National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812
AC(205)544-2121

NASA

Reply to Attn of: ED73(93-87)

September 9, 1993

TO: EL62/Allison Lee

FROM: ED73/Steve Brewster

SUBJECT: Optical Transient Detector (OTD) Sensor Vibration Development Test - LIS-DEV-ED93-060

A vibration development test for the OTD Sensor was completed on September 2, 1993. The test consisted of sine sweeps and random in all three axes. Since the first sine sweep detected a high gain resonance at around 120 Hz, the random vibration run was held at -12dB full level. This random vibration run confirmed the resonance, and consequently the test article would probably not have survived the full level vibration. One control accelerometer and twelve response accelerometers were placed on the test fixture and test item, respectively, as shown on the following page. After the tests, no anomalies were discovered.

Any questions concerning this report should be directed to J.P McGee, Rocky Stephens, or Bob Engberg at 544-1136.

Steve R Brewster

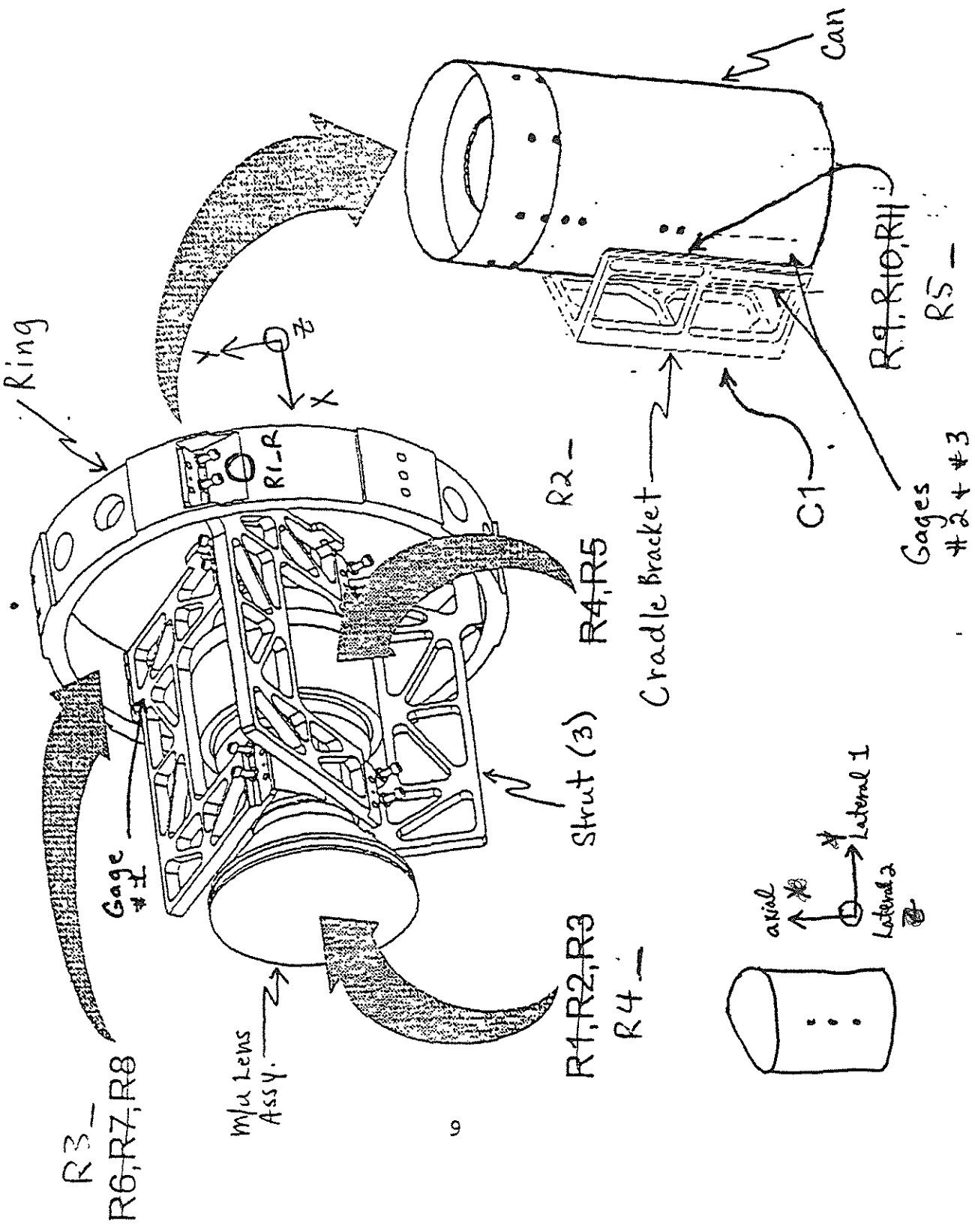
Steve R. Brewster
Chief, Dynamics Test Branch

Enclosure

cc:
ED23/Brad Perkins
ED71/Gerald Waggoner - w/o encl.
ED73/Rolf Hofmann (3 copies)
ED73/File Copy

5.0 FIGURES

5.1 Figure 1 - Accelerometer and Strain Gage Locations



TEST AND CHECKOUT PROCEDURE
FOR

OPTICAL TRANSIENT DETECTOR SENSOR VIBRATION DEVELOPMENT TEST
LIS-DEV-ED93-060

Date of Test: 9-2-93

Test Article Serial Number: _____

Test Requirements Documents: MTCP-DC-010-300

FOP's Attached: _____

Type of Test: Sine & Random Vibration Development

PREPARED BY: Robert C Engberg — 9-9-93
Test Engineer/ED73 — Date

Richard C. Hofmann — 9-8-93
Engineering Technician/ED73 — Date

APPROVED BY: Steve R Brewster — 9-9-93
Steve R. Brewster/ED73 — Date
Chief, Dynamics Test Branch

APPROVED BY: _____ — _____
Quality Assurance — Date

1.0 PURPOSE

This procedure defines the steps necessary to assure the proper check-out for and the execution of vibration and shock tests.

2.0 SCOPE

This procedure includes test levels, instrumentation and documentation necessary for the Test Engineer to conduct vibration and shock tests.

3.0 APPLICABLE DOCUMENTS

DST-FOP-VS-003 FACILITY OPERATION PROCEDURE (MARCH 21, 1983)

4.0 GENERAL REQUIREMENTS

The Test Engineer will be in charge of all preparations and activities during the vibration test phase.

5.0 SAFETY

When safety critical test conditions require personnel access, the Test Engineer will assure that the operation procedures and policies set forth in ET01-SOP-01, "Standard Operating Procedure for Safety Critical Operations" will be adhered to.

The Test Engineer will be responsible for the safety of personnel involved in the test activities; and will be notified immediately of any personnel injury.

TEST OPERATIONS SET-UP

		AXIS	Axial	Lateral 1	Lateral 2
1.1	Verify proper calibration of instruments to be used.		✓	✓	✓
1.2	Verify proper calibration of accelerometers to be used.		✓	✓	✓
1.3	Install test article on shaker and verify test axis.		✓	✓	✓
1.4	Install accelerometer(s) on test article.		✓	✓	✓
1.5	Verify continuity from accelerometer(s) to charge amplifier output(s)		✓	✓	✓

Torque Values:

Test Fixture: 65 ft-lbs

Test Article: 35 in-lbs

Shaker Used: Ling 335

Adapters Used: Cradle bracket on 18.5" diameter plate

SINE EVALUATION CHECK-OUT

AXIS	Axial	Lateral 1	Lateral 2

1.1 Verify test program and record the abort level below. ✓ ✓ ✓

Abort Level 99%

1.2 Perform levels as defined below and verify with plot. ✓ ✓ ✓

1.3 Record the following:

Amplifier Gain 50%

Charge Amp. F.S. 10 G control, 30 G response

5 - 2000 Hz at .5 G, limit +1, -3 dB

_____ - _____ Hz at _____, limit _____ dB

Sweep Rate = 1.00 oct/min

Test Level Concurrence: _____ _____

Component Assessment Branch Date

SINE TEST

		AXIS: Axial / Lateral 1 / Lateral 2
1.1	Record a minimum of 30 seconds of calibration signal on tape recorder.	///
1.2	Set full scale ranges on instrumentation amplifiers and note on data sheet.	///
1.3	Set power amplifier gain to position noted during sine test check-out.	///
1.4	Perform self check of control system.	///
1.5	Start tape recorder.	///
1.6	Begin sine sweep.	///
1.7	Note time of DCS "SWEEP UP" or "SWEEP DOWN" indication light. On Tape Sheet	///
1.8	During first sweep, press the "SAVE" button on DCS.	///
1.9	If more than one sweep, note time of DCS "SWEEP UP" or" "SWEEP DOWN" indication light. _____	___
1.10	At the completion of the sweep, set power amplifier gain to off	///
1.11	Stop tape recorder.	///
1.12	Inspect test article for damage or degradation.	///

RANDOM CHECK-OUT

AXIS	Axial	Lateral 1	Lateral 2

1.1 Verify test program and record RMS abort limit below. / / /

RMS abort limit ± 3.00 dB

1.2 Perform levels as defined below and verify with plot. / / /

1.3 Record the following:

Amplifier Gain 60%

Charge Amp. F.S. 100 G-

			20	Hz @	0.04	G^2/Hz,	limits +3, -1.5 dB
20	Hz -	50	Hz @	9.9	dB/oct	limits	
50	Hz -	110	Hz @	0.90	G^2/Hz	limits	
110	Hz -	200	Hz @	-14.2	dB/oct	limits	
200	Hz -	1350	Hz @	0.049	G^2/Hz	limits	
1350	Hz -	2000	Hz @	-13.7	dB/oct	limits	
	Hz -	2000	Hz @	0.0048	G^2/Hz	limits	✓
	Hz -		Hz @			limits	
	Hz -		Hz @			limits	

Composite = 12.137 Grms

Test Time = 60 Sec. at -12 dB from full level

Test Level Concurrence: _____ _____

Component Assessment Branch Date

RANDOM TEST

		AXIS: Axial / Lateral 1 / Lateral 2
1.1	Record a minimum of 30 seconds of calibration signal on tape recorder.	✓ ✓ ✓
1.2	Set full scale ranges on instrumentation amplifiers and note on data sheet.	✓ ✓ ✓
1.3	Set power amplifier gain to position noted during random test check-out.	✓ ✓ ✓
1.4	Perform self check of control system.	✓ ✓ ✓
1.5	Begin test sequence at - 12 dB from full level.	✓ ✓ ✓
1.6	At - 12 dB, start tape recorder.	✓ ✓ ✓
1.7	Note time when full level is reached. never reached	
1.8	At the completion of the test, set power amplifier gain to off.	✓ ✓ ✓
1.9	Stop tape recorder.	✓ ✓ ✓
1.10	Inspect test article for damage or degradation.	✓ ✓ ✓
1.11	Remove test article from shaker.	✓ ✓ ✓

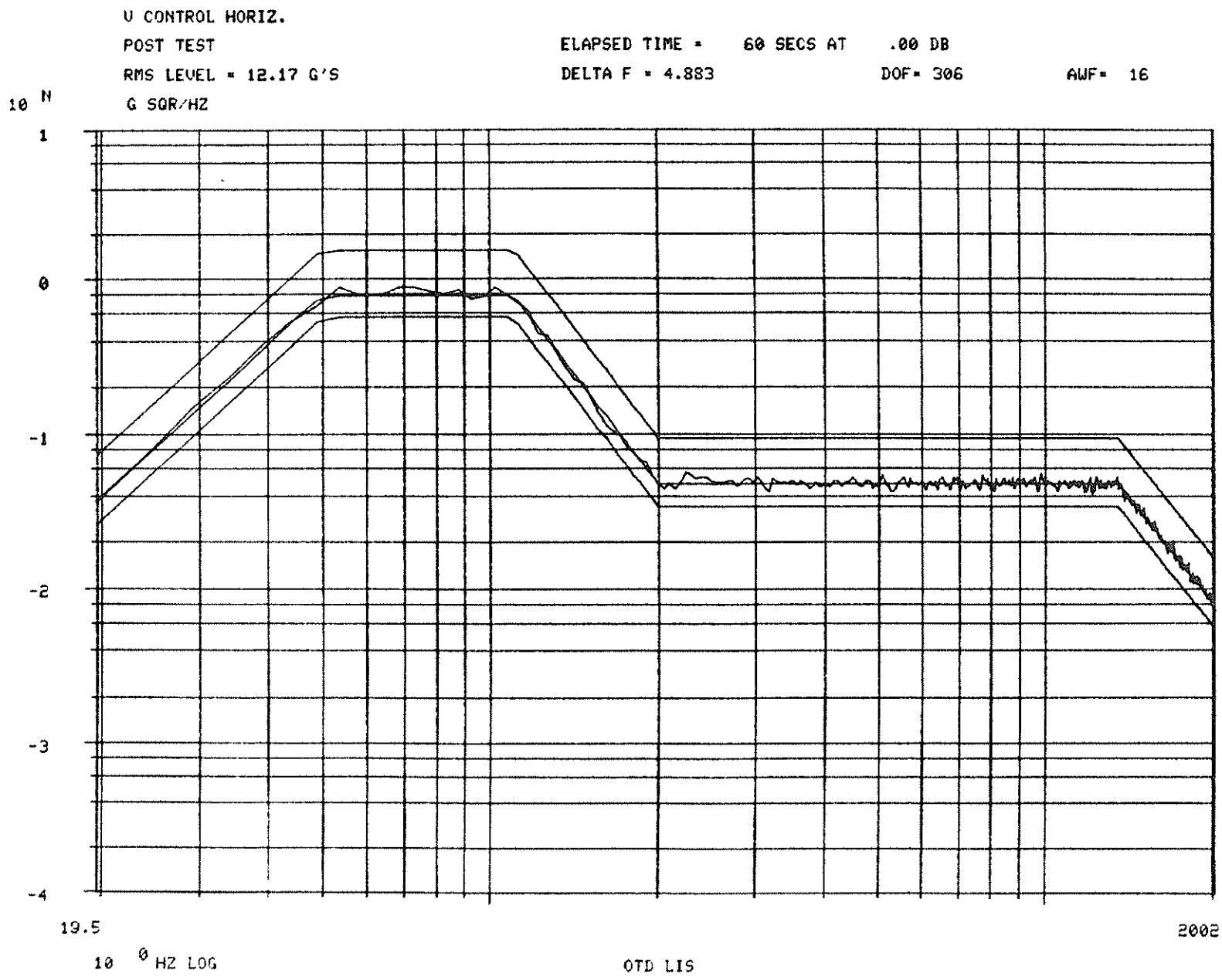
POST-TEST VERIFICATION

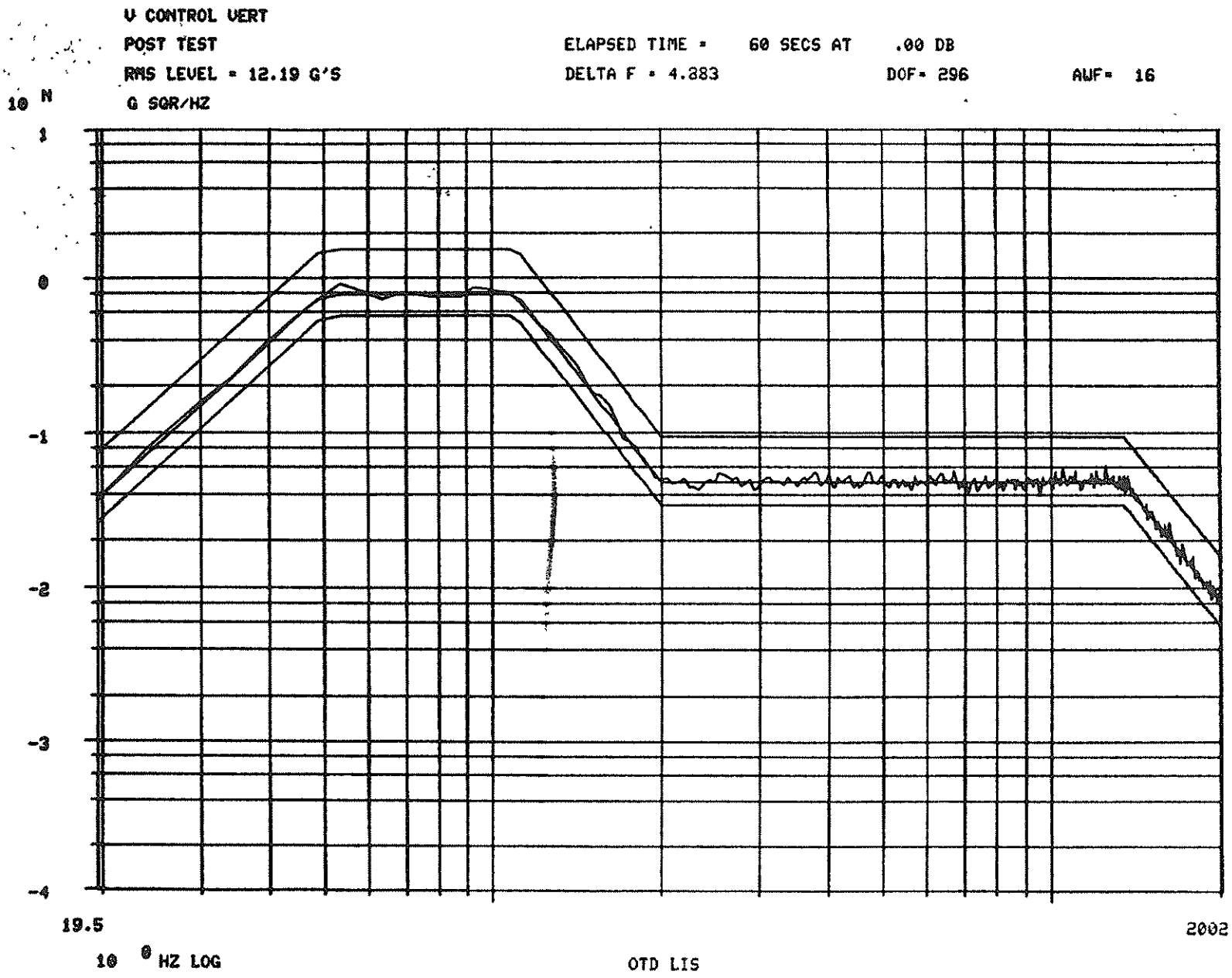
he Test and Checkout Procedure LIS-DEV-ED93-060
as been satisfactorily completed and documented.

Submitted by: Robert C. Engberg 9-9-93
Test Engineer/ED73/ Date

Verified by: _____ _____
Quality Assurance Monitor Date

SYSTEM VERIFICATIONS


U CONTROL HORIZ.
POST TEST
RMS LEVEL = 12.17 G'S
ELAPSED TIME = 60 SECS AT .00 DB
DELTA F = 4.883
DOF= 306
AWF= 16
10 N
G SQR/HZ
1
0
-1
-2
-3
-4
19.5
2002
10 0 HZ LOG
OTD LIS

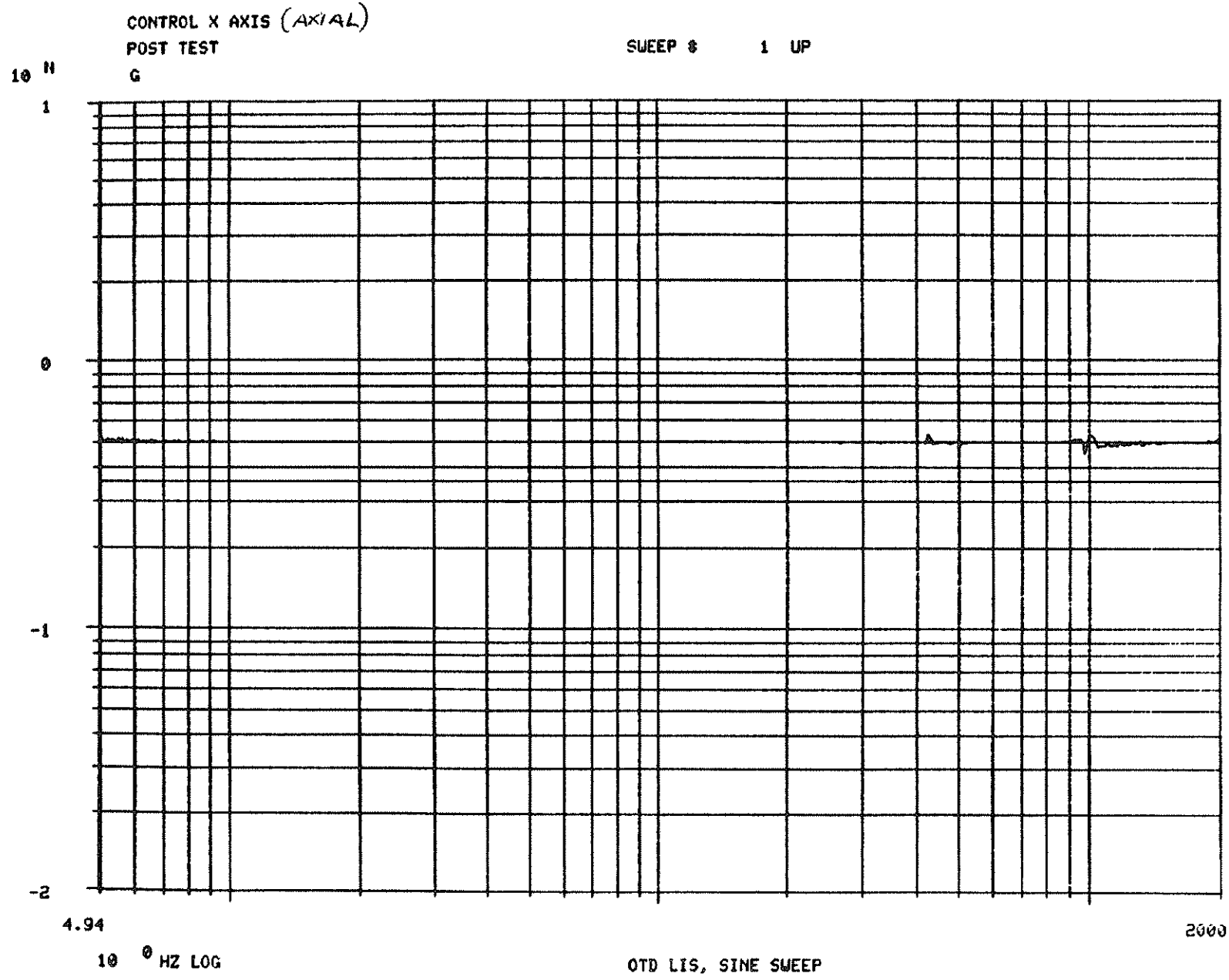

V CONTROL VERT
POST TEST
RMS LEVEL = 12.19 G'S
G SQR/HZ
ELAPSED TIME = 60 SECS AT .00 DB
DELTA F = 4.883
DOF= 296
AWF= 16
10 N
1
0
-1
-2
-3
-4
19.5
2002
10 0 HZ LOG
OTD LIS

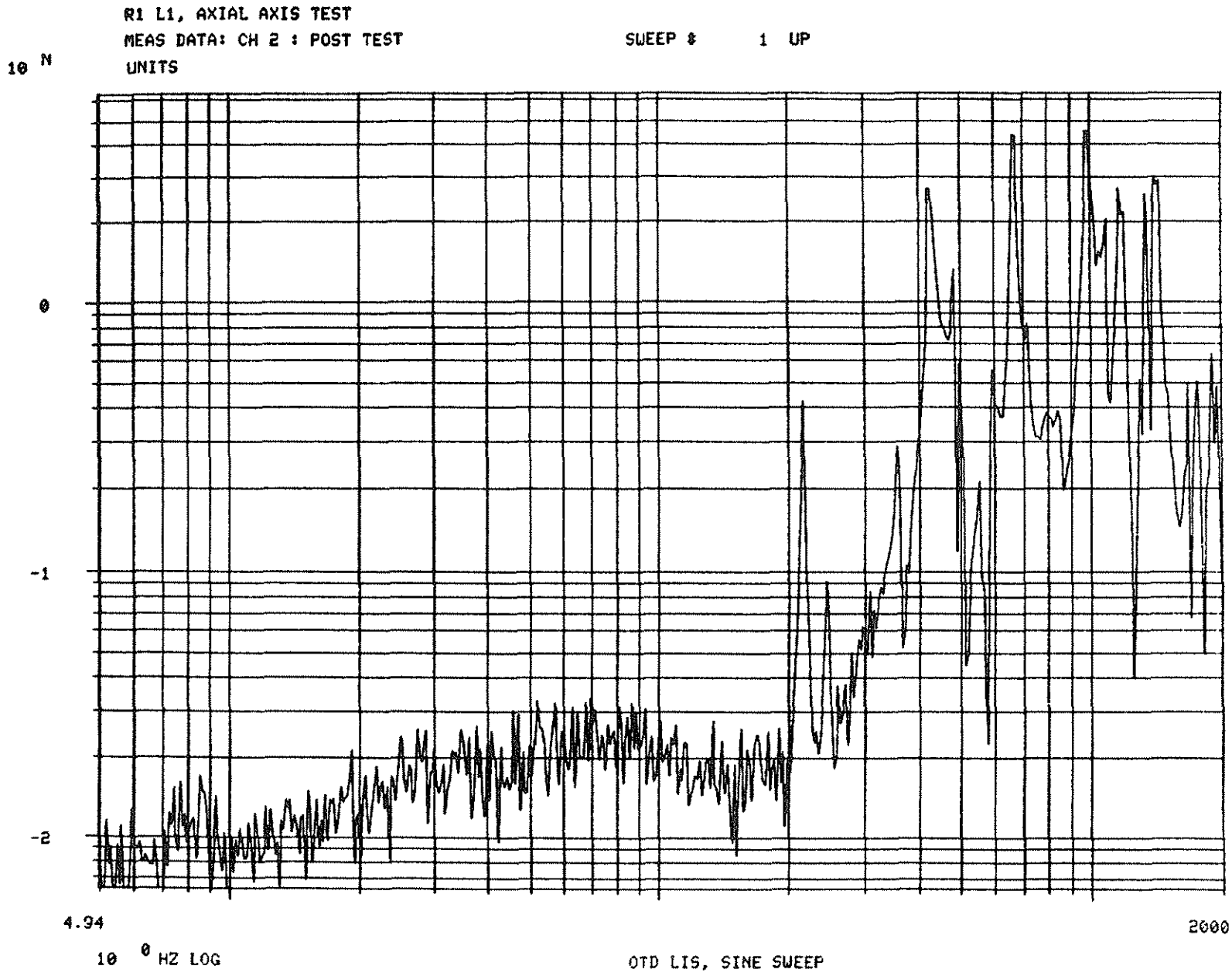
TEST SPECIFICATIONS

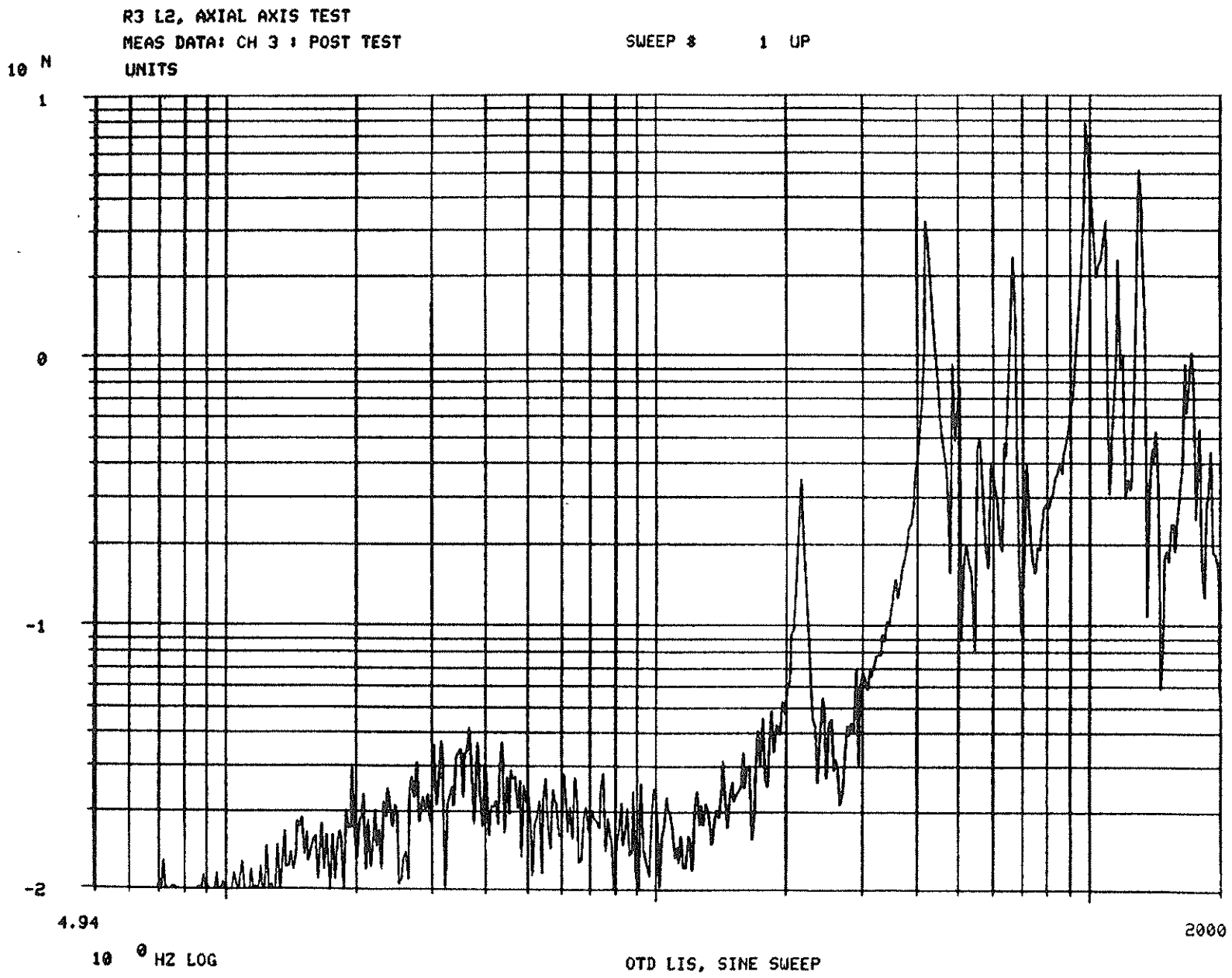
```
  1. IDENT?
OTD LIS, SINE SWEEP

  2. LOWER FREQ LIMIT? HZ
       5.0

  3. UPPER FREQ LIMIT? HZ
     2000.0

  4. STARTING FREQ? (+UP, -DOWN)
       5.0

  5. NUMBER OF SINGLE SWEEPS?
        1

  6. SWEEP MODE? 1=LOG, 2=LIN
     1

  7. SWEEP TIME OR RATE?
     1=TIME, 2=OCT MIN, 3=DEC/MIN
     2
     OCT/MIN?
      1.00
     SWEEP TIME =  8.644 MIN

  8. REFERENCE ENVELOPE SPECIFICATION

     UNITS? 1=IN, 2=CM
     1

     FORMAT:
     FREQ,AMPL,TYPE,LIMIT(DB)

     AMPLITUDE TYPES:
     1=G'S P ,2=IN/SEC ,3=IN P-P

     ENTER 0 TO TERMINATE

     POINT # 1?
     5.0       .5000 1   3.00
(    .50 G'S,   6.143 IN/S,   .3911 IN)

     POINT # 2?
  2000.0       .5000 1   3.00
(    .50 G'S,    .015 IN/S,   .0000 IN)

  9. MUX? YES;NO
     NO

 10. NUMBER OF CONTROL CHANNELS?
      1
     ACCELERATION CALIBRATIONS?
     CHANNEL #, MV/G
      1    300.000

 11. CONTROL MEAS METHOD?
     1=PEAK, 2=AVG, 3=RMS, 4=FILTER
     4

 12. CONTROL STRATEGY?
     1=MAX, 2=MIN, 3=AVG
     3

 13. NUMBER OF LIMIT CHANNELS?
      0

 15. NUMBER OF MEAS CHANNELS?
      4
     MEAS SPECIFICATIONS?
     CHANNEL #,MV/UNIT
      1    300.000
     CHANNEL #,MV/UNIT
      2    100.000
     CHANNEL #,MV/UNIT
      3    100.000
     CHANNEL #,MV/UNIT
      4    100.000

 16. MEASUREMENT MEAS METHOD?
     1=PEAK, 2=AVG, 3=RMS, 4=FILTER
     4

 17. START-UP TIME? SEC
      5.0

 18. SHUT-DOWN TIME? SEC
      1.0

 19. MANUAL MODE ENABLED? YES;NO
     YES

 20. MAX DRIVE? MV PEAK
      5000.

 21. SELF CHECK LEVEL? MV PEAK
       500

 22. ALARM LEVEL? % ABORT
     99.0

     MAX DISP =     .3911 IN P-P
     MAX VEL  =    6.143 IN/SEC P
     MAX ACCEL=      .50 G S P

FUNCTION? ,C,/R,/L,/S,DL,PU,/E,??
```

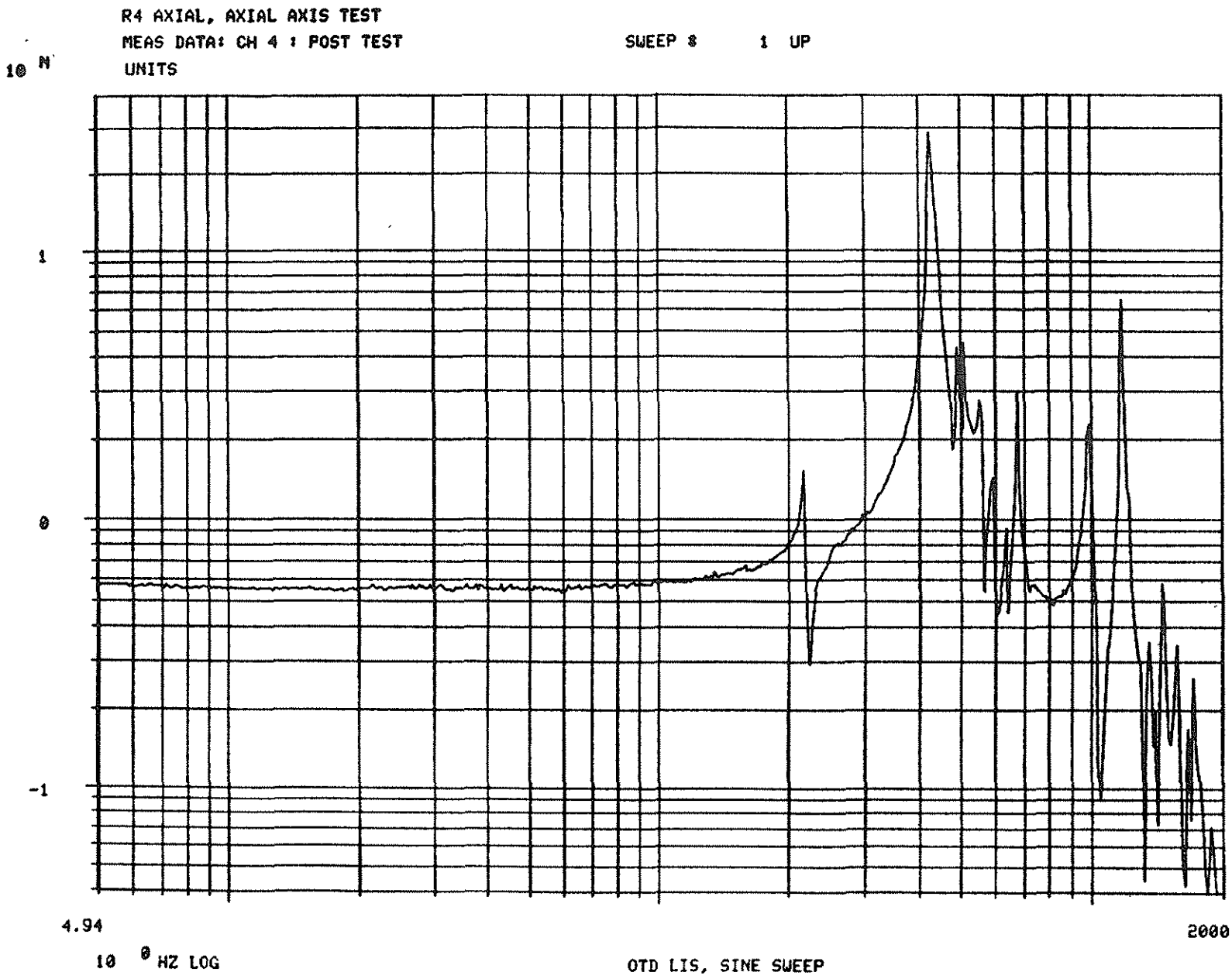
```
1. IDENT:
OTD LIS

2. TRUE RANDOM MODE? YES;NO
   YES

3. AVERAGING WEIGHTING FACTOR?
    16

   AVGS/LOOP?
     5

4. 3 SIGMA CLIPPING? YES;NO
   YES

5. MEASUREMENT MODE? YES;NO
   YES

   # OF AVGS?
    20

   AVGS/LOOP?
     5

6. # CONTROL CHANNELS?
     1

7. CALIBRATION? MV/G

    CHANNEL A
   30.00

    CHANNEL B
   30.00

8. SYSTEM GAIN? G/VOLT @ INPUT
   24.00

9. SELF CHECK LEVEL? -DB
   -6.00

10. LEVEL SCHEDULE
    LEVEL(-DB),TIME(SEC)?
     1. -12.00      60.

11. LINE ABORTS ENABLED? -DB
   -3.00

    ABORT TIME? 10 SEC MAX
    1.00

12. MANUAL MODE ENABLED? YES;NO
   YES

13. LINE ALARM LIMIT? %

14. RMS ABORT LIMIT? DB
    3.00

15. # LINES?
   512

16. LOWEST FREQ?
   20.00

17. HIGHEST FREQ?
 2000.00

 MAX FREQ.=  2500.00 HZ

 RESOLUTION=  4.88 HZ

 LOG HORIZ.= 3 DECADES

18. INPUT MODE?
    1=MAG.,FREQ,LIMIT+,LIMIT-(DB);
    2=SLOPE,FREQ,LIMIT+,LIMIT-(DB);
    3=DISC
     1

19. MAGNITUDE? GSQR/HZ, F=  20 HZ
     .040000

20. MAG.,FREQ,LIMIT+,-?
     .800000   50.00  3.00  1.50

21. MAG.,FREQ,LIMIT+,-?
     .800000  110.00  3.00  1.50

22. MAG.,FREQ,LIMIT+,-?
     .048000  200.00  3.00  1.50

23. MAG.,FREQ,LIMIT+,-?
     .048000 1350.00  3.00  1.50

24. MAG.,FREQ,LIMIT+,-?
     .008000 2000.00  3.00  1.50

 RMS VALUE=    12.137 G'S

FUNCTION? /C,/R,/L,/S,DL,PU,/E,??
```

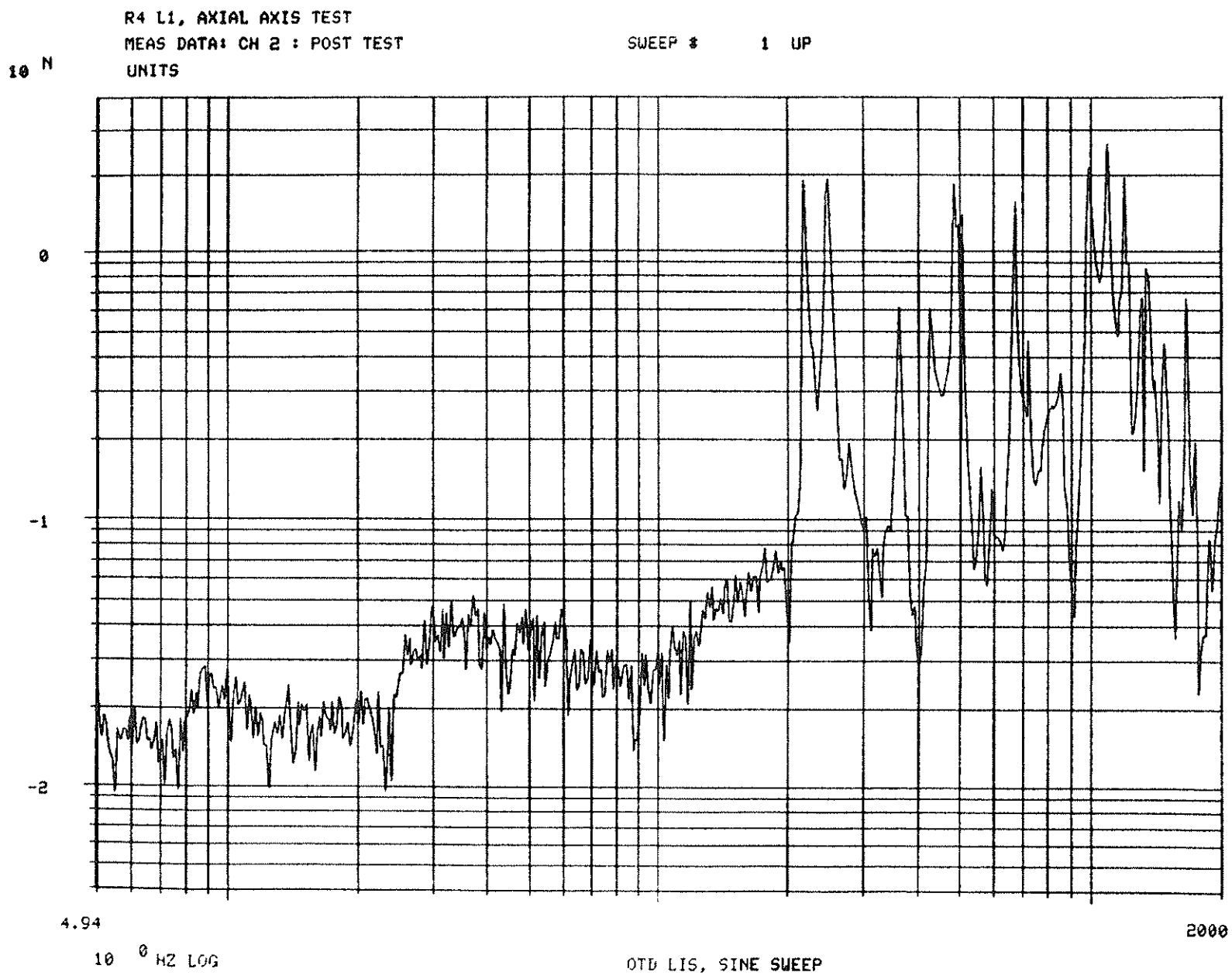
SINE SWEEP, AXIAL (X) AXIS

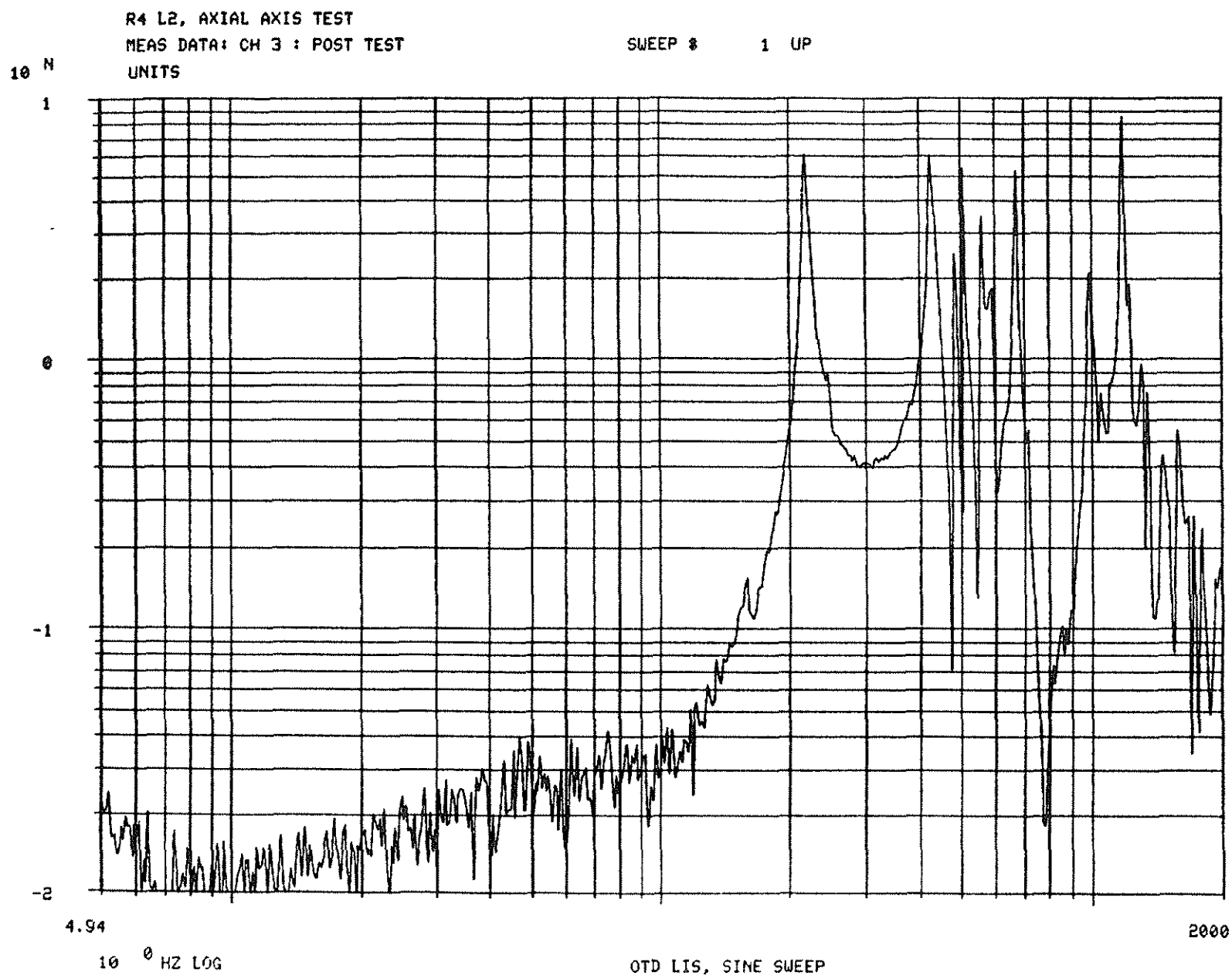

CONTROL X AXIS (AXIAL)
POST TEST
SWEEP # 1 UP
10 N
G
1
0
-1
-2
4.94
10 0 HZ LOG
2000
OTD LIS, SINE SWEEP

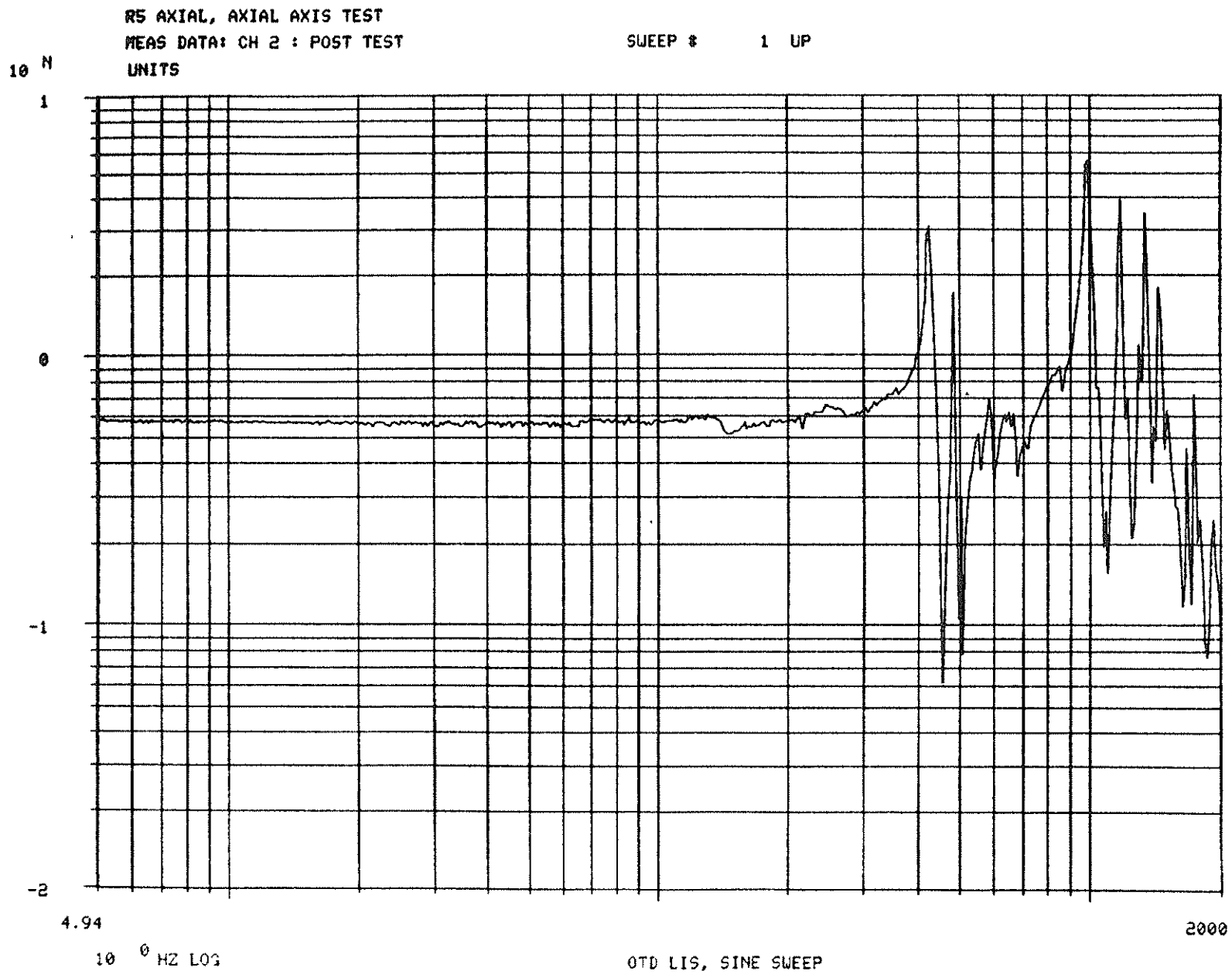

R1 L1, AXIAL AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R3 L2, AXIAL AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4 AXIAL, AXIAL AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP 8 1 UP
UNITS
10 N
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4 L1, AXIAL AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4 L2, AXIAL AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R5 AXIAL, AXIAL AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
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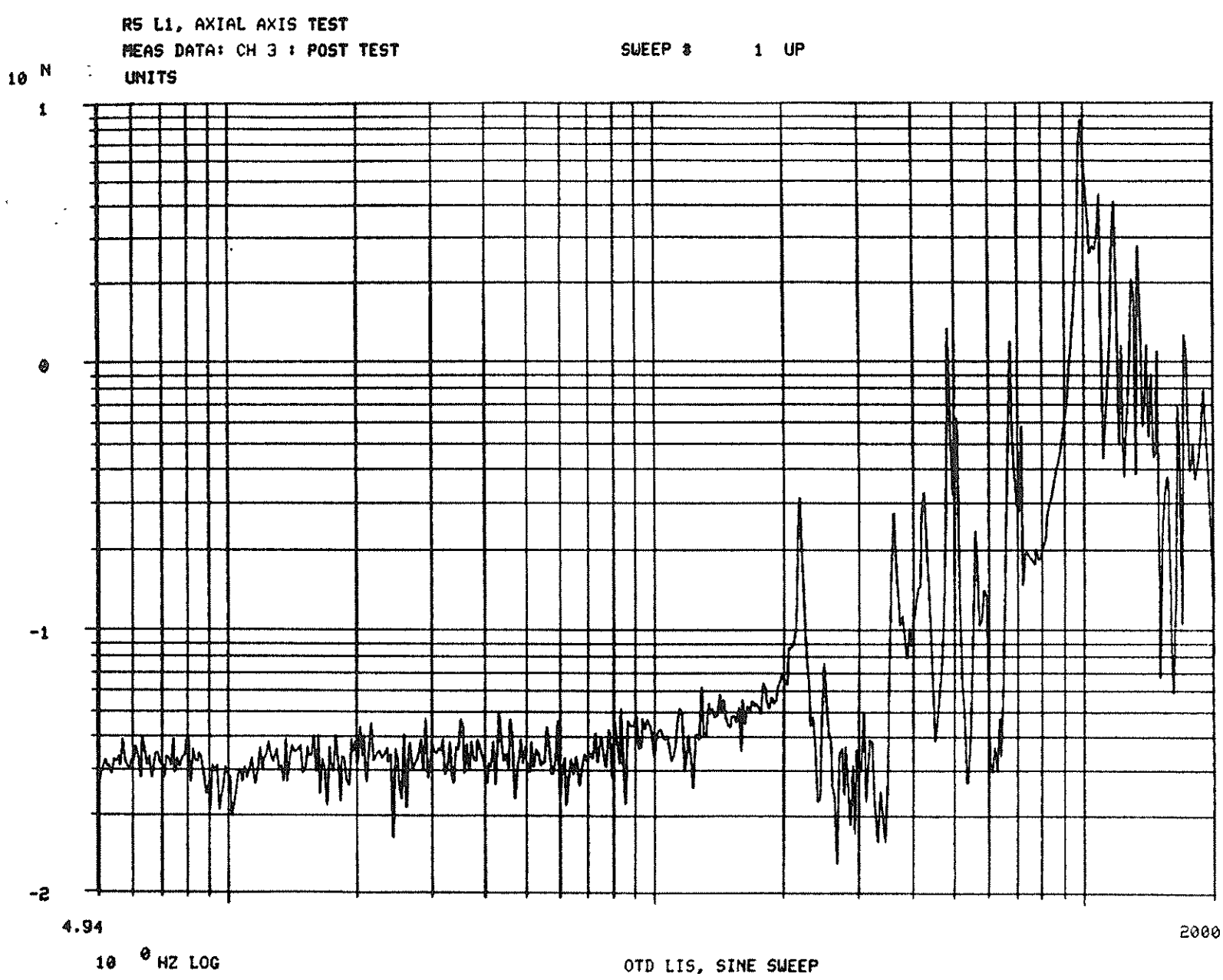
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


RS L1, AXIAL AXIS TEST
MEAS DATA: CH 3 : POST TEST
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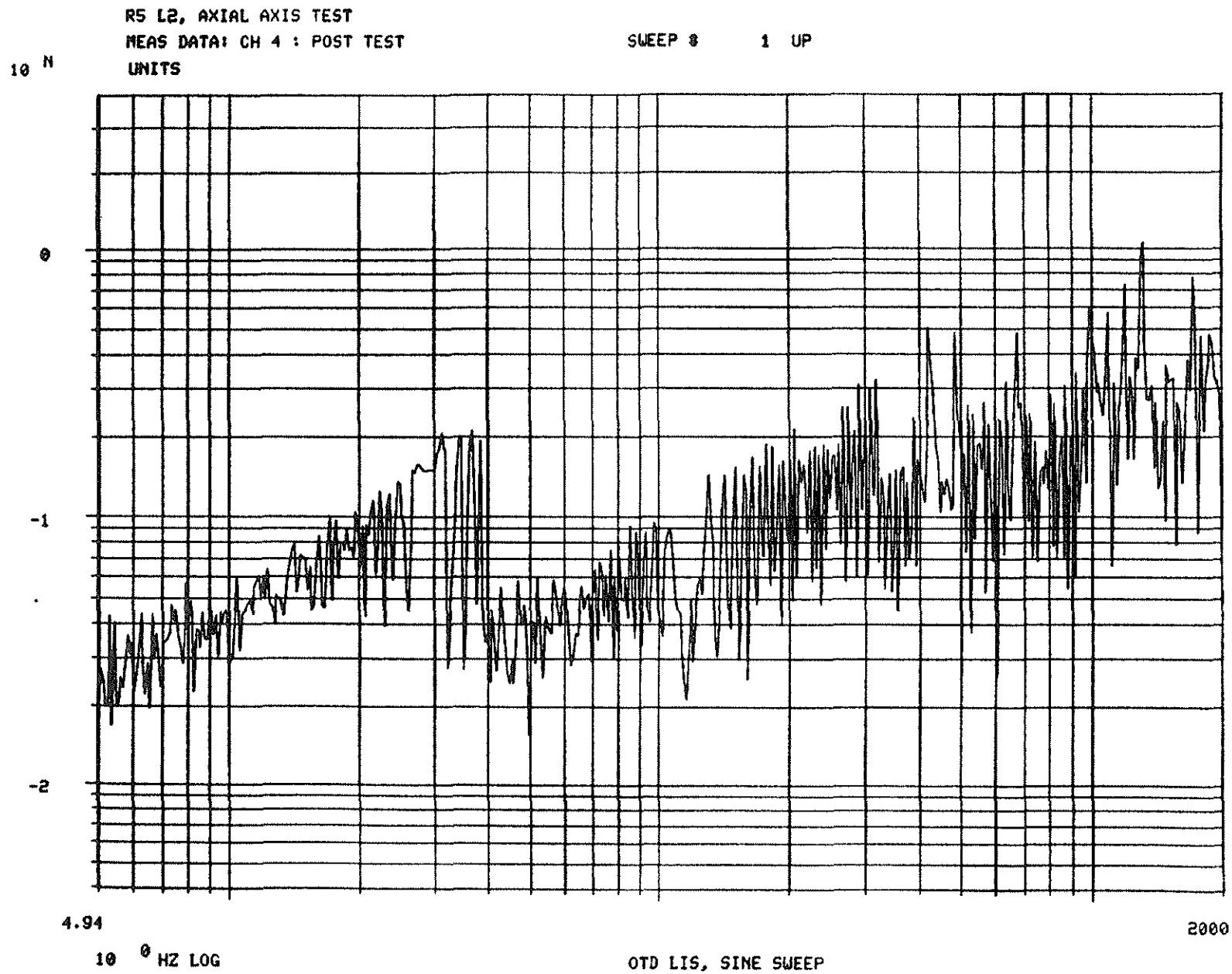
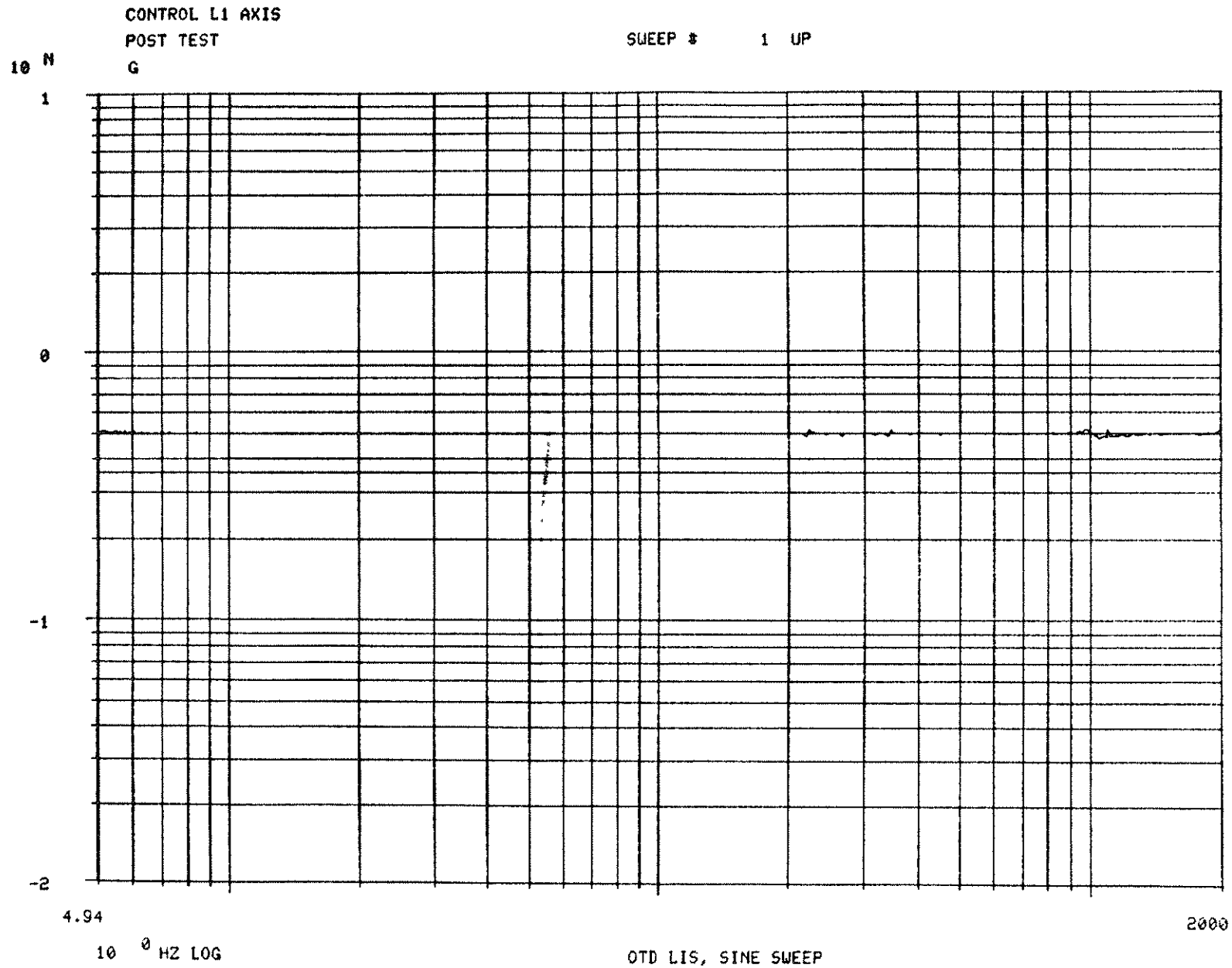
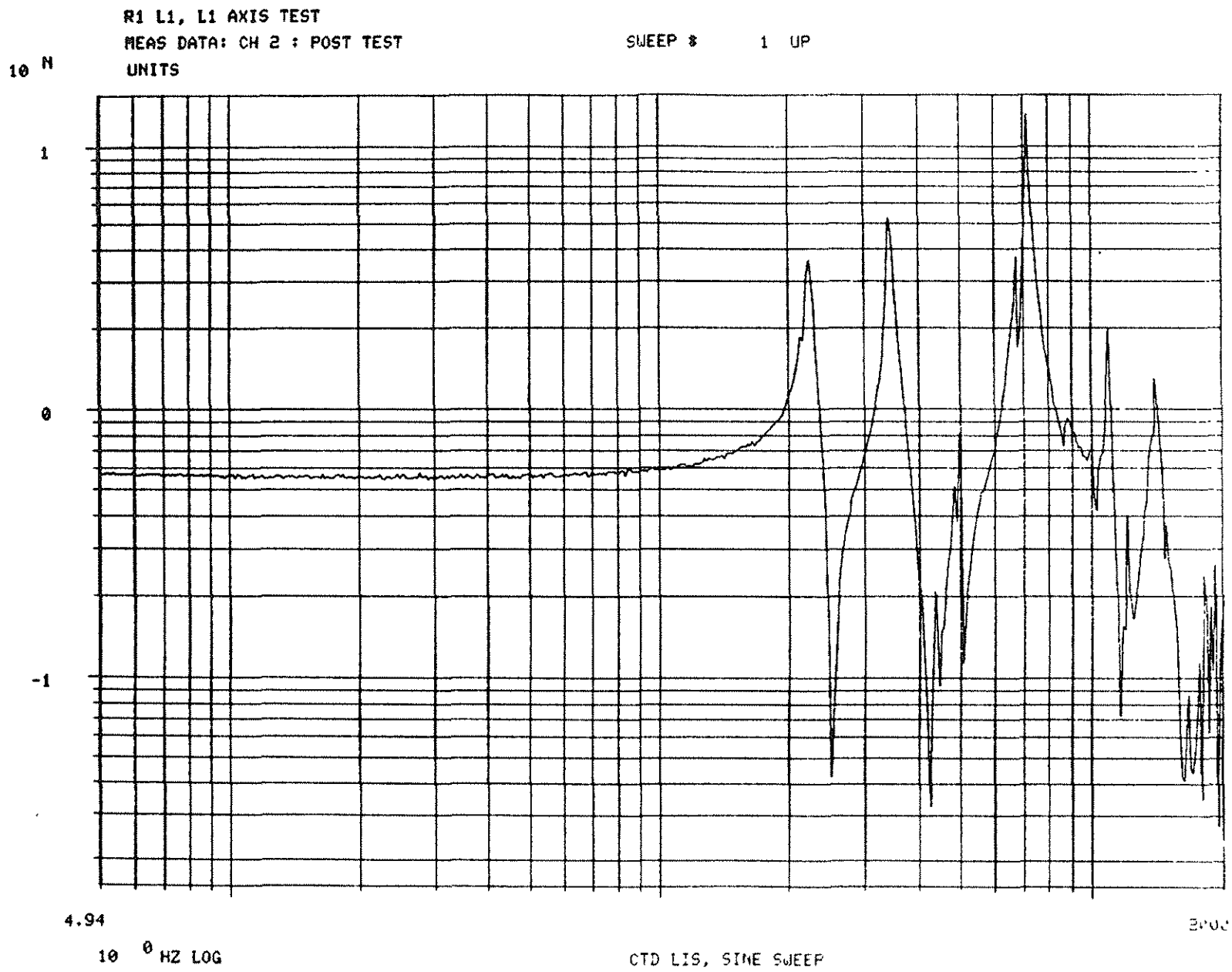
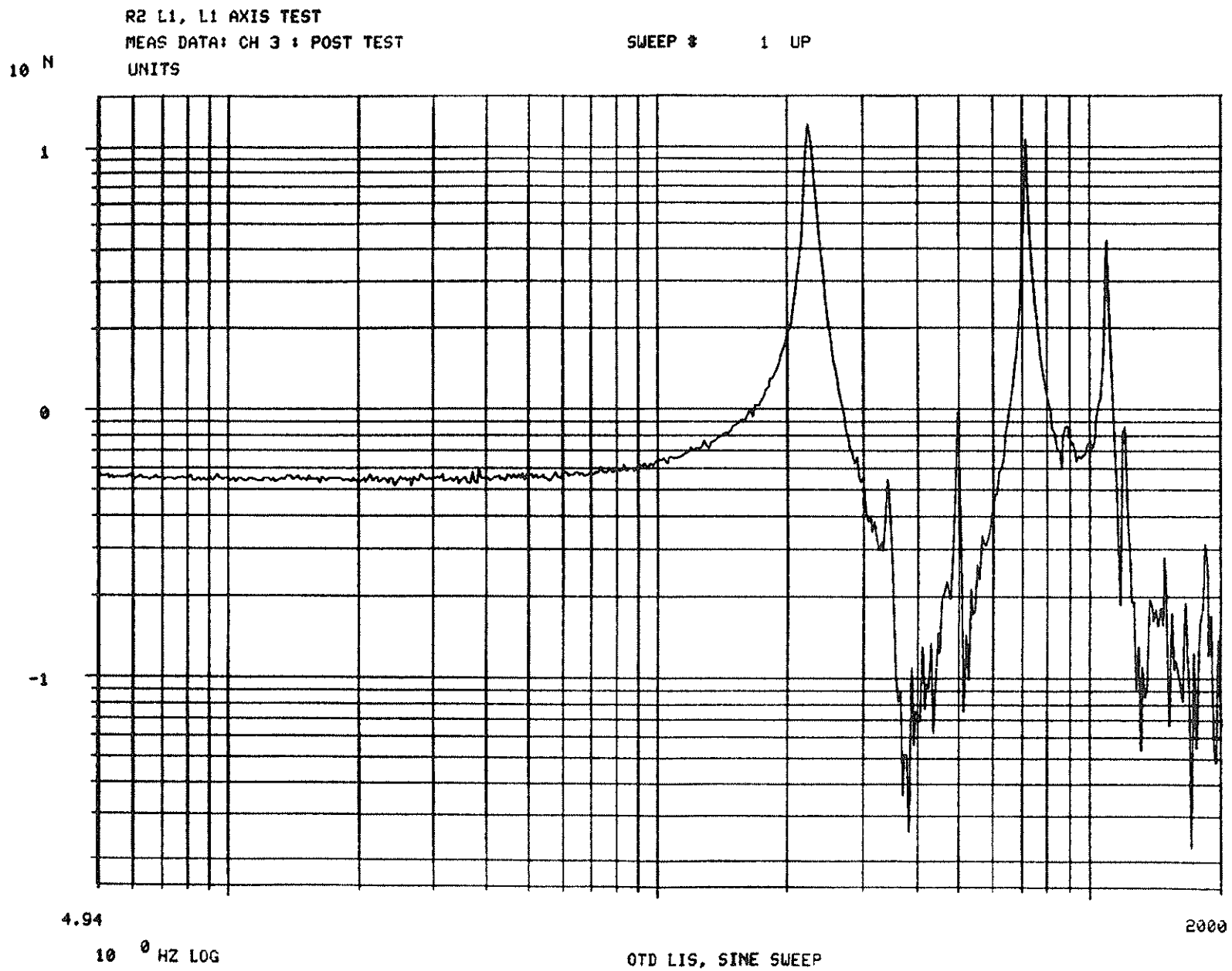
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

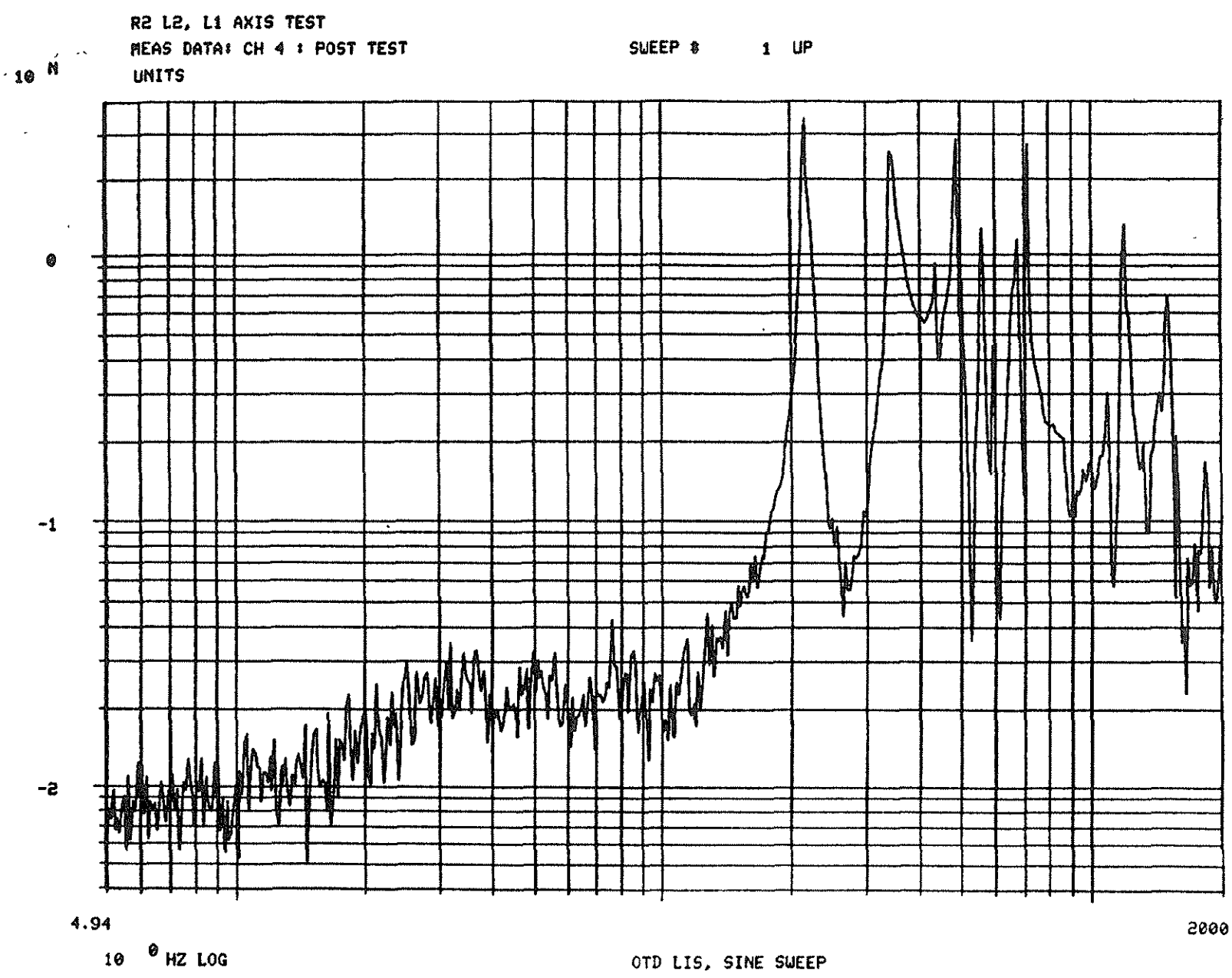

R5 L2, AXIAL AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP 8 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

SINE SWEEP, LI (Y) AXIS


CONTROL L1 AXIS
POST TEST
SWEEP # 1 UP
10 N
G
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R1 L1, L1 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
10 0 HZ LOG
CTD LIS, SINE SWEEP


R2 L1, L1 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP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MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
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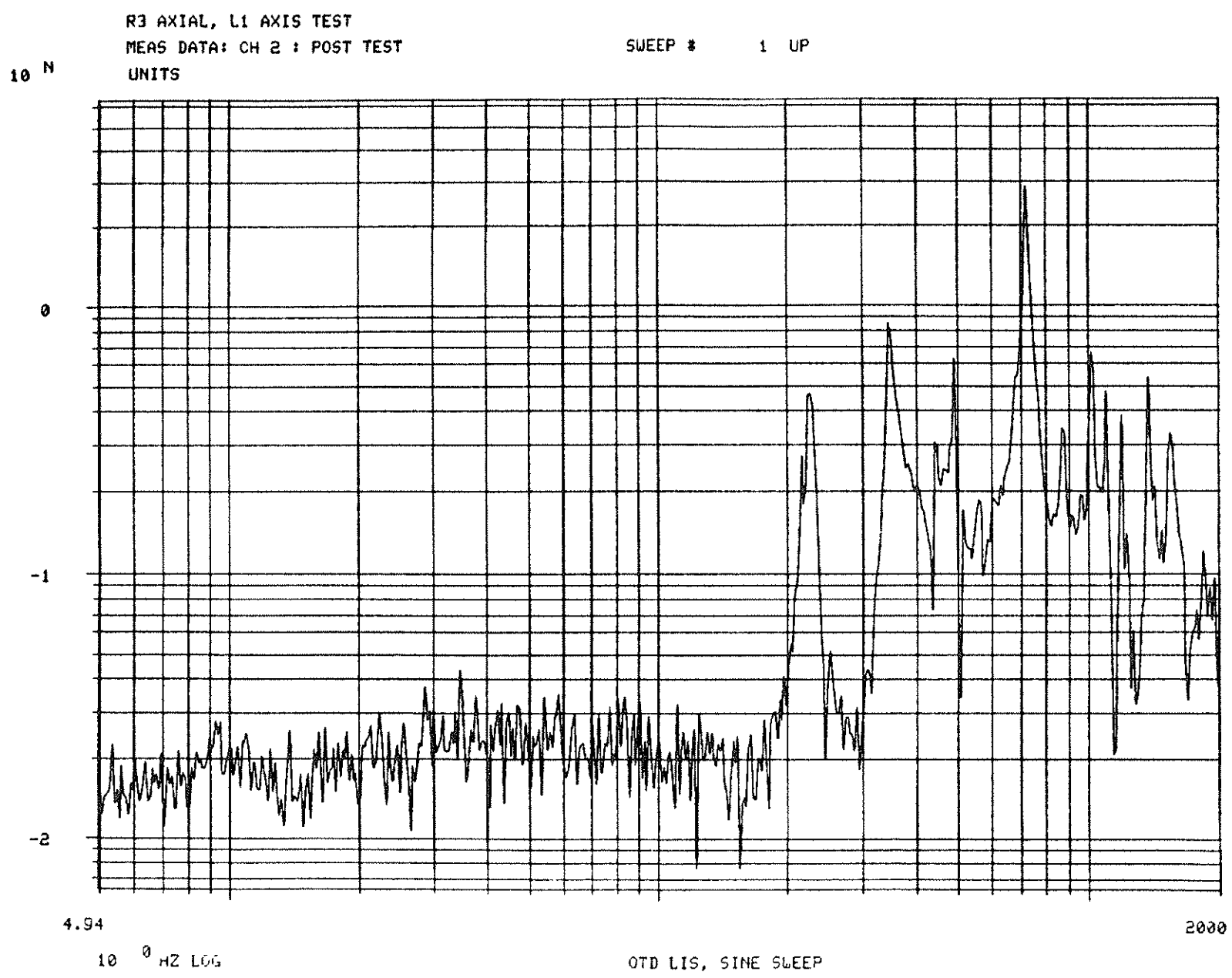
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP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MEAS DATA: CH 2 : POST TEST
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UNITS
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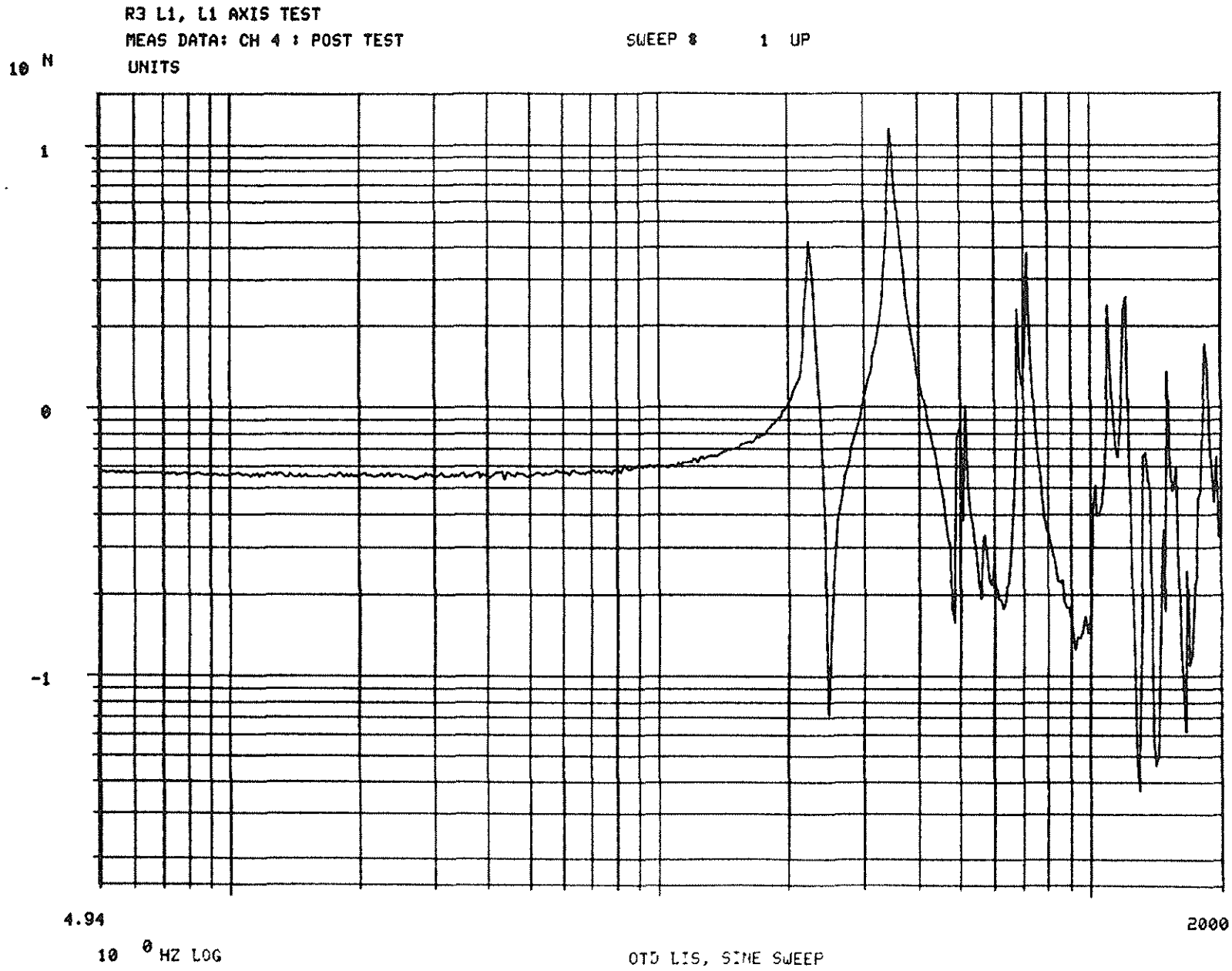
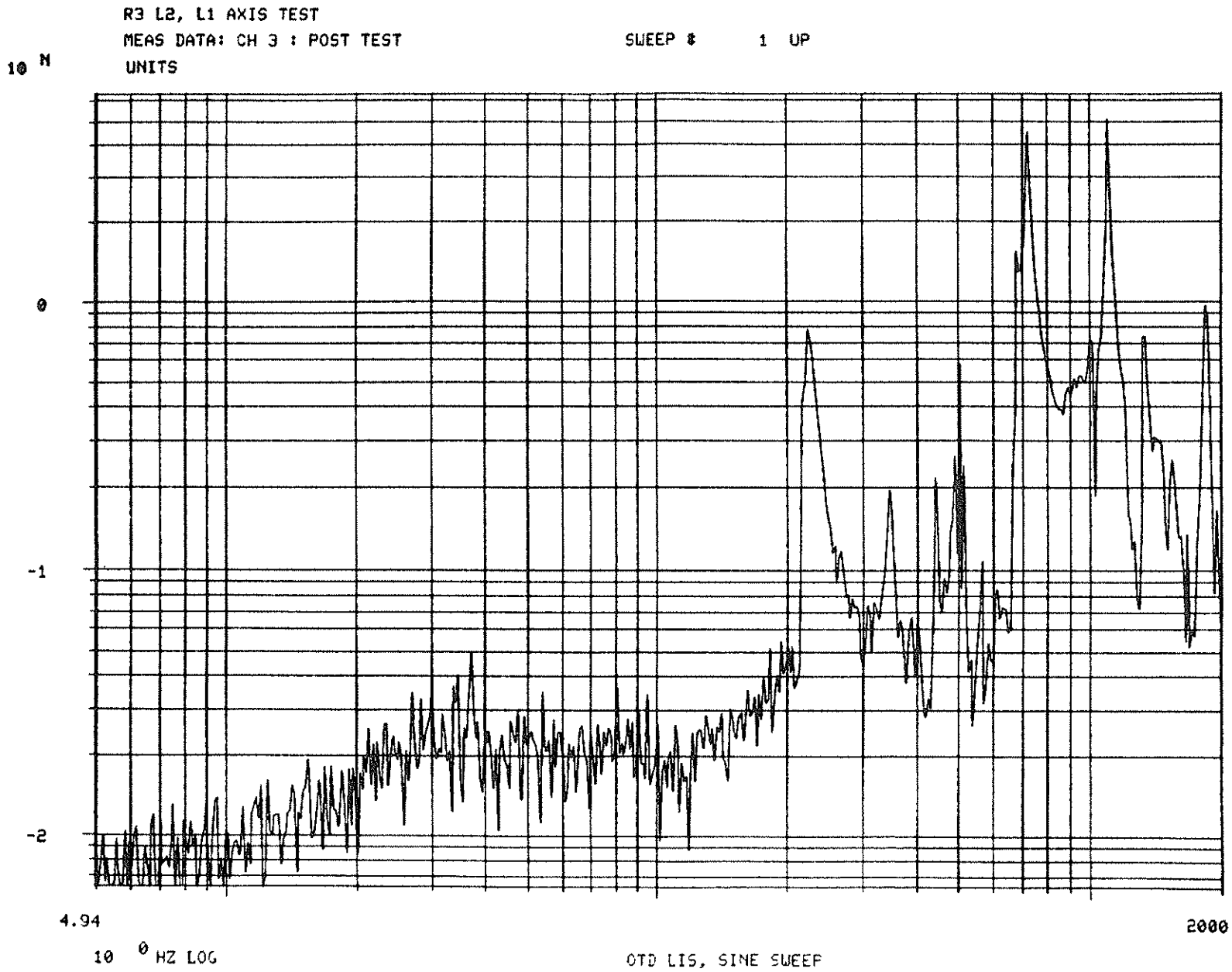
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R3 L1, L1 AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP 8 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R3 L2, L1 AXIS TEST
MEAS DATA: CH 3 : POST TEST
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UNITS
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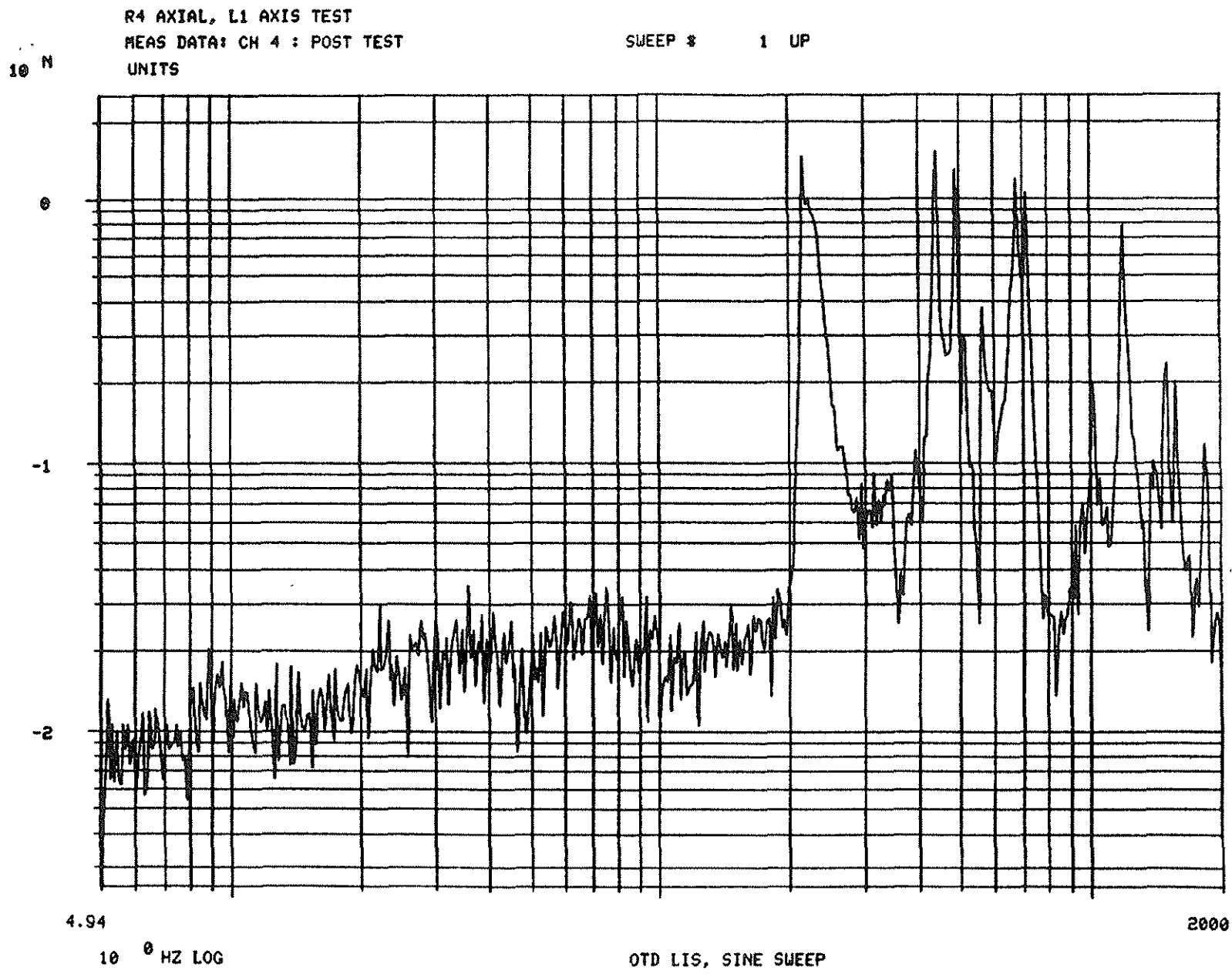
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4 AXIAL, L1 AXIS TEST
MEAS DATA: CH 4 : POST TEST
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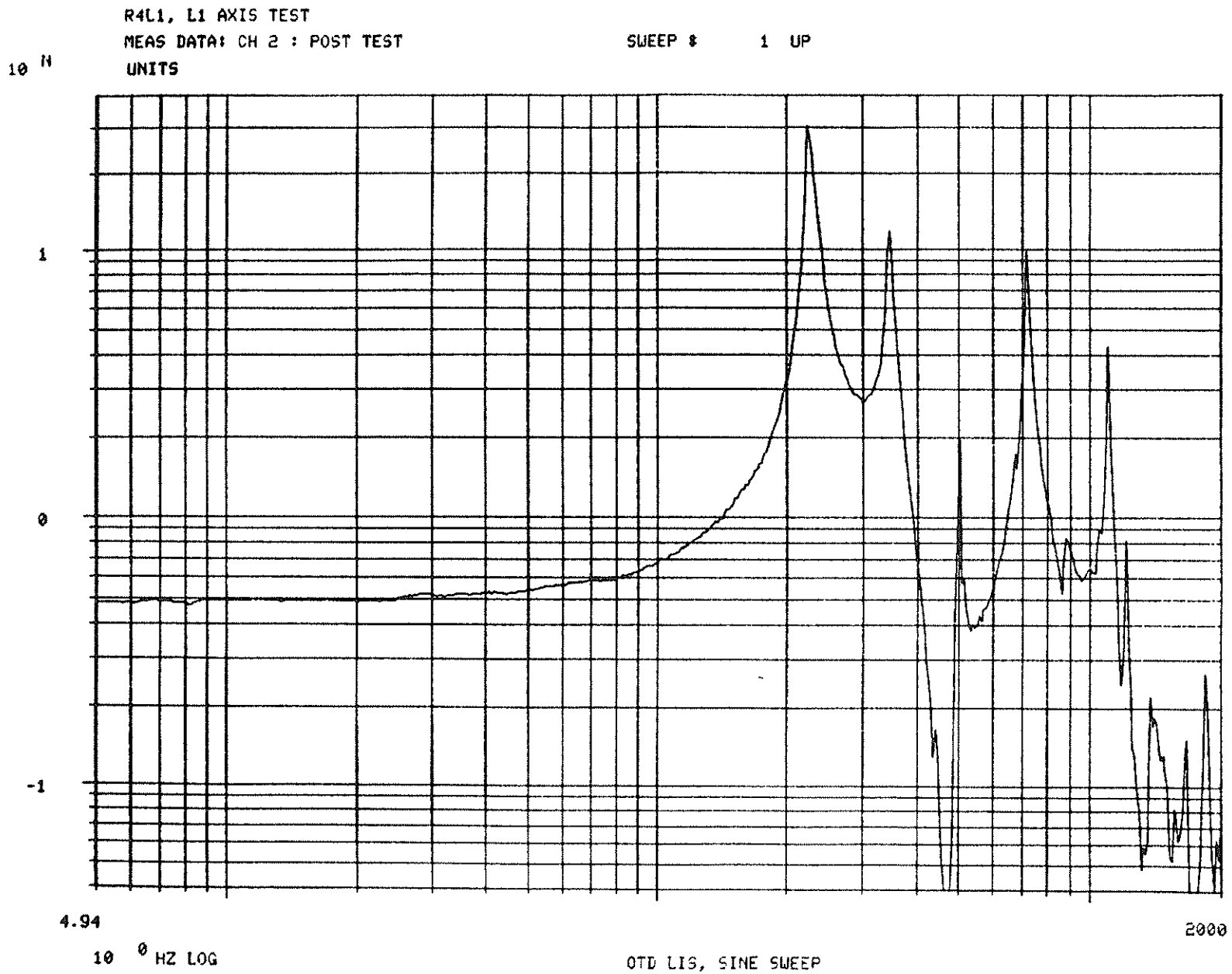
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4L1, L1 AXIS TEST
MEAS DATA: CH 2 : POST TEST
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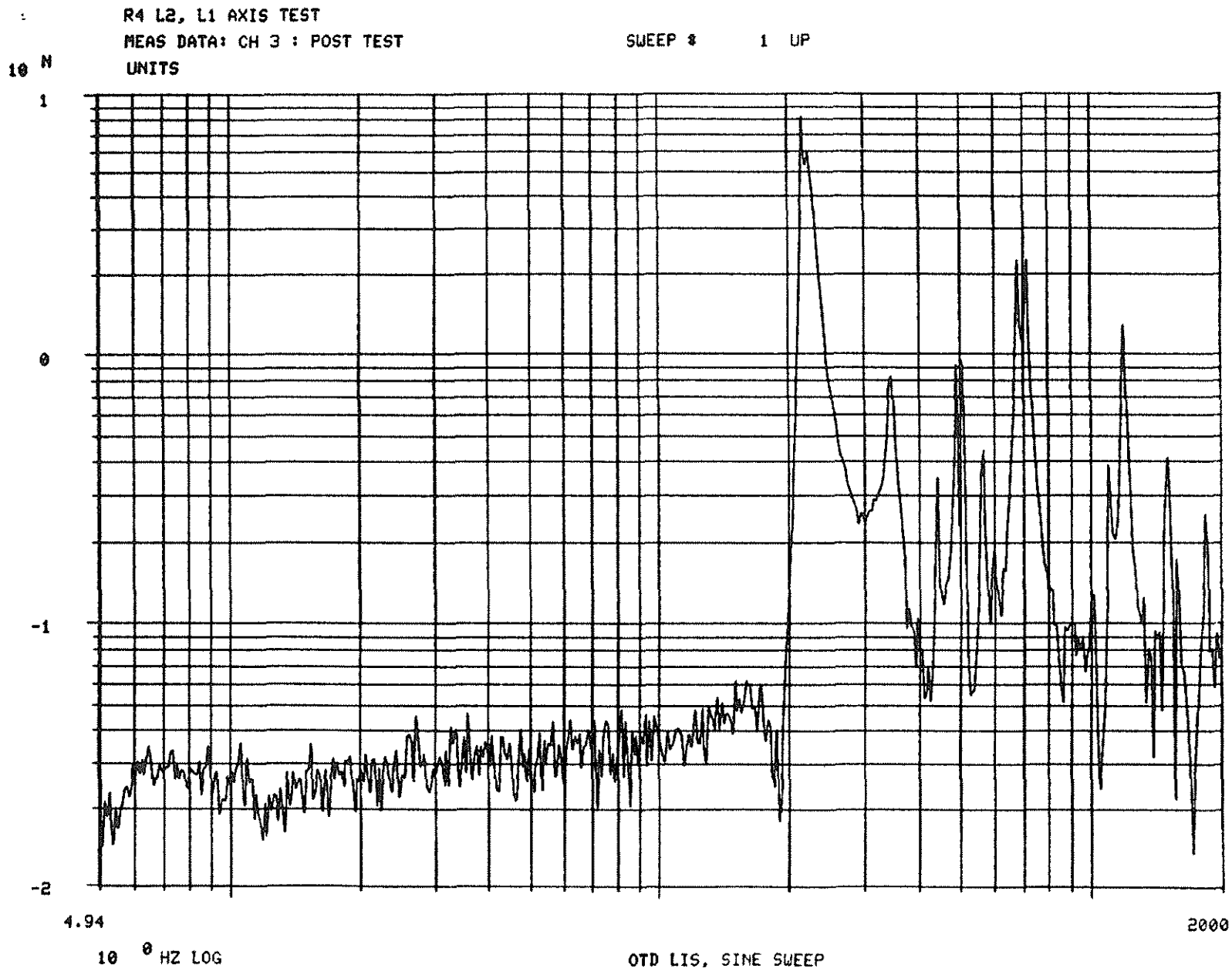
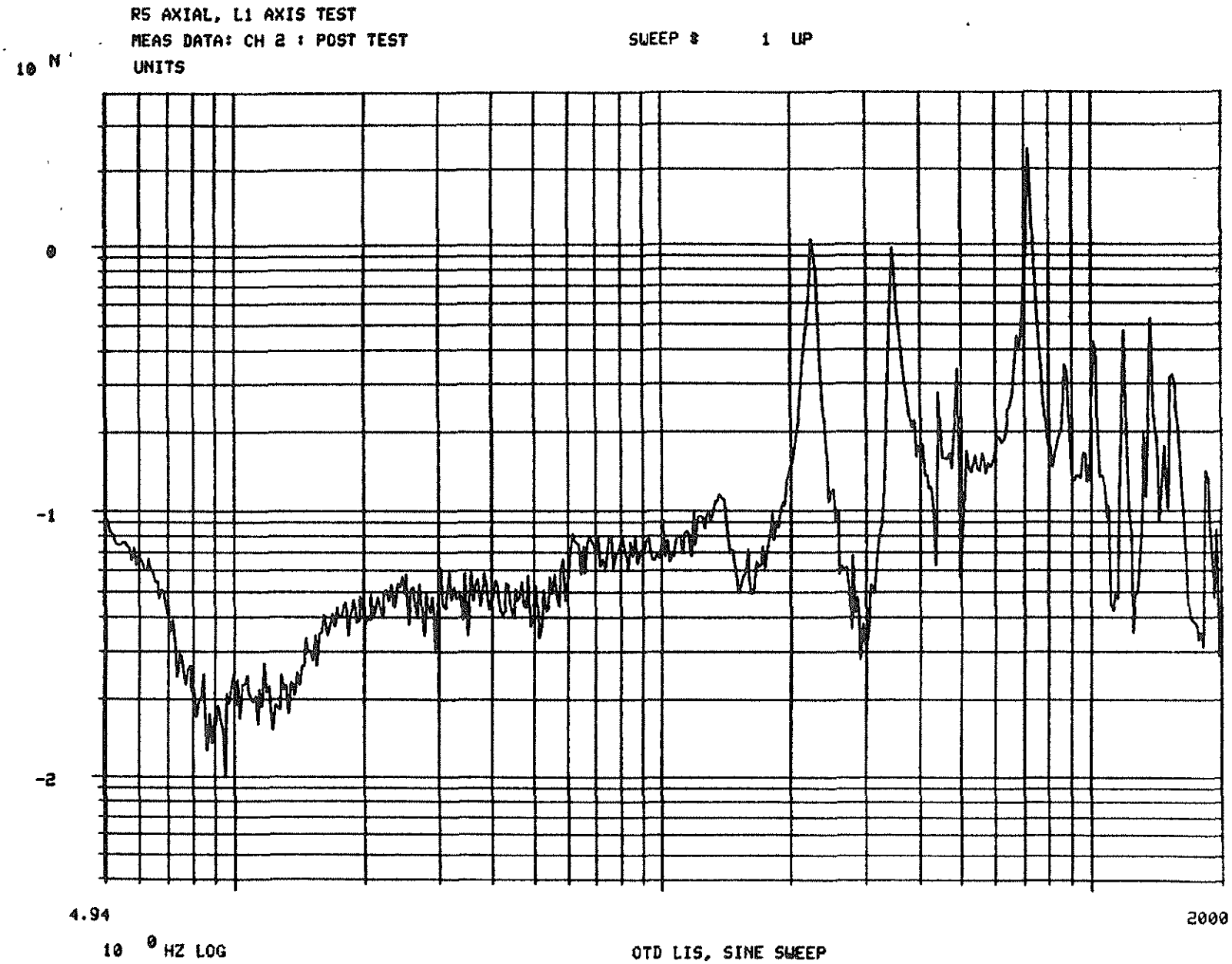
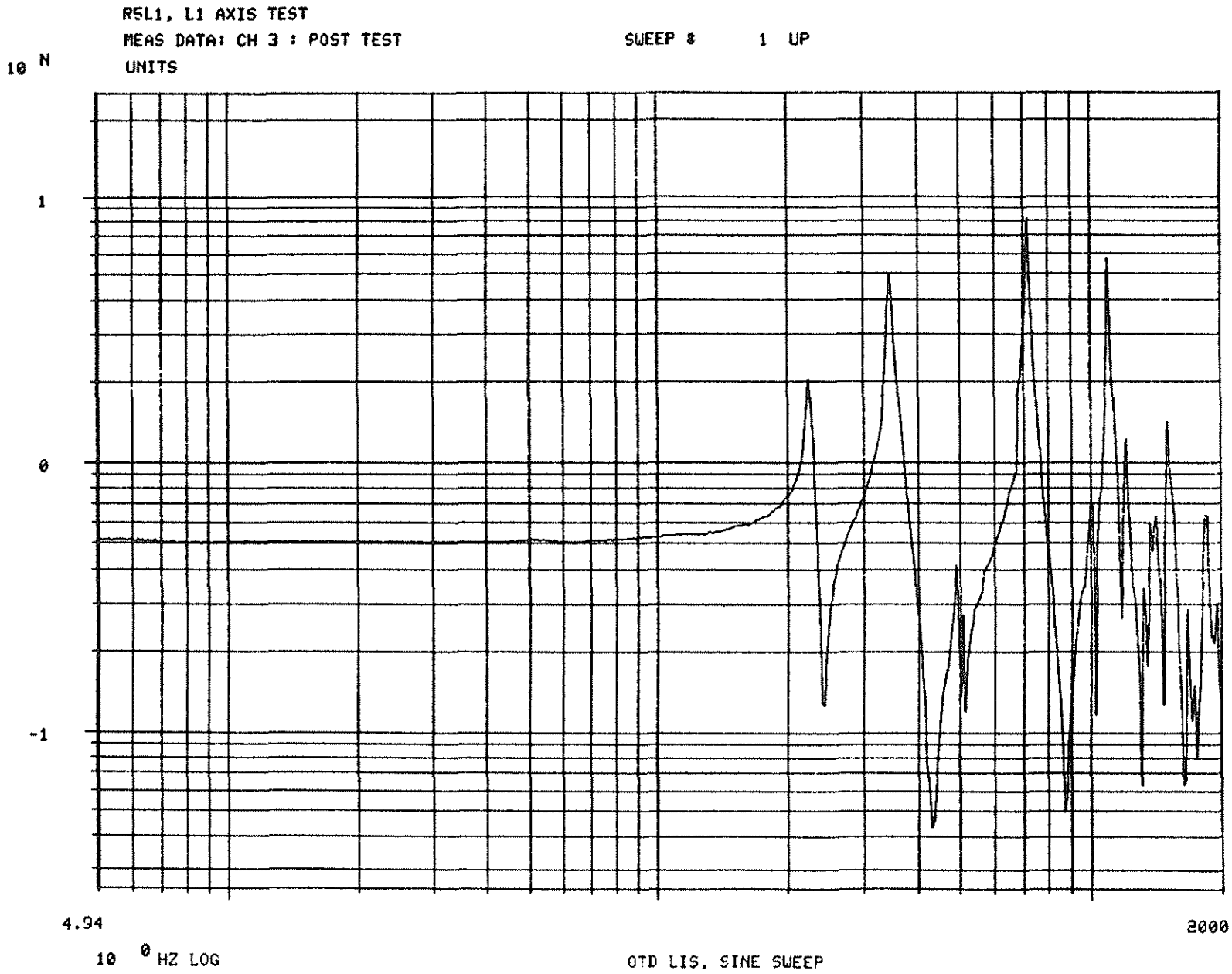
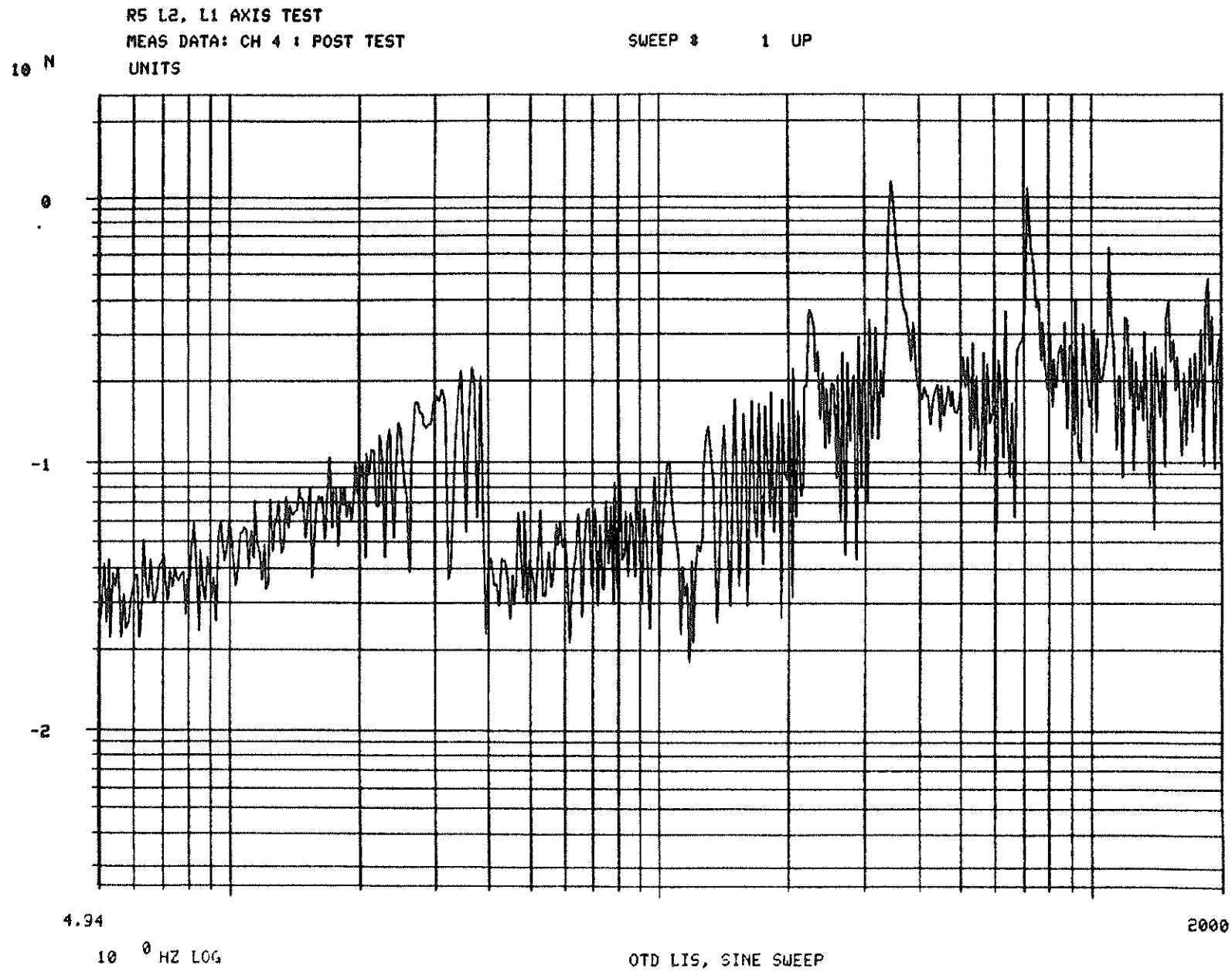
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

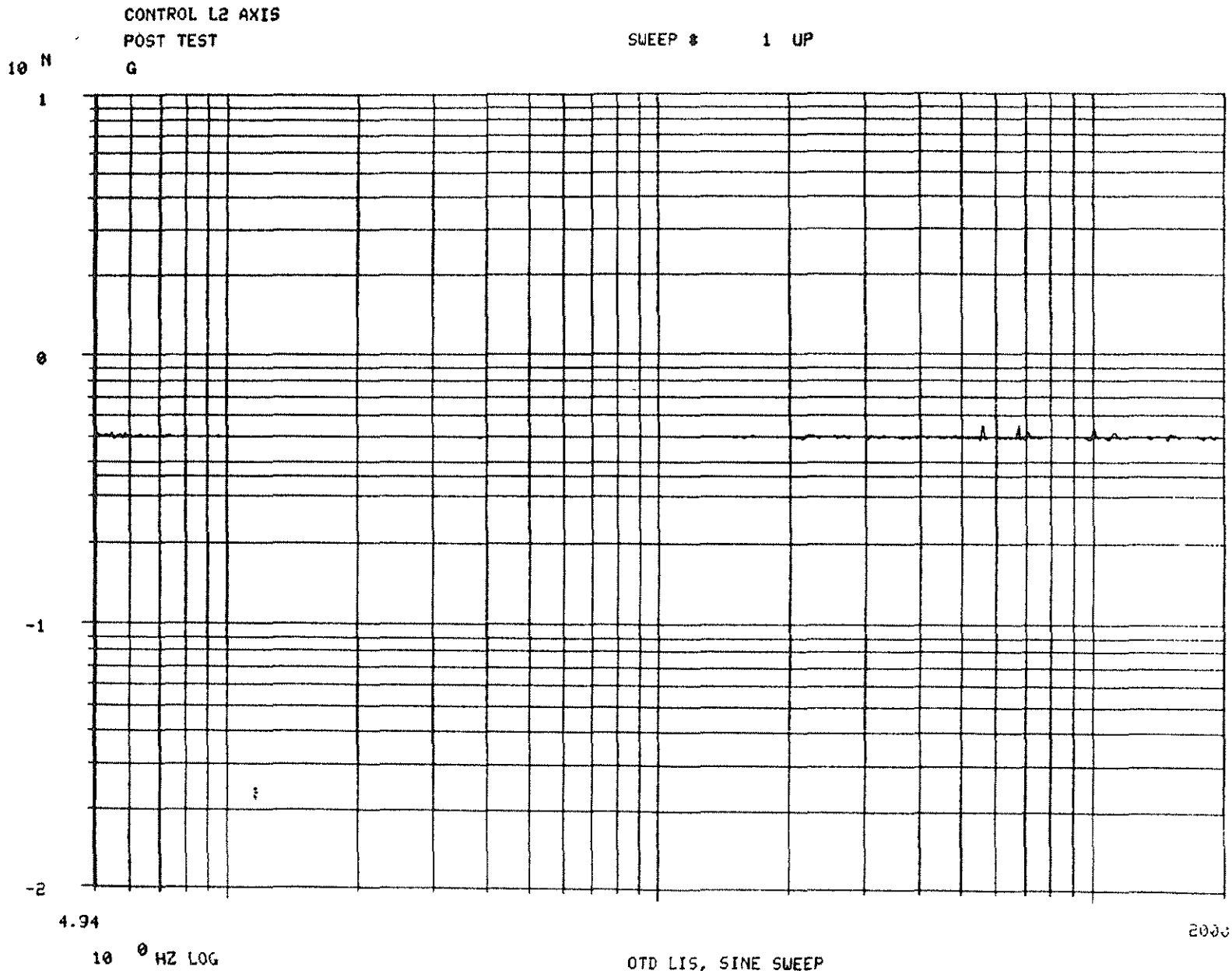

R4 L2, L1 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

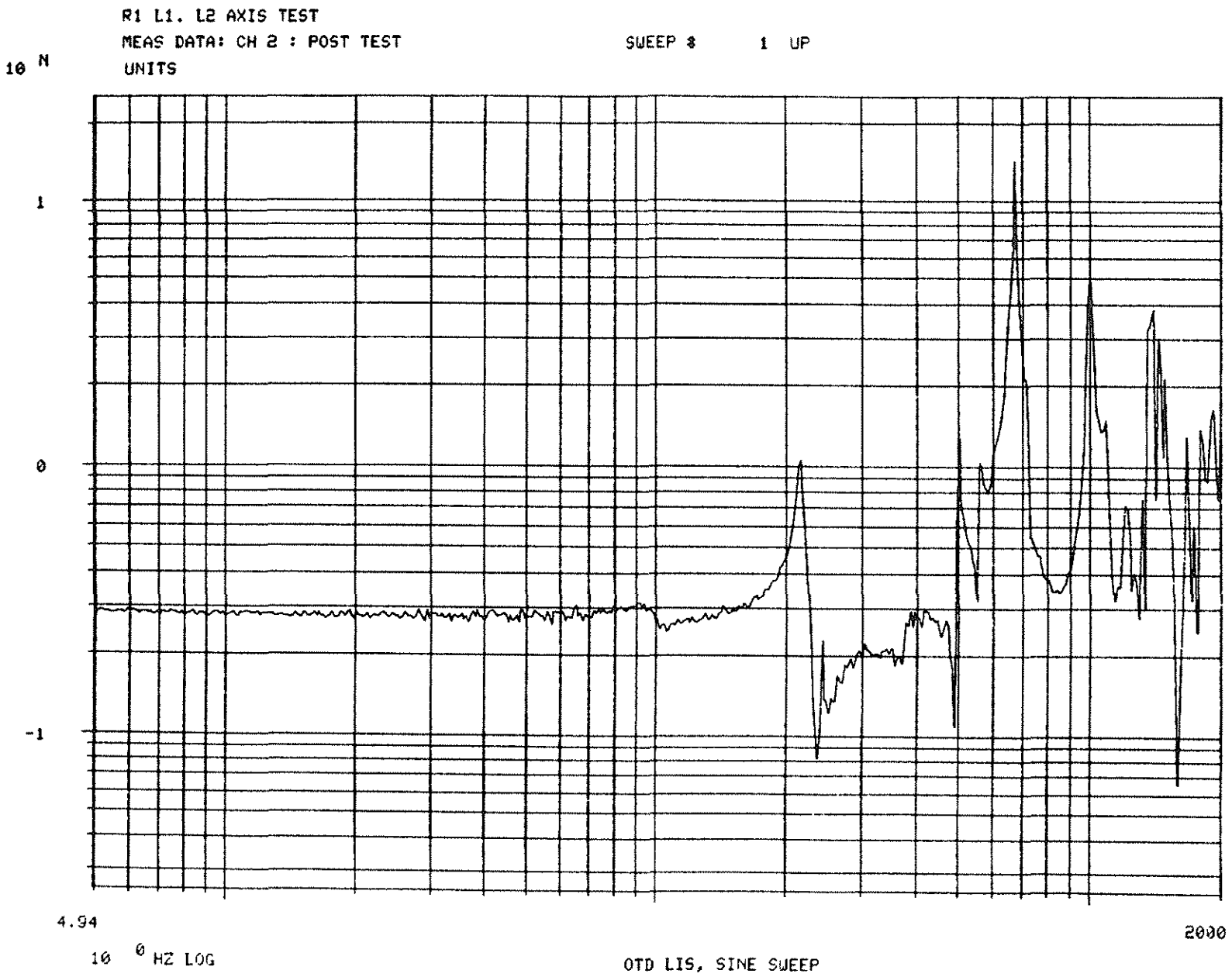

R5 AXIAL, L1 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

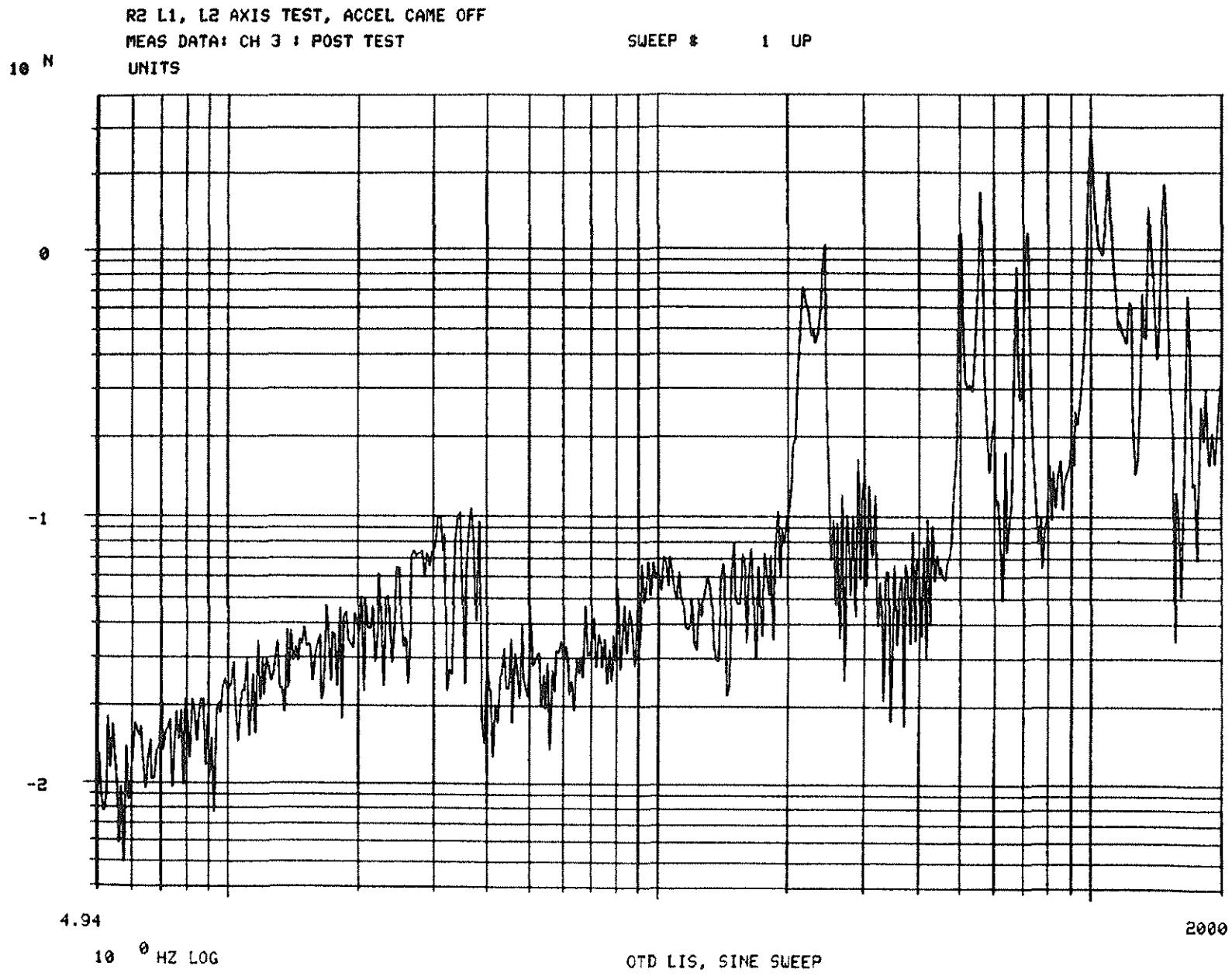

R5L1, L1 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

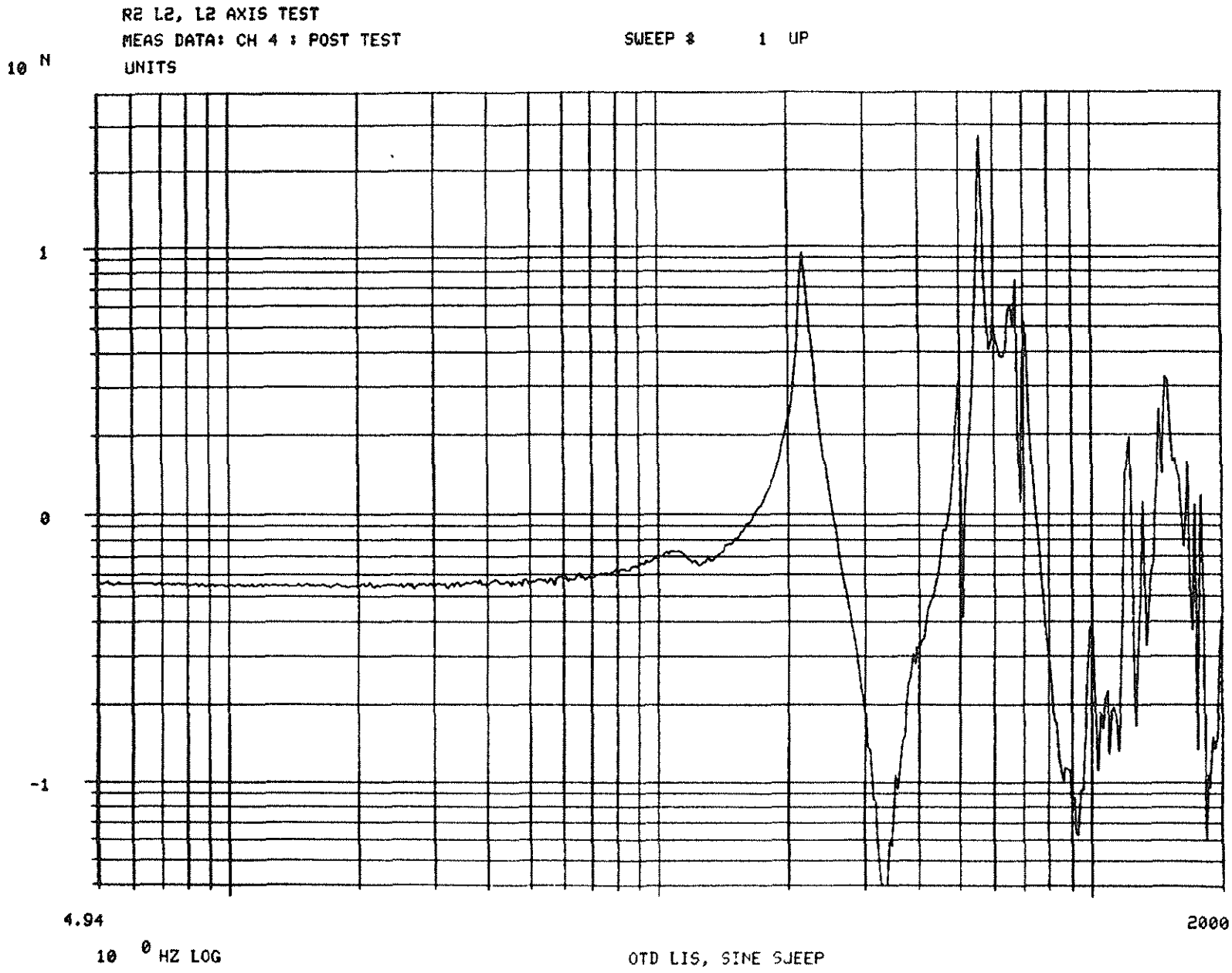

R5 L2, L1 AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

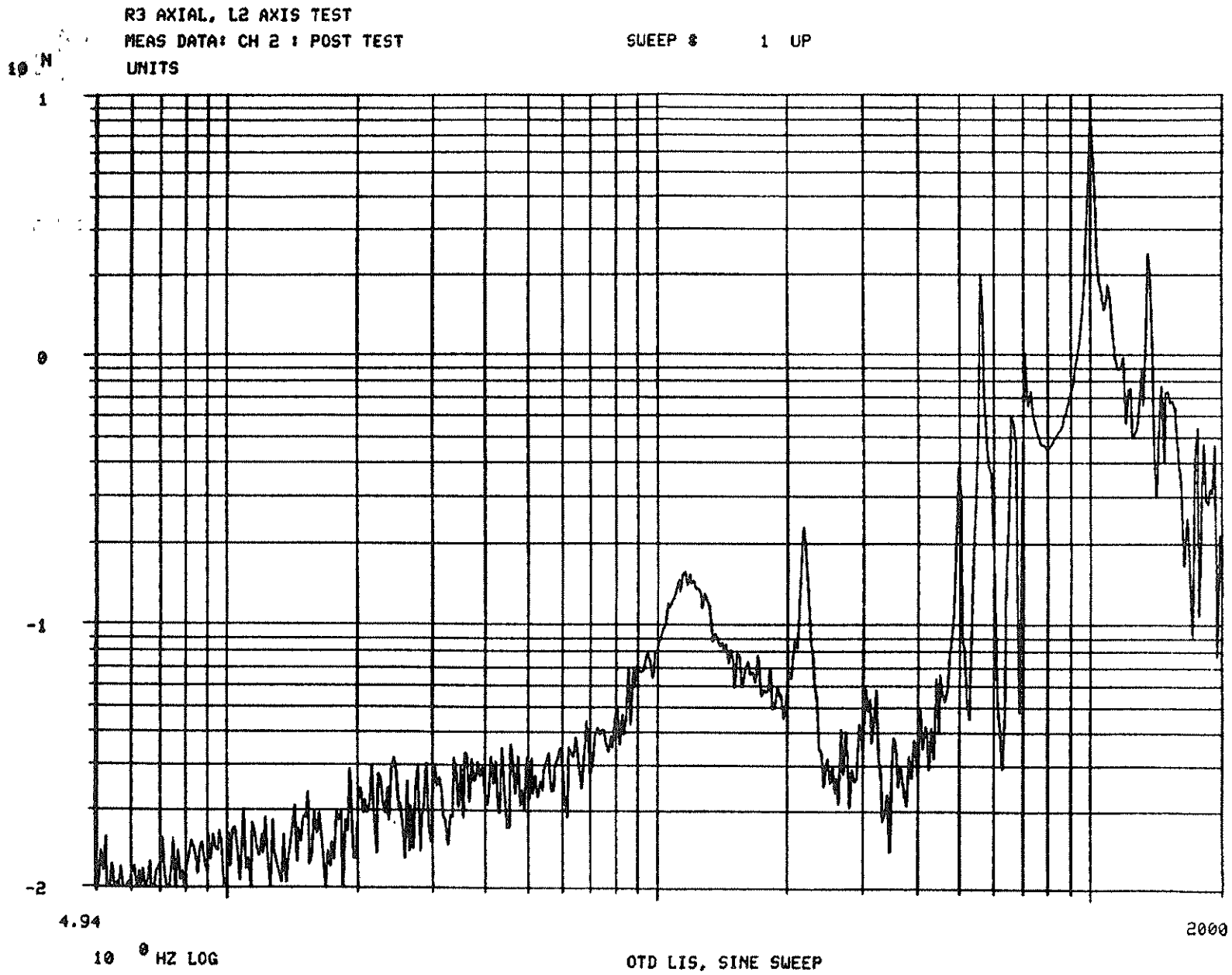
SINE SWEEP, L2 (Z) AXIS

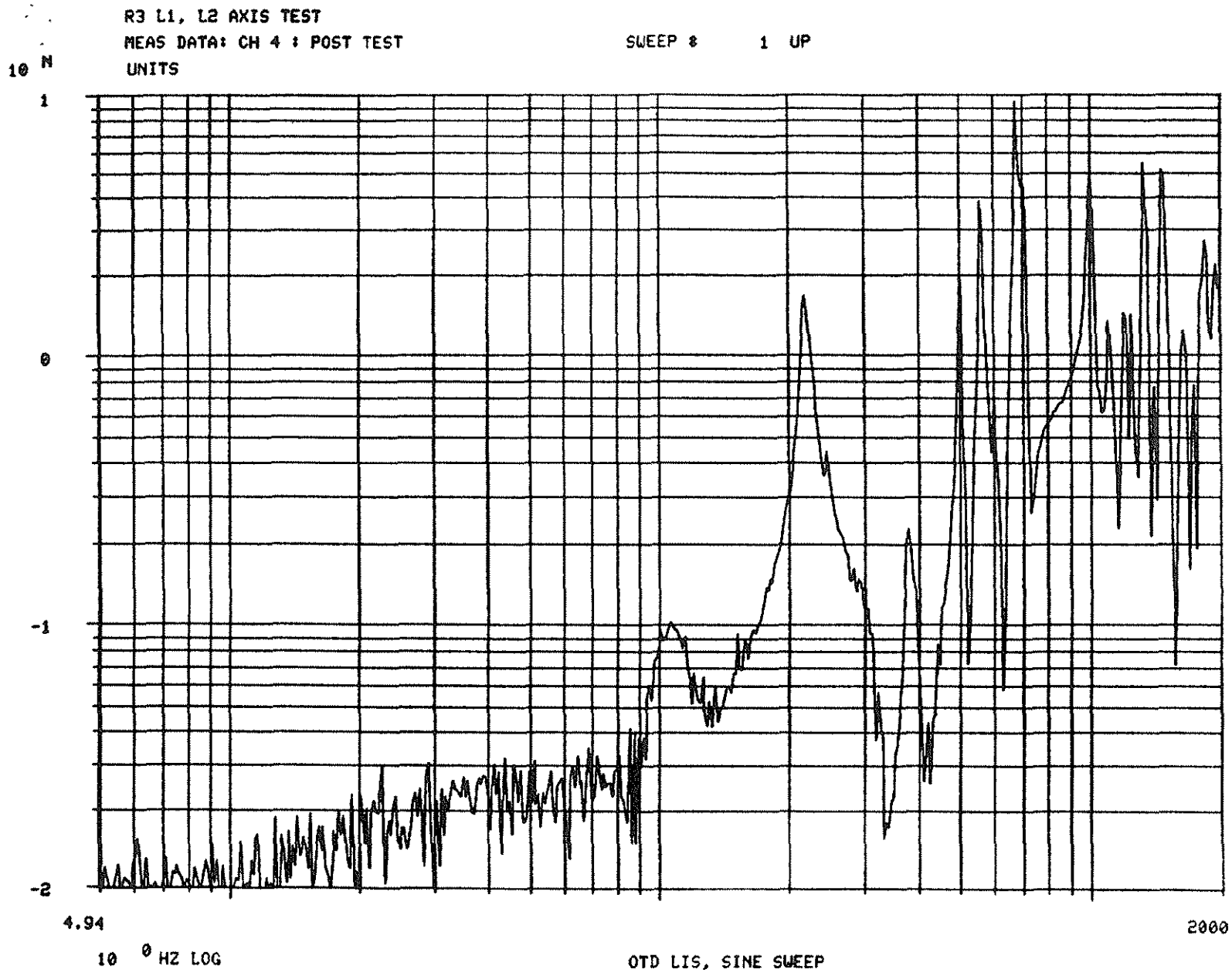

CONTROL L2 AXIS
POST TEST
SWEEP # 1 UP
10 N
G
1
0
-1
-2
4.94
10 0 HZ LOG
OTD LIS, SINE SWEEP

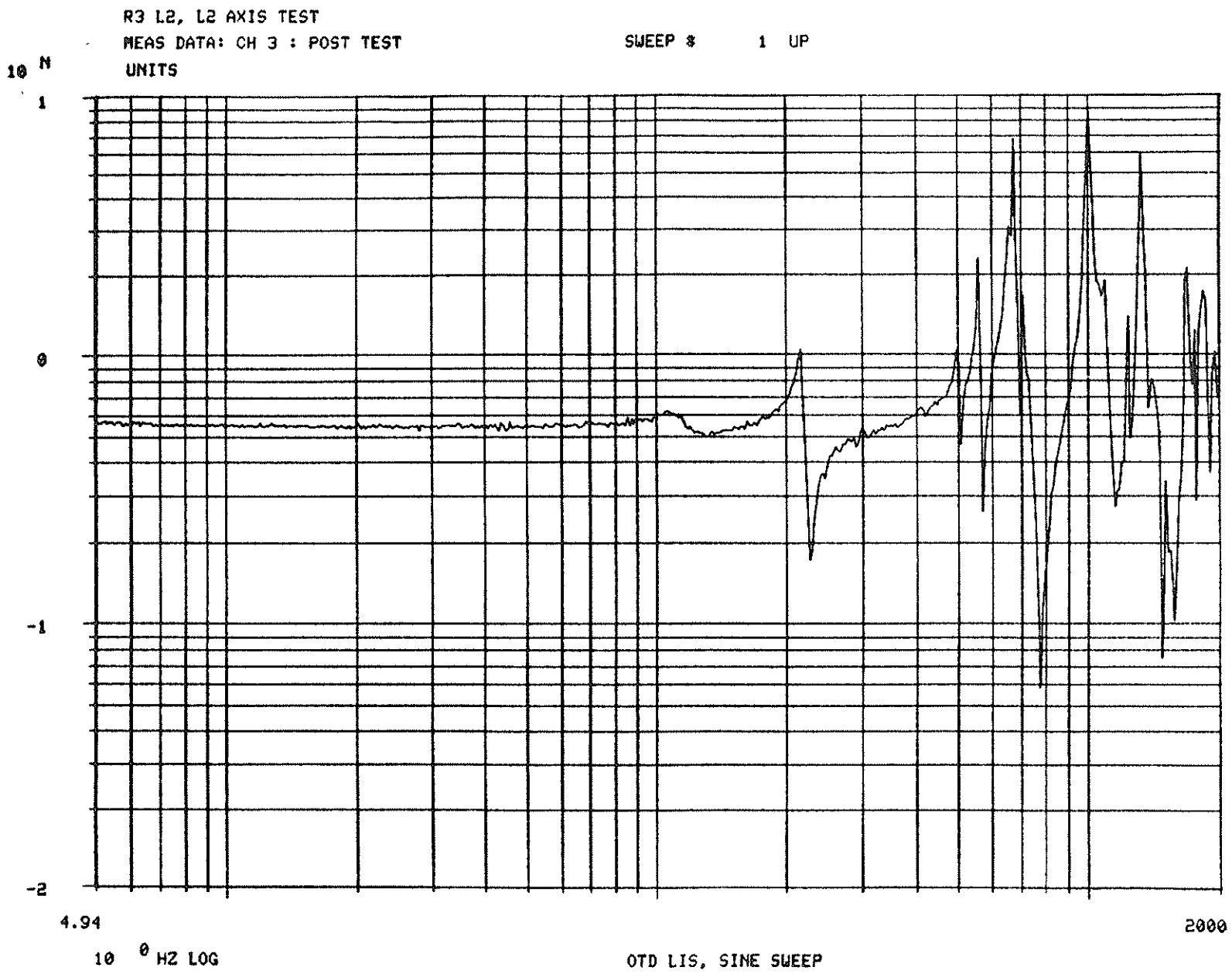

R1 L1. L2 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

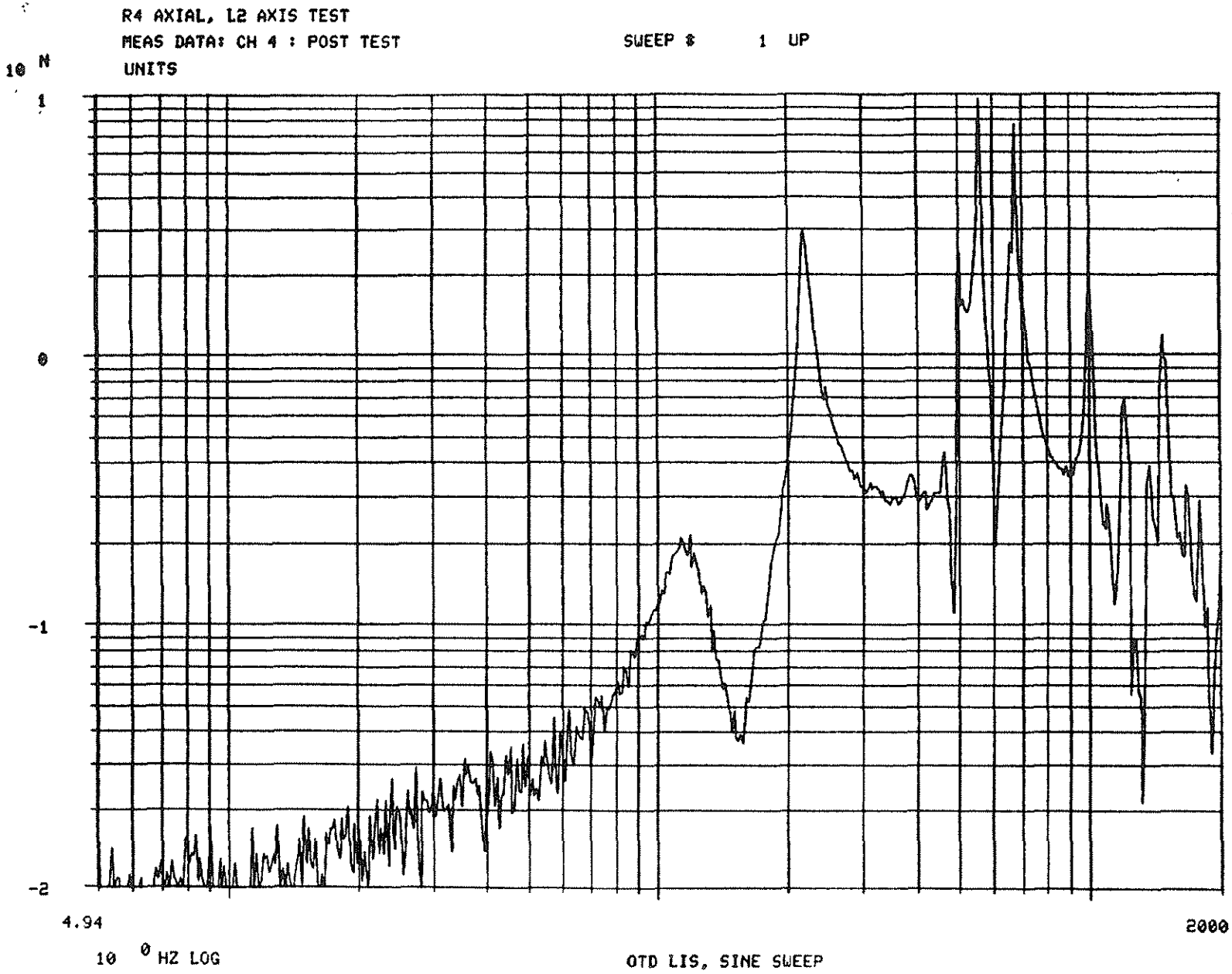

R2 L1, L2 AXIS TEST, ACCEL CAME OFF
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

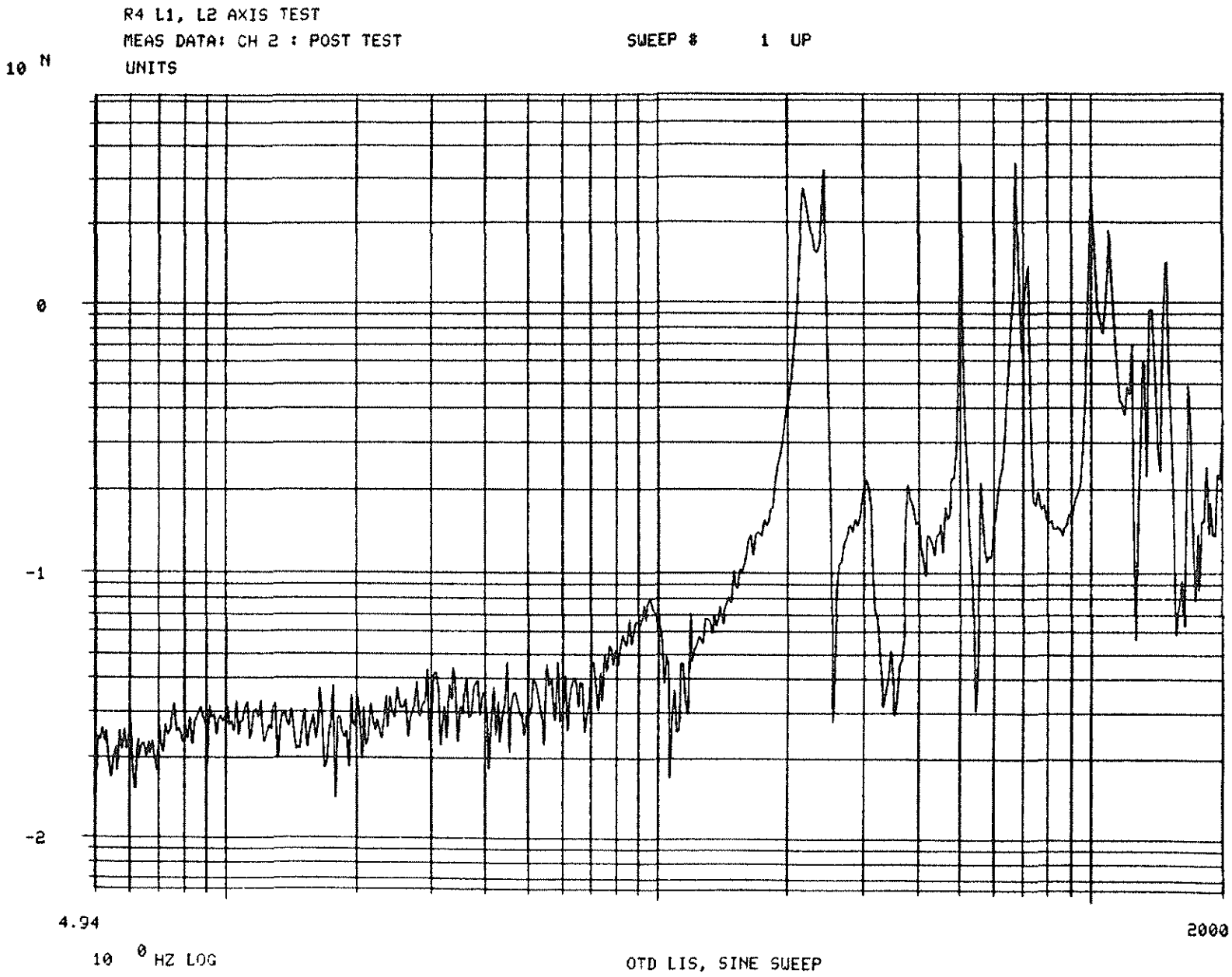

R2 L2, L2 AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

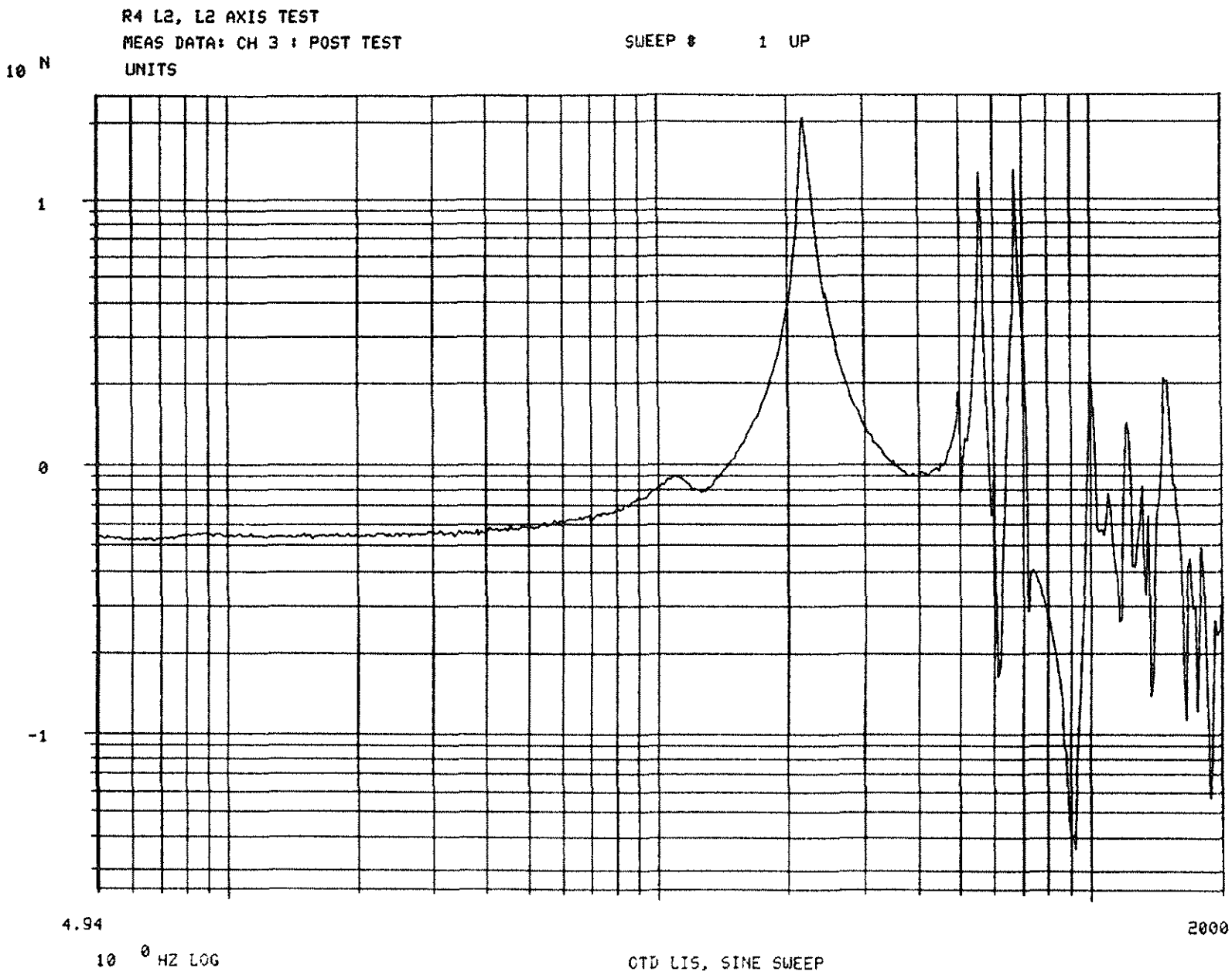

R3 AXIAL, L2 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

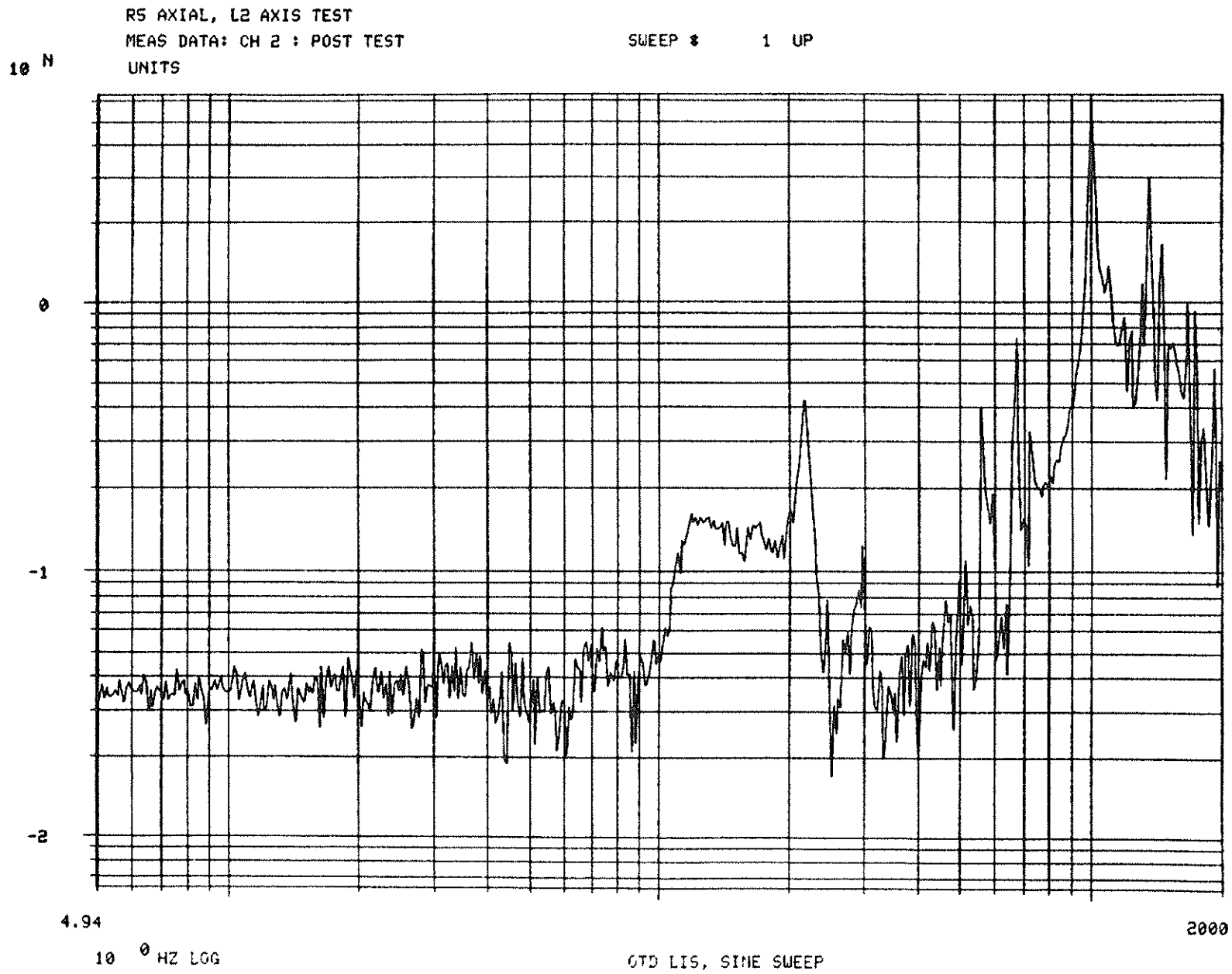

R3 L1, L2 AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

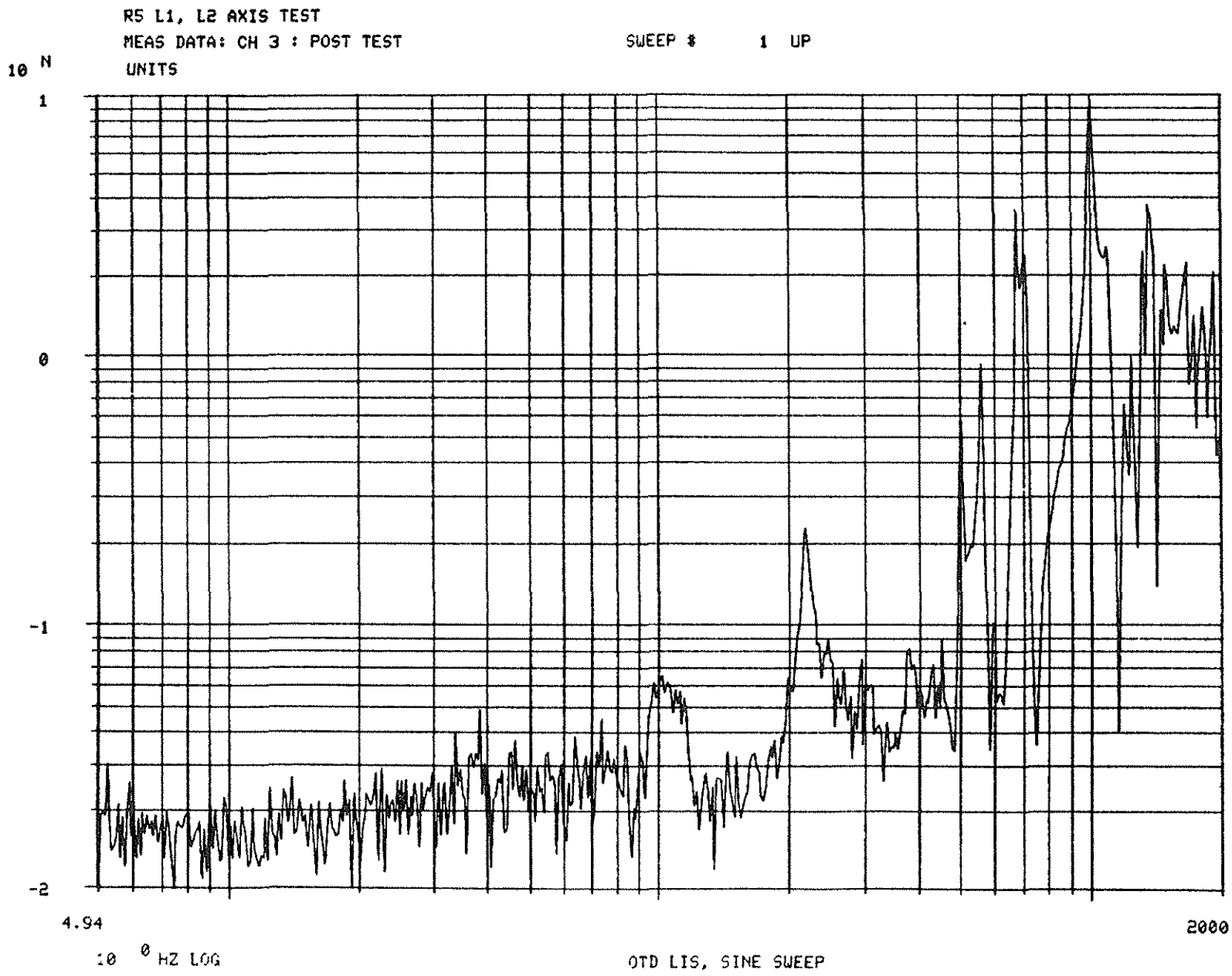

R3 L2, L2 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

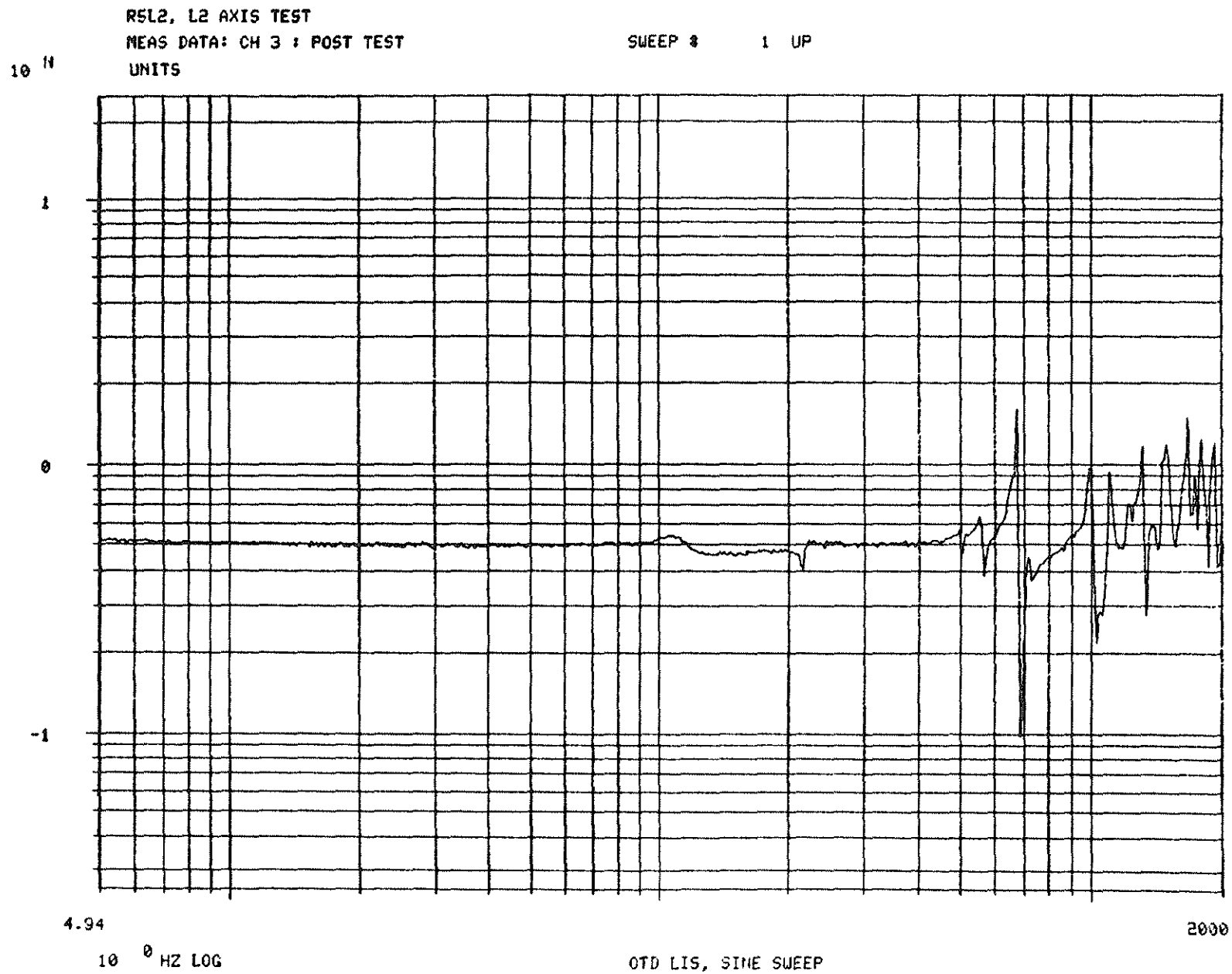

R4 AXIAL, L2 AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R4 L1, L2 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

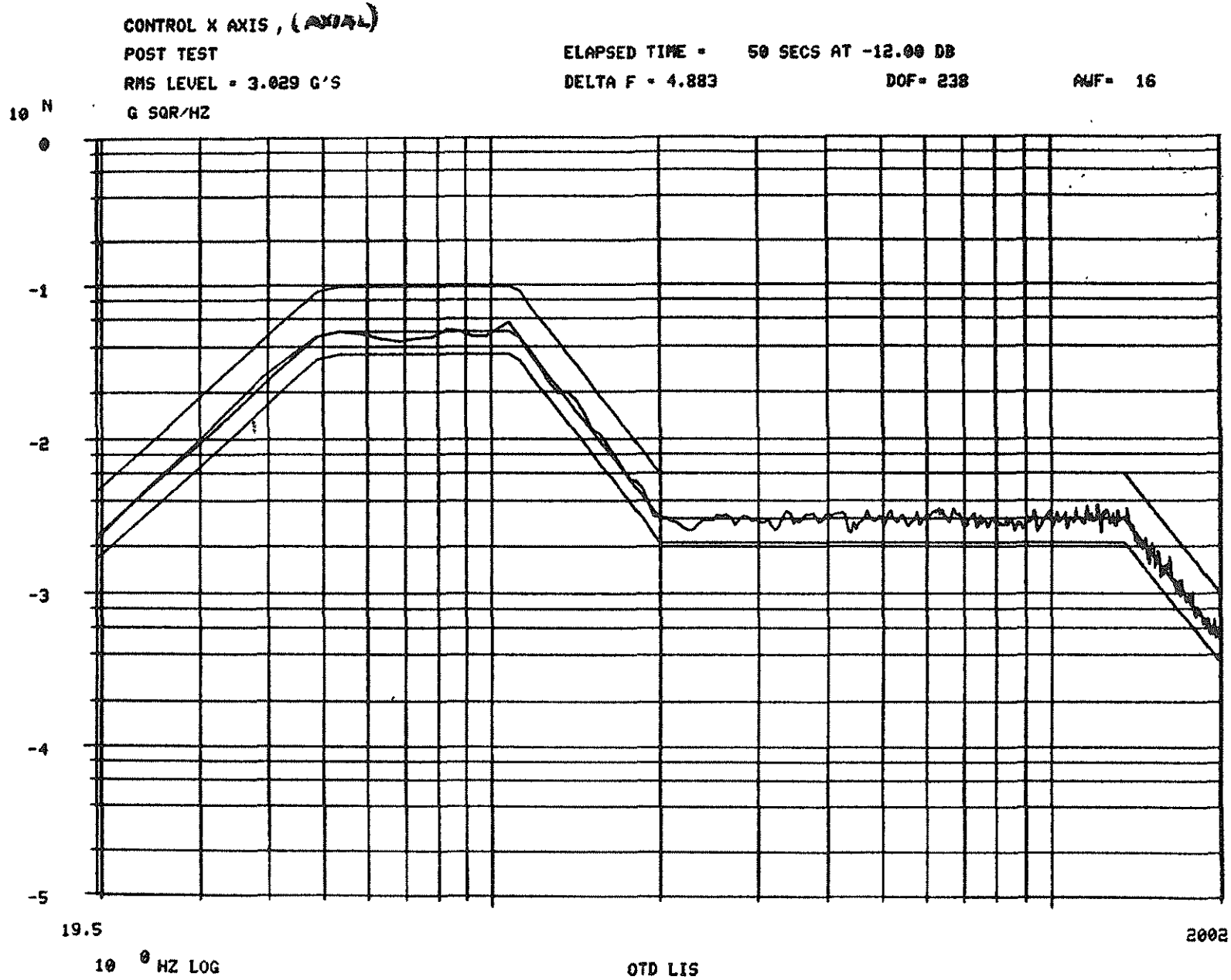

R4 L2, L2 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
UNITS
10 N
1
0
-1
4.94
2000
10 0 HZ LOG
CTD LIS, SINE SWEEP

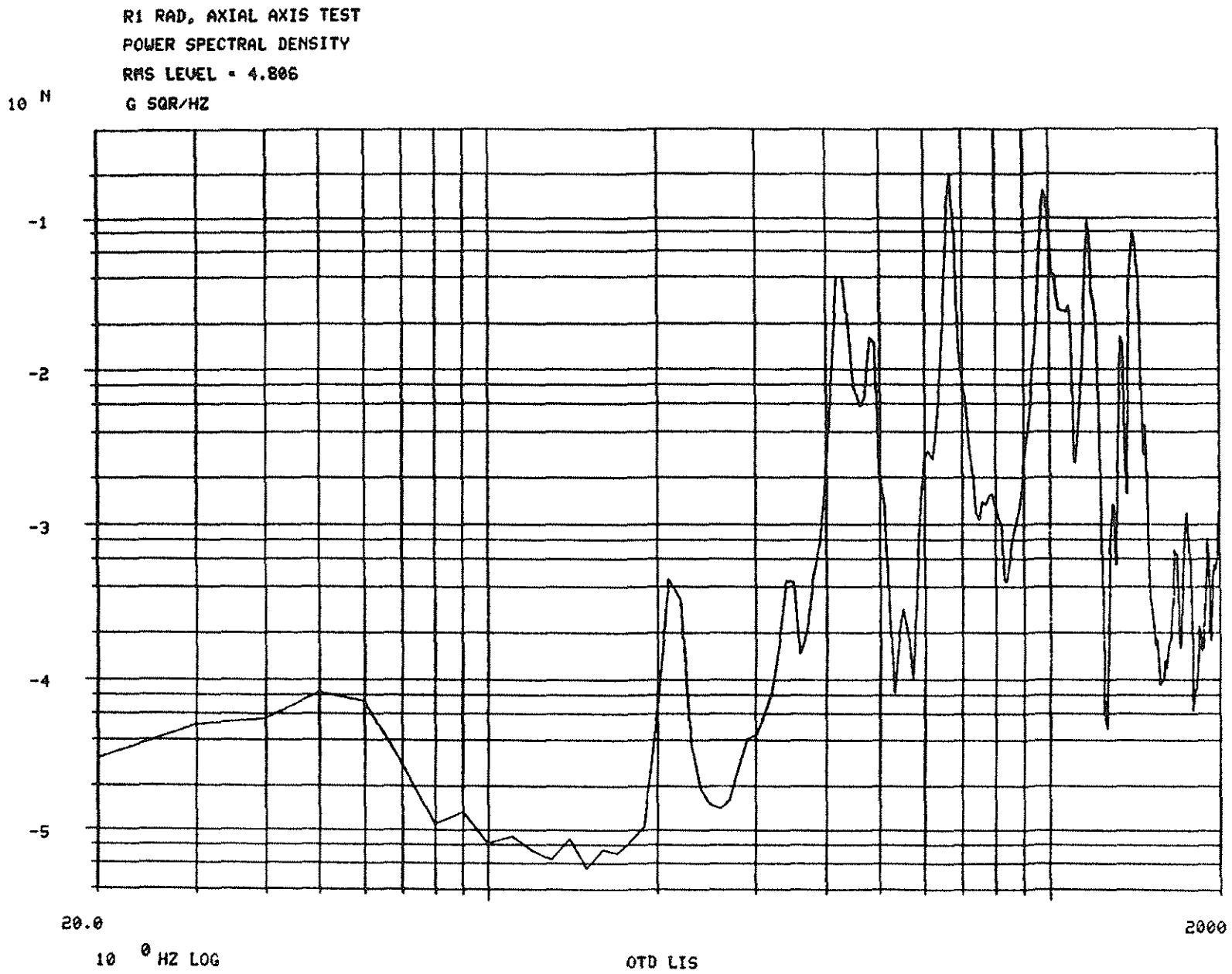

R5 AXIAL, L2 AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
GTD LIS, SINE SWEEP

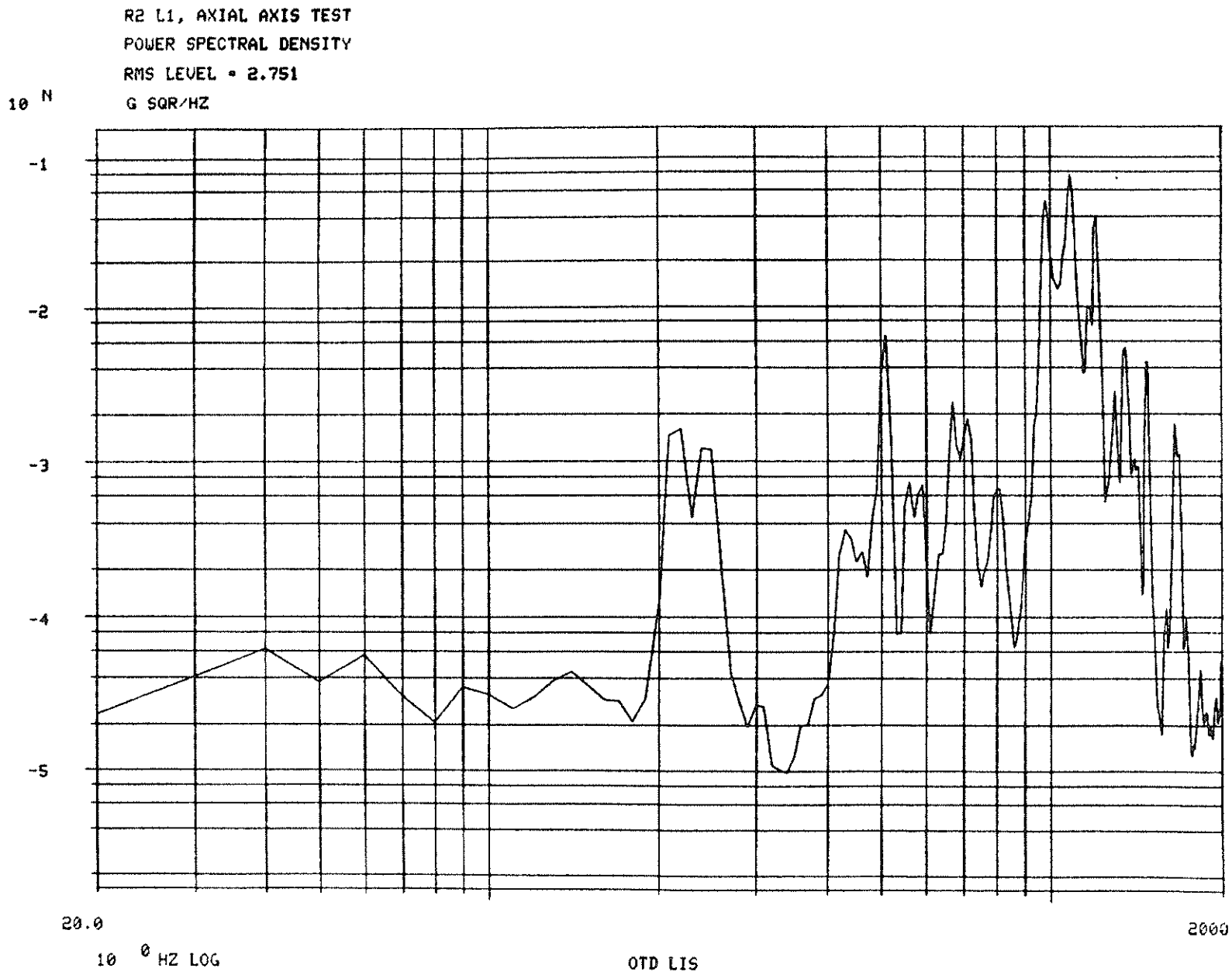

R5 L1, L2 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R5L2, L2 AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

RANDOM, AXIAL (X) AXIS


CONTROL X AXIS , (AXIAL)
POST TEST
ELAPSED TIME = 50 SECS AT -12.00 DB
RMS LEVEL = 3.029 G'S
DELTA F = 4.883
DOF= 238
AVF= 16
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
19.5
2002
10 0 HZ LOG
OTD LIS


R1 RAD, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 4.806
10 N
G SQR/HZ
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

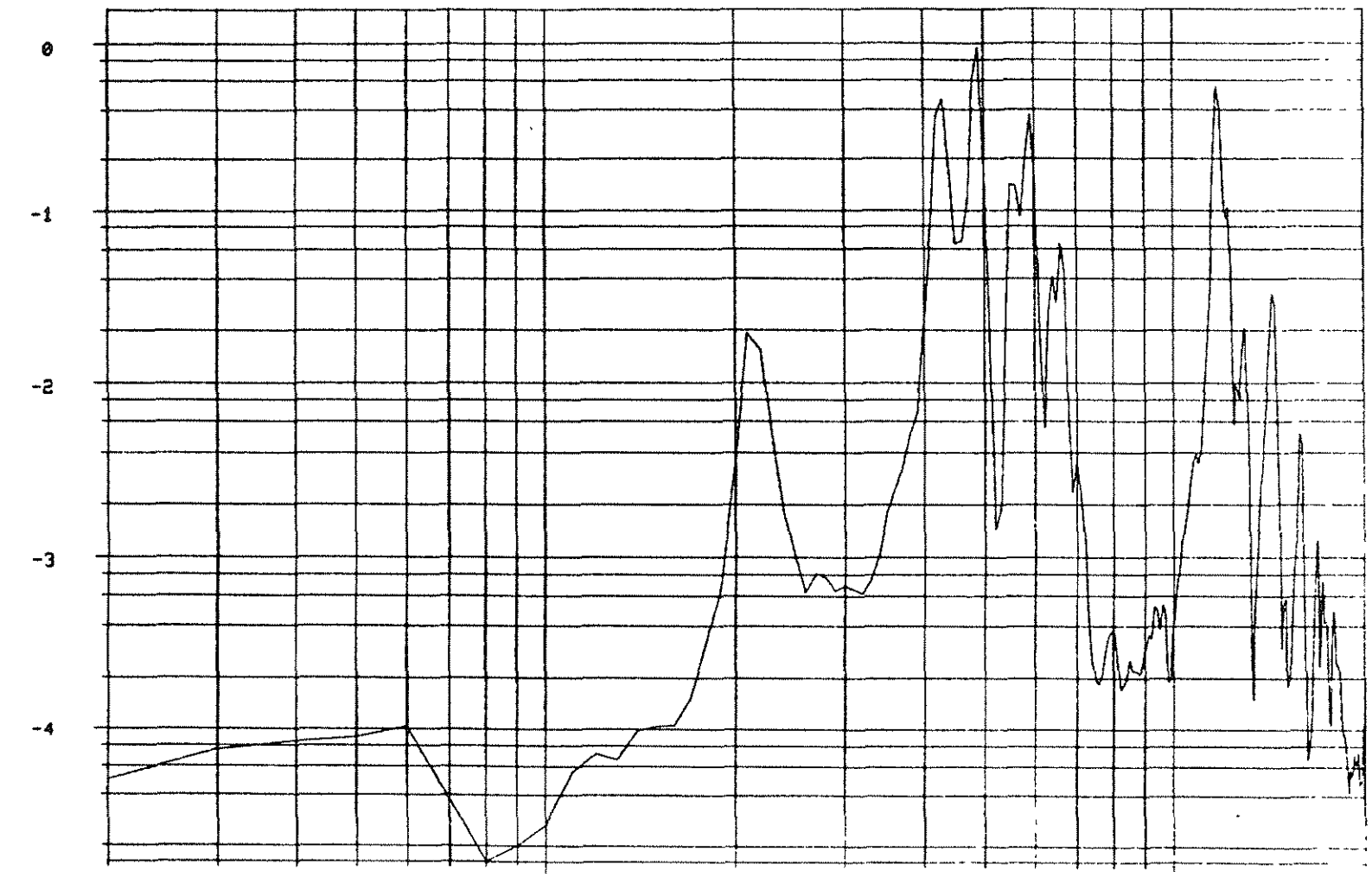

R2 L1, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 2.751
10 N
G SQR/HZ
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

R2 L2, AXIAL AXIS TEST

POWER SPECTRAL DENSITY

RMS LEVEL = 8.299

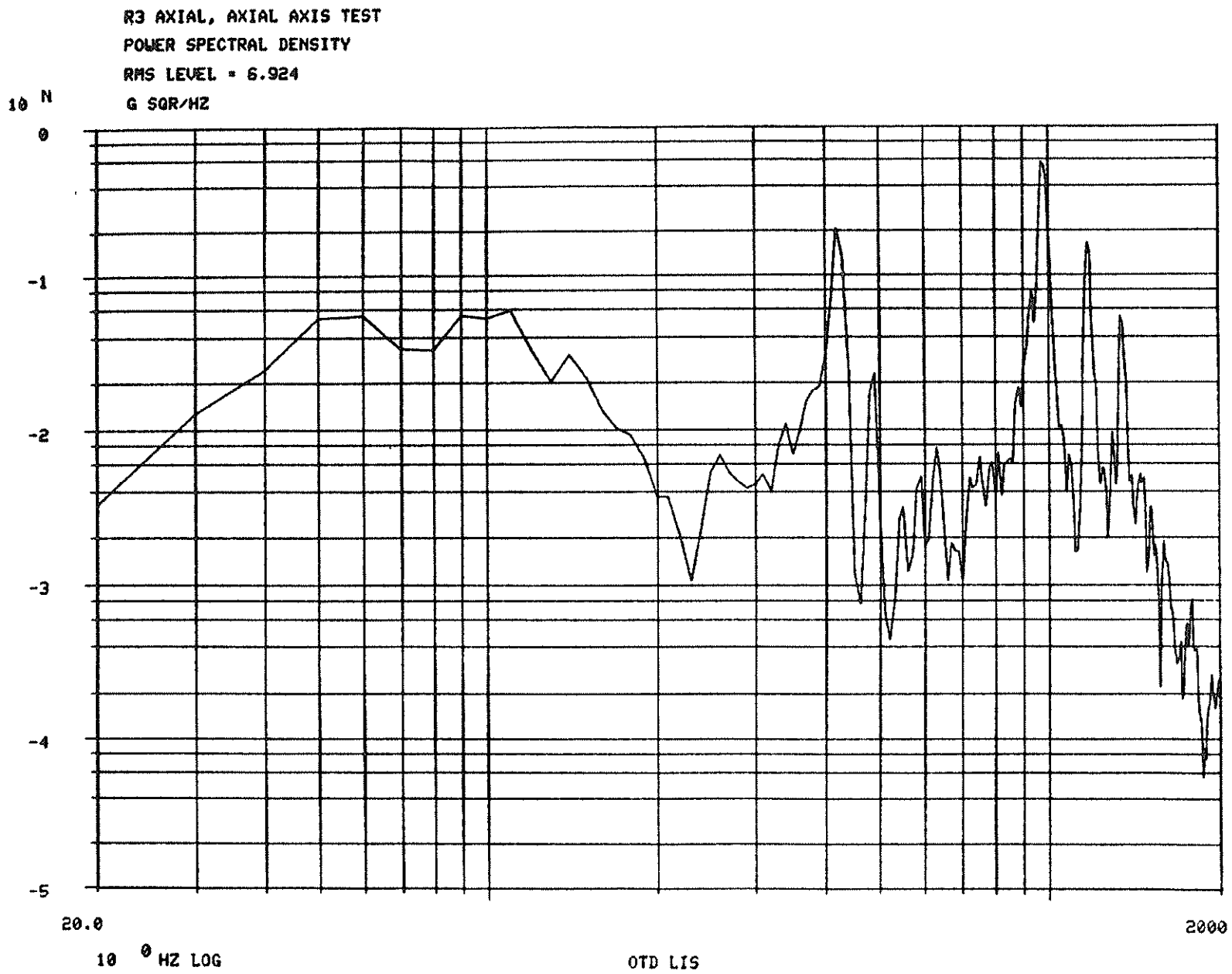
10 ^{N} G SQR/HZ

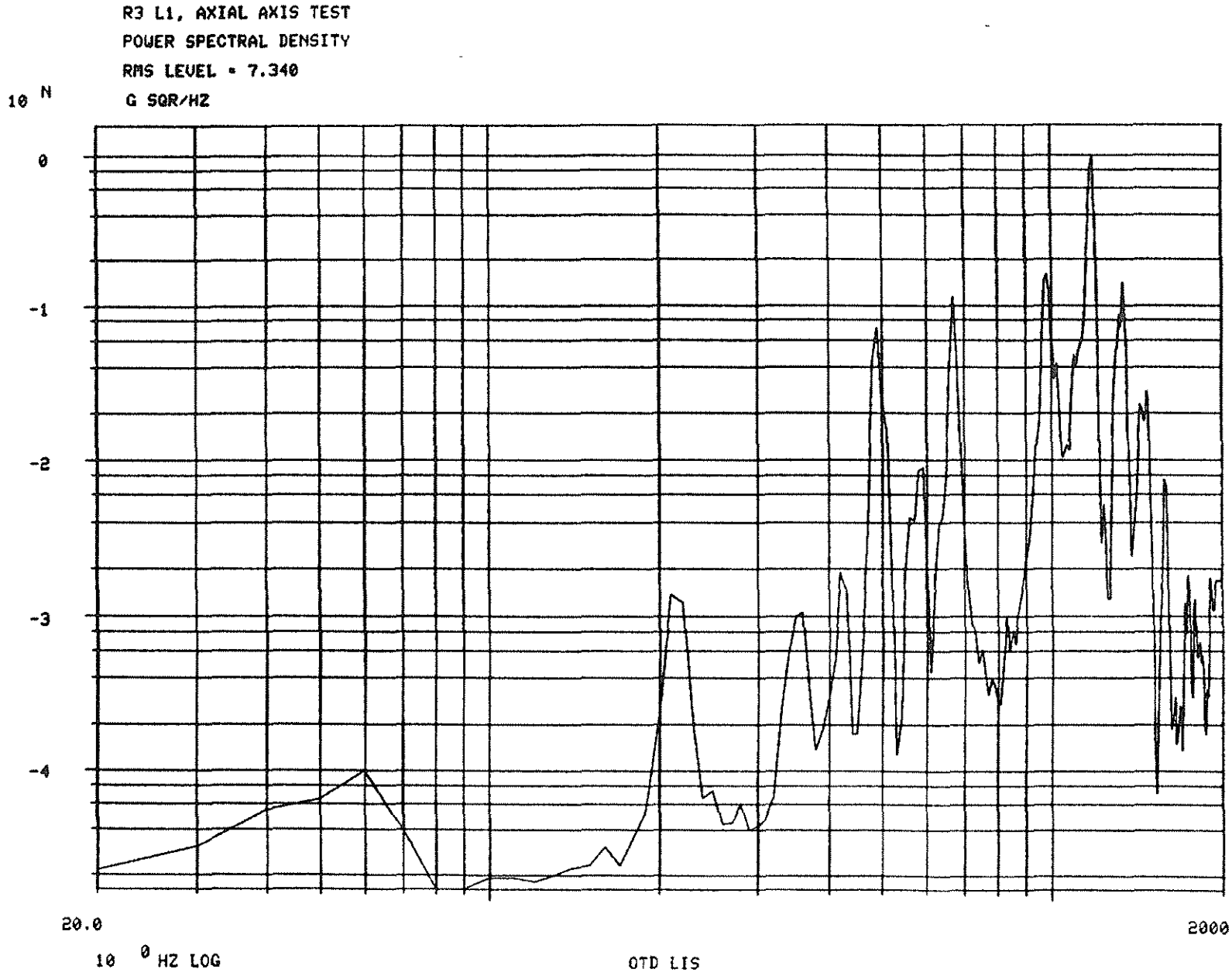


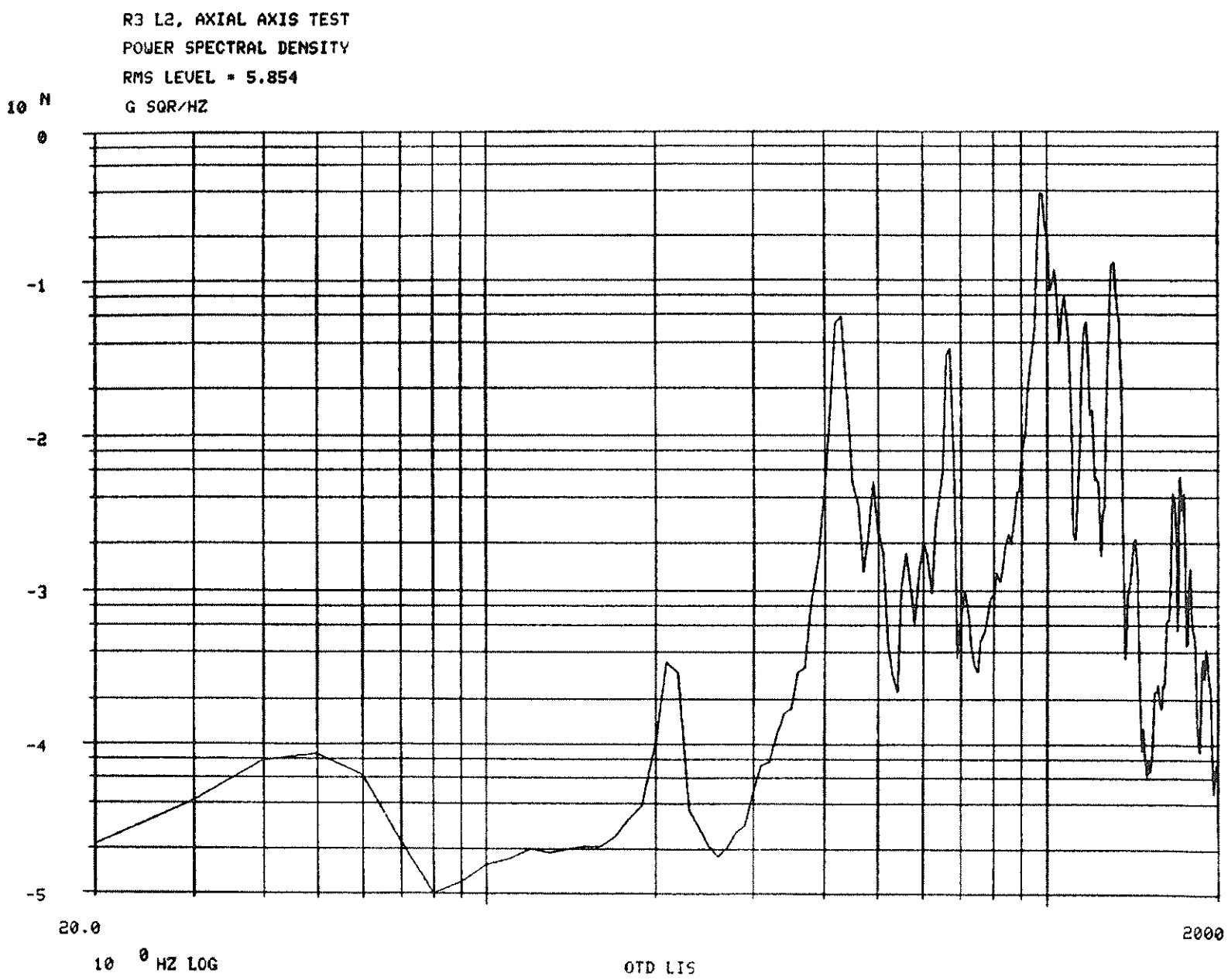
20.0

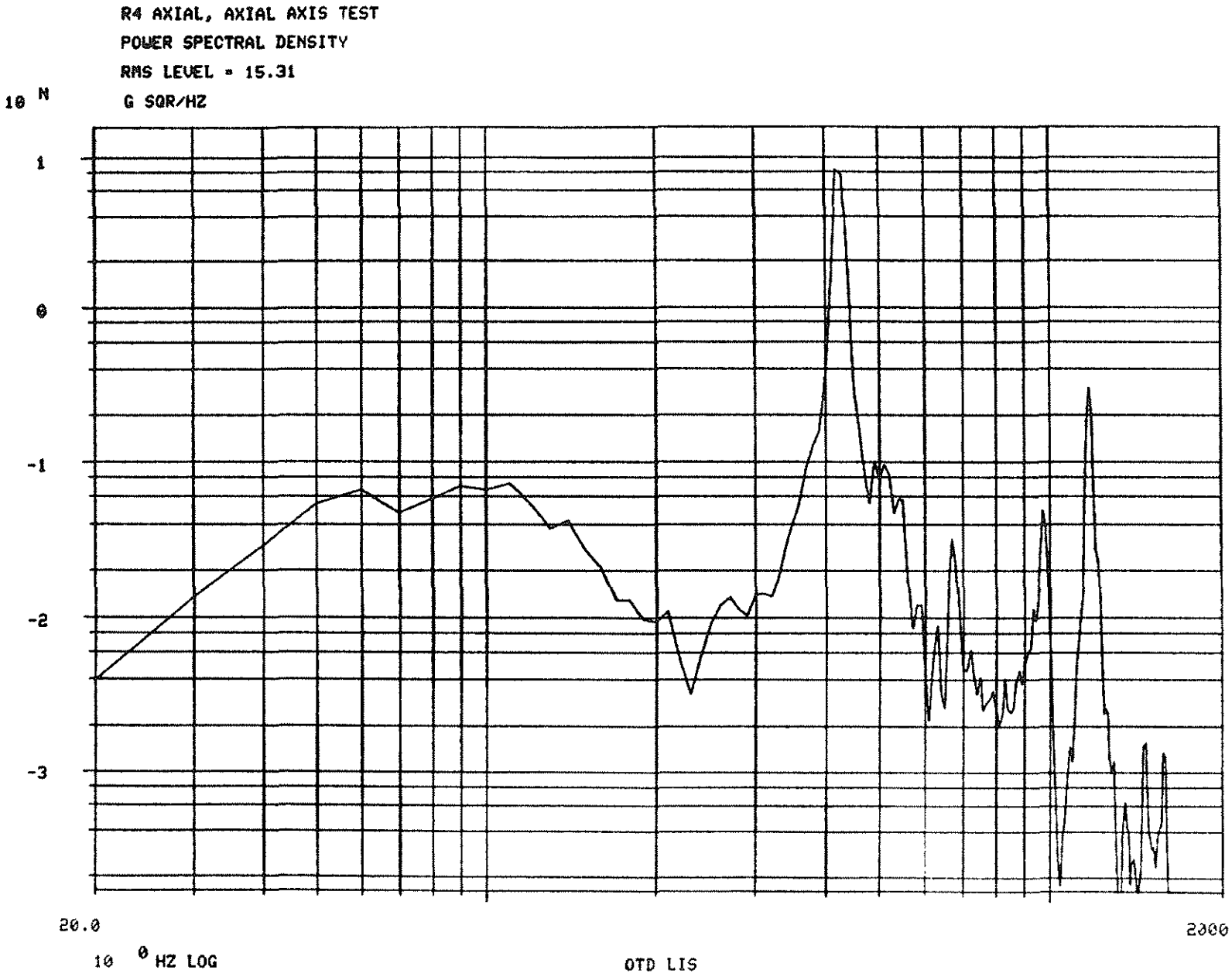
10 ^{0} HZ LOG

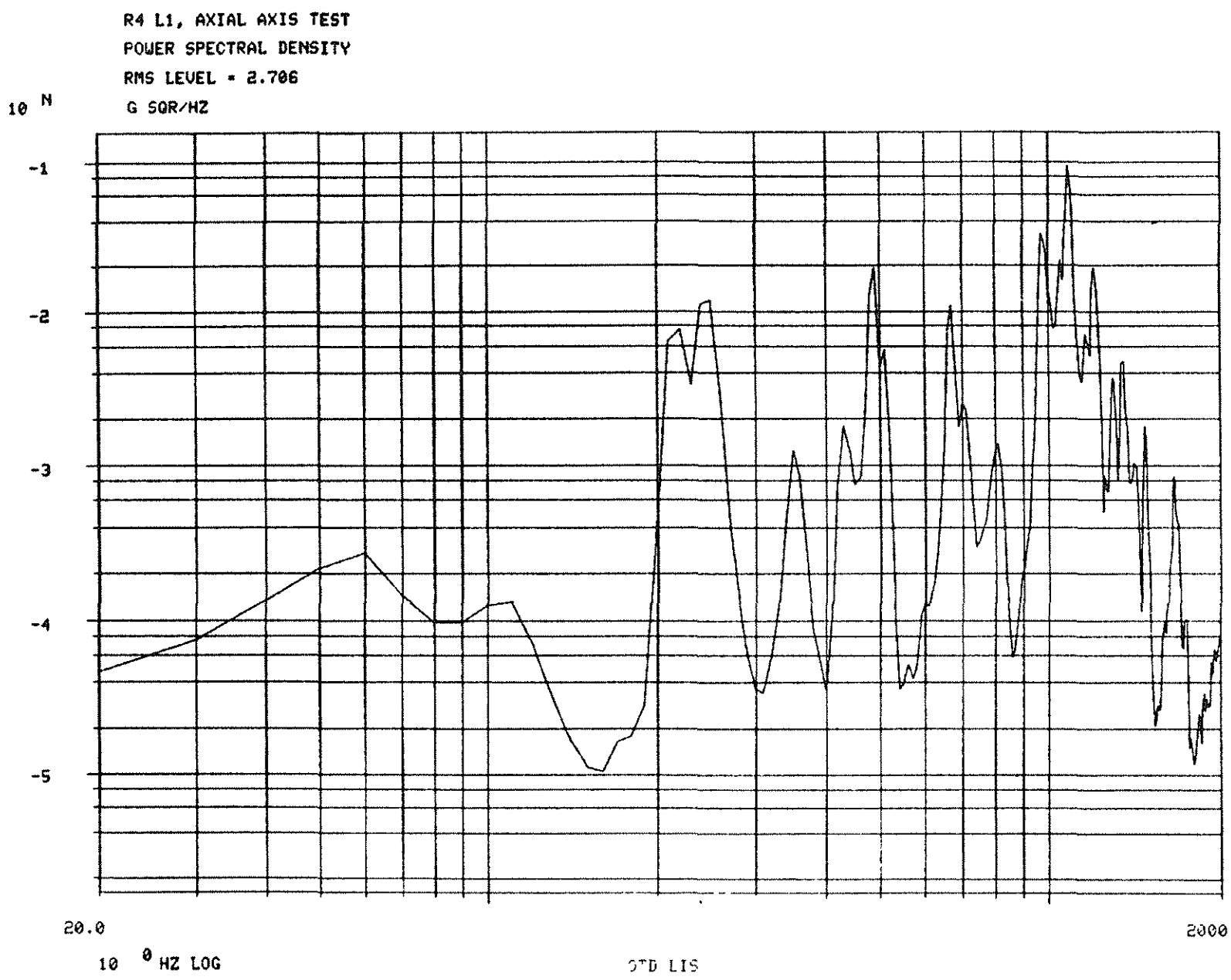
OTD LIS

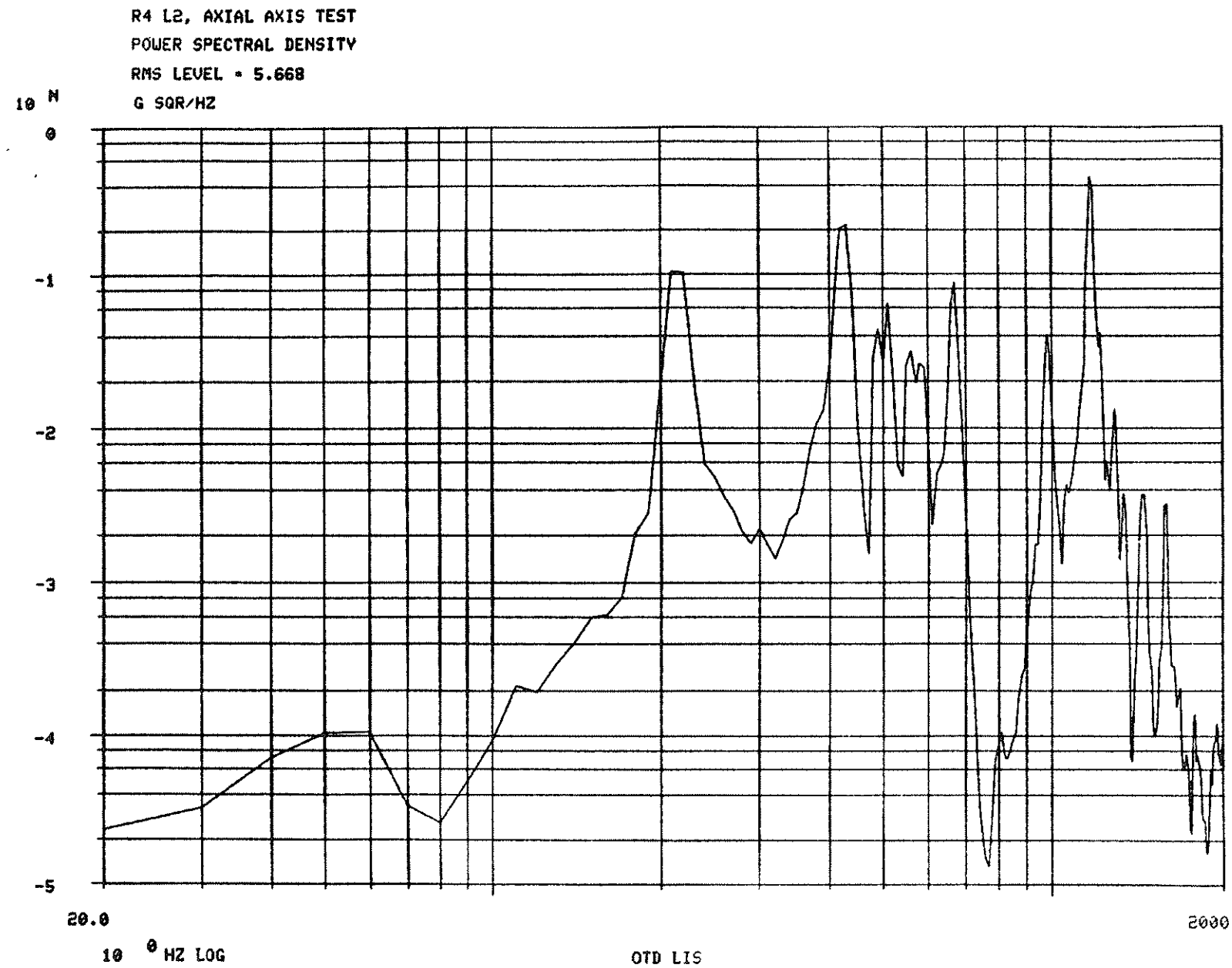

R3 AXIAL, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 6.924
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

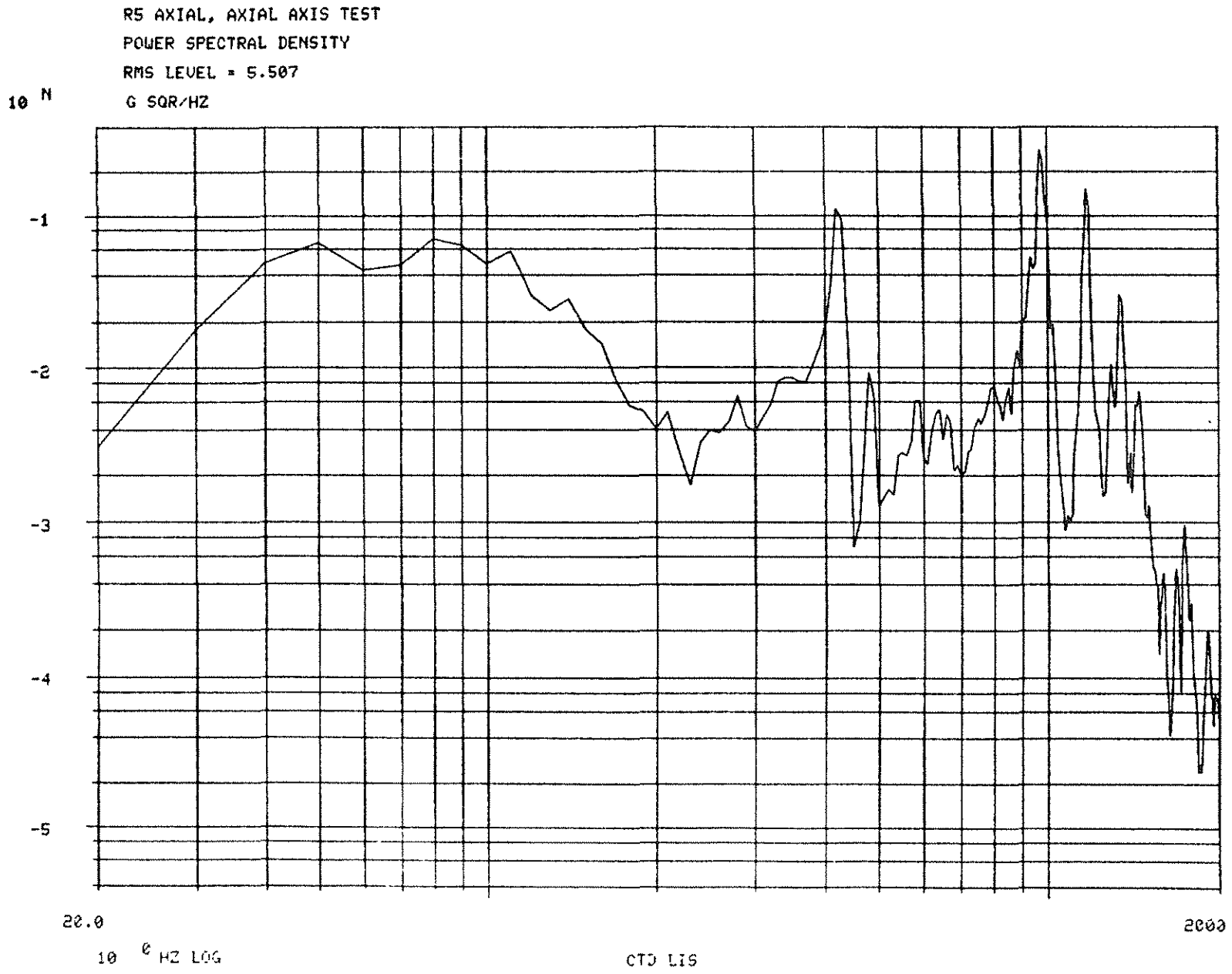

R3 L1, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 7.340
10 N G SQR/HZ
0
-1
-2
-3
-4
20.0
2000
10 0 HZ LOG
OTD LIS

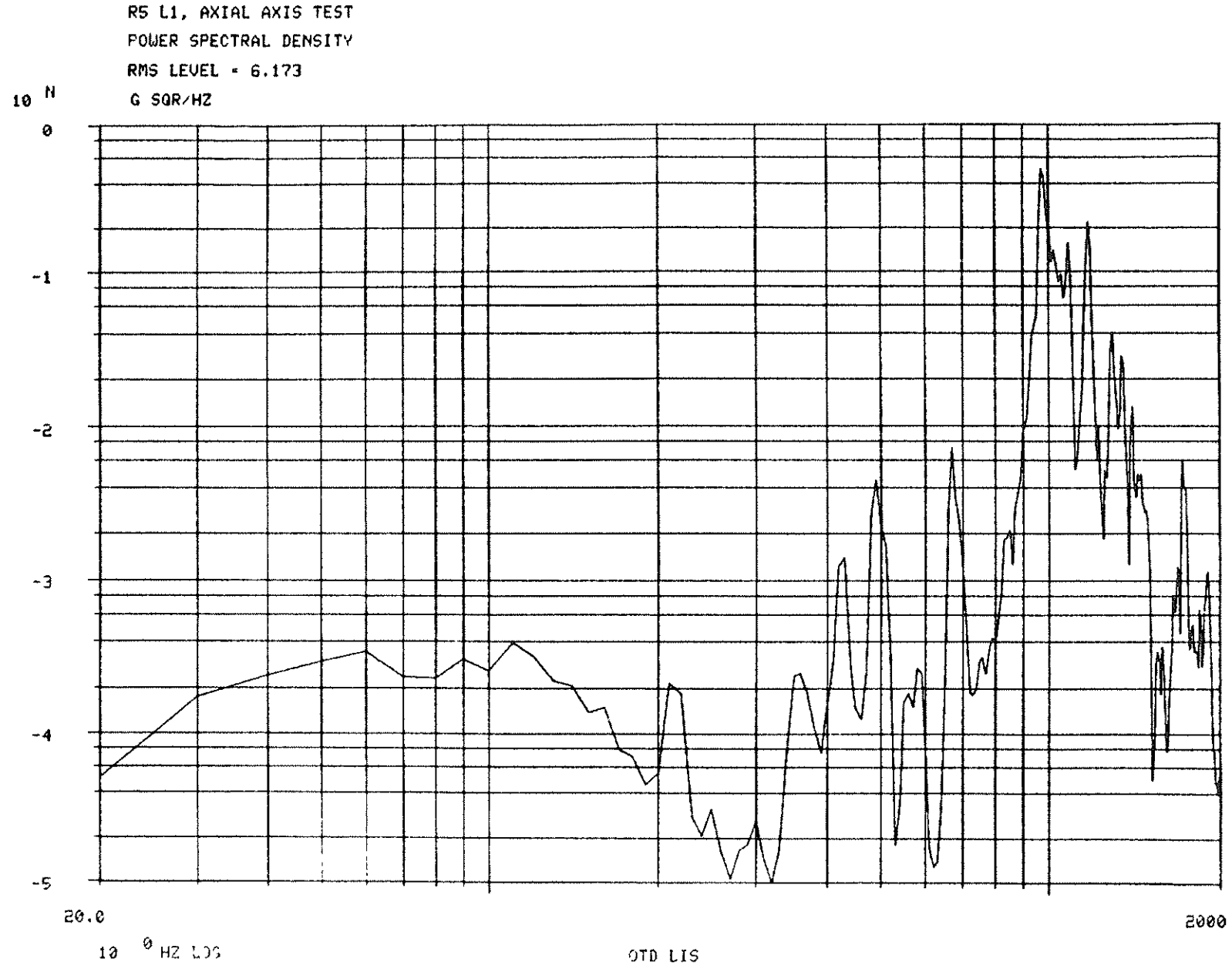

R3 L2, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 5.854
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

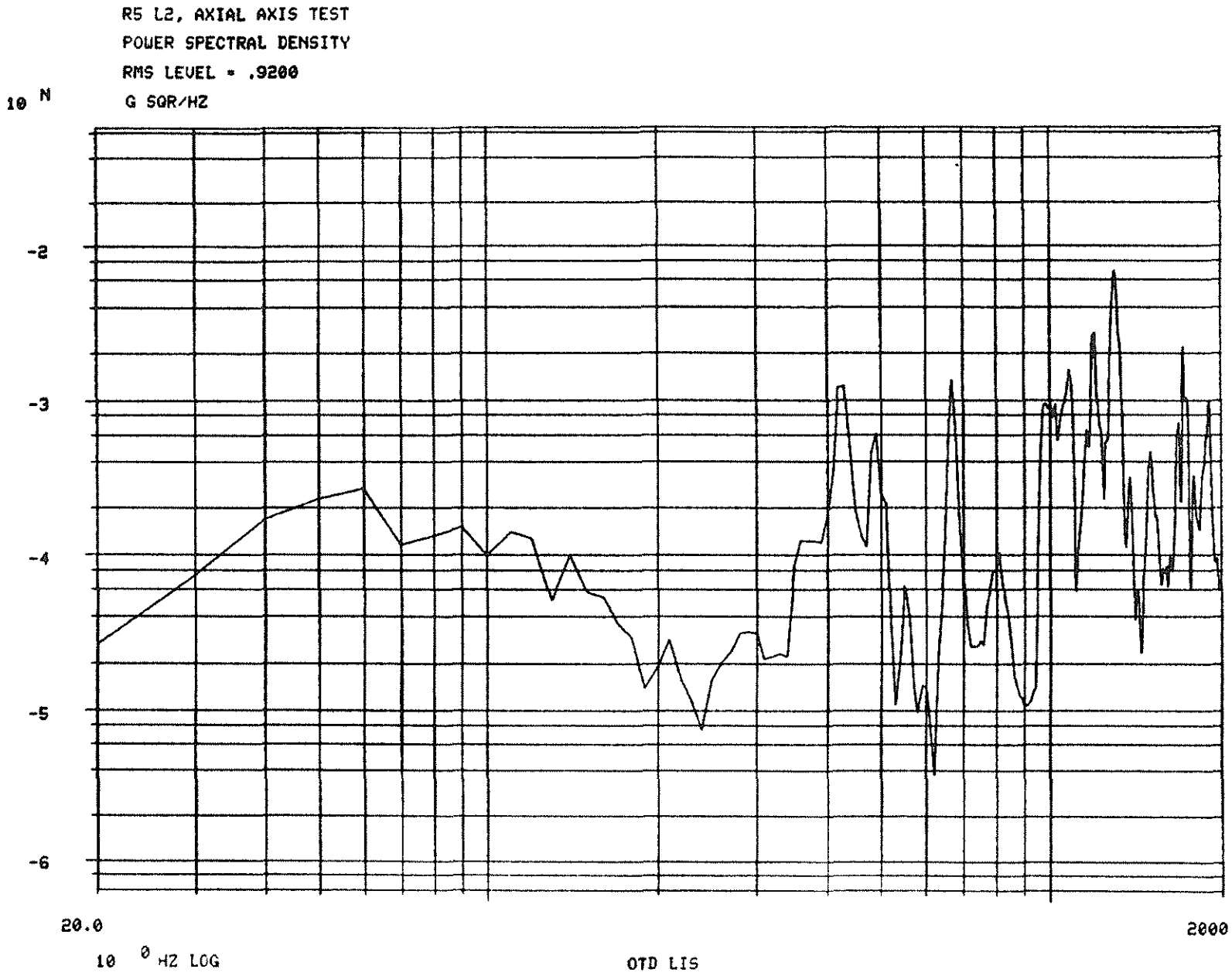

R4 AXIAL, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 15.31
10 N G SQR/HZ
1
0
-1
-2
-3
20.0
2000
10 0 HZ LOG
OTD LIS


R4 L1, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 2.706
G SQR/HZ
10 N
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
STD LIS

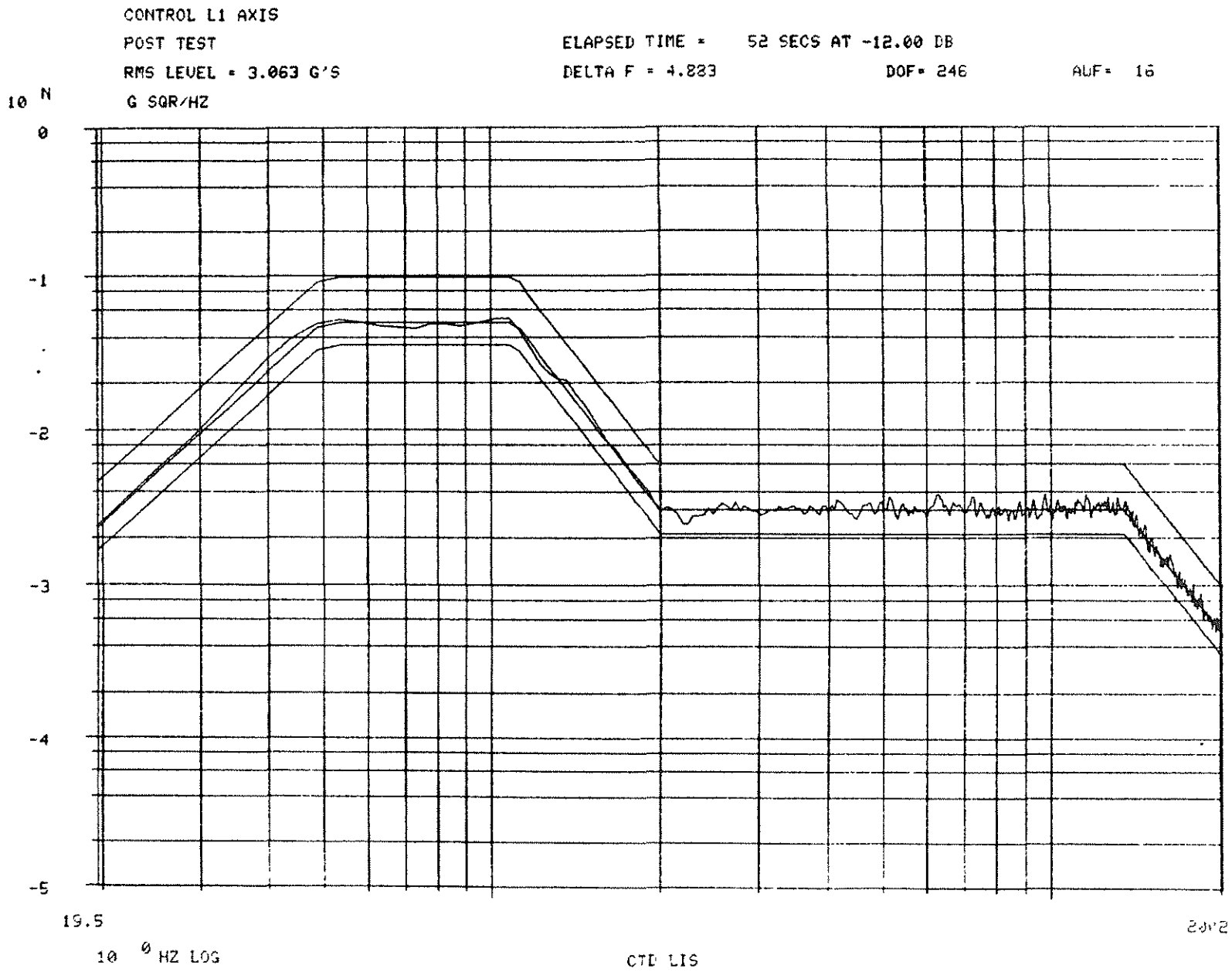

R4 L2, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 5.668
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

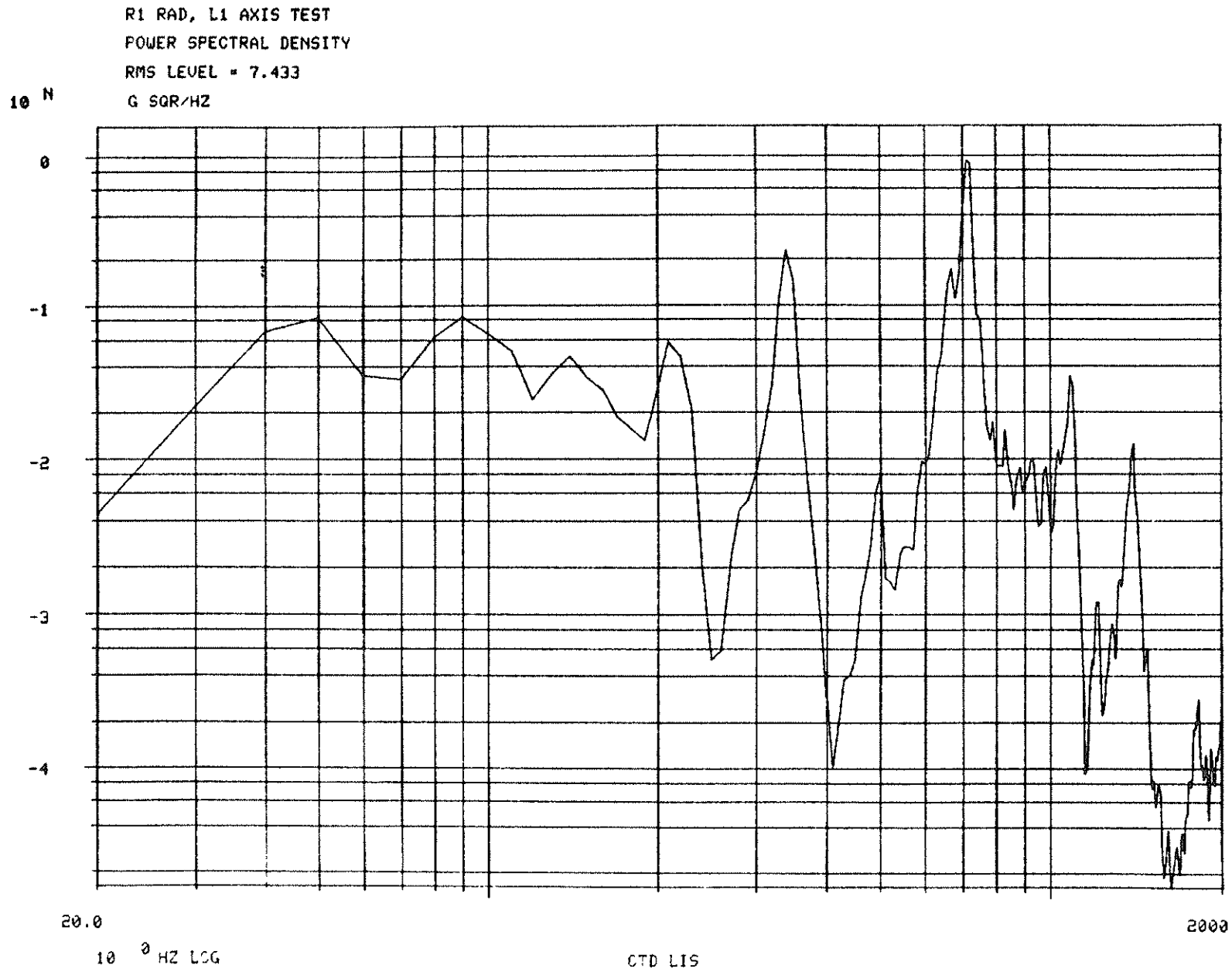

R5 AXIAL, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 5.507
G SQR/HZ
10 N
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
CTD LIS

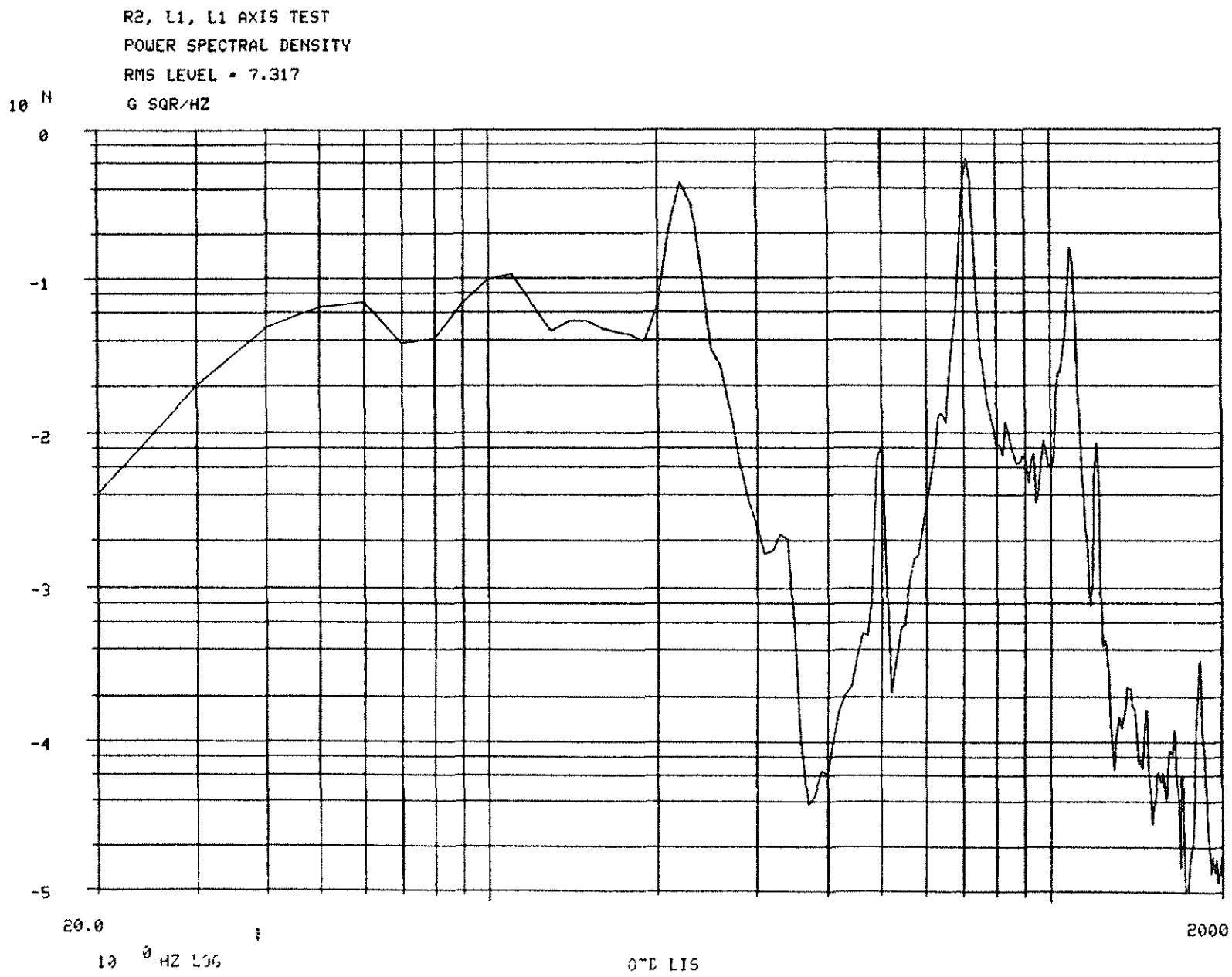

R5 L1, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 6.173
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

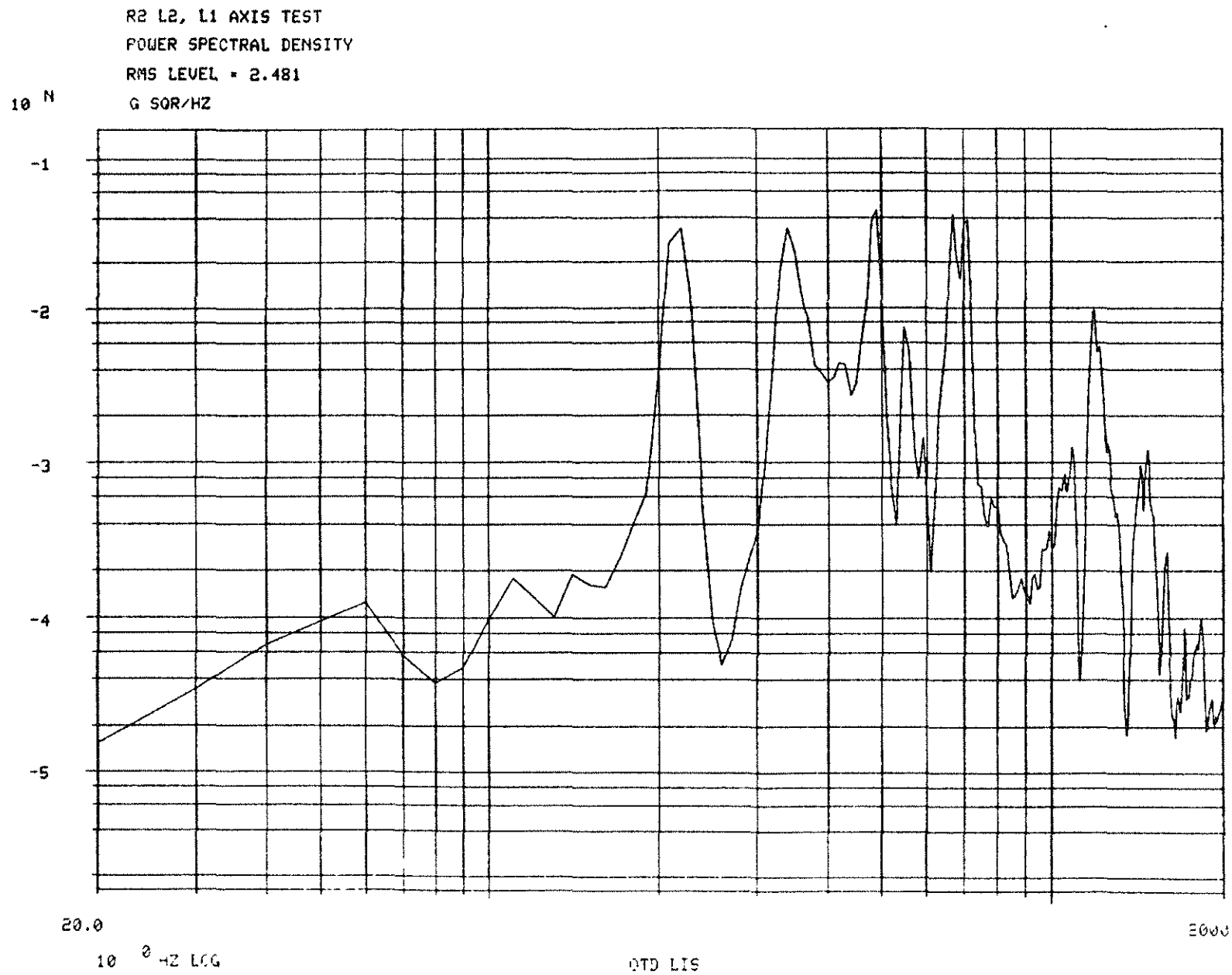

R5 L2, AXIAL AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = .9200
10 N
G SQR/HZ
-2
-3
-4
-5
-6
20.0
2000
10 0 HZ LOG
OTD LIS

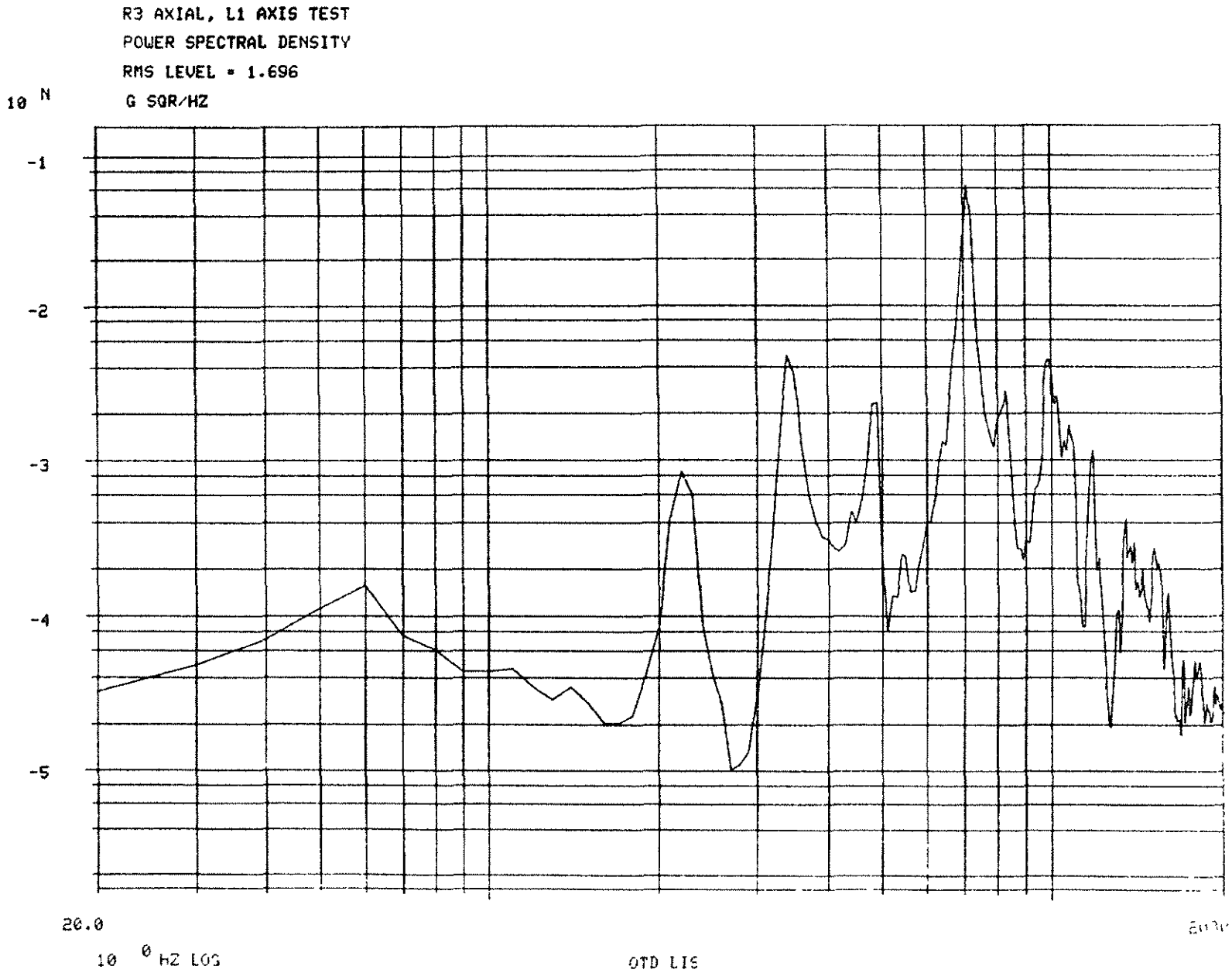
RANDOM, LI (Y) AXIS

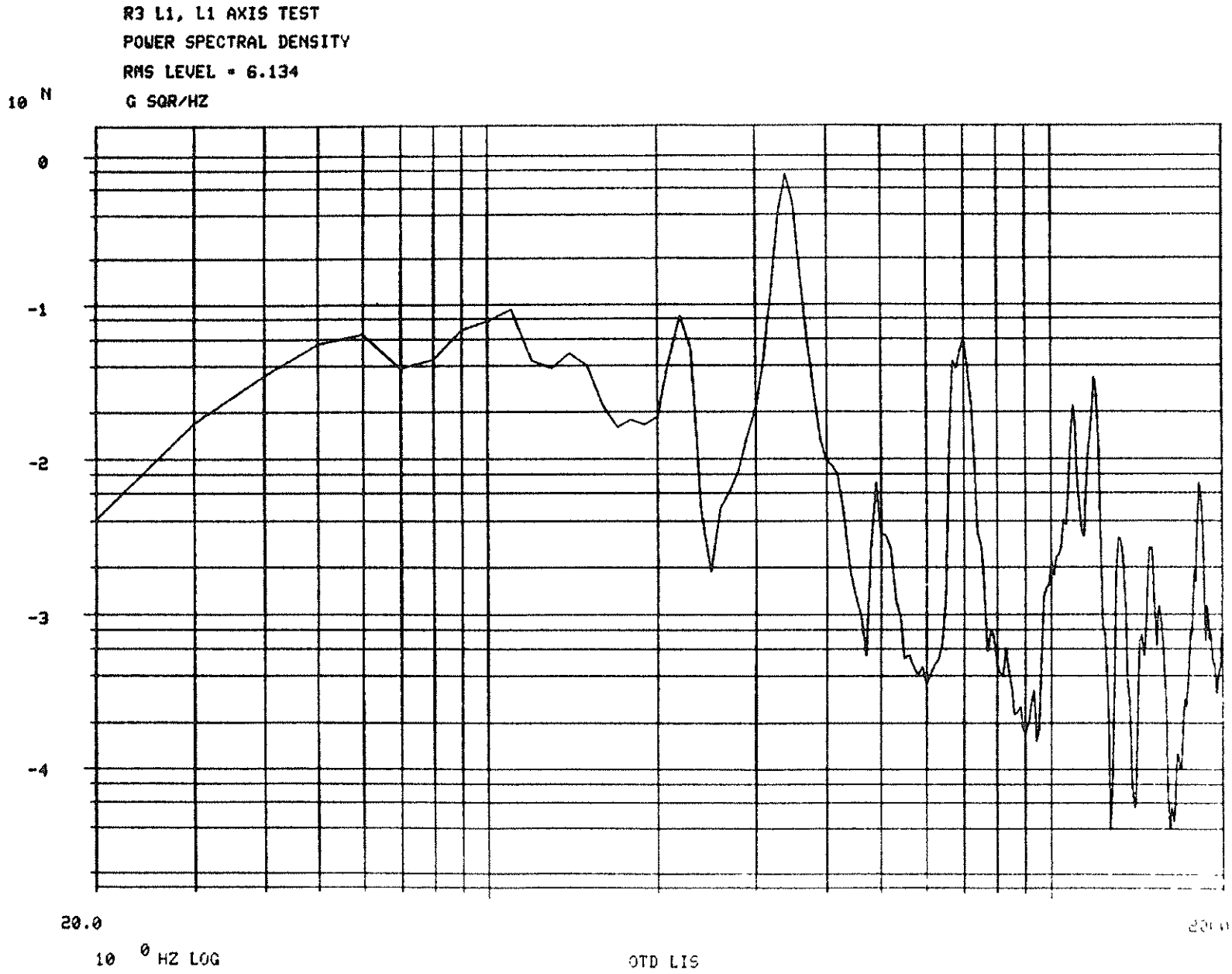

CONTROL L1 AXIS
POST TEST
RMS LEVEL = 3.063 G'S
G SQR/HZ
ELAPSED TIME = 52 SECS AT -12.00 DB
DELTA F = 4.883
DOF= 246
AUF= 16
10 N
0
-1
-2
-3
-4
-5
19.5
10 0 HZ LOG
CTD LIS

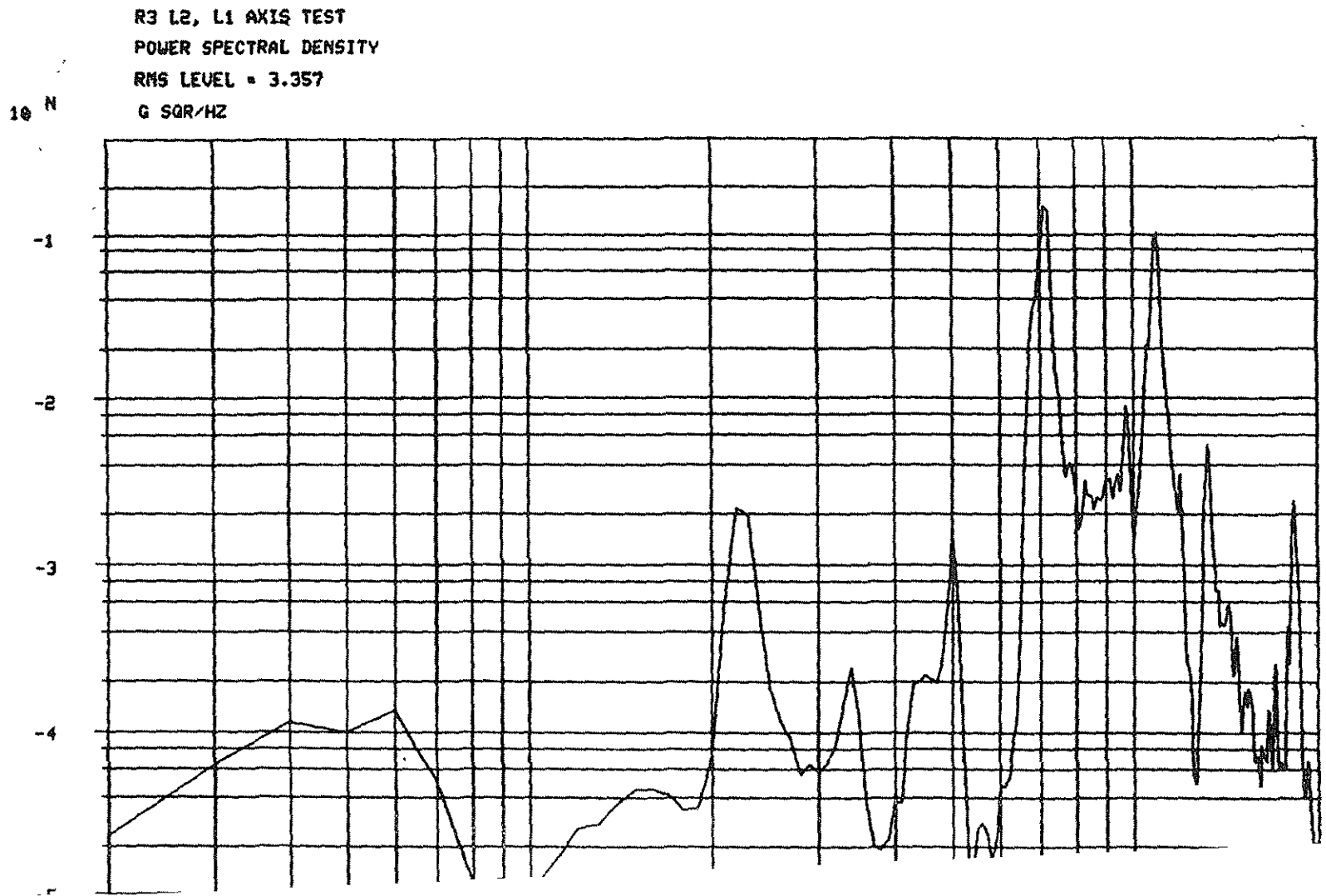

R1 RAD, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 7.433
10 N G SQR/HZ
0
-1
-2
-3
-4
20.0
2000
10 0 HZ LOG
CTD LIS


R2, L1, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 7.317
G SQR/HZ
10 N
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG


R2 L2, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 2.481
G SQR/HZ
10 N
-1
-2
-3
-4
-5
20.0
10 0 HZ LOG
OTD LIS


R3 AXIAL, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 1.696
G SQR/HZ
10 N
-1
-2
-3
-4
-5
20.0
10 0 HZ LOG
OTD LIS


R3 L1, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 6.134
G SQR/HZ
10 N
0
-1
-2
-3
-4
20.0
10 0 HZ LOG
OTD LIS

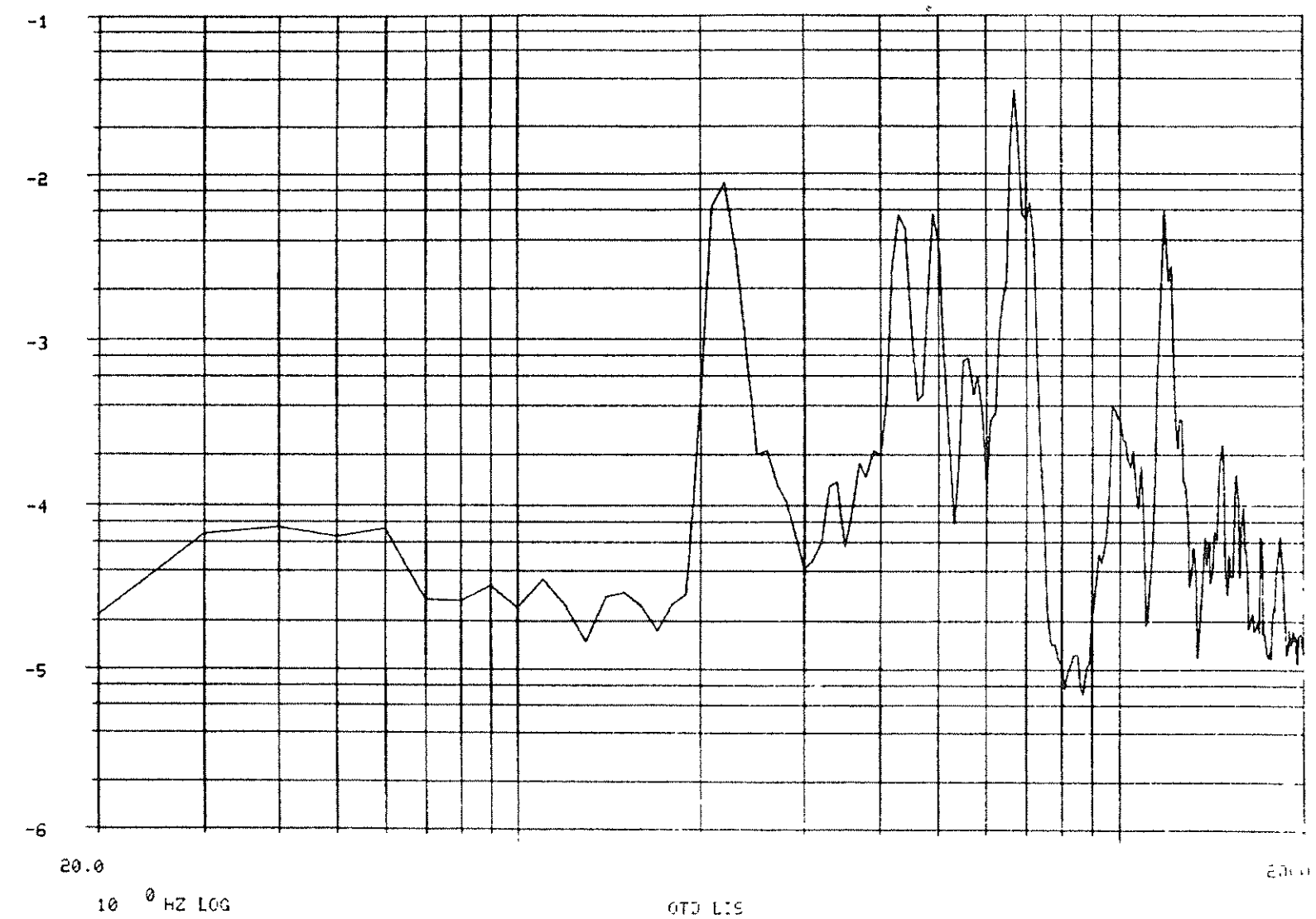

R3 L2, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 3.357
G SQR/HZ
10 N
-1
-2
-3
-4

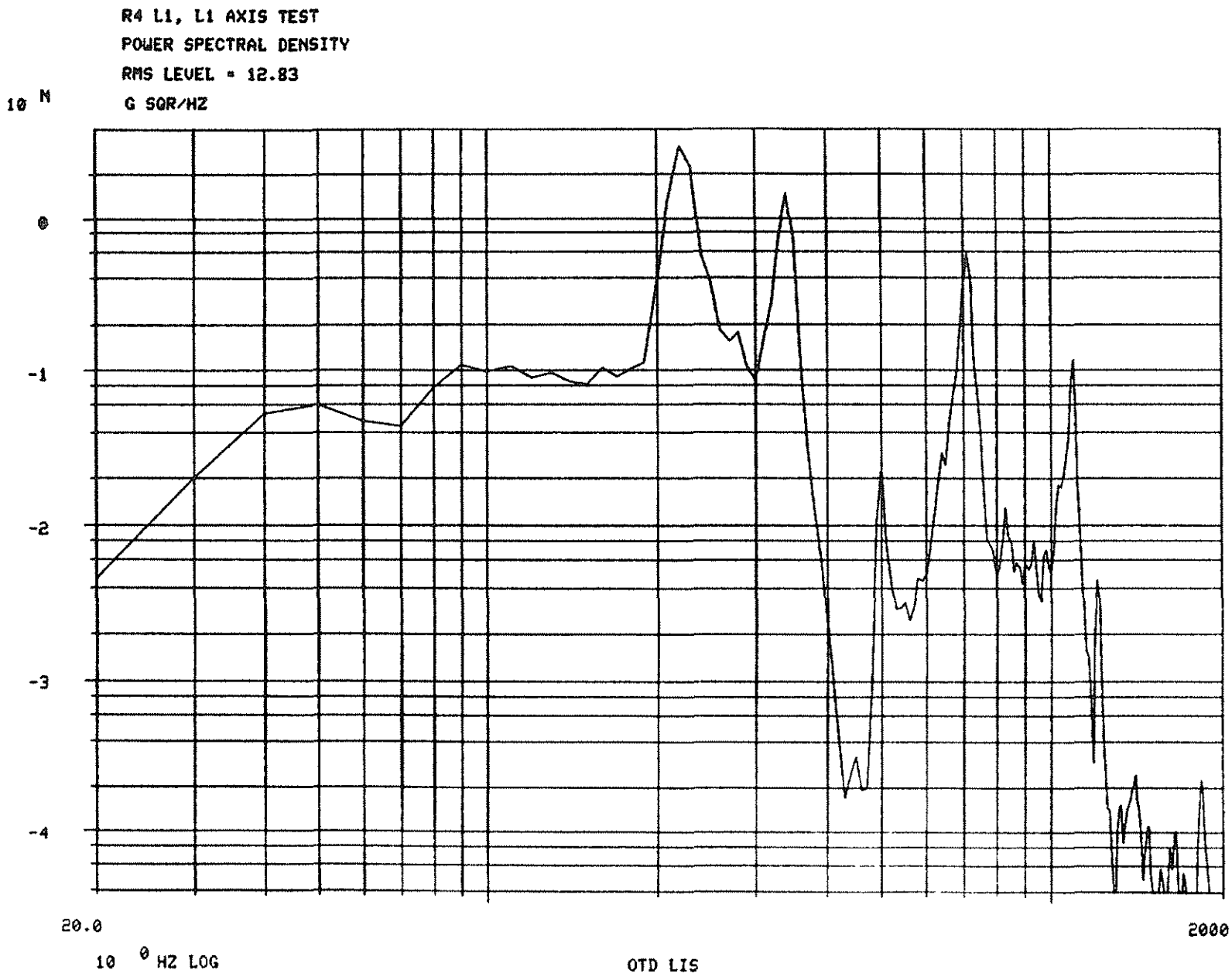
R4 AXIAL, L1 AXIS TEST

POWER SPECTRAL DENSITY

RMS LEVEL = 1.328

G SQR/HZ



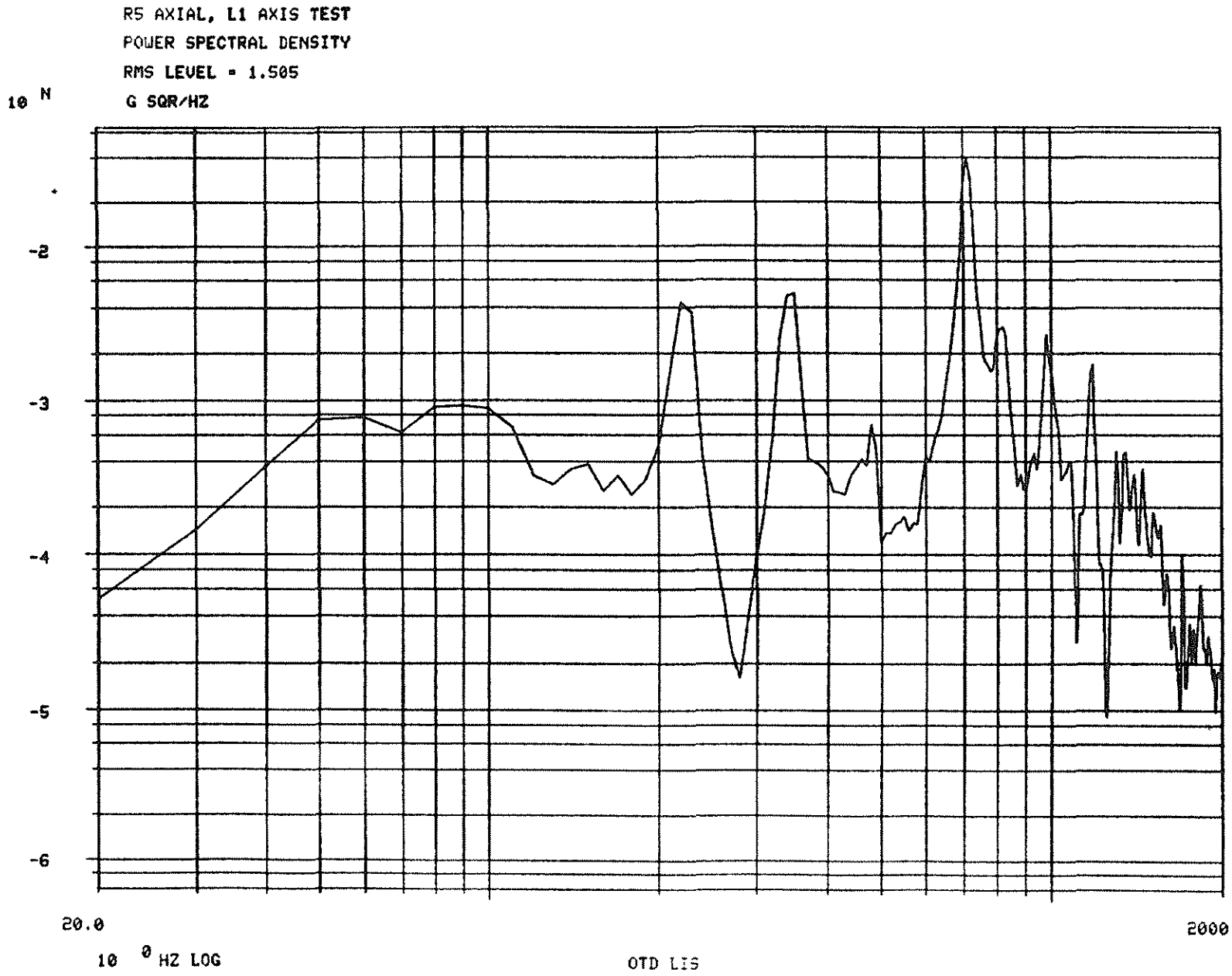

R4 L1, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 12.83
G SQR/HZ
10 M
0
-1
-2
-3
-4
20.0
2000
10 0 HZ LOG
OTD LIS

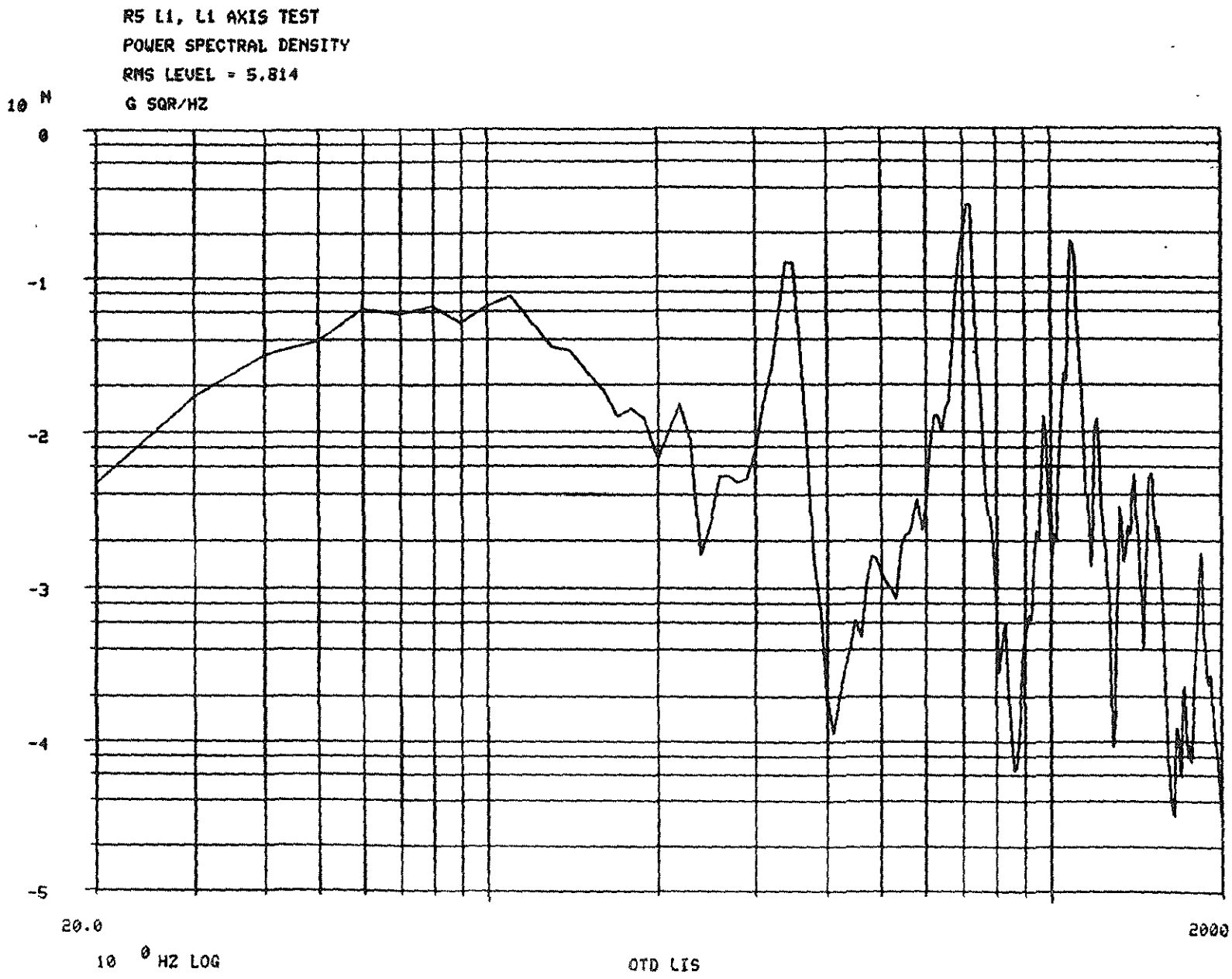
R4 L2, L1 AXIS TEST

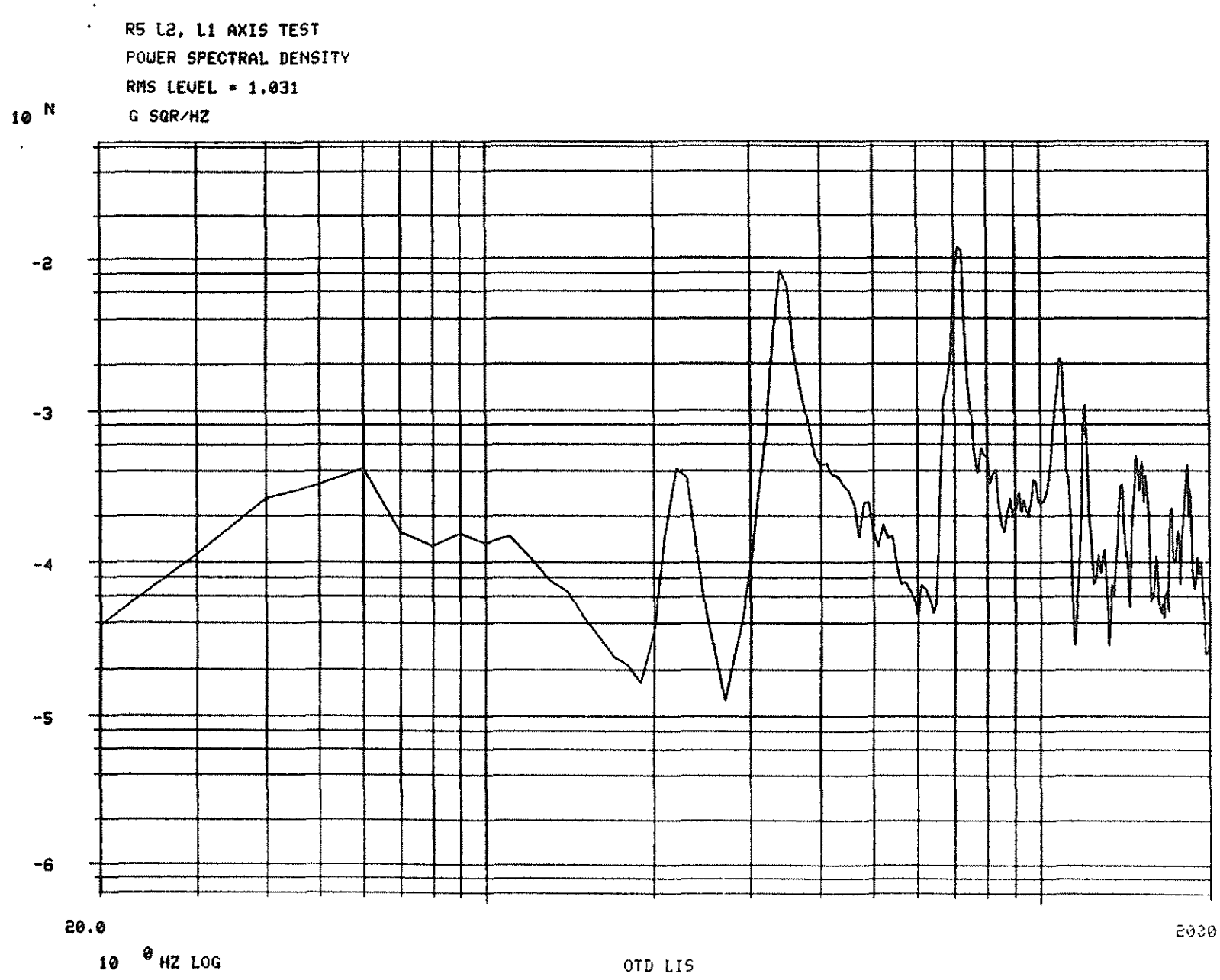
POWER SPECTRAL DENSITY

RMS LEVEL = 3.323

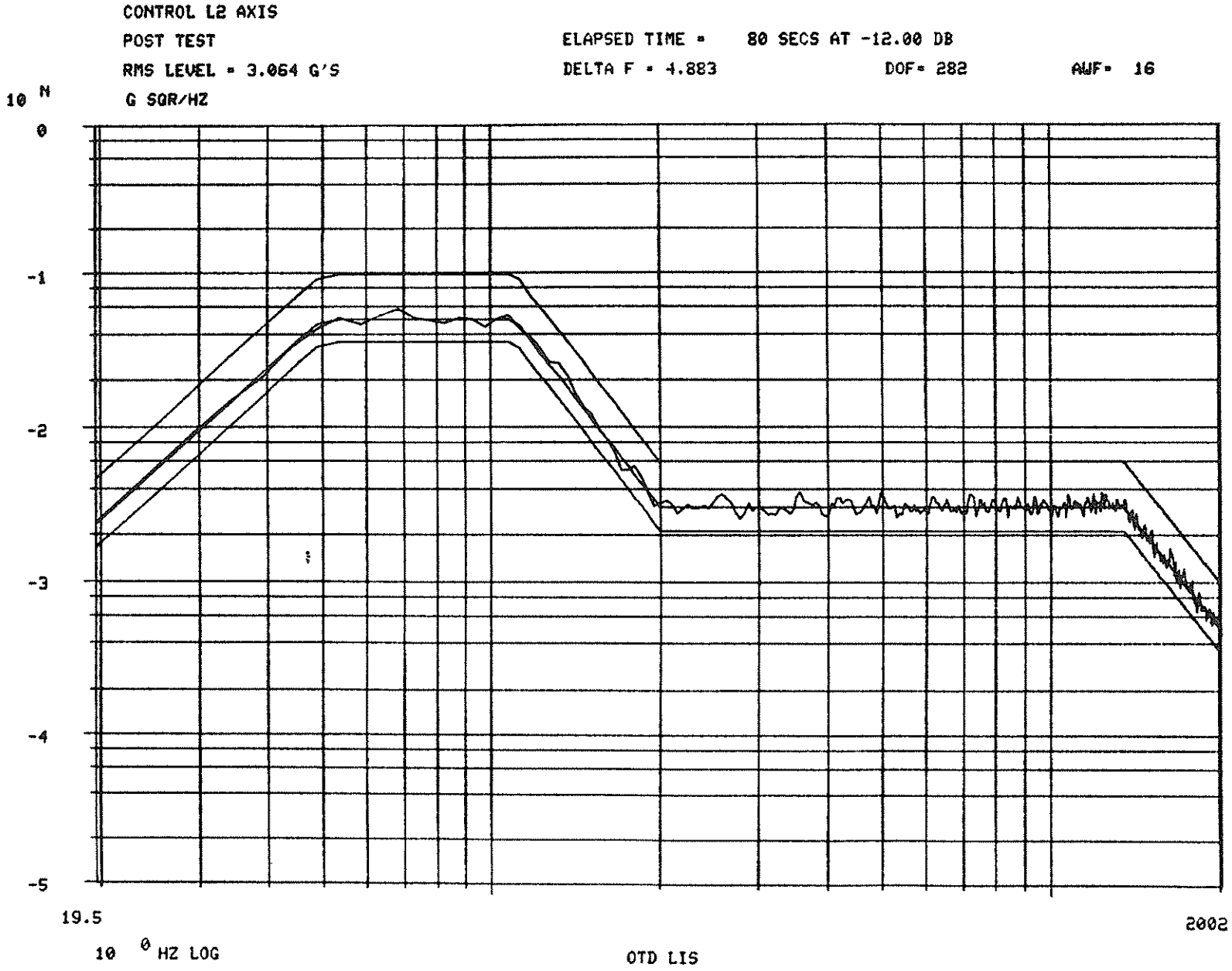
G SQR/HZ

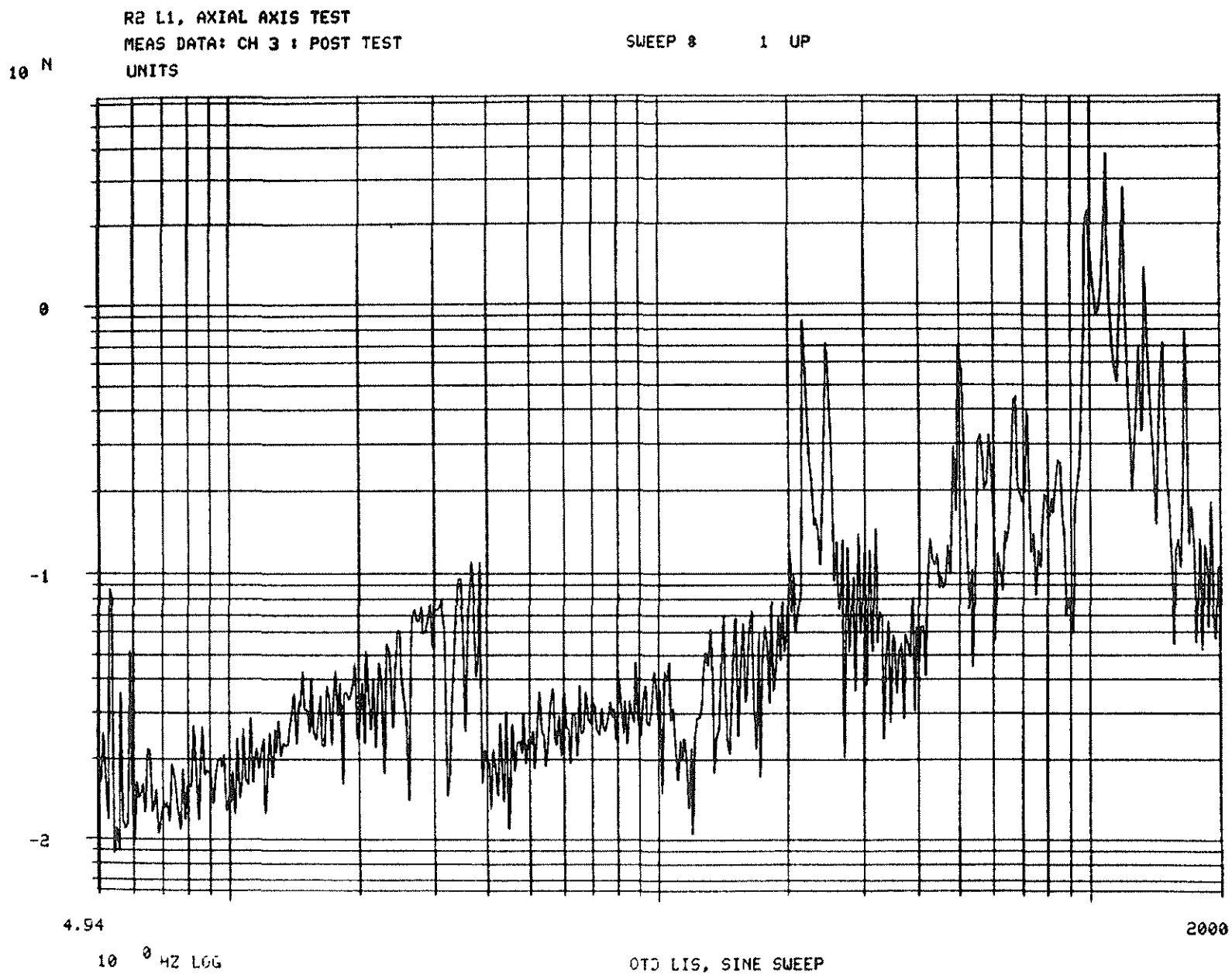

R5 AXIAL, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 1.505
G SQR/HZ
10 N
-2
-3
-4
-5
-6
20.0
2000
10 0 HZ LOG
OTD LIS

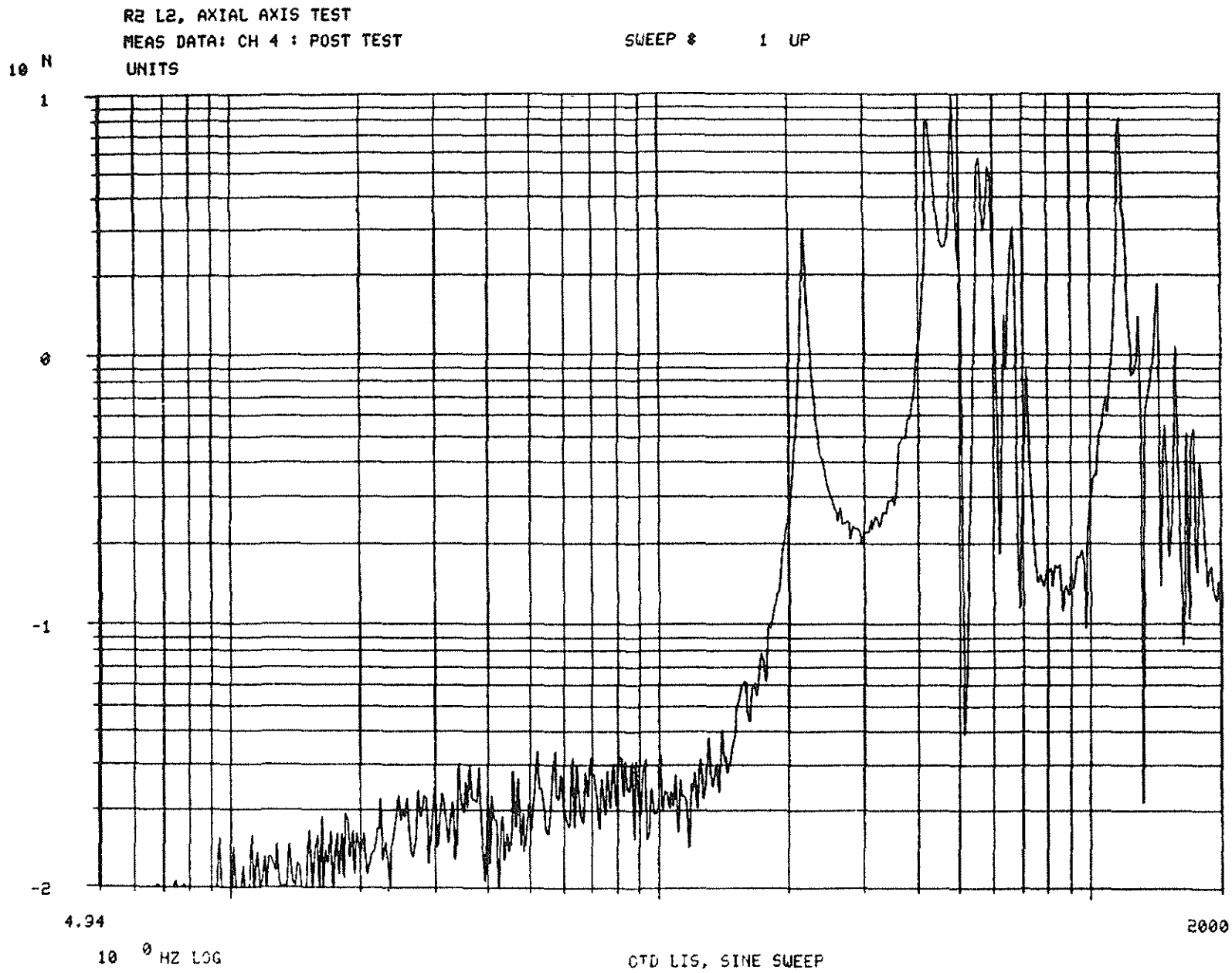

R5 L1, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 5.814
G SQR/HZ
10 N
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

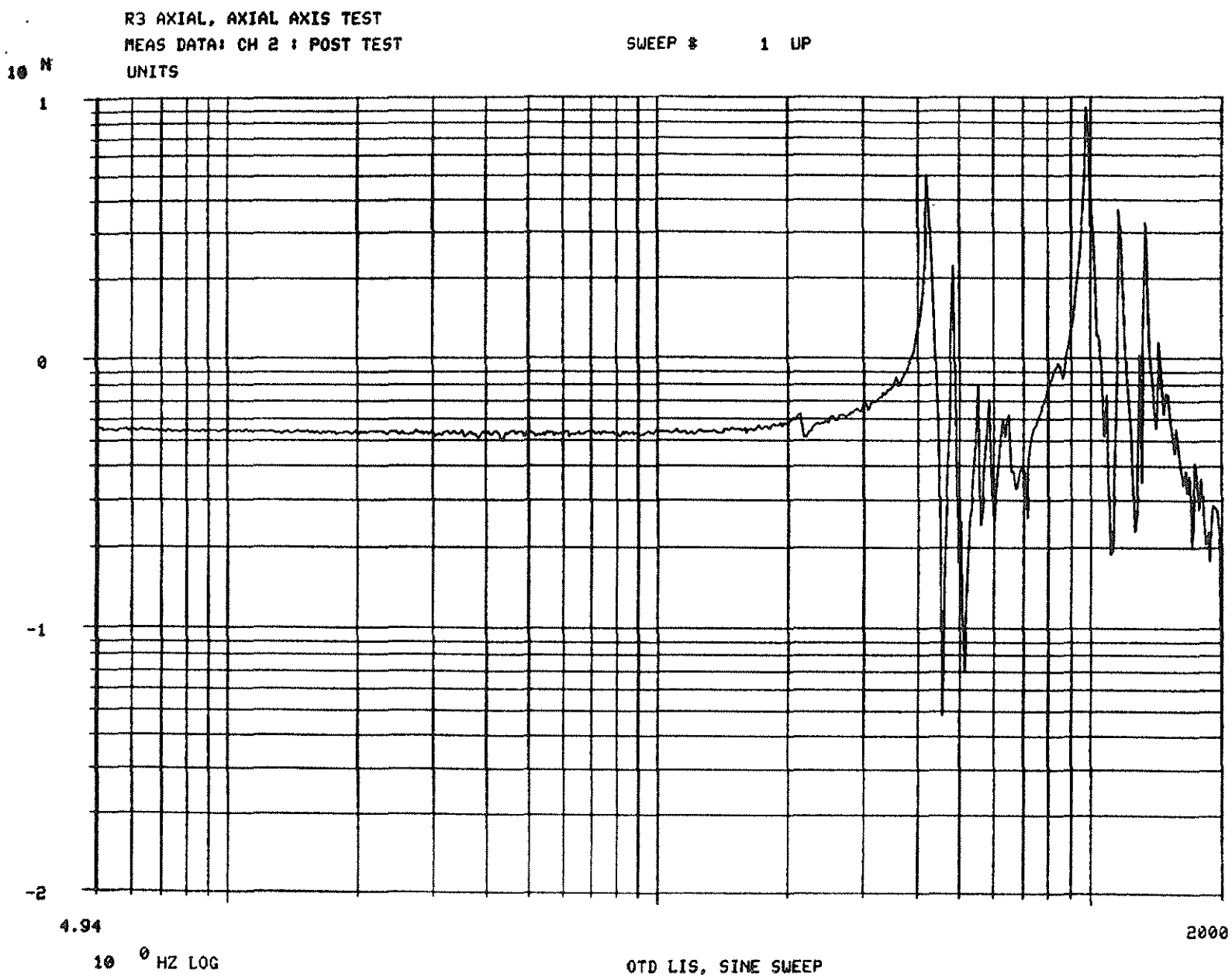

R5 L2, L1 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 1.031
G SQR/HZ
10 N
-2
-3
-4
-5
-6
20.0
2000
10 0 HZ LOG
OTD LIS

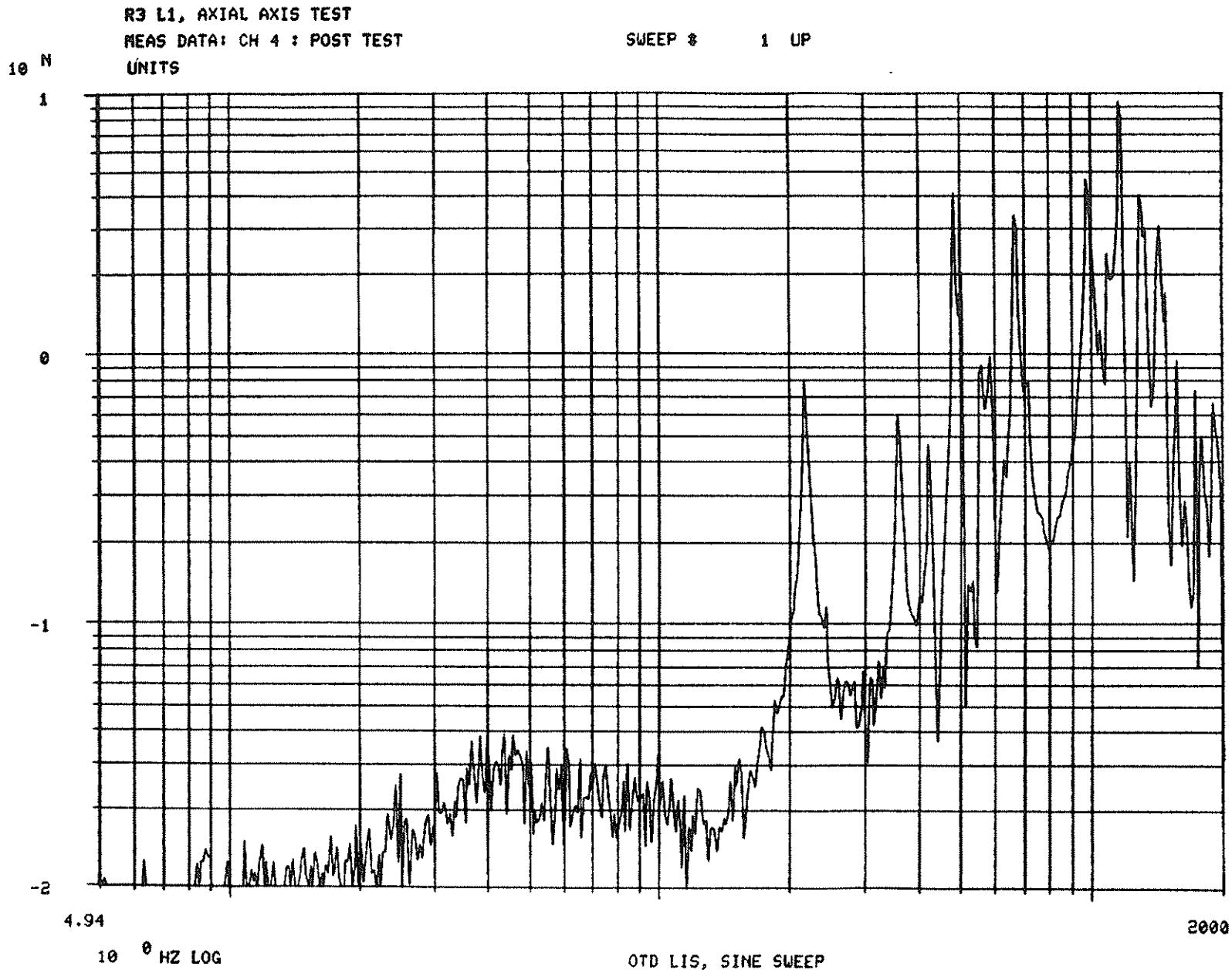
RANDOM, L2 (Z) AXIS


CONTROL L2 AXIS
POST TEST
RMS LEVEL = 3.064 G'S
G SQR/HZ
ELAPSED TIME = 80 SECS AT -12.00 DB
DELTA F = 4.883
DOF= 282
AWF= 16
10 N
0
-1
-2
-3
-4
-5
19.5
2002
10 0 HZ LOG
OTD LIS


R2 L1, AXIAL AXIS TEST
MEAS DATA: CH 3 : POST TEST
SWEEP 8 1 UP
10 N
UNITS
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R2 L2, AXIAL AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
CTD LIS, SINE SWEEP


R3 AXIAL, AXIAL AXIS TEST
MEAS DATA: CH 2 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP


R3 L1, AXIAL AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD LIS, SINE SWEEP

DSD = .00001 in²/Hz

ON Cor

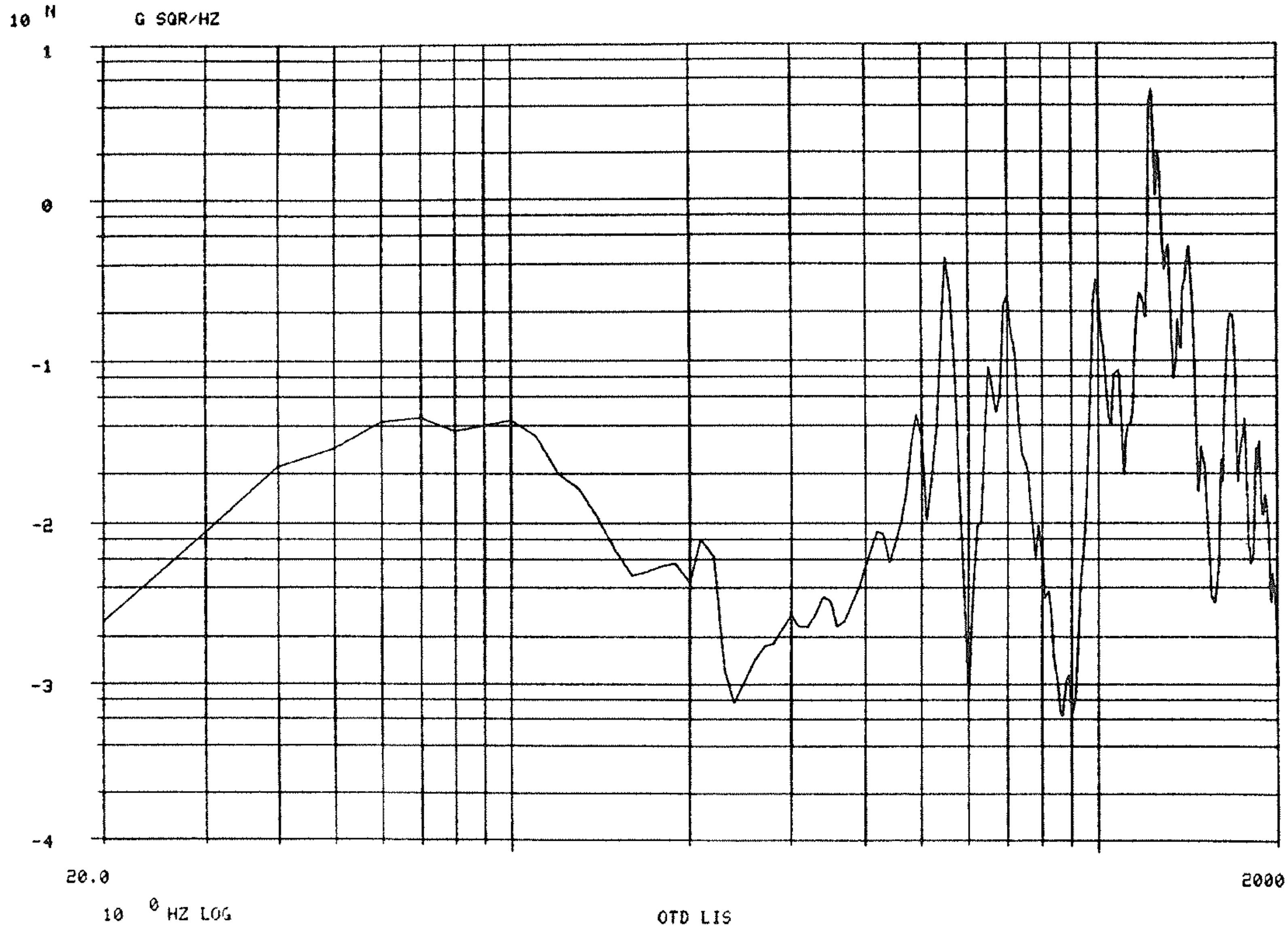
= .025"

R1 L2, L2 AXIS TEST, RELOCATED

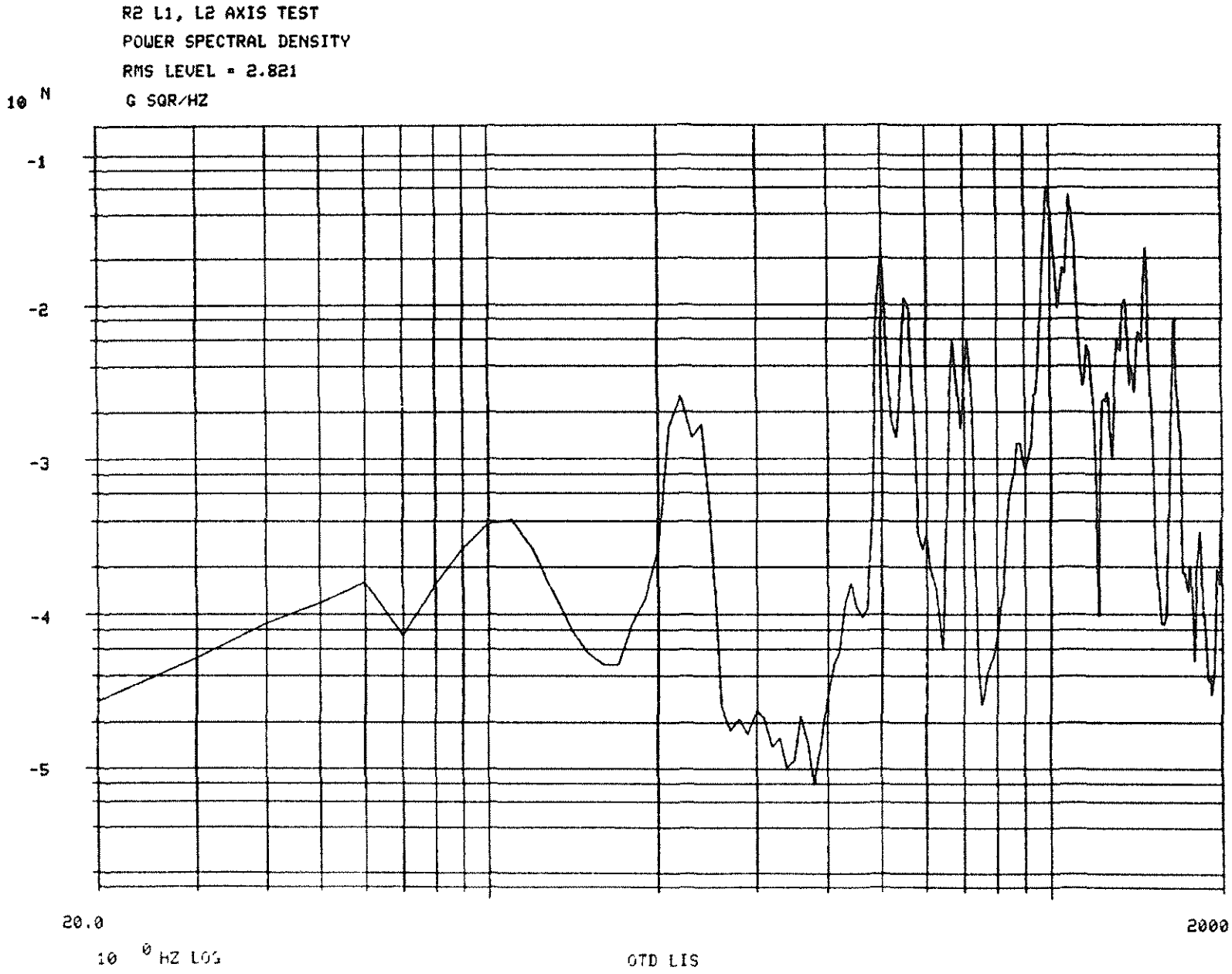
POWER SPECTRAL DENSITY

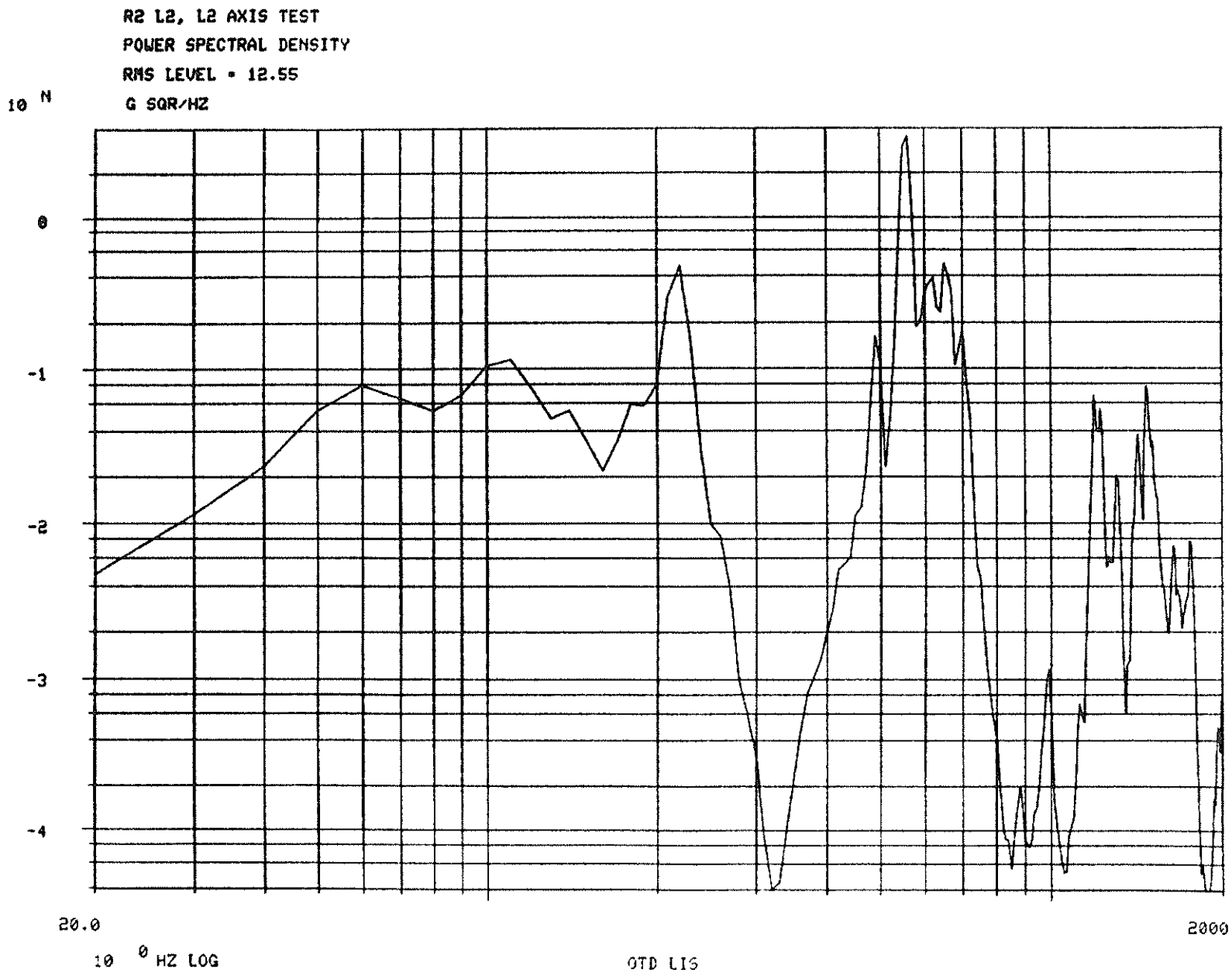
RMS LEVEL = 17.21

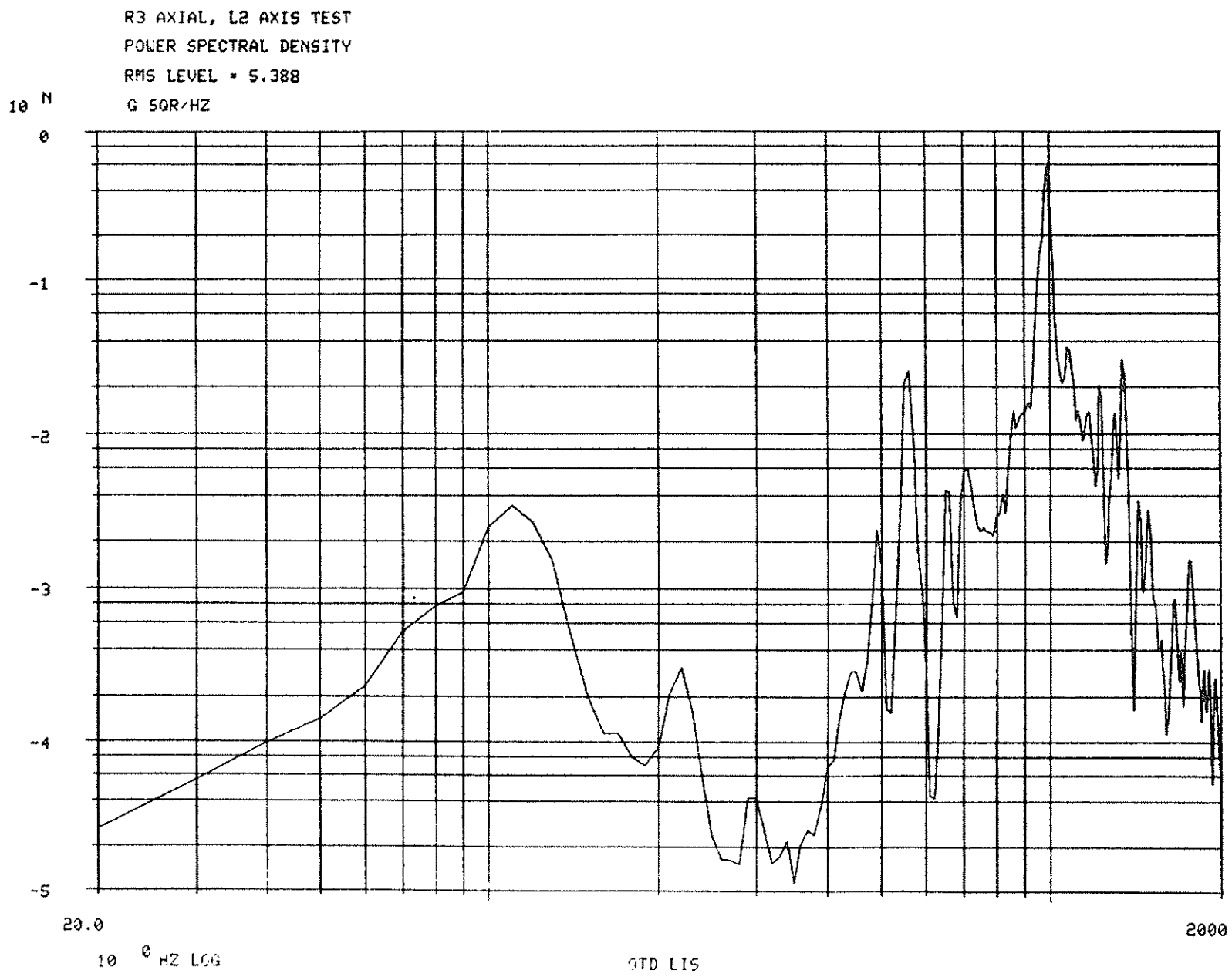
G SQR/HZ

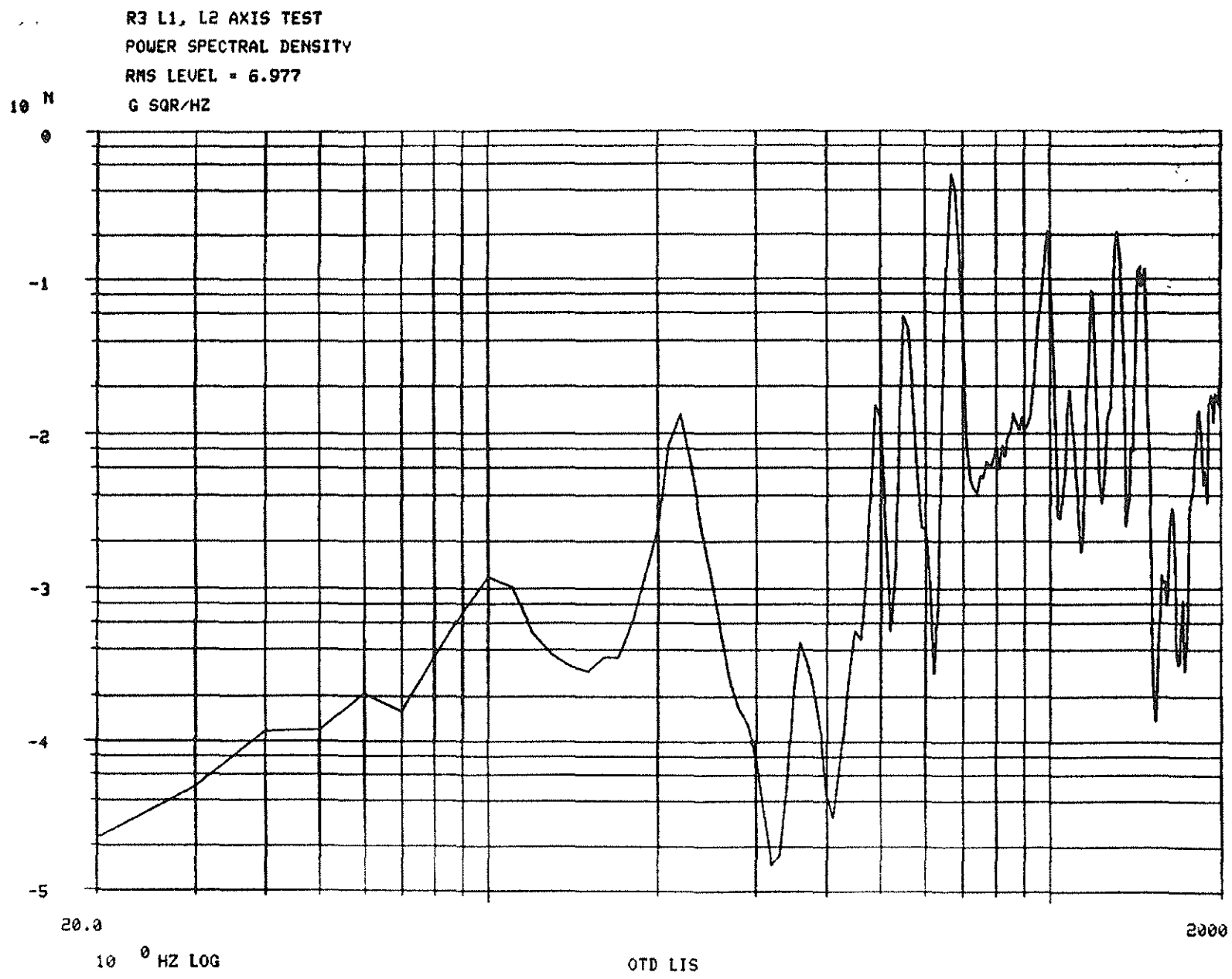


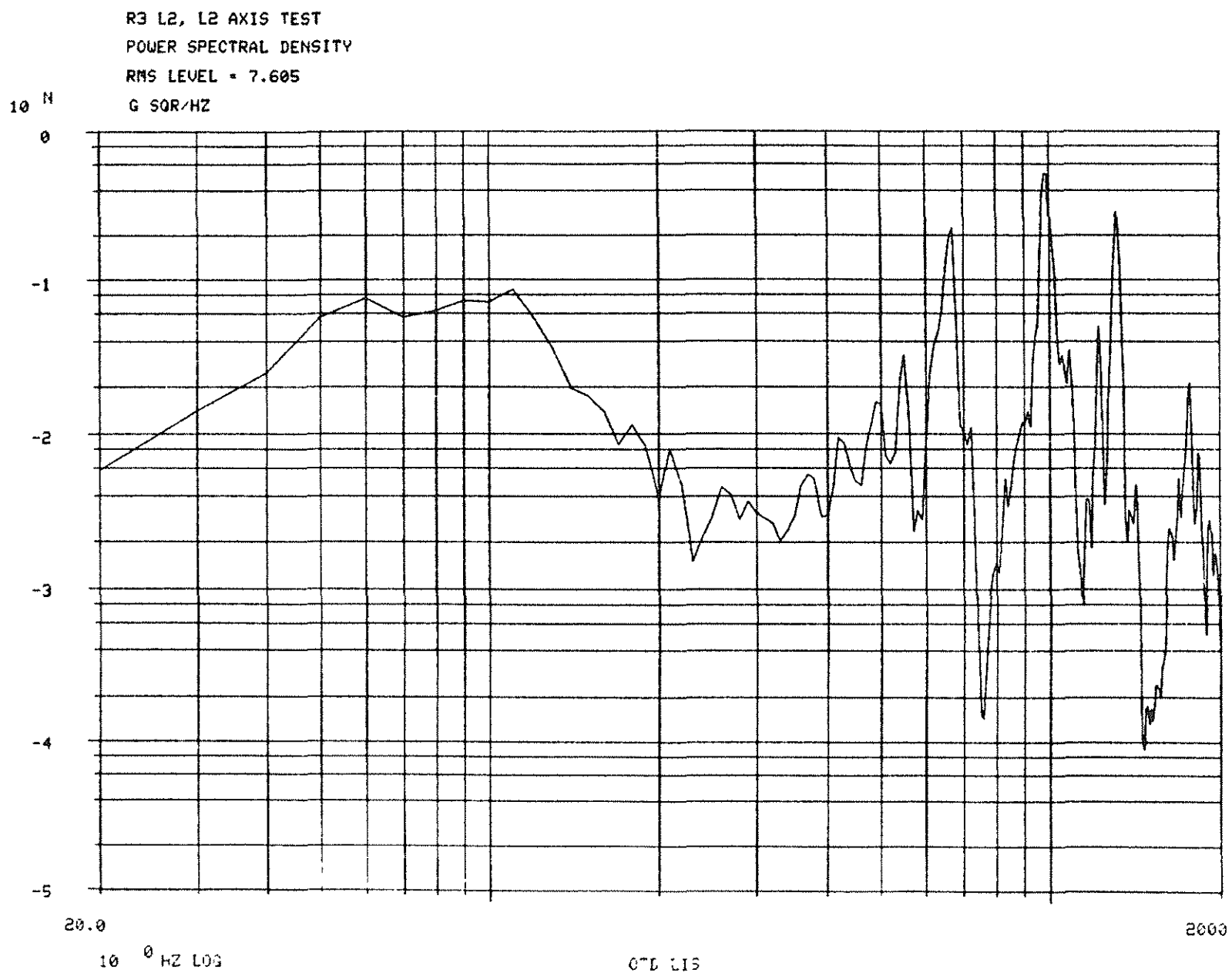
OTD LIS

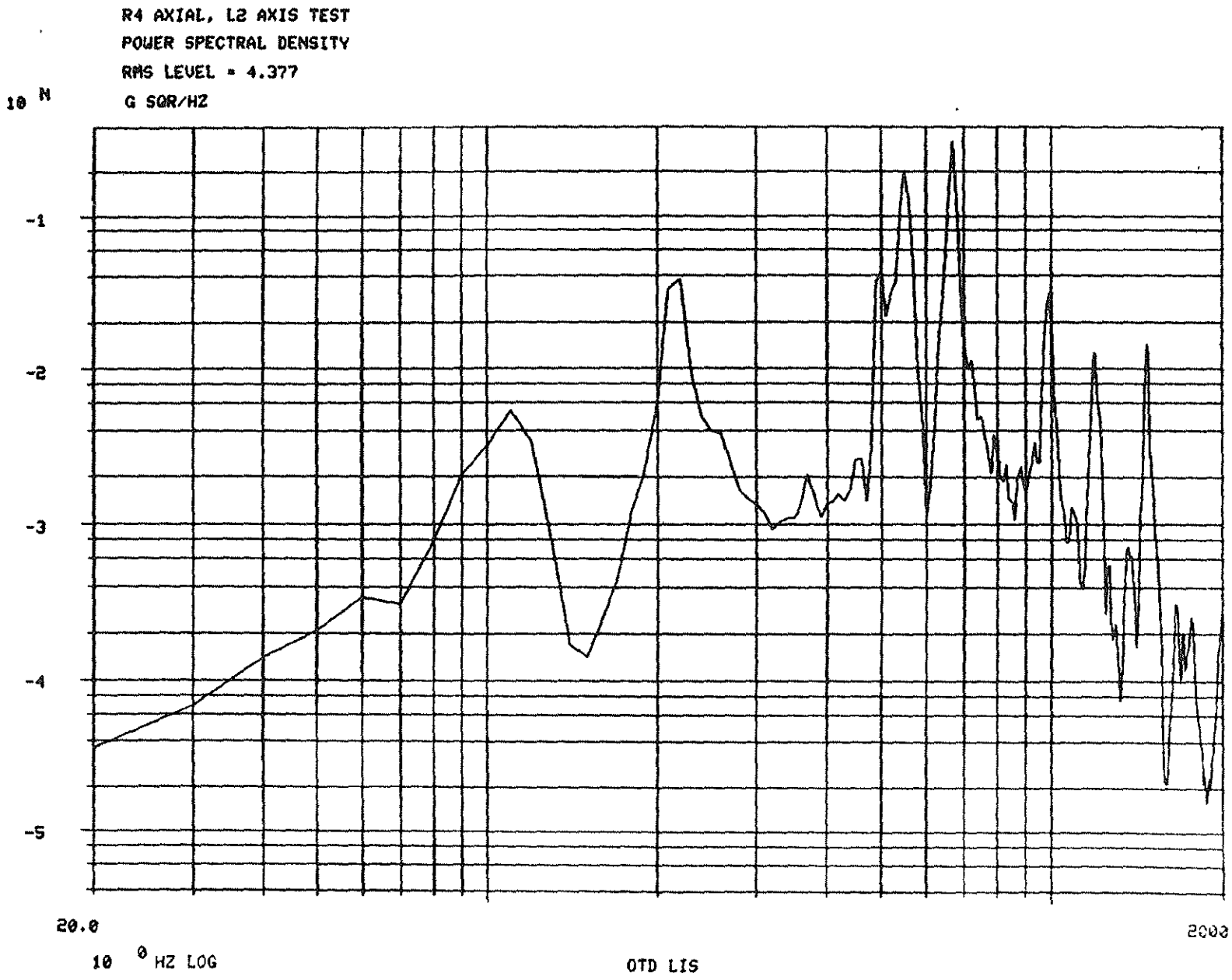

R2 L1, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 2.821
10 N
G SQR/HZ
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

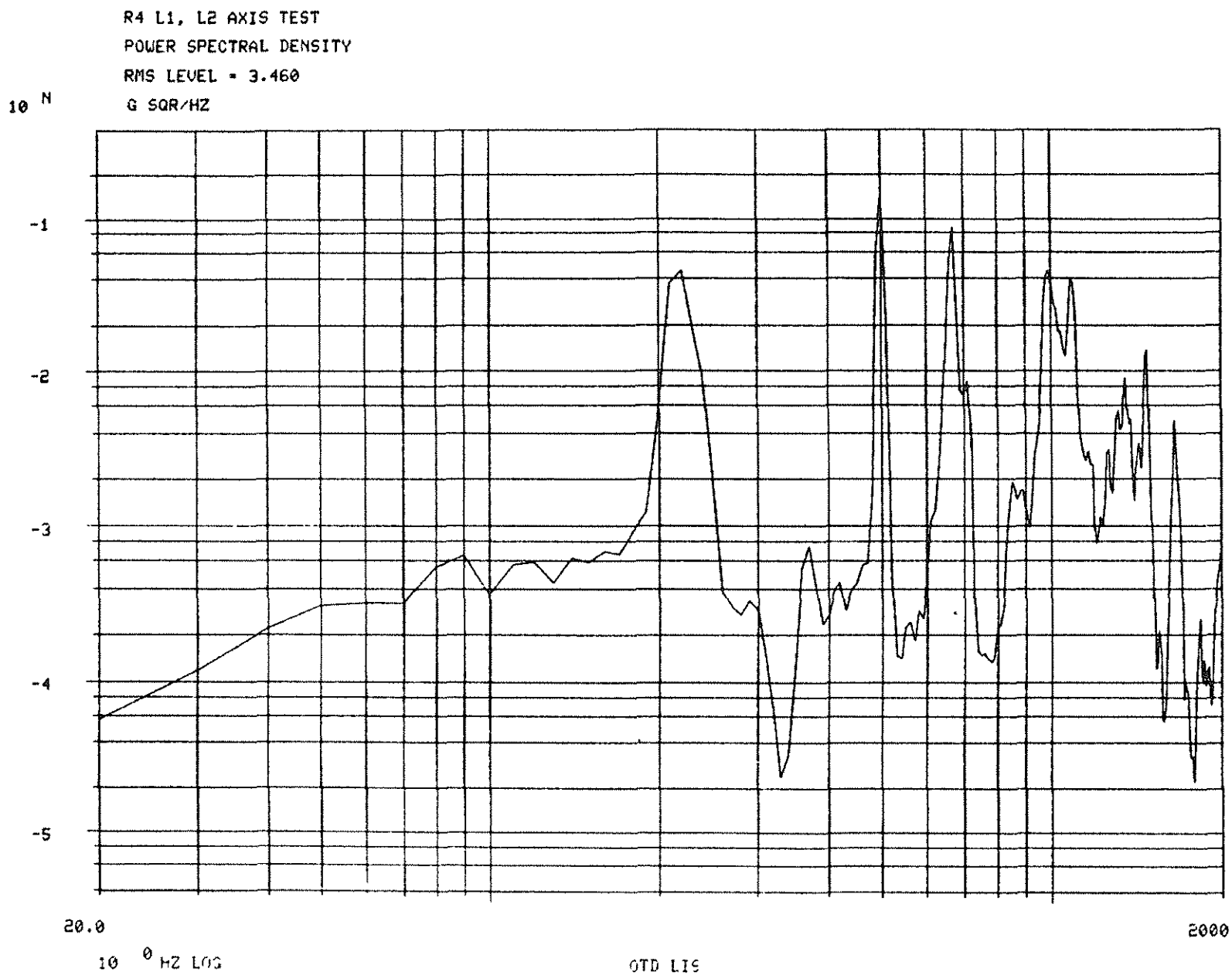

R2 L2, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 12.55
G SQR/HZ
10 N
0
-1
-2
-3
-4
20.0
2000
10 0 HZ LOG
OTD LIS


R3 AXIAL, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 5.388
G SQR/HZ
10 N
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
QTD LIS

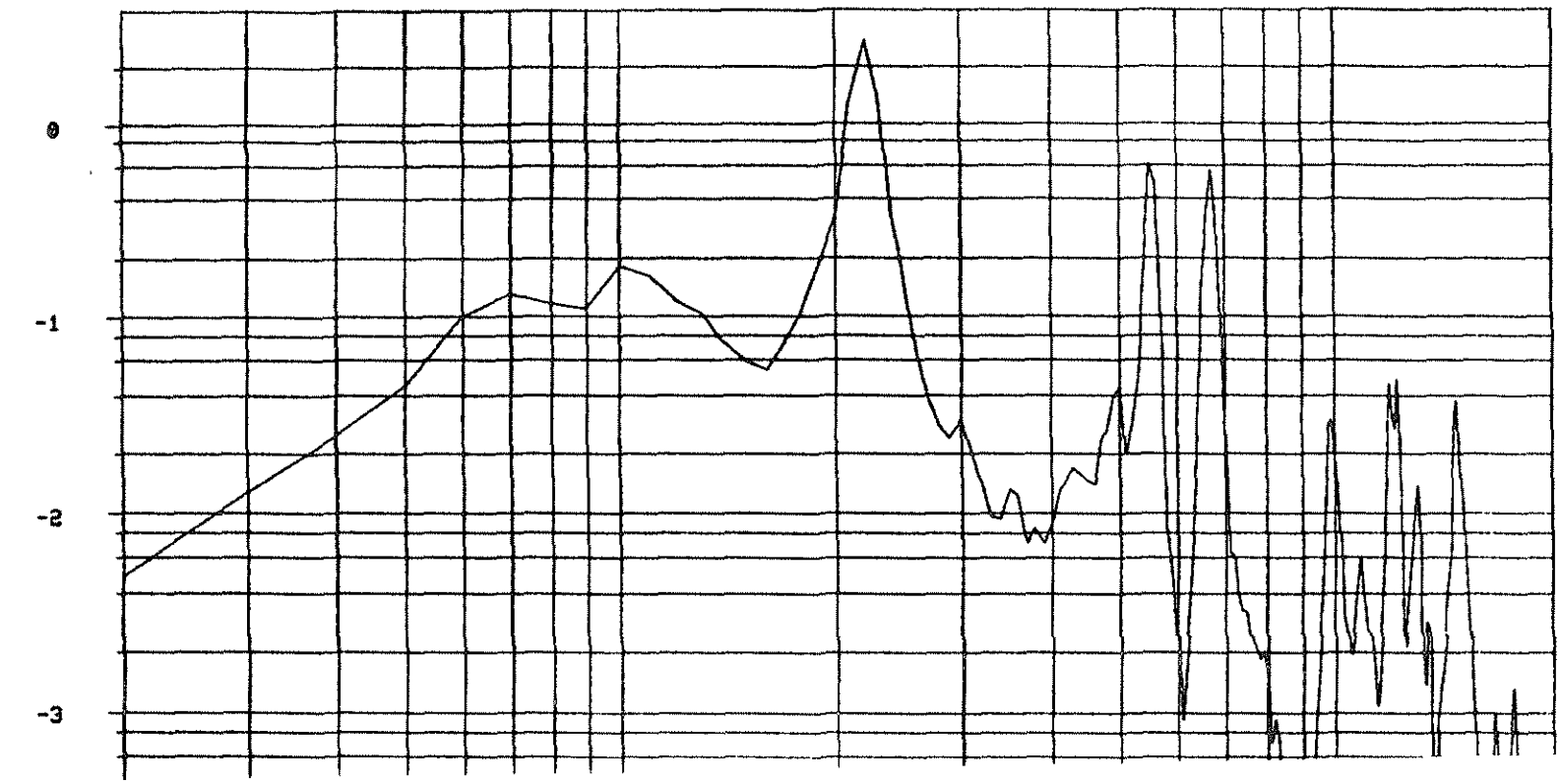

R3 L1, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 6.977
G SQR/HZ
10 N
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

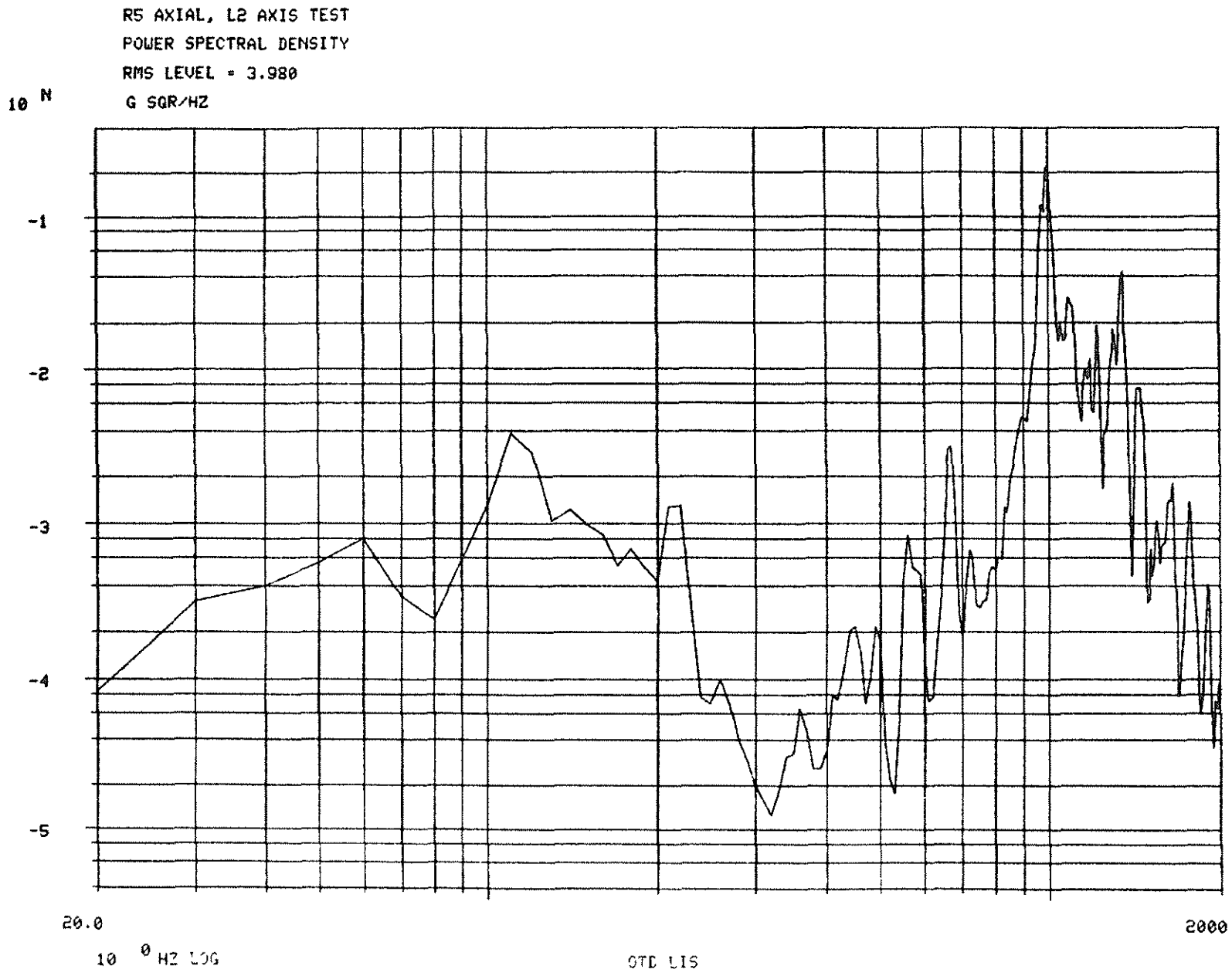

R3 L2, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 7.605
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG

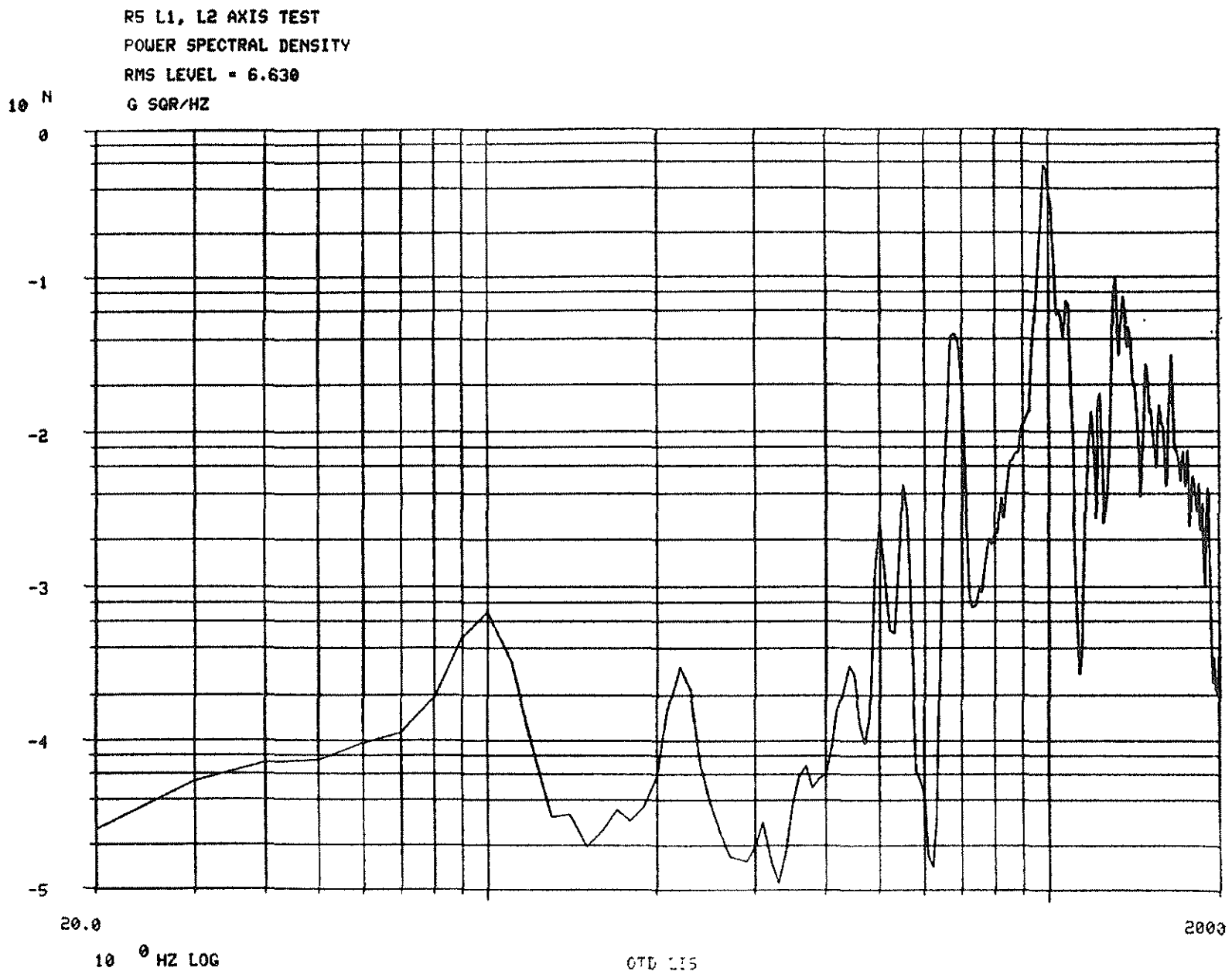

R4 AXIAL, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 4.377
G SQR/HZ
10 N
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

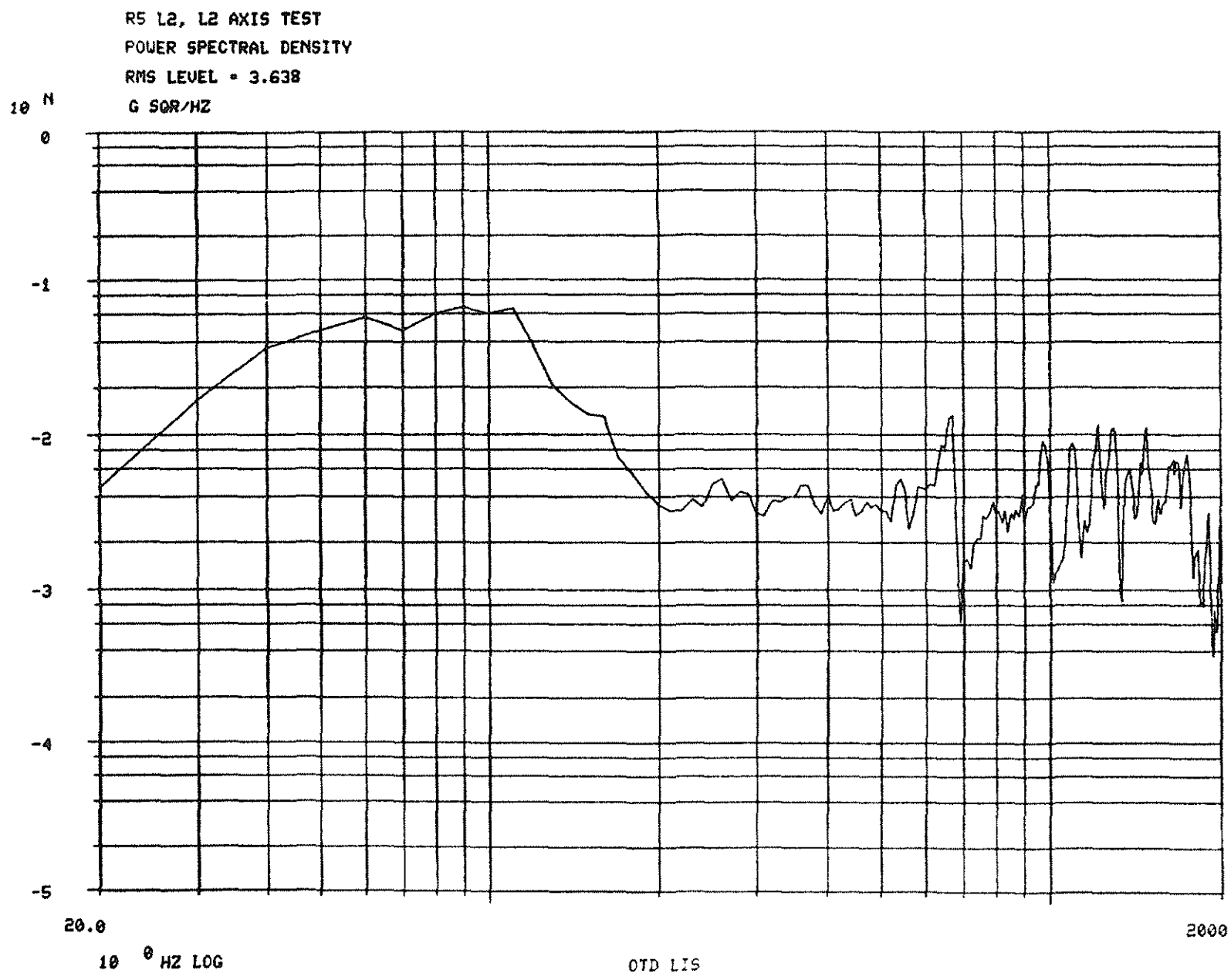

R4 L1, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 3.460
10 N
G SQR/HZ
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

R4 L2, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 11.03
G SQR/HZ

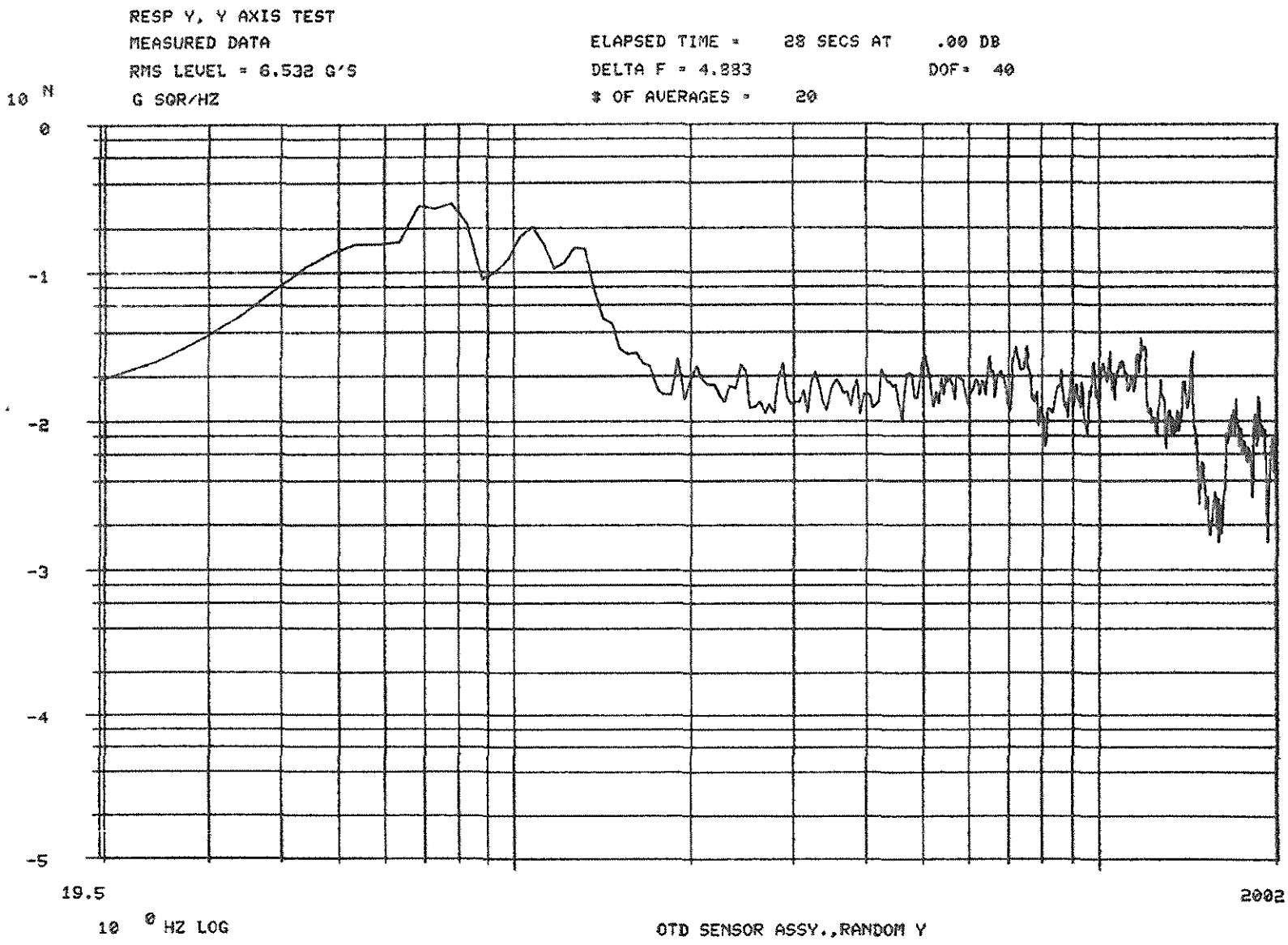


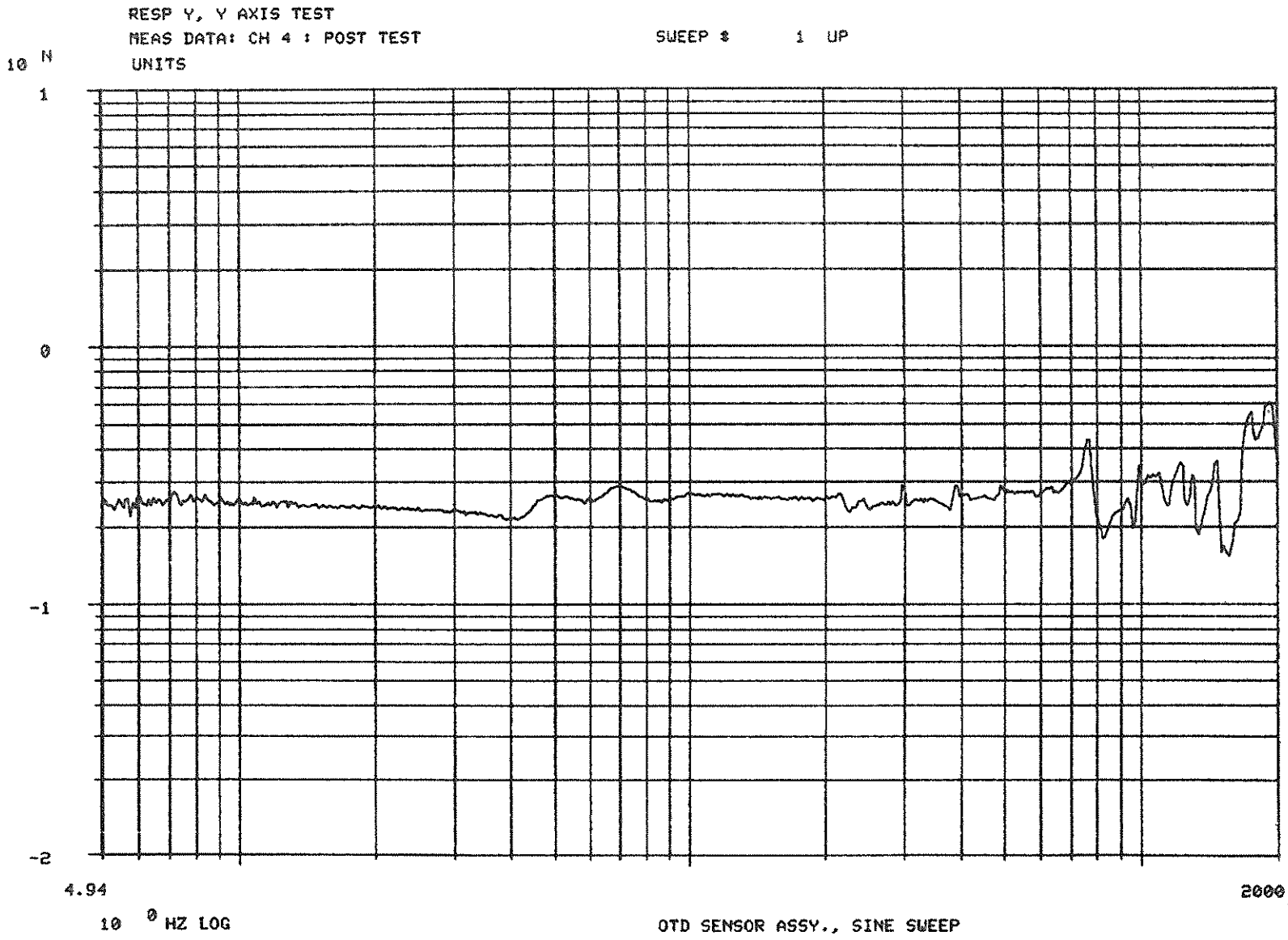

R5 AXIAL, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 3.980
10 N
G SQR/HZ
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

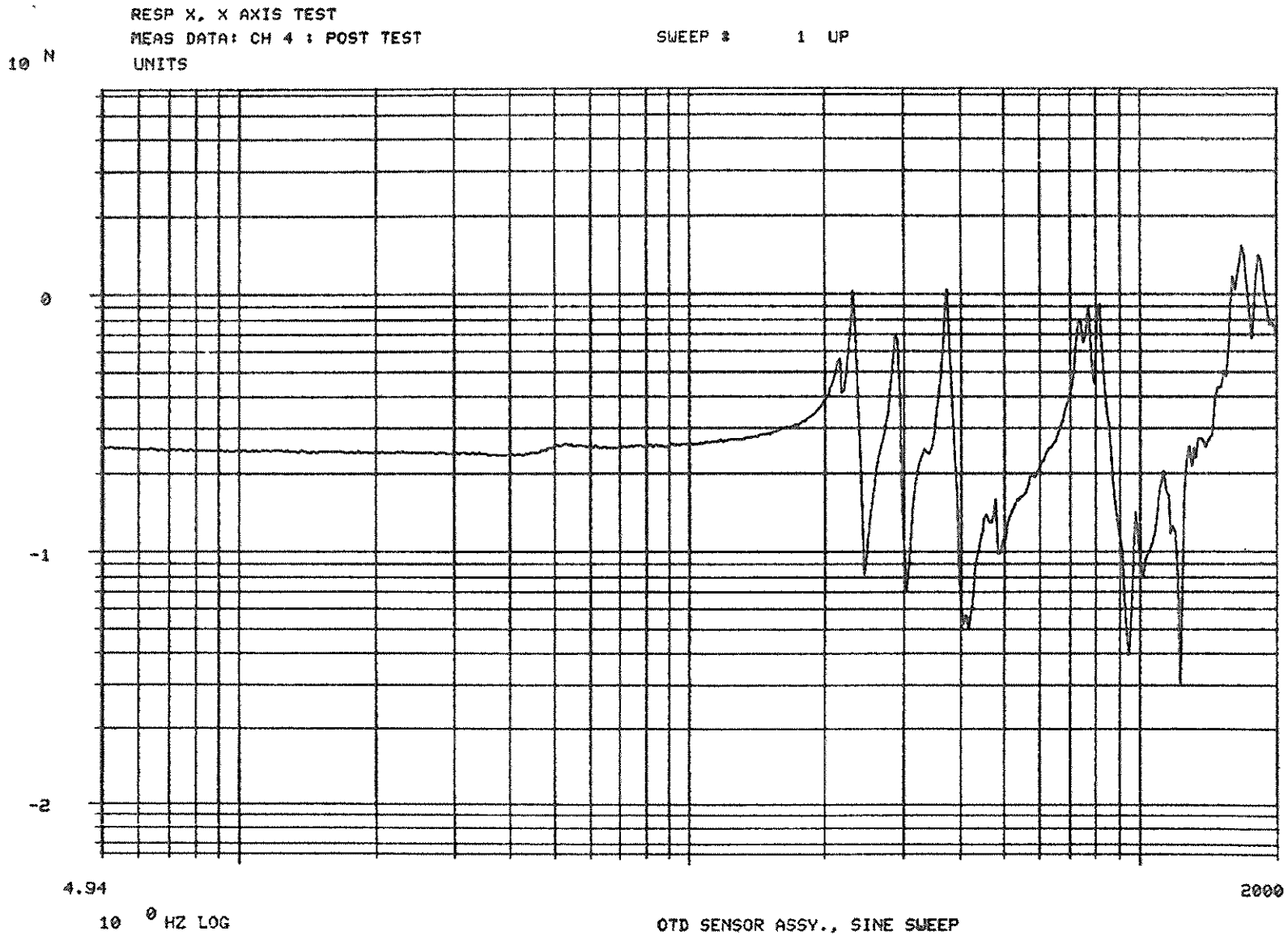

R5 L1, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 6.630
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

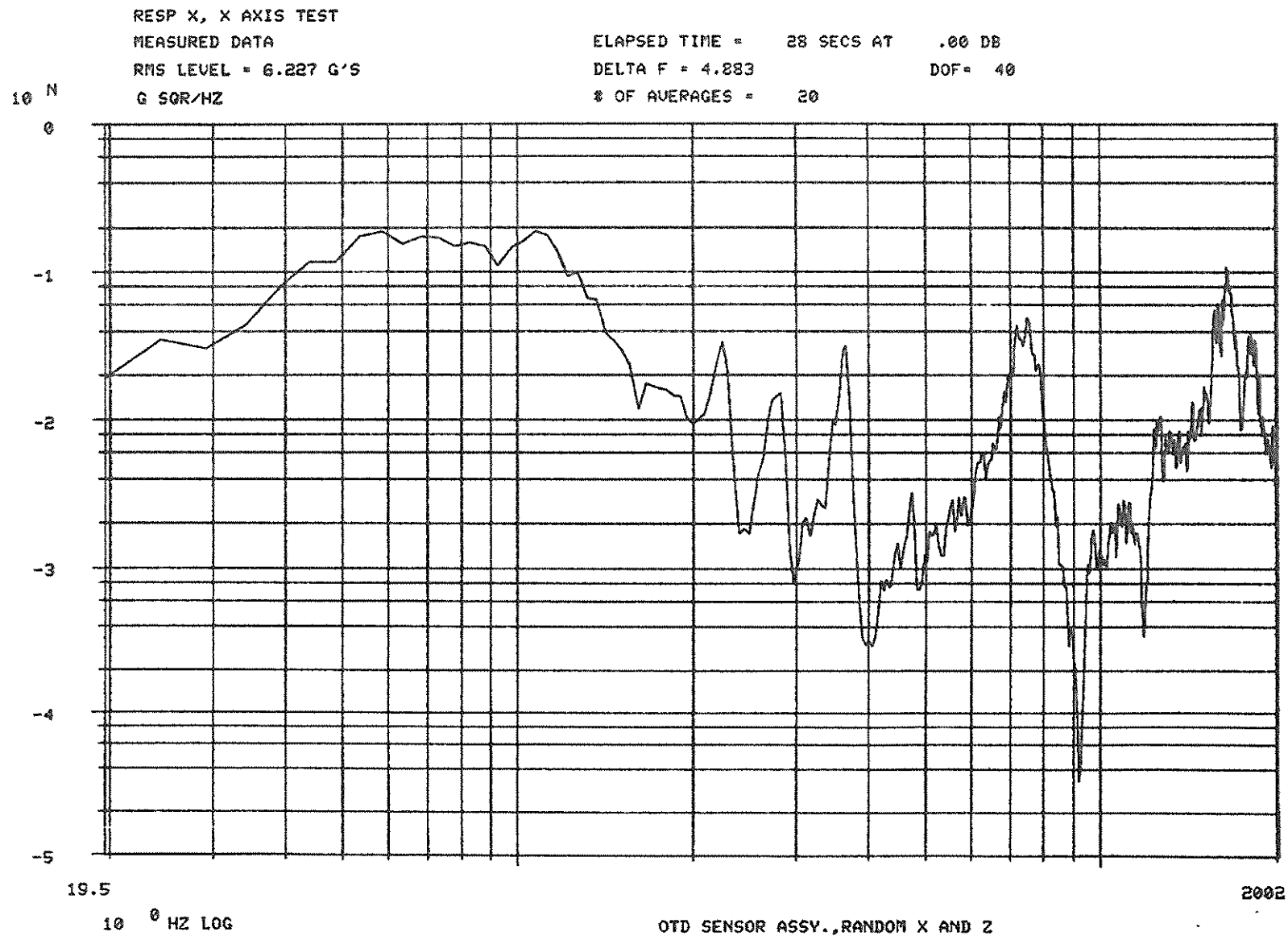

R5 L2, L2 AXIS TEST
POWER SPECTRAL DENSITY
RMS LEVEL = 3.638
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
20.0
2000
10 0 HZ LOG
OTD LIS

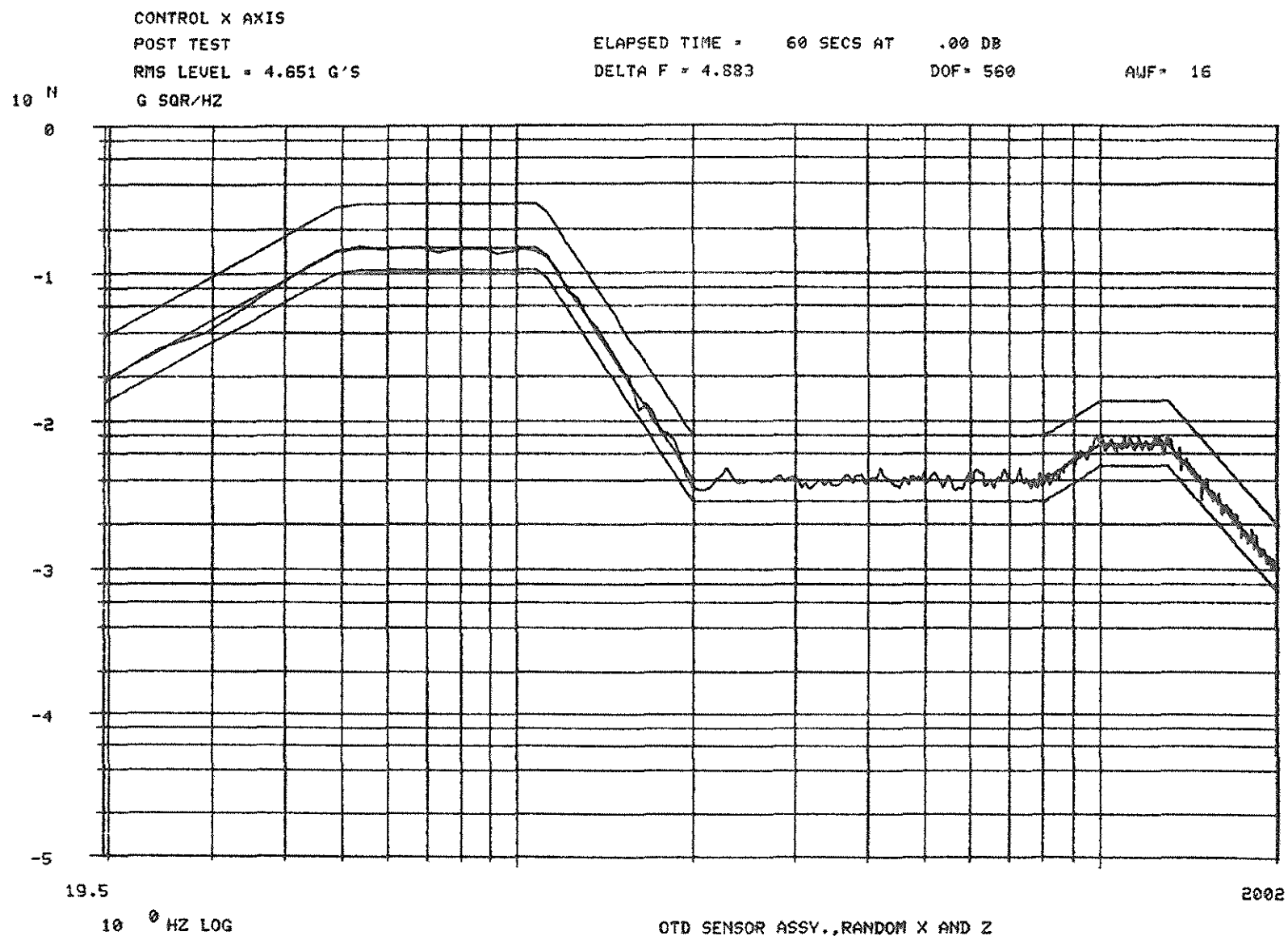
Reshake of Sensor 1/26/94




RESP Y, Y AXIS TEST
MEAS DATA: CH 4 : POST TEST
SWEEP # 1 UP
10 N
UNITS
1
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD SENSOR ASSY., SINE SWEEP


RESP X, X AXIS TEST
MEAS DATA: CH 4 : POST TEST
UNITS
SWEEP # 1 UP
10 N
0
-1
-2
4.94
2000
10 0 HZ LOG
OTD SENSOR ASSY., SINE SWEEP


RESP X, X AXIS TEST
MEASURED DATA
RMS LEVEL = 6.227 G'S
G SQR/HZ
ELAPSED TIME = 28 SECS AT .00 DB
DELTA F = 4.883
DOF= 40
# OF AVERAGES = 20
10 N
0
-1
-2
-3
-4
-5
19.5
2002
10 0 HZ LOG
OTD SENSOR ASSY.,RANDOM X AND Z


CONTROL X AXIS
POST TEST
RMS LEVEL = 4.651 G'S
ELAPSED TIME = 60 SECS AT .00 DB
DELTA F = 4.883
DOF= 560
AWF= 16
10 N
G SQR/HZ
0
-1
-2
-3
-4
-5
19.5
2002
10 0 HZ LOG
OTD SENSOR ASSY.,RANDOM X AND Z