry, Matra Marconi Space UK Limited, Anchorage Road, Portsmouth, England, PO3 5PU. Postage will be refunded.

CONTENTS

1. SUMMARY **4**

2. INTRODUCTION **4**

3. APPLICABLE DOCUMENTS **4**

4. TEST ITEM **4**

5. TEST LOCATION AND EQUIPMENT **5**

5.1 TEST LOCATION 5
5.2 TEST EQUIPMENT 5

6. VIBRATION TEST SEQUENCE **6**

7. VIBRATION TESTS **7**

7.1 JIG SURVEY 7
7.2 LOW LEVEL SINE SURVEY 7
7.3 WORKMANSHIP LEVEL RANDOM TEST 7

8. RESULTS **8**

9. CONCLUSIONS **9**

DISTRIBUTION LIST **30**

CHANGE RECORD **30**

1. SUMMARY

This report summarises the workmanship level vibration tests performed on the HIRDLS Sunshield Subsystem (SSH) Flight Model (FM).

The test results show that the unit has a first natural frequency of approximately 64 Hz. This contravenes the 120 Hz requirement but is acceptable at a system level for the reasons given in Section 8.

The unit completed workmanship level vibration testing with no detectable structural degradation. No significant variations were detected in the results of the low level sine surveys performed before, during, and after any of the tests.

2. INTRODUCTION

The HIRDLS SSH Flight Model has been subjected to workmanship level vibration tests. The findings are reported herein.

The purpose of the tests is to verify the build standard of the unit.

3. APPLICABLE DOCUMENTS

AD 1	SP-HIR-50 Issue D	Sunshield Subsystem Requirements Specification
AD 2	HR1L100 Issue 001	Sunshield / HDA Assembly
AD 3	TP-MMS-452 Issue 1	Sunshield Assembly FM Test Procedure
AD 4	ELCL2400	HIRDLS SSH S/N FM Vibration Test Log Book
AD 5	HDRLS-PA-001	SSH FM Test Readiness Review Minutes
AD 6	HIR-RD-SA001-MMP	Waiver for LTM SSH first resonance

4. TEST ITEM

The test item is the SSH FM as defined in Drawing Number HR1L100 Issue 1 (AD 2). Figure 1 shows the location of the 2 triaxial accelerometers used to monitor unit responses and defines the test axes.

Testing was carried out in accordance with the Test Procedure (AD 3).

5. TEST LOCATION AND EQUIPMENT

5.1 Test Location

The SSH FM was subjected to qualification level testing in the Environmental Test Laboratory, MMS, Portsmouth, England, over the period 7-8 September 1999.

5.2 Test Equipment

All tests were performed using the Ling L980 vibrator which is capable of being turned through 90° to enable testing in all 3 axes.

The Genrad Spectral Dynamics 2552B controller was used for both sine and random vibration testing. A 2 point average control strategy was adopted; the 2 points being at opposite diagonal corners of the vibration jig.

Endevco accelerometers and Kistler charge amplifiers were used to monitor and control the tests. All data was stored and subsequently analysed on the Cranfield Data Systems EDASP 7610 data analyser.

A full equipment list and calibration data is contained in the Environmental Test Log Book (AD 4) which is available for examination at the location detailed in Section 5.1.

6. VIBRATION TEST SEQUENCE

Prototype qualification level vibration testing was carried out in accordance with the sequence specified in Table 7-1. Note that qualification level sine vibration tests have been added to the sequence defined in AD 3 for the reasons discussed in Section 8. This and other minor changes to the Test Procedure were subject to standard company occurrence reporting procedures.

Test No	Description	Axis	Table
1	Jig survey	Z	7.1-1
2	Low level sine survey	Z	7.1-1
3	Workmanship level random	Z	7.3-1
4	Low level sine survey	Z	7.1-1
5	Jig survey	Y	7.1-1
6	Low level sine survey	Y	7.1-1
7	Workmanship level random	Y	7.3-1
8	Low level sine survey	Y	7.1-1
9	Jig survey	X	7.1-1
10	Low level sine survey	X	7.1-1
11	Workmanship level random	X	7.3-1
12	Low level sine survey	X	7.1-1

Table 6-1 Workmanship Vibration Test Sequence

7. VIBRATION TESTS

7.1 Jig Survey

Vibration jig surveys were performed by a single sweep increasing in frequency as defined in Table 7.1-1.

AXIS	FREQUENCY (Hz)	ACCELERATION	SWEEP RATE (Oct/min)
ALL	5 - 2000	± 0.2g	2

Table 7.1-1 Jig and Low Level Sine Survey

7.2 Low Level Sine Survey

Low level sine surveys were performed by a single sweep increasing in frequency as defined in Table 7.1-1.

7.3 Workmanship Level Random Test

Workmanship level random vibration testing was performed to the levels defined in Table 7.3-1.

AXIS	FREQUENCY (Hz)	PSD (g^2/Hz)	DURATION
ALL	20 20 – 160 160 – 250 250 – 2000 2000	0.01 +3 dB / octave 0.08 -3 dB / octave 0.01	1 minute
Overall		7.4 g RMS	

Table 7.3-1 Workmanship Random Vibration Levels

8. RESULTS

A complete record of all test data is available for examination at the location detailed in Section 5.1.

The following response plots are included herein :-

Figure 2 Random response – Position 1x in-axis
Figure 3 Random response – Position 2x in-axis
Figure 4 Random response – Position 1y in-axis
Figure 5 Random response – Position 2y in-axis
Figure 6 Random response – Position 1z in-axis
Figure 7 Random response – Position 2z in-axis
Figure 8 Pre and Post random test low level sine responses – Position 1x in-axis
Figure 9 Pre and Post random test low level sine responses – Position 2x in-axis
Figure 10 Pre and Post random test low level sine responses – Position 1y in-axis
Figure 11 Pre and Post random test low level sine responses – Position 2y in-axis
Figure 12 Pre and Post random test low level sine responses – Position 1z in-axis
Figure 13 Pre and Post random test low level sine responses – Position 2z in-axis
Figure 14 EM and FM low level sine responses – Position 1x in-axis
Figure 15 EM and FM low level sine responses – Position 2x in-axis
Figure 16 EM and FM low level sine responses – Position 1y in-axis
Figure 17 EM and FM low level sine responses – Position 2y in-axis
Figure 18 EM and FM low level sine responses – Position 1z in-axis
Figure 19 EM and FM low level sine responses – Position 2z in-axis

Figures 2 – 7 show the peak responses and overall G r.m.s. levels recorded at each accelerometer position during random vibration testing.

Figures 8 – 13 show that there are no significant variations between the results of the low level sine surveys performed before and after the random vibration tests.

Figures 14 – 19 compare responses measured during SSH Engineering Model testing with the Flight Model data at the corresponding accelerometer locations. They illustrate good repeatability for the main equipment resonance's which implies an equivalent FM build standard to the qualified EM design.

No Occurrence Reports were raised during testing.

A waiver has been raised against the Specification requirement that the first SSH resonance shall be greater than 120 Hz. This is identical to AD 6 which was accepted and approved for the Engineering Model.

9. CONCLUSIONS

1. The SSH FM has been shown to have a first natural frequency of approximately 64 Hz. This does not satisfy the requirements of AD 1 but is considered to be acceptable. A waiver has been raised for Project approval for this discrepancy.

2. The SSH FM has been subjected to workmanship level vibration tests without detectable mechanical failure.

3. No significant variations were detected in the results of the low level sine surveys performed before, during and after any of the tests.

4. Comparisons between corresponding EM and FM unit responses demonstrate good build repeatability for the SSH panels and mechanisms.

5. The SSH FM has been successfully subjected to workmanship level vibration tests. The Environmental Test Certificate is included as Figure 20.

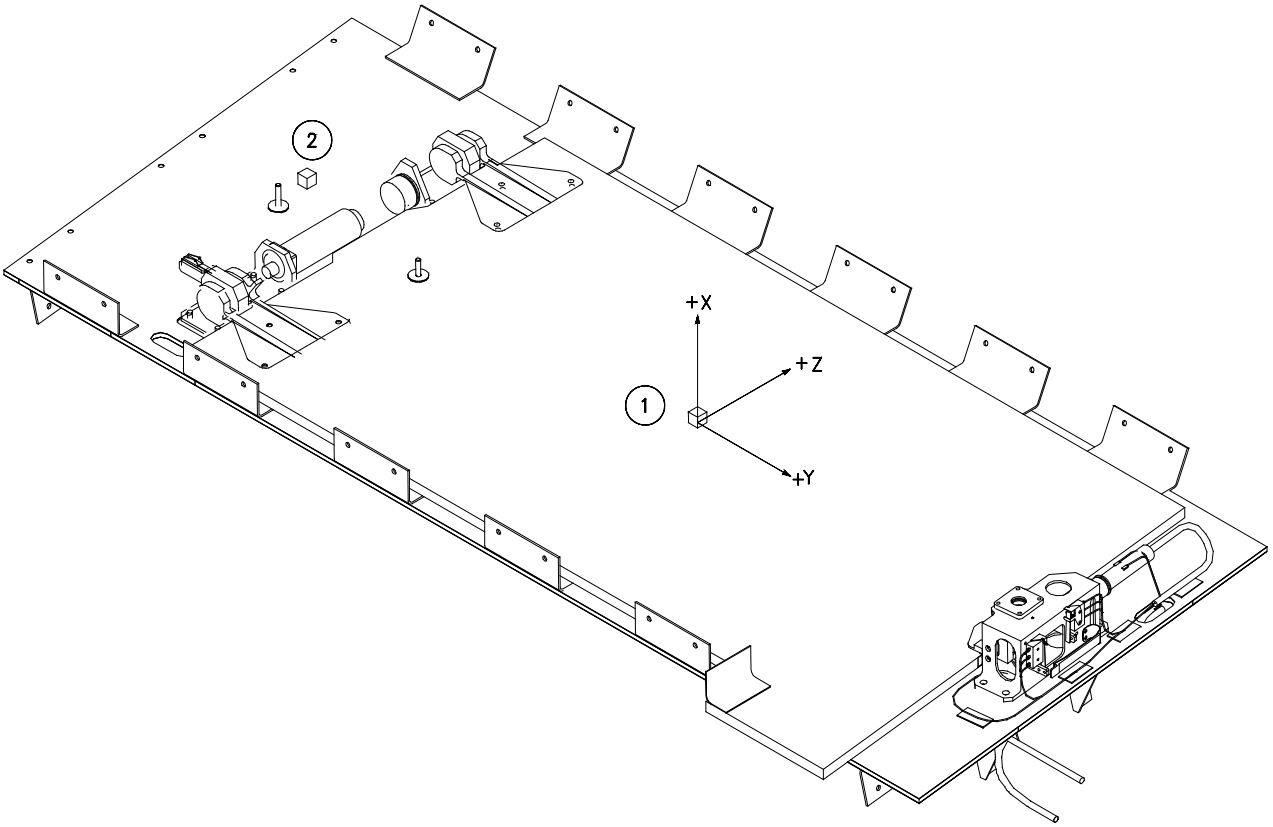

Figure 1 Test Item Monitoring Equipment

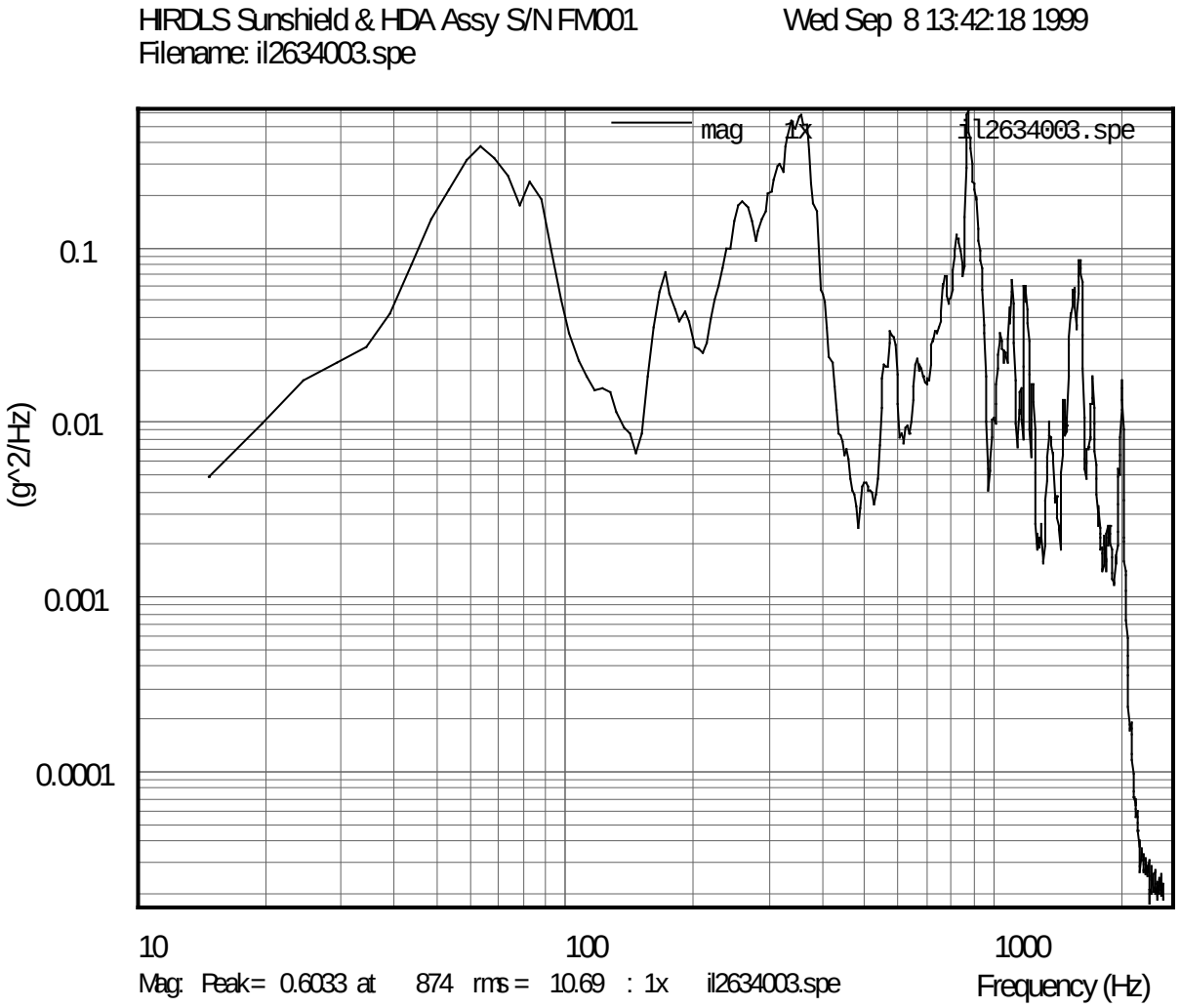

Figure 2 Random response – Position 1x in-axis

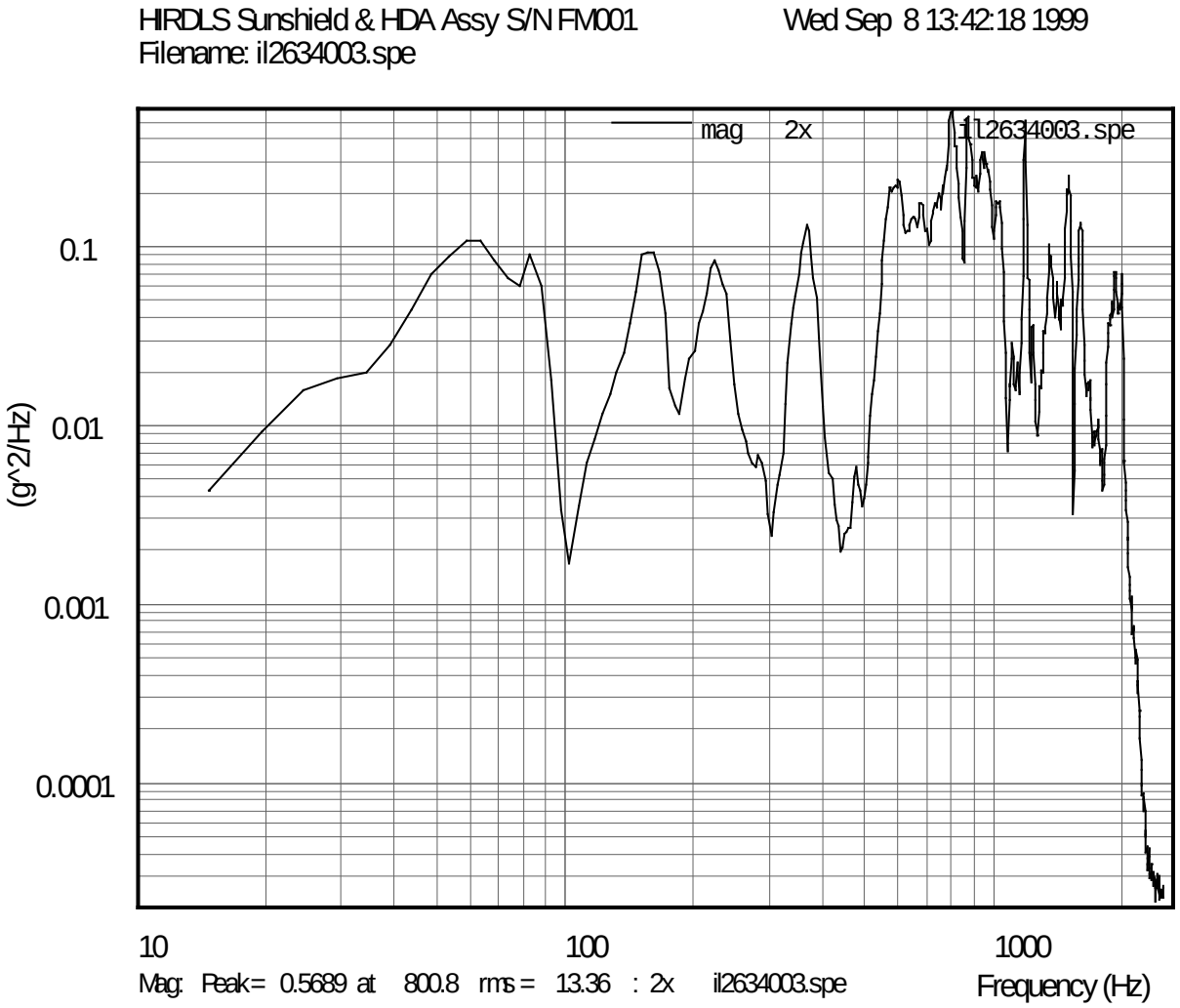

Figure 3 Random response – Position 2x in-axis

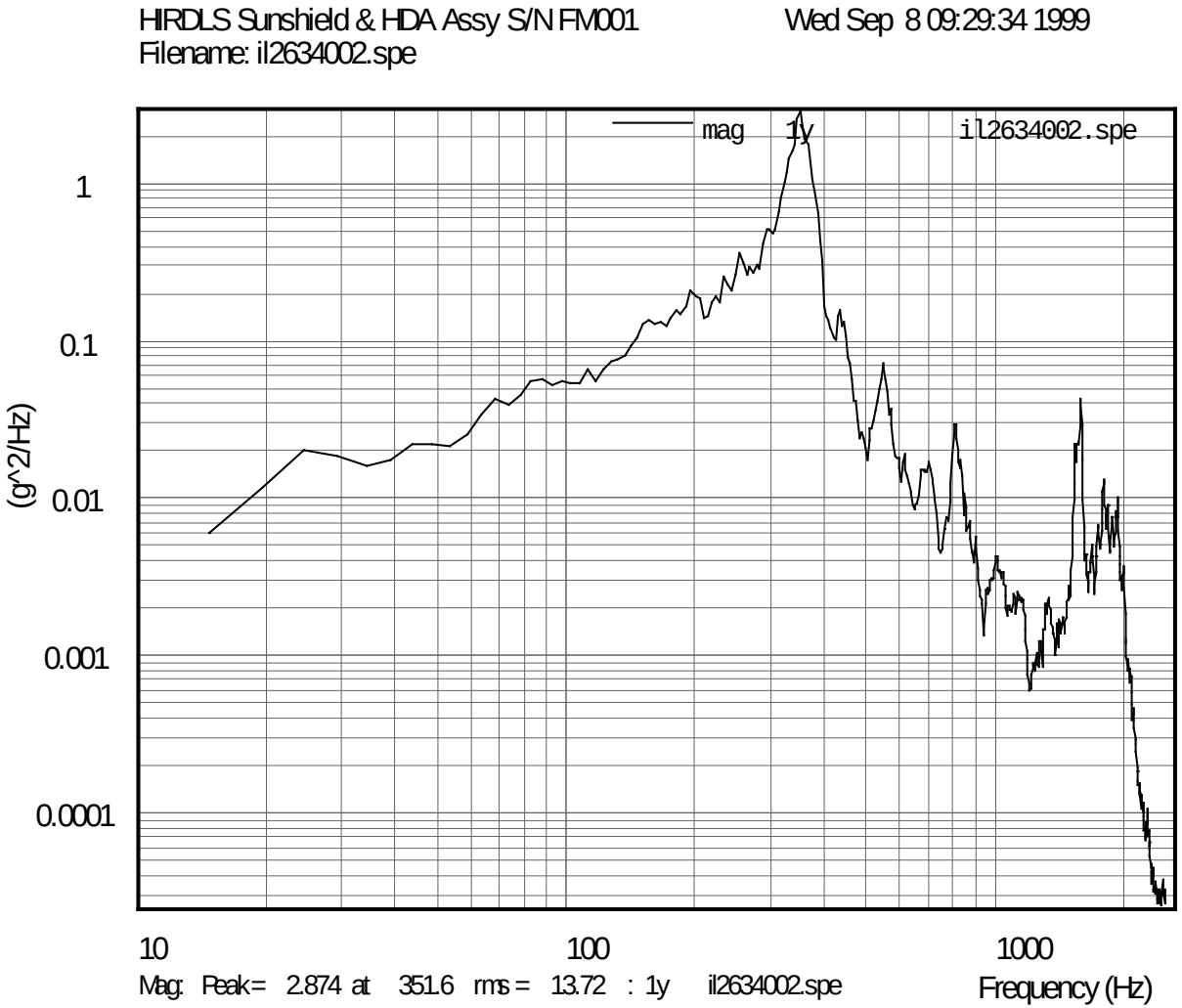

Figure 4 Random response – Position 1y in-axis

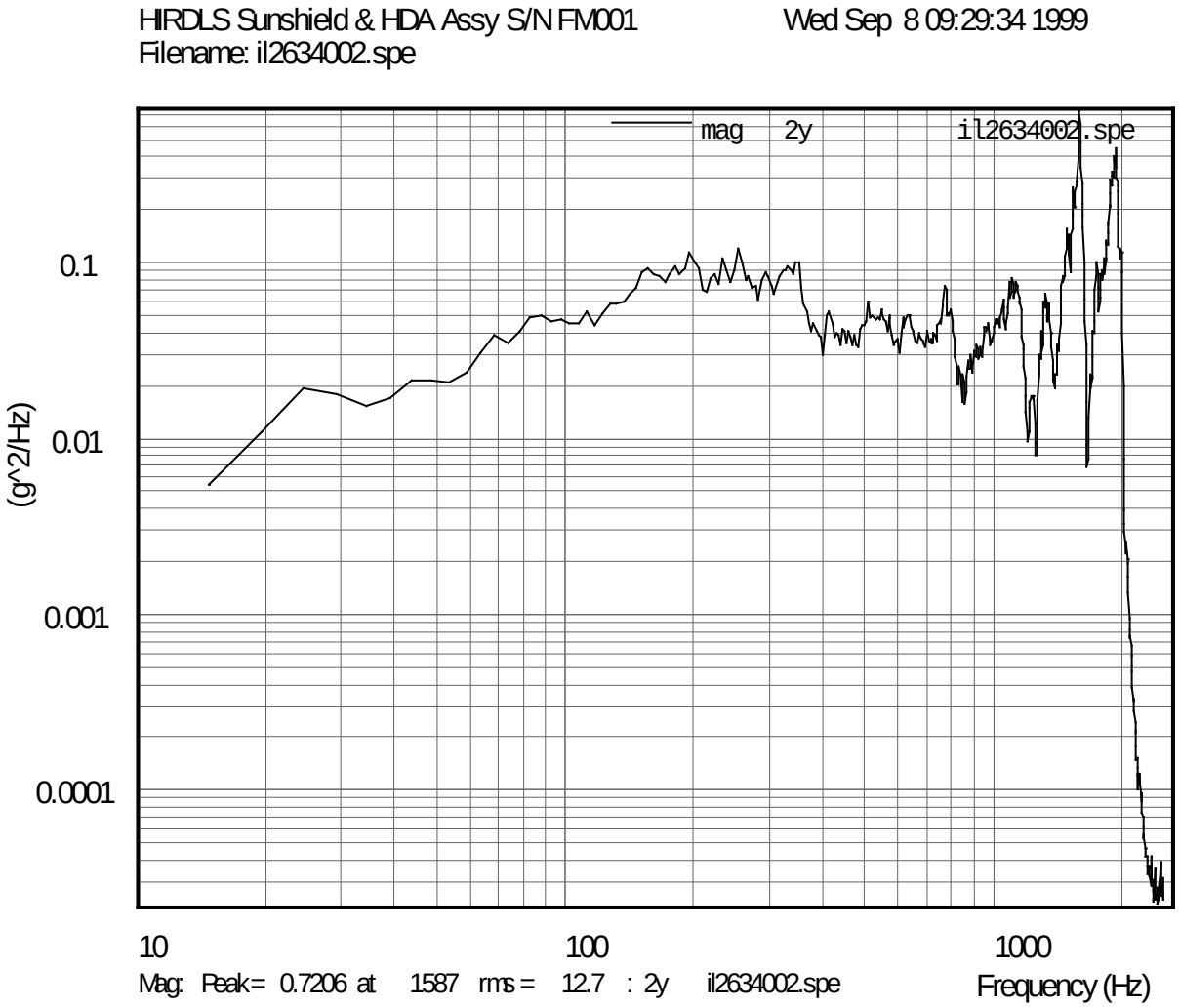

Figure 5 Random response – Position 2y in-axis

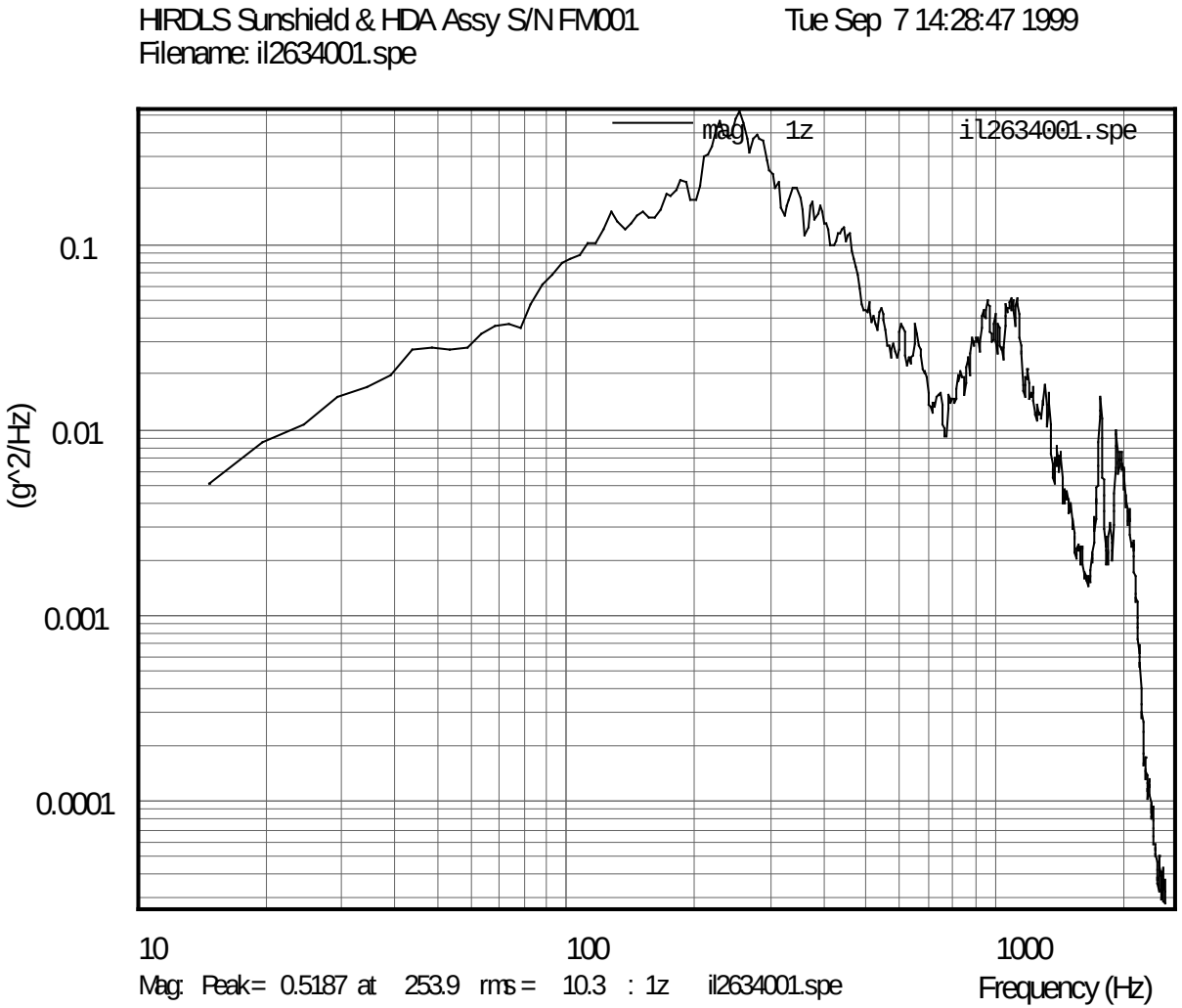

Figure 6 Random response – Position 1z in-axis

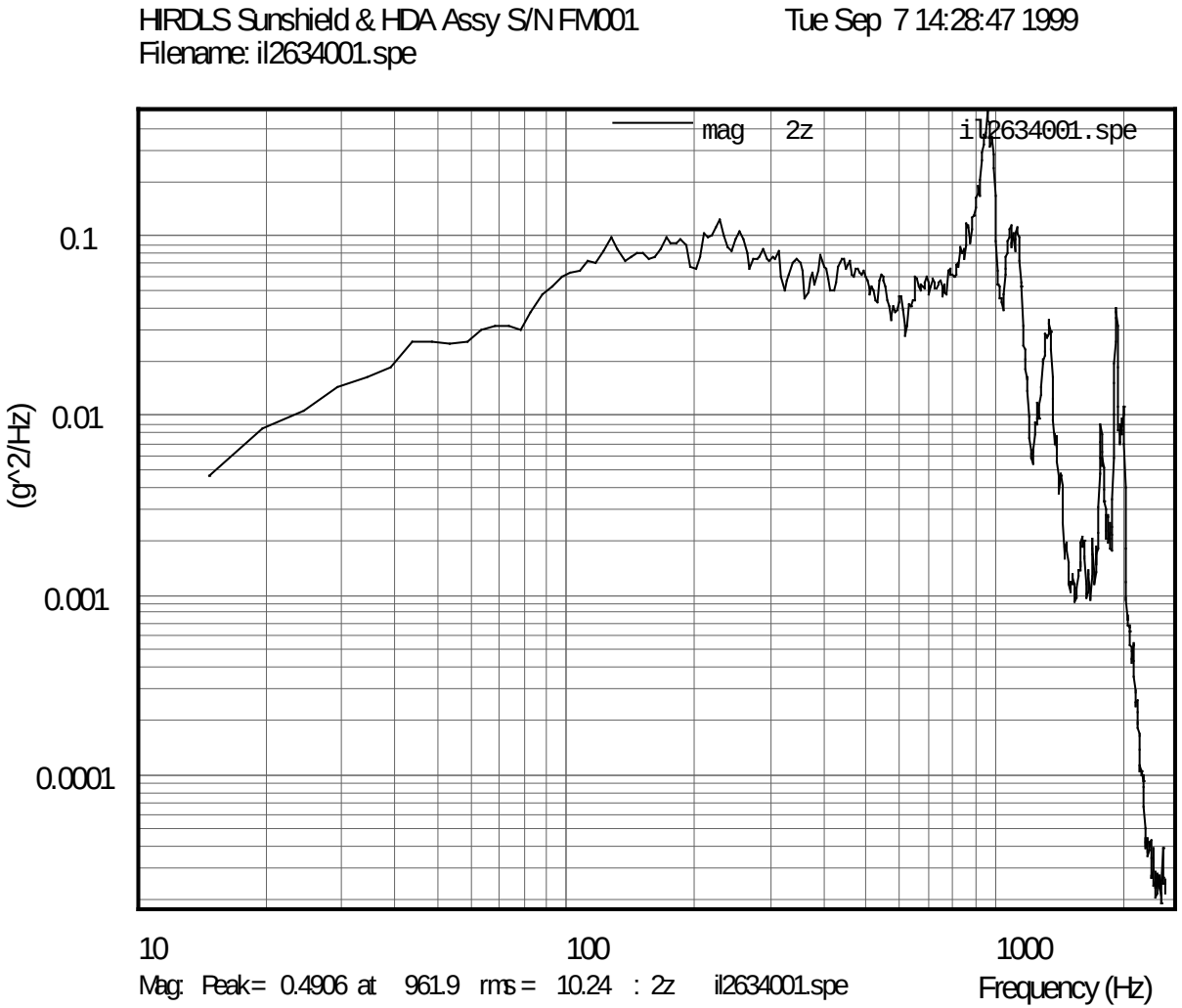

Figure 7 Random response – Position 2z in-axis

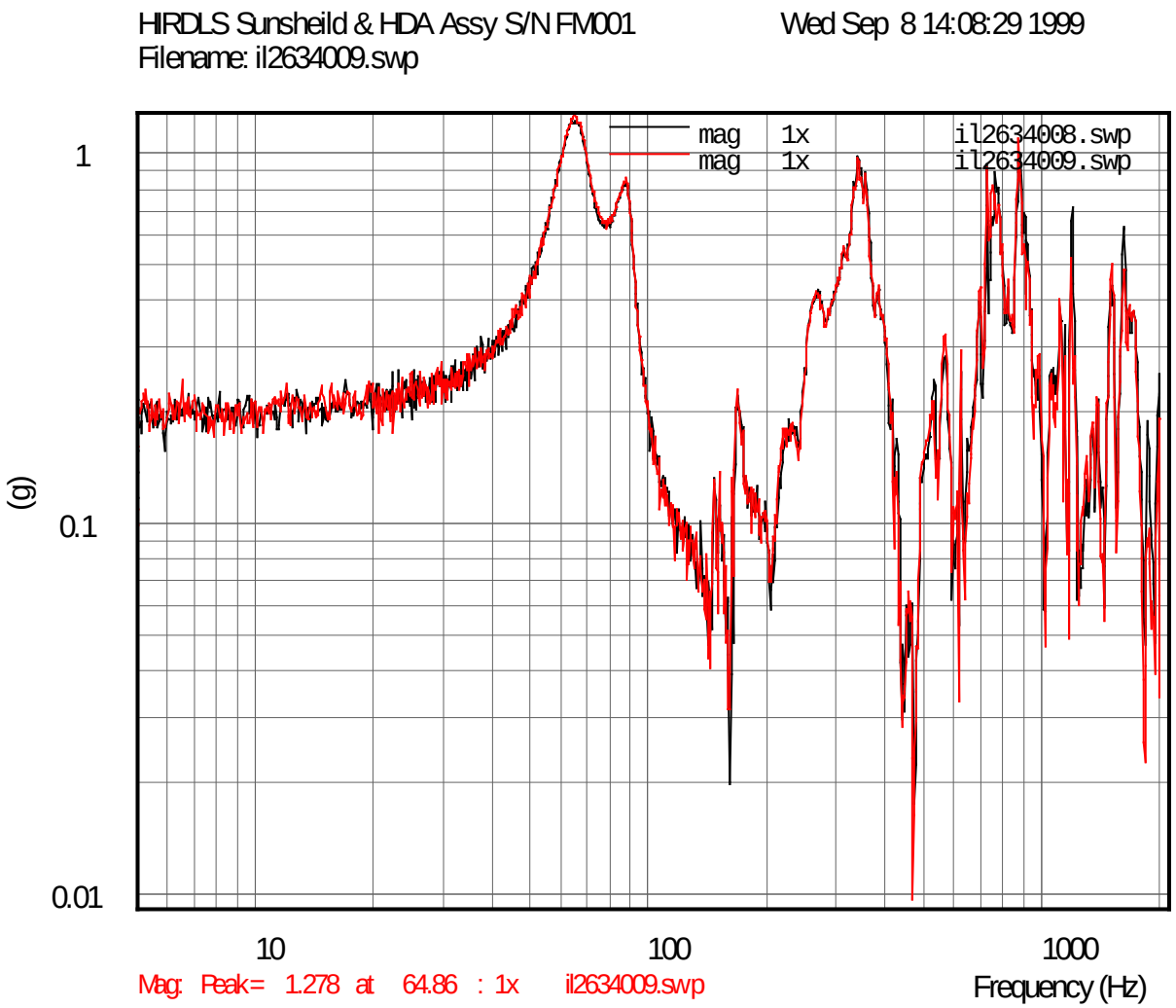

Figure 8 Pre and Post random test low level sine responses – Position 1x in-axis

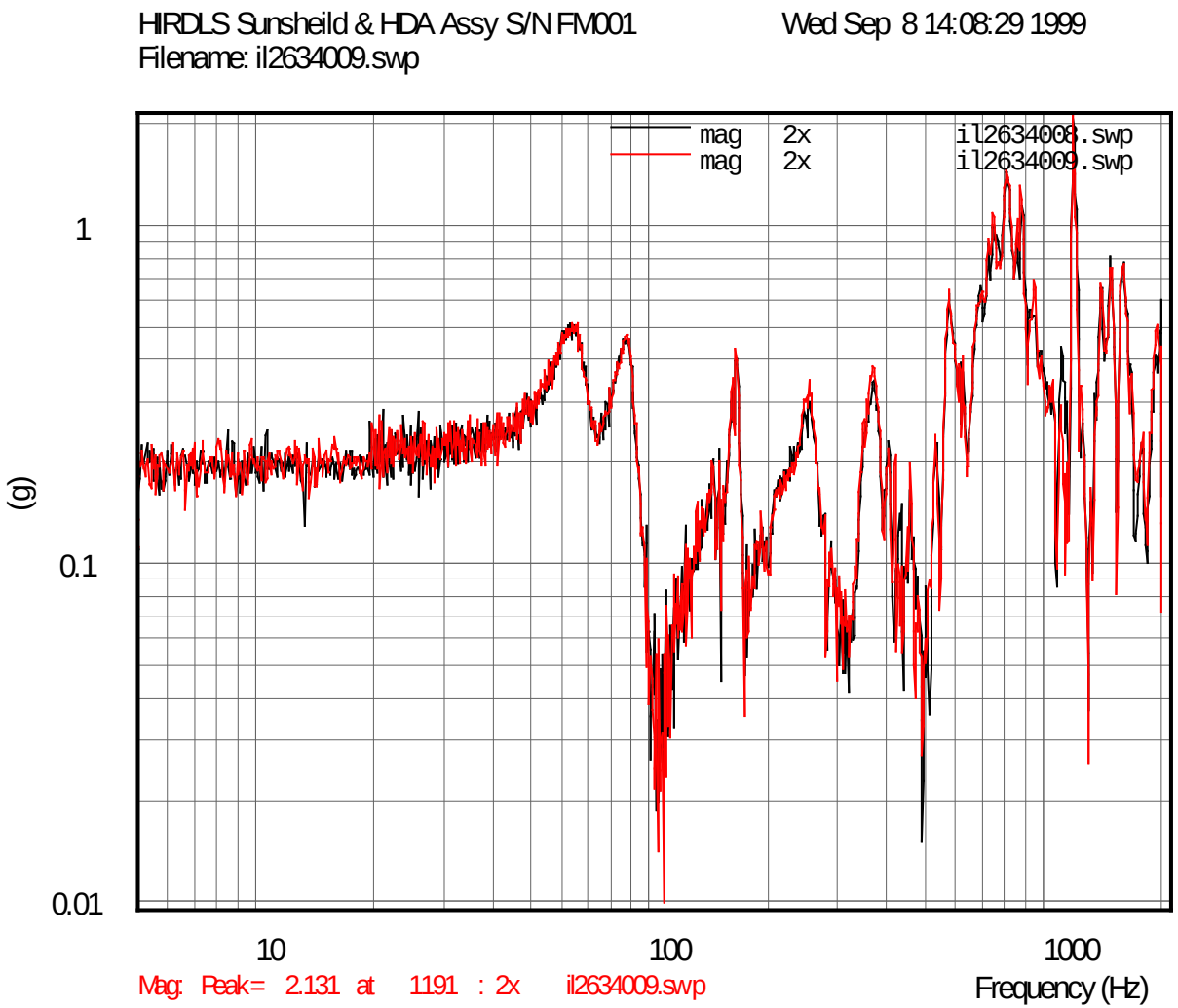

Figure 9 Pre and Post random test low level sine responses – Position 2x in-axis

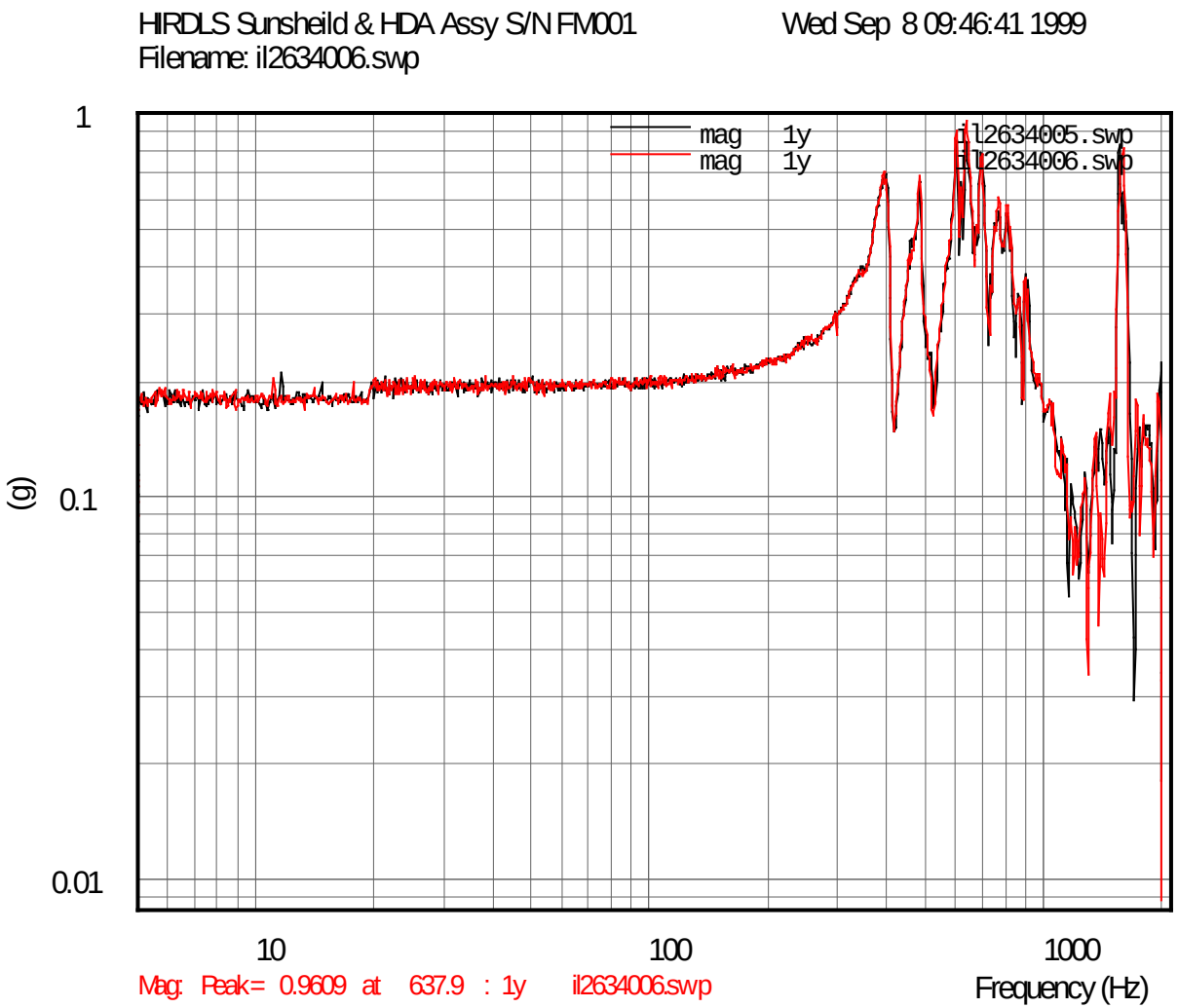

Figure 10 Pre and Post random test low level sine responses – Position 1y in-axis

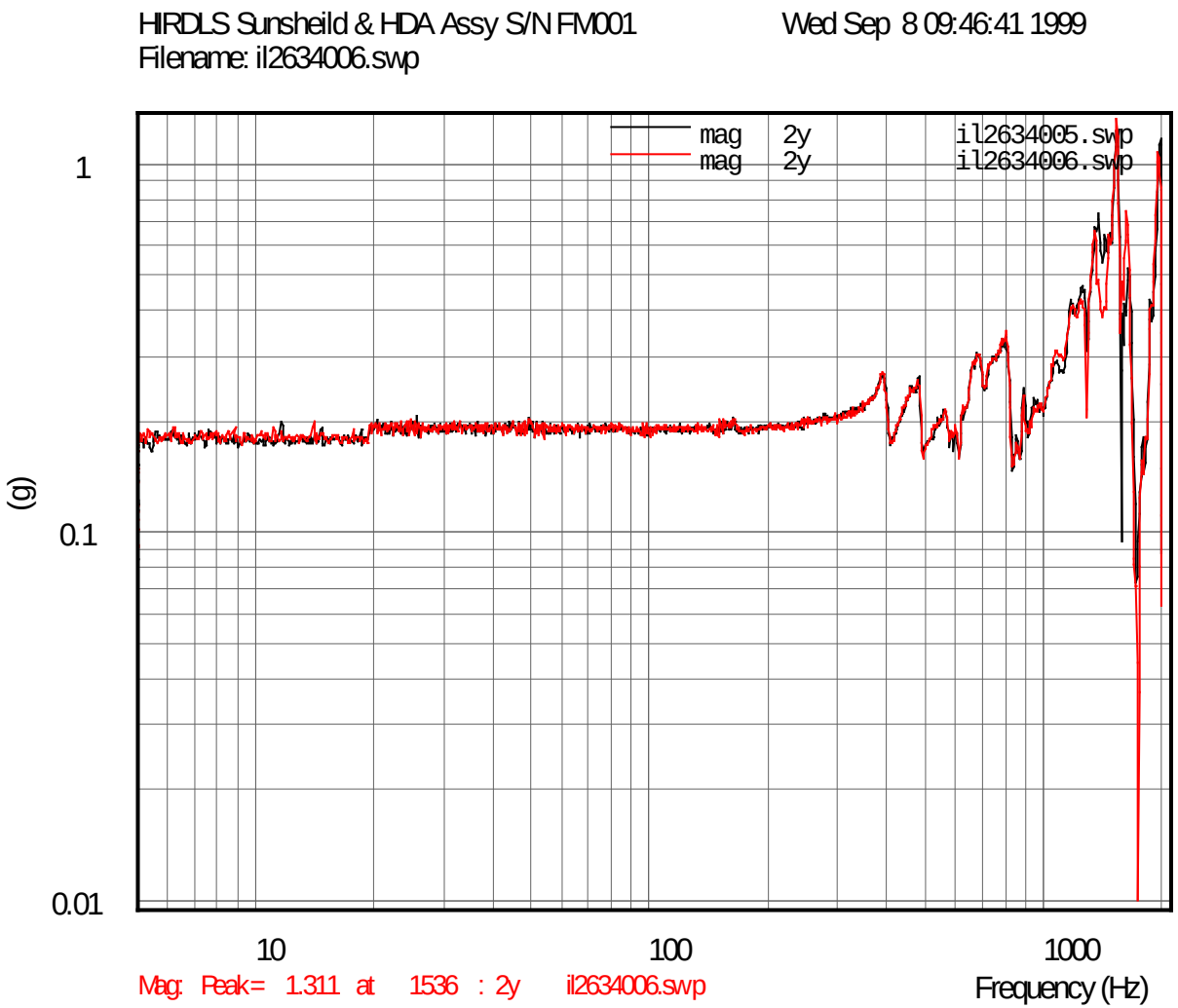

Figure 11 Pre and Post random test low level sine responses – Position 2y in-axis

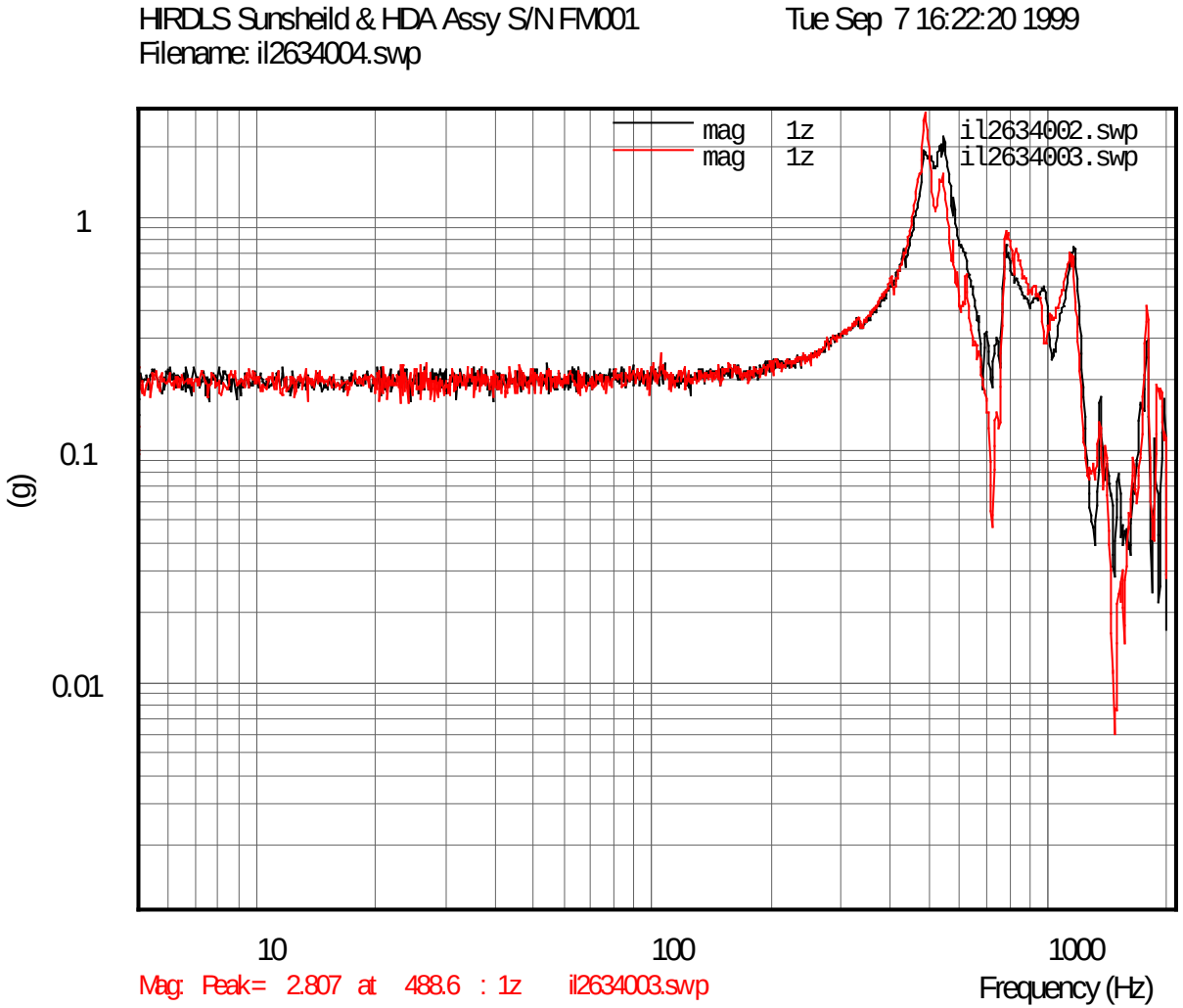

Figure 12 Pre and Post random test low level sine responses – Position 1z in-axis

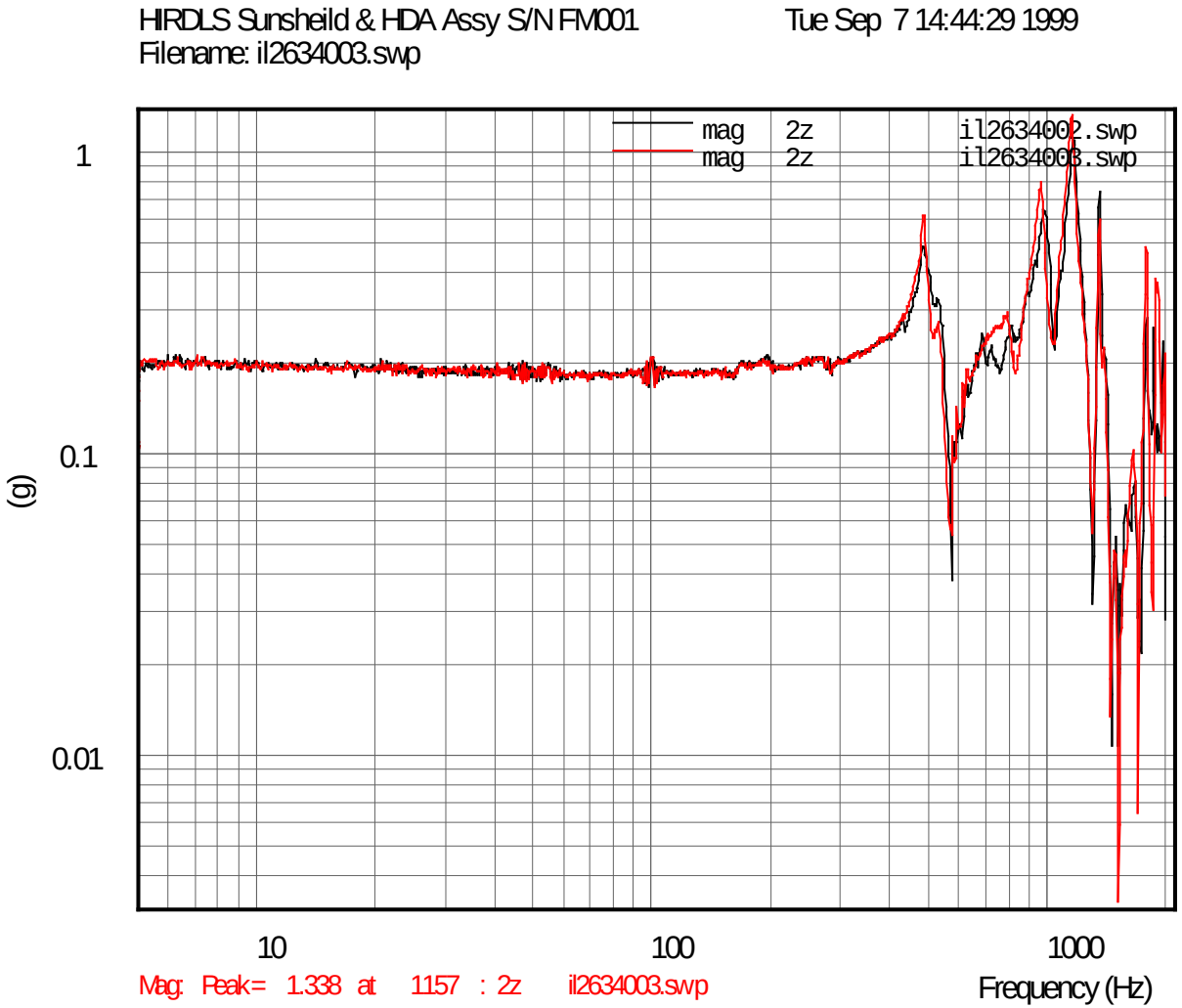

Figure 13 Pre and Post random test low level sine responses – Position 2z in-axis

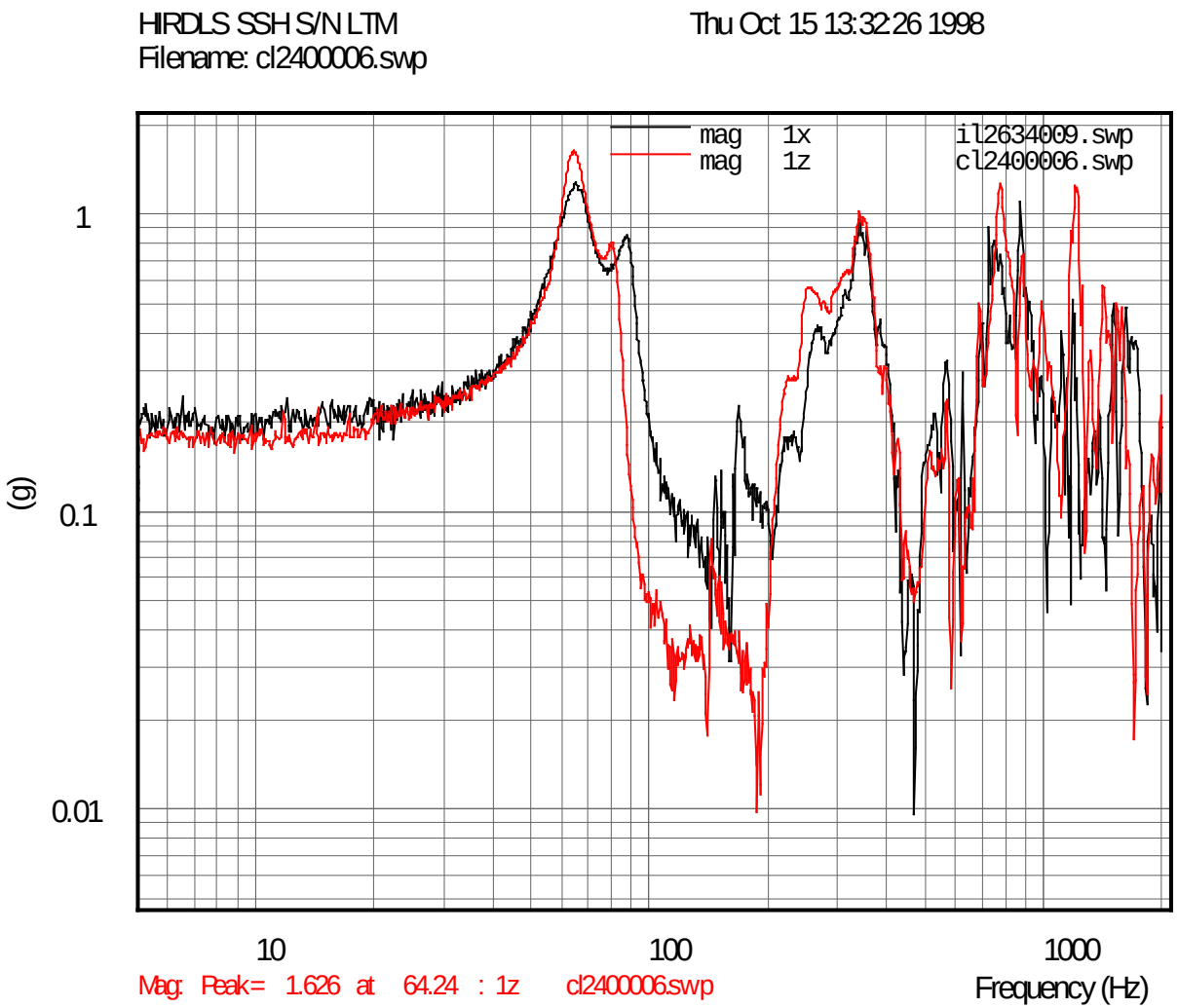

Figure 14 EM and FM low level sine responses - Position 1x in-axis

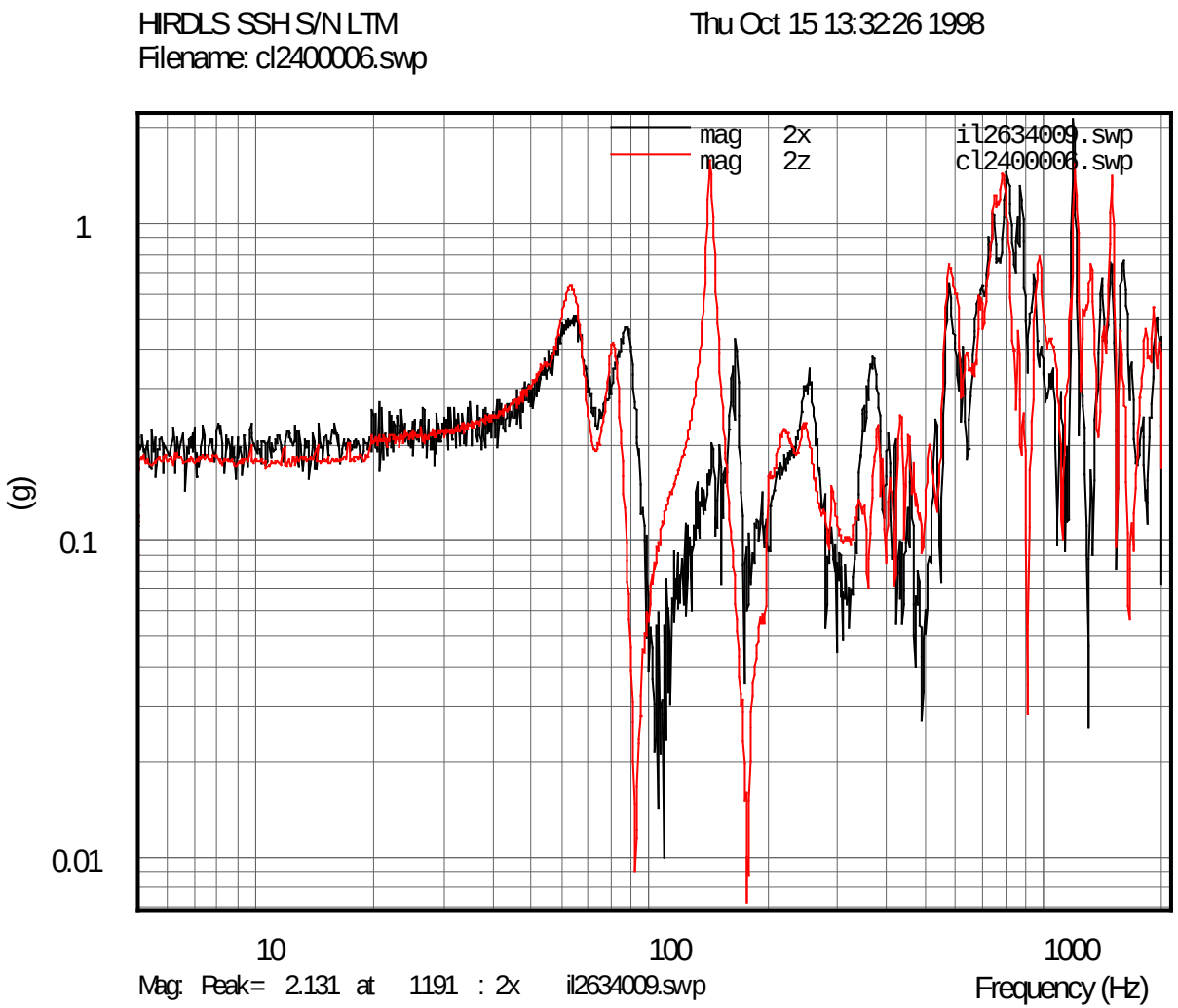

Figure 15 EM and FM low level sine responses - Position 2x in-axis

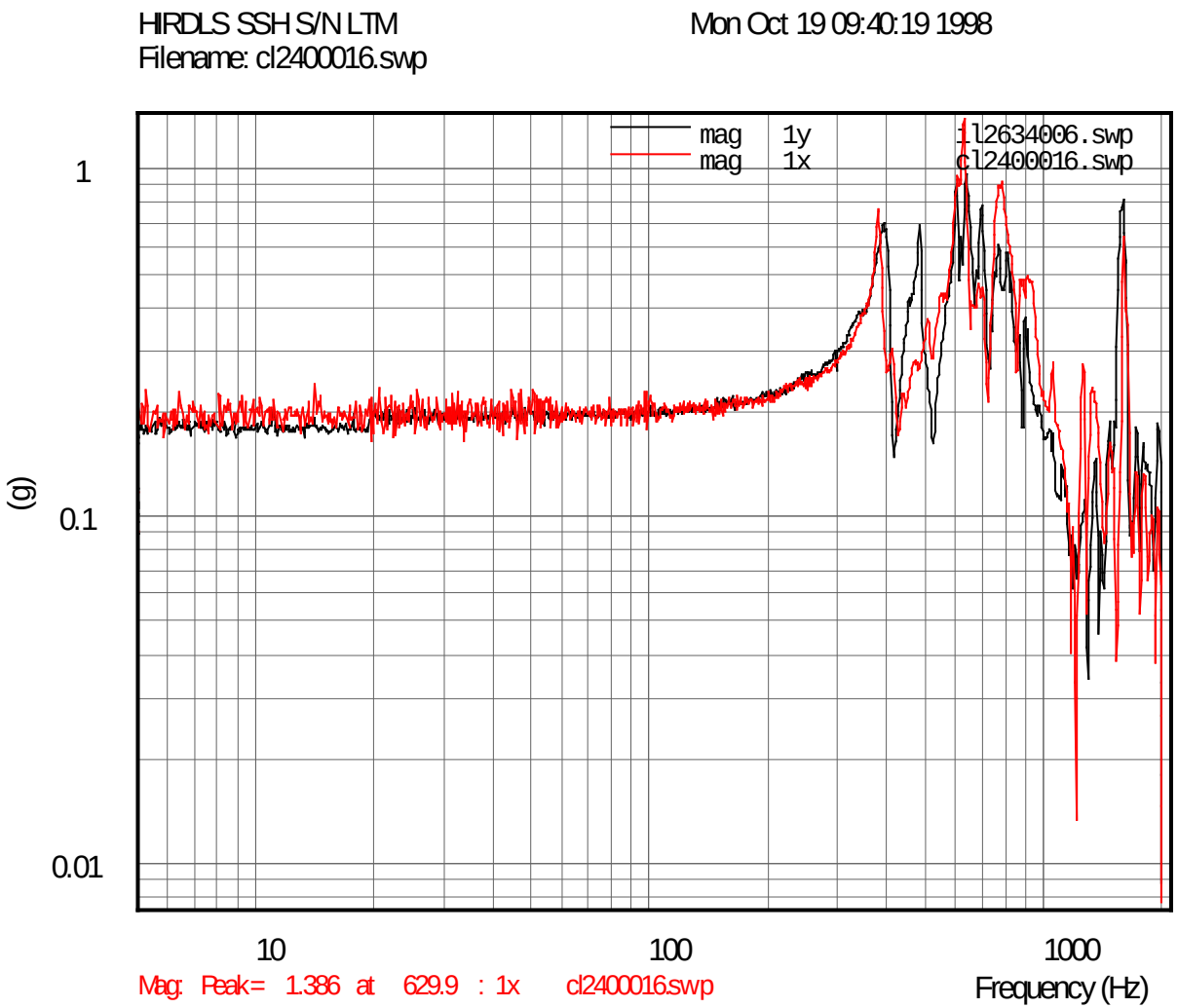

Figure 16 EM and FM low level sine responses - Position 1y in-axis

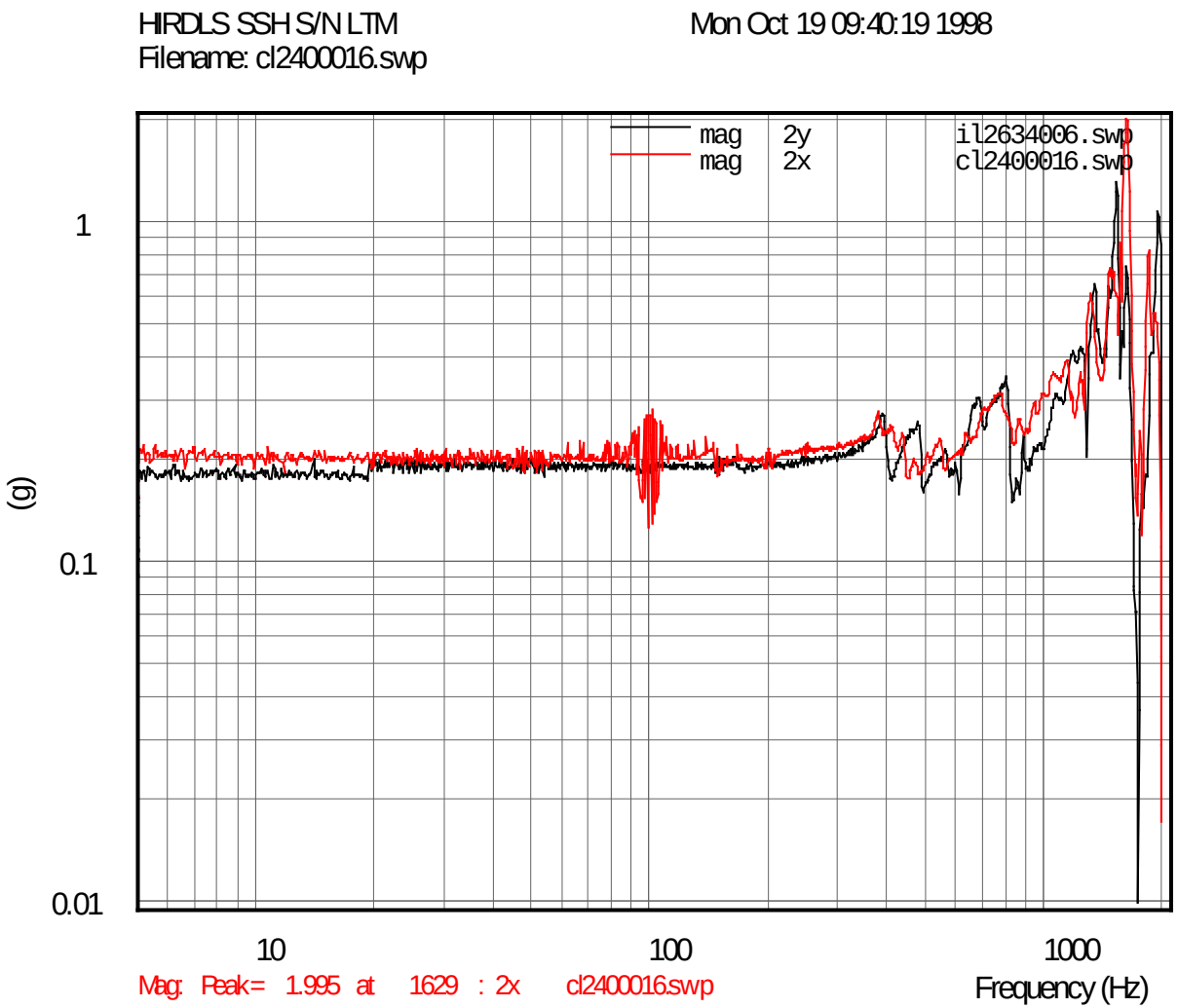

Figure 17 EM and FM low level sine responses - Position 2y in-axis

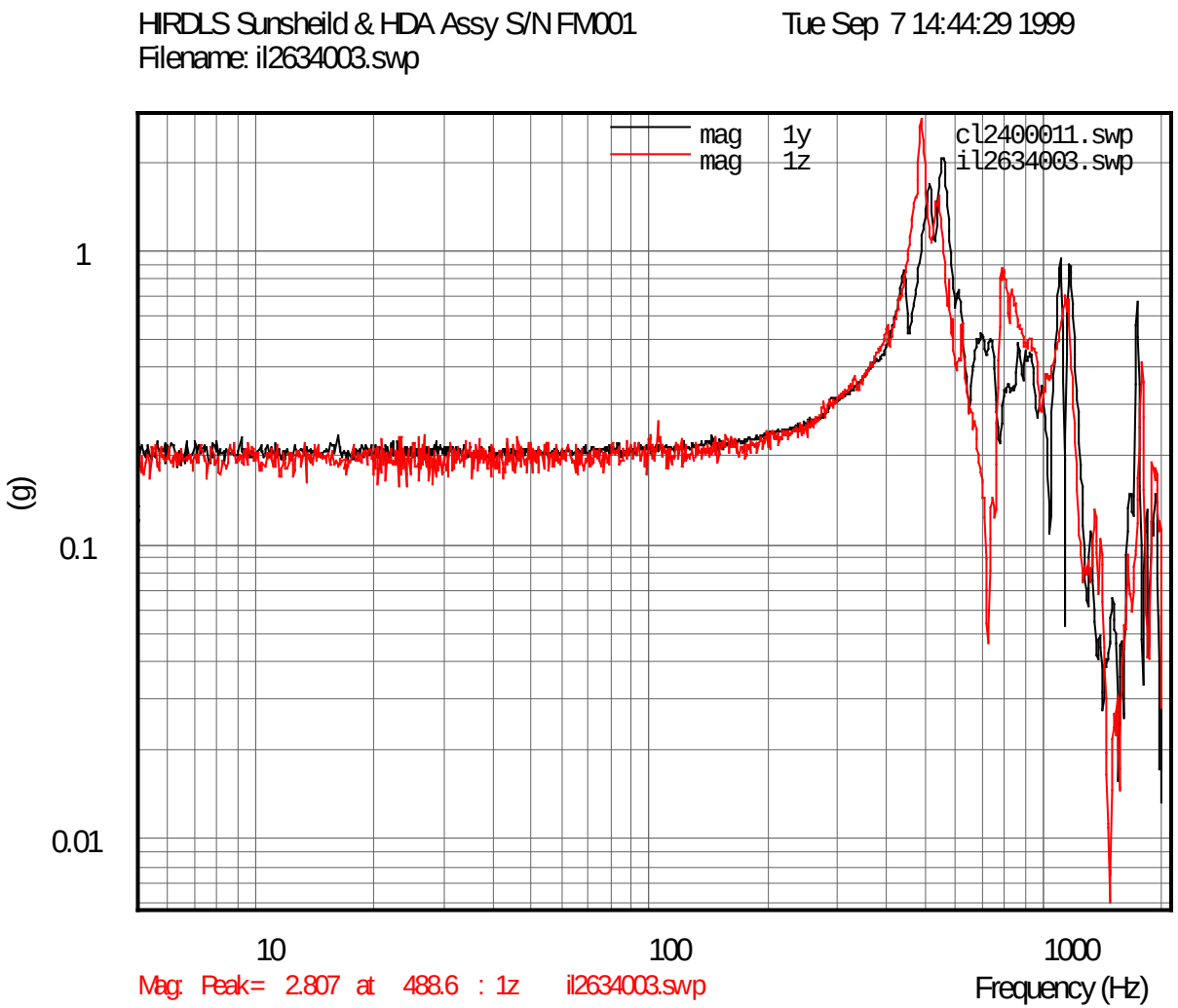

Figure 18 EM and FM low level sine responses - Position 1z in-axis

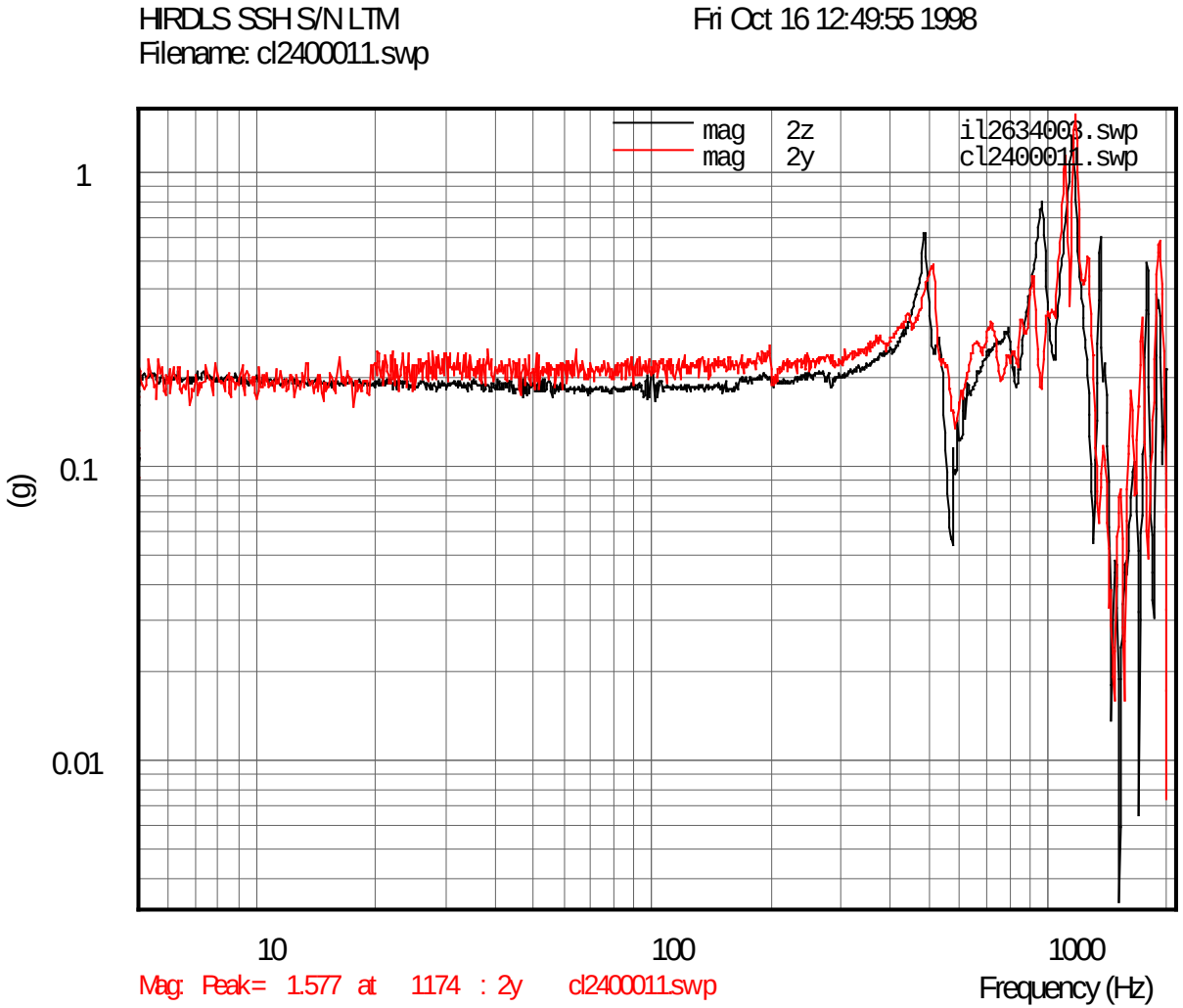

Figure 19 EM and FM low level sine responses - Position 2z in-axis

MATRA MARCONI SPACE

ENVIRONMENTAL ENGINEERING & TEST LABORATORY
Anchorage Road, Portsmouth, Hants PO3 5PU
Tel 01705 704510 Fax 01705 708278

NAMAS
TESTING
No. 0093

TEST CERTIFICATE

ISSUED UNDER **UKAS** REGISTRATION No: 0093 Serial No: IL2634-1

To:	Matra Marconi Space (UK) Ltd HIRDLS F.A.O. N.Crossland (Ext 5409)	**Customer Order No:**	N/A
Title:	Acceptance Vibration of Sunshield and HDA Assembly.		
Description/Identification of Test Item(s):	Drawing Number: HR1L100, Issue 4.		
Serial Number(s):	FM001		
Date of Receipt:	6th September 1999		
Specification/Method/ Procedure (& Issue):	3164-SA030-TPF, Issue 1.		
Deviations from above:	None by EVT.		
Results/Observations:	All testing carried out in accordance with test procedure. All results held in EVT logbook IL2634.		

The tests detailed above are certified to have been carried out to the requirements of the contract/order unless otherwise stated above. This certificate is issued in accordance with the quality control arrangements granted by our **UKAS TESTING** accreditation.

AUTHOR B Wearn MMS 122 UK APPROVED BY S W Forster S W FORSTER
(Signature and print name)
FOR AND ON BEHALF OF THE
ENVIRONMENTAL TEST LABORATORY MANAGER.

DATE: 9/9/99

Page 1 of 1

Registered office: The Grove, Warren Lane, Stanmore, Middlesex, HA7 4LY . No 2519610

Figure 20 Environmental Test Certificate

DISTRIBUTION LIST

INTERNAL	EXTERNAL
N Crossland	N Morris (RAL)
I Stewart	
T Forward	
A Stewart	
R Coupe	
Project Library	

CHANGE RECORD

CHANGE NUMBER	CLASS	CHANGE DETAILS	ISSUE
3164-	-	First Issue	1