N91-12410

11. SPACELAB-3 LOW-g ACCELEROMETER DATA FROM THE FLUID EXPERIMENTS SYSTEM (FES)

Gary Arnett, BGB, Inc.

ABSTRACT

The FES flown aboard SL-3 contained a "Miniature Electrostatic Accelerometer" (MESA). This accelerometer was purchased from Bell Aerospace, Textron and had three range (auto switching), bidirectional, three orthogonal axis capability. BGB, Inc. is in the process of examining the total mission data from this instrument. From these data, areas of interest are identified and related back to mission events. The basic format of the data for the total mission is RMS, with two (2) hours per plot.

My talk today is about a program where we are primarily looking into the accelerometer data that came from Dr. Lal's FES Experiment. We have titled the study very appropriately "The Spacelab 3 Low-g Accelerometer Data from the FES" as shown in Figure 1.

We looked at the data and know that many people, especially here, have a use for gravitational data from Spacelab 1, 2, and 3, whatever it might be, because it may help them reduce their own data. Another experiment that I know can use this kind of data is the Geophysical Fluid Flow Cell. We are just getting into this program, so I'm not going to give you any startling conclusions, but we are going to show you the track that we are taking. The first thing that we wanted to do was to provide a total mission format that the basic user could compare with his own experiment data. Our data might help him select areas of special interest in his own data. The first of our overall objectives is to take this whole mission data, find a format that is of

BGB, Inc.
4321 University Drive • Suite 300
Huntsville, Alabama 35816-3009 • Phone (205) 895-0341

PROGRAM: SL-3 LOW-G ACCELEROMETER DATA FROM THE FLUID EXPERIMENT SYSTEM (FES)

NAME: G. ARNETT

DATE: AUGUST 1986

CHART NO.:

OBJECTIVES OF STUDY

- PROVIDE USEABLE FORMAT OF TOTAL MISSION DATA FROM FLUID EXPERIMENT SYSTEM (FES), LOW-G ACCELEROMETER.
- IDENTIFY AREAS OF INTEREST AND ATTEMPT TO CORRELATE WITH BASIC MISSION EVENTS.
- IDENTIFY SPECIFIC G DATA OF INTEREST TO FES RESULTS (I.E. G-DATA DURING TIME OF HOLOGRAM EXPOSURES).

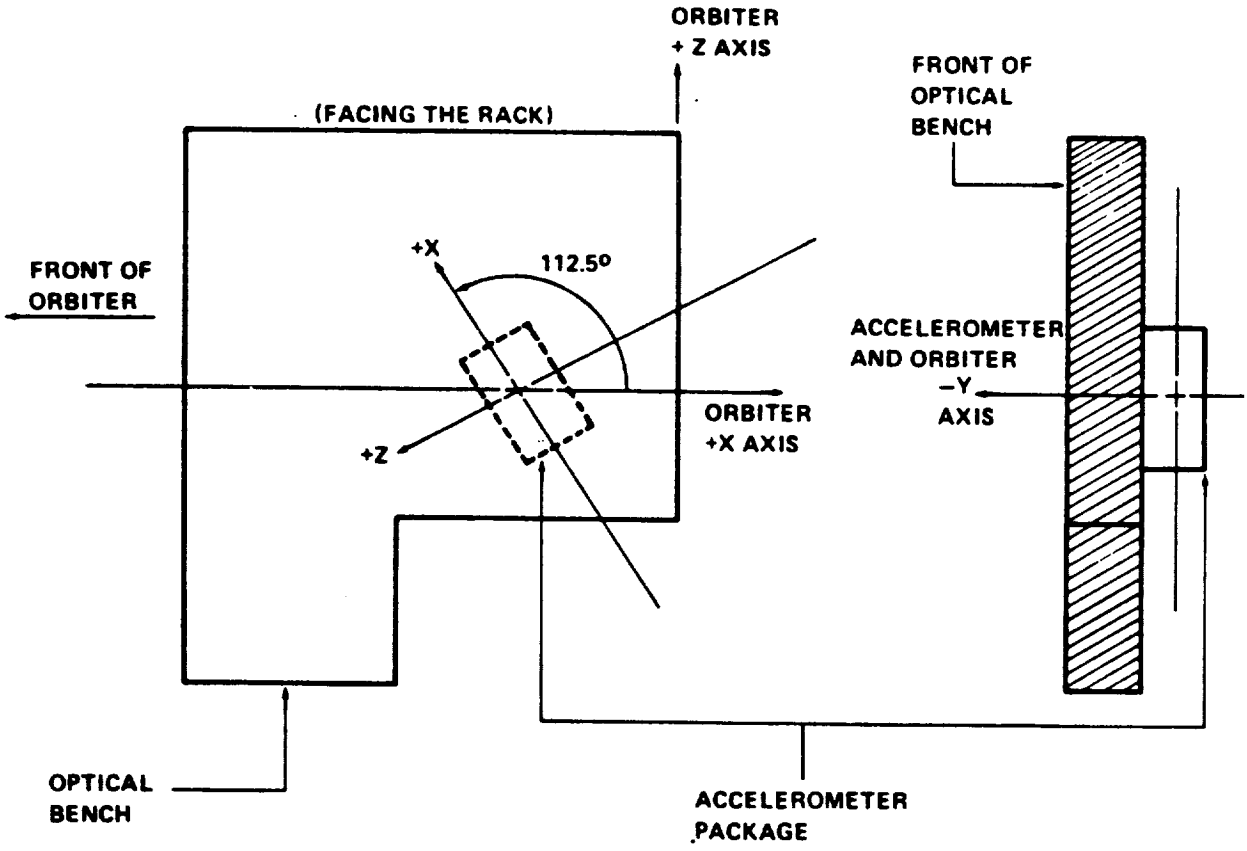
Figure 1.

general use and make it available to the user. Then when you get into the data reduction, you want to correlate the data with basic mission events. One of the best jobs that I've seen done on that was in the earlier presentation by Dr. Hamacher. His talk was very informative, but we are taking the opposite approach, we are looking at the g-data and going back and identifying things that might cause it. Since we are working very closely with Dr. Lal on his FES results, we want to overlap some of the things that would be of interest to him, especially the holograms you saw in an earlier presentation.

The FES was located radially, slightly more than a meter off the center of gravity of the orbiter. The FES accelerometer orientation is shown in Figure 2. You must decide which set of coordinates you want to use. This set actually is in terms of the structure of the orbiter where the X axis is measured toward the tail or away from the cabin. If you think in terms of dynamic coordinates, you must turn those coordinates around and the plus X axis is toward the cabin. Figure 2 depicts that the accelerometer unfortunately could not be mounted with its X, Y, Z axes totally aligned with the Shuttle's X, Y, Z axes. We are off from the positive Y axis and the XZ plane is rotated in the structural coordinate system 112.5 degrees, or if you want to think in terms of the dynamic axis, it's off by the complement of that, or 67.5 degrees. The Y-axis is in plane and the XZ plane is rotated.

Some basic background information on the accelerometer that was used is shown in Figure 3. It was a miniature electrostatic accelerometer and had automatic switching with three ranges. The three ranges were 127 micro-g, 1.27 milli-g, and 12.7 milli-g. The really important information shown is the measurement rate of about 300 samples/second. I think Roger Chassay said that sample rate would produce 150 million pieces of data. That is factor of about 100 too many when you start looking at the data. There was a force rebalance loop (Figure 4) on the X and Y axis, and Z was very similar. You had an ac pickoff and the dc forcing function.

FLUIDS EXPERIMENT SYSTEM
ACCELEROMETER ORIENTATION



FES MEASUREMENT NUMBER	FES ACCEL. AXIS
L20Q6002A	X
L20Q6005A	Y
L20Q6008A	Z

Figure 2.

BGB, Inc.
4321 University Drive • Suite 300
Huntsville, Alabama 35816-3009 • Phone (205) 895-0341

PROGRAM: SL-3 LOW-G ACCELEROMETER DATA FROM THE FLUID EXPERIMENT SYSTEM (FES)

NAME: G. ARNETT

DATE: AUGUST 1986

CHART NO.:

TYPE: MINIATURE ELECTROSTATIC ACCELEROMETER (MESA)

MANUFACTURER: BELL AEROSPACE, TEXTRON

CAPABILITY:

- THREE RANGES (AUTOMATIC RANGING):
  - 1 MICRO-G RESOLUTION AT 127 MICRO-G FULL SCALE
  - 10 MICRO-G RESOLUTION AT 1.27 MILLI-G FULL SCALE
  - 100 MICRO-G RESOLUTION AT 12.7 MILLI-G FULL SCALE
- BI-DIRECTIONAL
- THREE INDEPENDENT ORTHOGONAL AXIS
- MEASUREMENT RATE: 300 SAMPLES/SEC

CONFIGURATION:

- CYLINDRICAL "PROOF MASS" ELECTROSTATICALLY SUSPENDED IN A CYLINDRICAL, HERMETICALLY-SEALED CASING

OPERATION:

- "PROOF MASS" POSITION IS SENSED CAPACITIVELY
- DC ELECTROSTATIC FORCE IS GENERATED TO RESTORE TO NULL POSITION
- DC VOLTAGE IS CONVERTED TO FREQUENCY PROPORTIONAL TO ACCELERATION
- FREQUENCY PULSES COUNTED FOR FIXED DURATION
- FINAL SUM OUTPUT AS DIGITAL VALUE PROPORTIONAL TO ACCELERATION ON "PROOF MASS"

Figure 3.

FORCE REBALANCE LOOP, X AND Y AXES
(Y ONLY SHOWN)

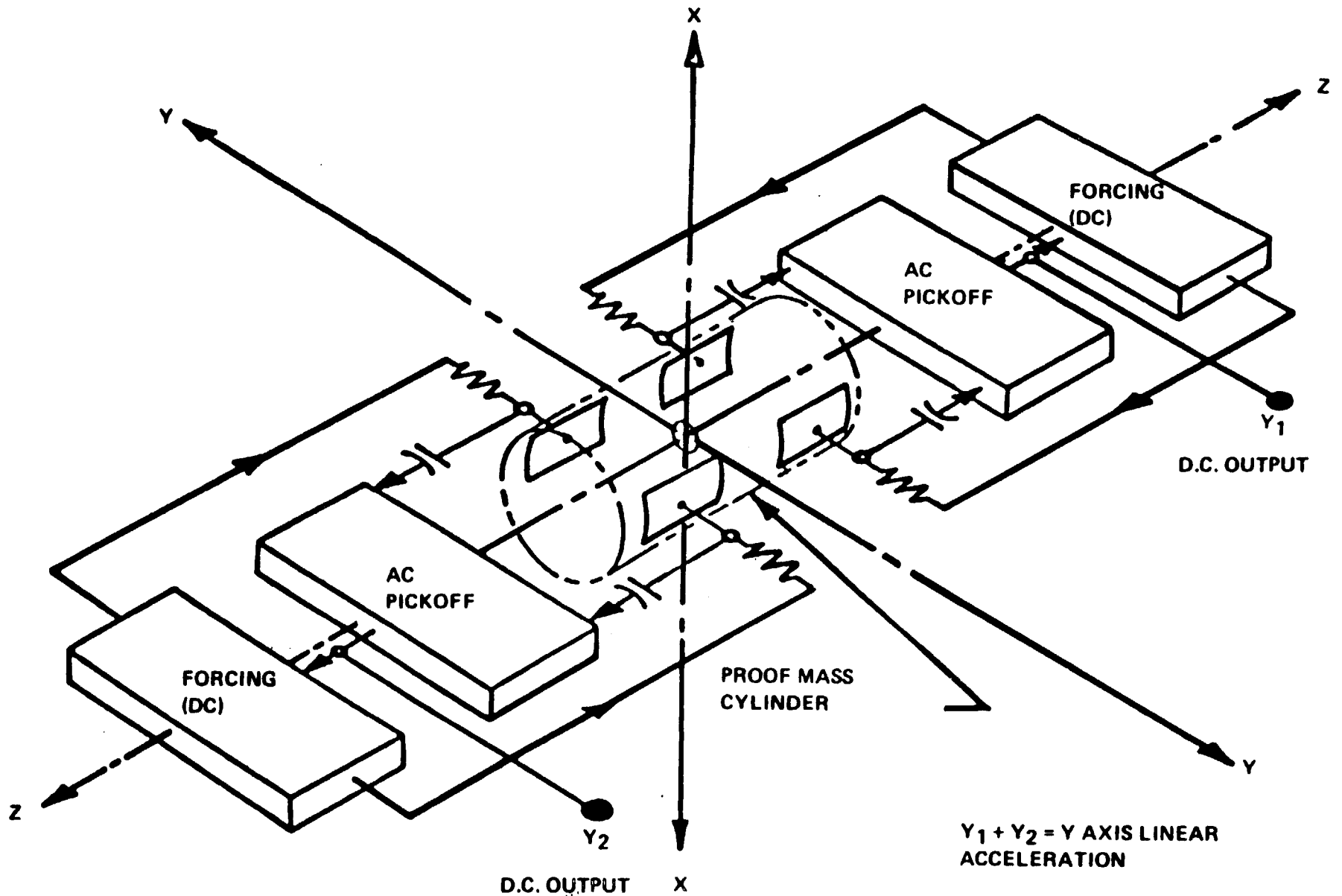


Figure 4.

JA-11,673-86

There are some terms (Figure 5) that I want to define before showing our data reduction results. We have tried to format the data to meet that first objective where people look at it and identify those areas of interest to themselves. We ended up integrating over a 10-second period of time. That meant that we were integrating about 3,000 points for each point that we plot. We define that time interval as delta HST. This is the format that the Computation Lab at Marshall gives us the data. We plotted our data as an RMS, or a standard deviation plot with a delta HST of 10 seconds. We defined a crest factor which is the peak value within that 10-second period divided by the RMS. All of these are designed to smooth the data because with 300 points per second, your data looks very rough and I will discuss that later. We define power spectral density as a plot of the power input versus the frequency.

One of the things that we have done so far is to look at the real effect of the RCS engines. In the upper right corner of Figure 6 we selected six typical engines that we would try to track to see their effects. We would look at the time they were moderately active and when very active. The F location, as seen in the upper left corner, is in the forward module, the 5 means that it was through that manifold number, and in the upper center is a definition of what A, F, L, R, U, and D mean in terms of thruster plume direction. The box in the right center shows the direction of thruster plume which causes a movement in the opposite direction. The dynamic body coordinates are shown in the lower right-hand box, and the structural coordinates are shown at the lower left, where poxitive X goes from the cabin back, if you are looking for a station location.

The typical raw data we started out with is shown in Figure 7 and, as you can see, we had to do something with the data. There was something in the hardware/software cycle that drove us over scale at a very regular period of time. I had a discourse on this from our software people from the Computation Lab, and their first recommendation was

BGB, Inc.
4321 University Drive • Suite 300
Huntsville, Alabama 35816-3009 • Phone (205) 895-0341

PROGRAM
SL-3 LOW-G ACCELEROMETER DATA FROM THE FLUID EXPERIMENT SYSTEM (FES)

NAME
G. ARNETT

DATE
AUGUST 1986

CHART NO.

DEFINITIONS

ΔHST = TIME INTERVAL OVER WHICH THE RAW DATA IS INTEGRATED

= 10 SECONDS ON TOTAL MISSION DATA

RMS = ROOT MEAN SQUARE OF DATA WITHIN THE ΔHST TIME PERIOD, OR STANDARD DEVIATION OVER THE 10 SECOND TIME PERIOD

CREST FACTOR = $\frac{\text{PEAK VALUE WITHIN } \Delta\text{HST}}{\text{RMS}}$

PSD = POWER SPECTRAL DENSITY - DISTRIBUTION OF POWER (ENERGY) INPUT VERSUS FREQUENCY

Figure 5.

F5L L5D R5R

F5R L5L R5D

DATA USED FROM THESE THRUSTERS

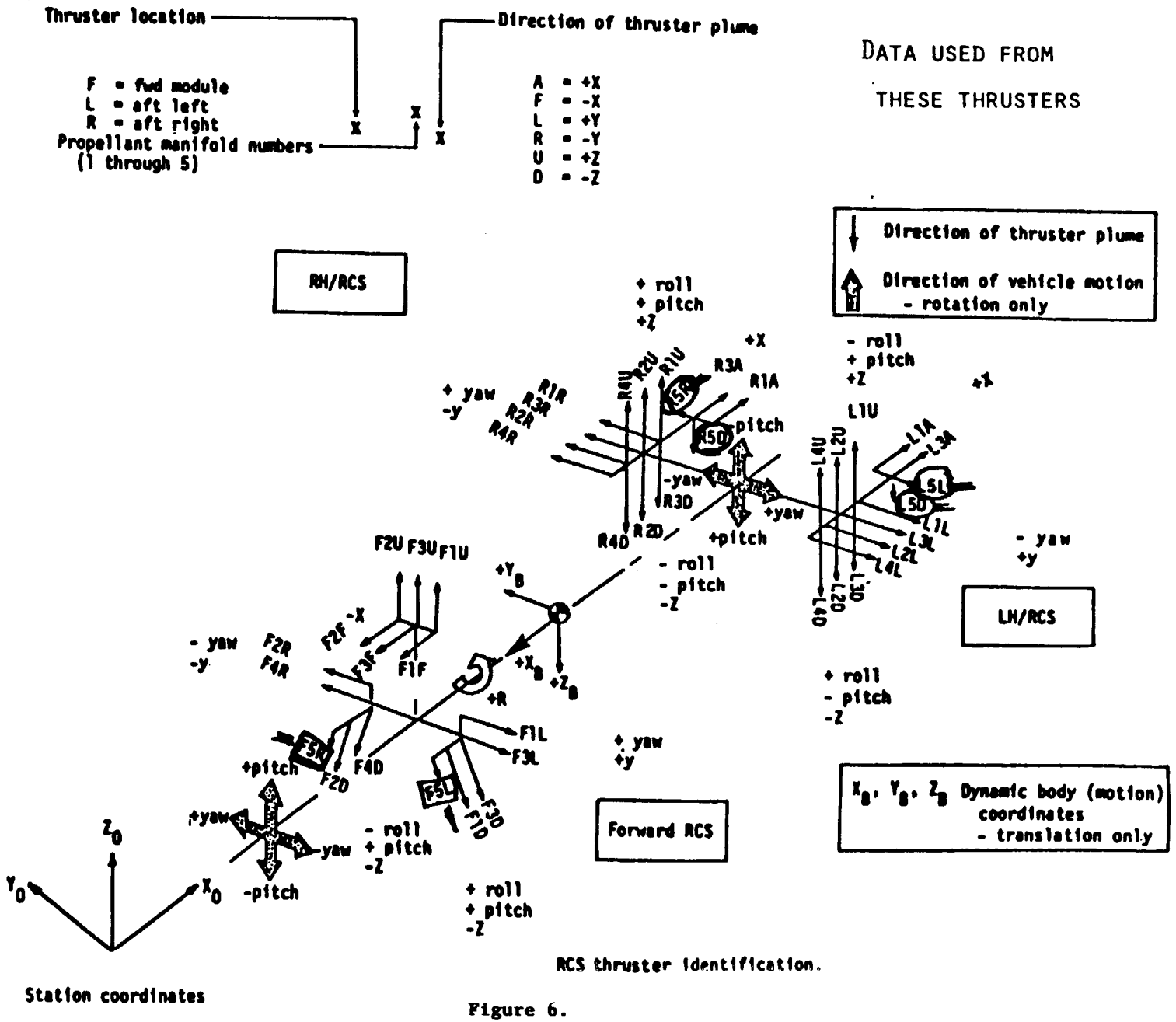


Figure 6.

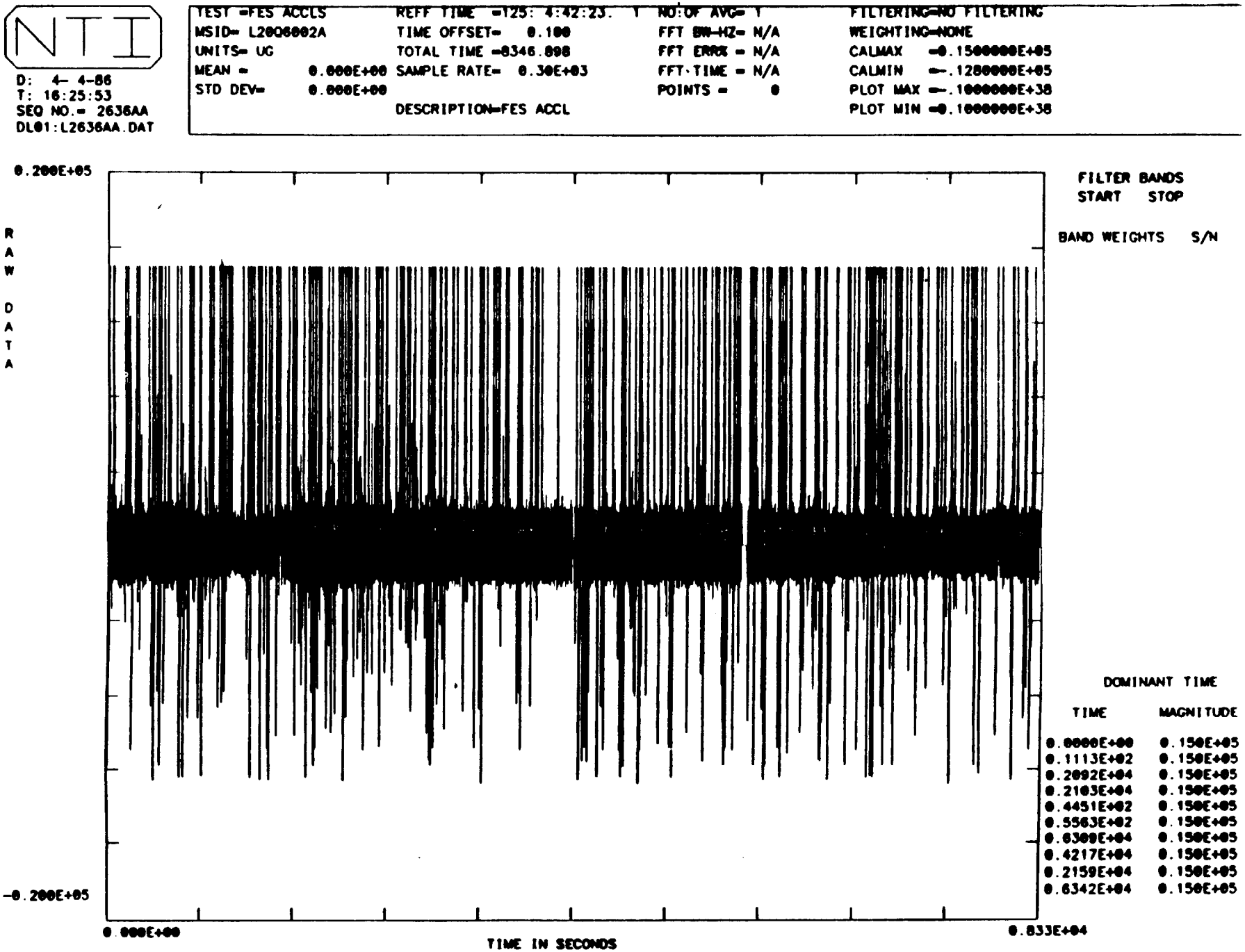

NTI
D: 4- 4-86
T: 16:25:53
SEQ NO.= 2636AA
DL01:L2636AA.DAT
TEST =FES ACCLS
MSID= L20Q6002A
UNITS= UG
MEAN = 0.000E+00
STD DEV= 0.000E+00
REFF TIME =125: 4:42:23.
TIME OFFSET= 0.100
TOTAL TIME =8346.898
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACCL
NO OF AVG= 1
FFT BW-HZ= N/A
FFT ERR% = N/A
FFT TIME = N/A
POINTS = 0
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1280000E+05
PLOT MAX =-.1000000E+38
PLOT MIN =0.1000000E+38
0.200E+05
-0.200E+05
RAW DATA
0.000E+00
0.833E+04
TIME IN SECONDS
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.0000E+00 0.150E+05
0.1113E+02 0.150E+05
0.2092E+04 0.150E+05
0.2103E+04 0.150E+05
0.4451E+02 0.150E+05
0.5563E+02 0.150E+05
0.6309E+04 0.150E+05
0.4217E+04 0.150E+05
0.2159E+04 0.150E+05
0.6342E+04 0.150E+05

Figure 7.

to throw out every thing that is over scale -- something about a bit-flipping and then it would drive the reading over scale, and then come back and give an accurate reading. What we are really doing is peaking out and this is really not good data. Often, you could be throwing away a piece of data, but when you are trying to look at so much data, you may have to throw away a piece or two of good data in your data reduction.

QUESTION: Can you say that is data, or is it electronic noise?

ANSWER: It was described to me as not necessarily noise but a characteristic of the software in the reduction cycle. Some of it could be noise and some of it could be real data. What I'm trying to explain to you is what we settled on as a data reduction method and format.

A part of the RMS time history in the same timeframe is shown in Figure 8. This is just slightly over one hour of data, and we used a 5-second integration time. We did identify that the peak was a true peak.

In Figure 9, we were trying to plot two hours of time and make it meaningful, so you would have only about 70 rather than 1,000 pieces of paper to scan through the mission g-data. We used a 10-second integration time for this plot and found that the real data was retained. We settled on this two-hour format with a 10-second integration time for the basic mission data reduction.

I want to show a very significant event which was a roll maneuver which is depicted in Figures 10 through 12. This was after the FES experiment was over, but the optical bench was still on. They left the optical bench on so we could utilize the accelerometer to ensure that we could see an event such as a roll maneuver. If you have events spread over a relatively large period of time, you should see it in the RMS time history. Crest is peak value over RMS value, so if you have a peak value for quite a period of time, the RMS value is going to equal peak value, and you will not see a large long time period event. The crest value is intended to bring out more isolated events. So RMS shows you some of the long time period events, and crest value shows the isolated

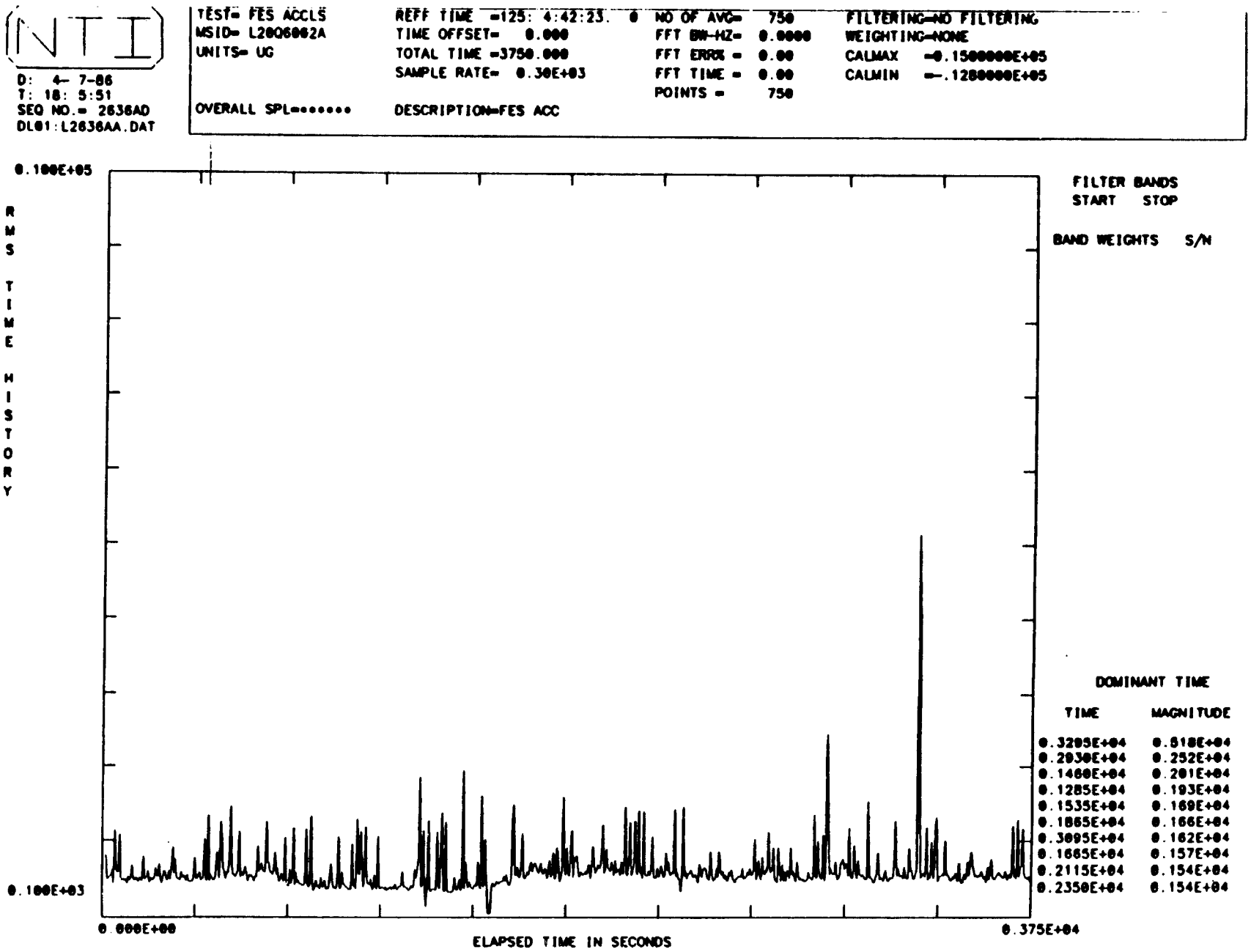

NTI
D: 4- 7-86
T: 18: 5:51
SEQ NO.= 2636AD
DL01:L2636AA.DAT
TEST= FES ACCLS
MSID= L28Q6002A
UNITS= UG
OVERALL SPL=******
REFF TIME =125: 4:42:23. 0
TIME OFFSET= 0.000
TOTAL TIME =3750.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
NO OF AVG= 750
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 750
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1200000E+05
0.100E+05
0.100E+03
RMS TIME HISTORY
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.3295E+04 0.818E+04
0.2930E+04 0.252E+04
0.1460E+04 0.201E+04
0.1285E+04 0.193E+04
0.1535E+04 0.169E+04
0.1865E+04 0.166E+04
0.3095E+04 0.162E+04
0.1665E+04 0.157E+04
0.2115E+04 0.154E+04
0.2350E+04 0.154E+04
0.000E+00
0.375E+04
ELAPSED TIME IN SECONDS

Figure 8.

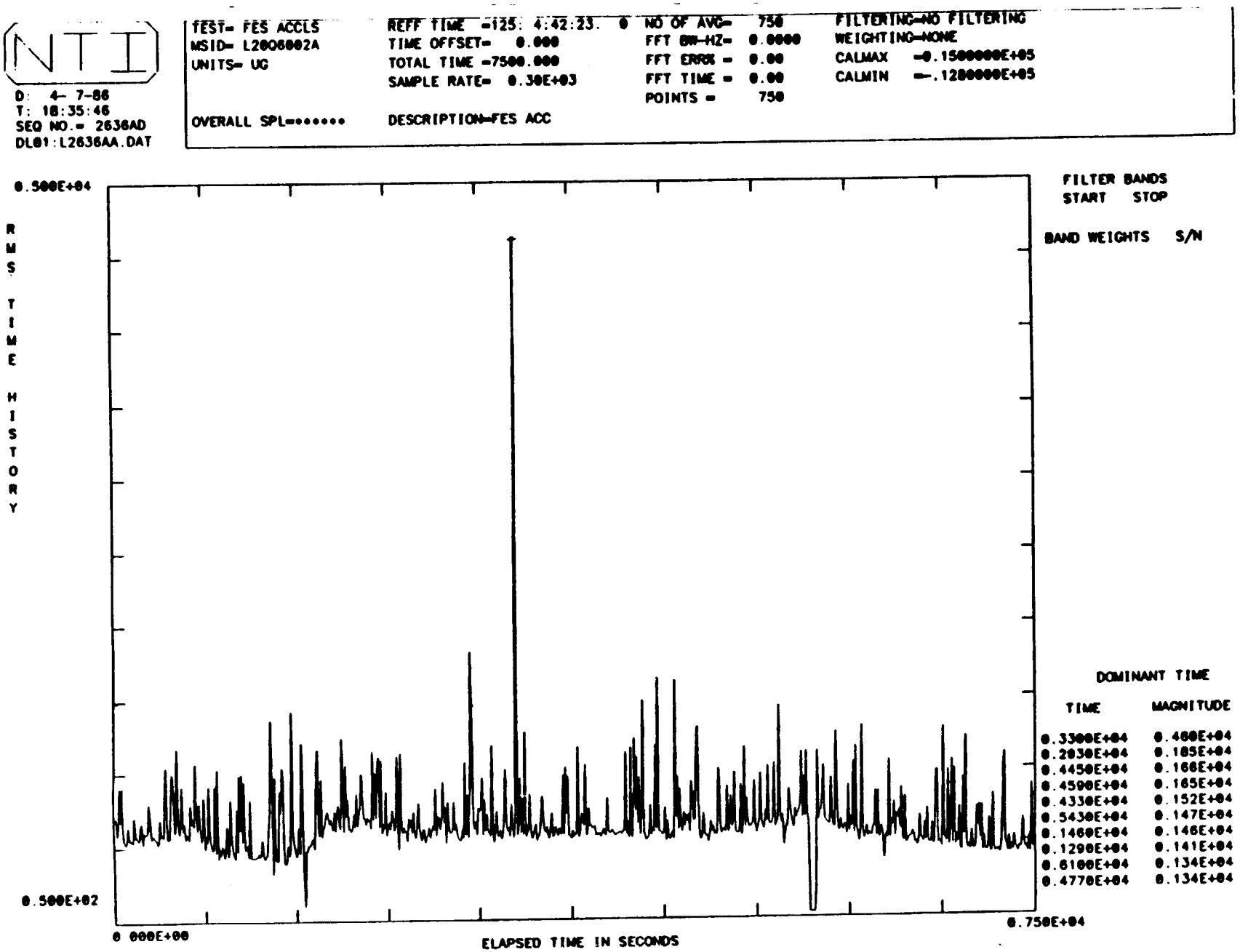

NTI
D: 4- 7-86
T: 18:35:46
SEQ NO.= 2636AD
DL01:L2636AA.DAT
TEST= FES ACCLS
MSID= L2006002A
UNITS= UG
OVERALL SPL=******
REFF TIME =125: 4:42:23. 0
TIME OFFSET= 0.000
TOTAL TIME =7500.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
NO OF AVG= 750
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 750
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1200000E+05
0.500E+04
RMS TIME HISTORY
0.500E+02
0.000E+00
ELAPSED TIME IN SECONDS
0.750E+04
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.3300E+04 0.460E+04
0.2030E+04 0.185E+04
0.4450E+04 0.166E+04
0.4590E+04 0.165E+04
0.4330E+04 0.152E+04
0.5430E+04 0.147E+04
0.1460E+04 0.146E+04
0.1290E+04 0.141E+04
0.6100E+04 0.134E+04
0.4770E+04 0.134E+04

Figure 9.

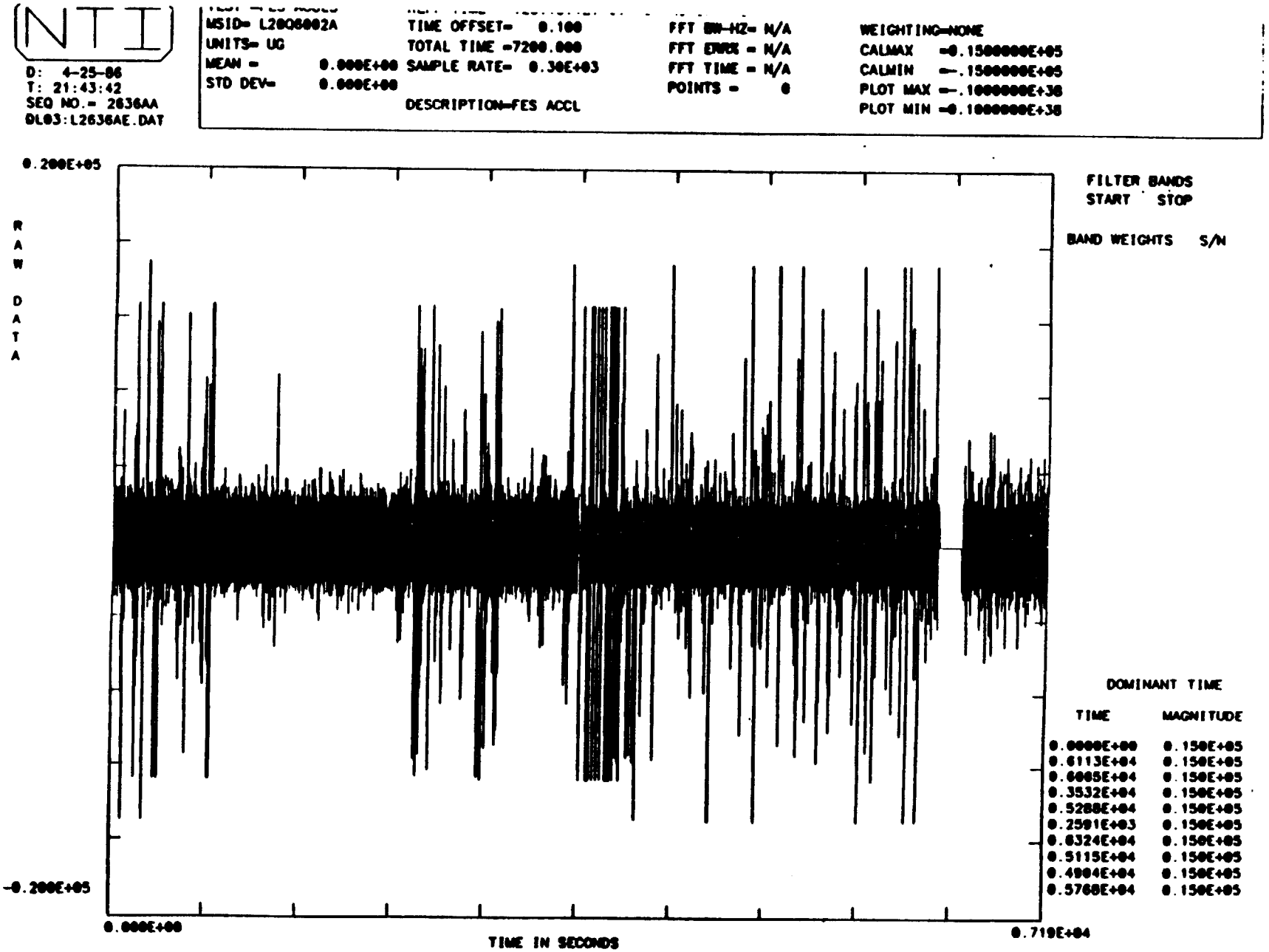

NTI
D: 4-25-86
T: 21:43:42
SEQ NO.= 2636AA
DL03:L2636AE.DAT
MSID= L28Q8002A
UNITS= UG
MEAN = 0.000E+00
STD DEV= 0.000E+00
TIME OFFSET= 0.100
TOTAL TIME =7200.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACCL
FFT BW-HZ= N/A
FFT ERROR = N/A
FFT TIME = N/A
POINTS = 0
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
PLOT MAX =-.1000000E+38
PLOT MIN =0.1000000E+38
0.200E+05
RAW DATA
-0.200E+05
0.000E+00
TIME IN SECONDS
0.719E+04
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.0000E+00 0.150E+05
0.6113E+04 0.150E+05
0.6065E+04 0.150E+05
0.3532E+04 0.150E+05
0.5288E+04 0.150E+05
0.2591E+03 0.150E+05
0.6324E+04 0.150E+05
0.5115E+04 0.150E+05
0.4904E+04 0.150E+05
0.5768E+04 0.150E+05

Figure 10.

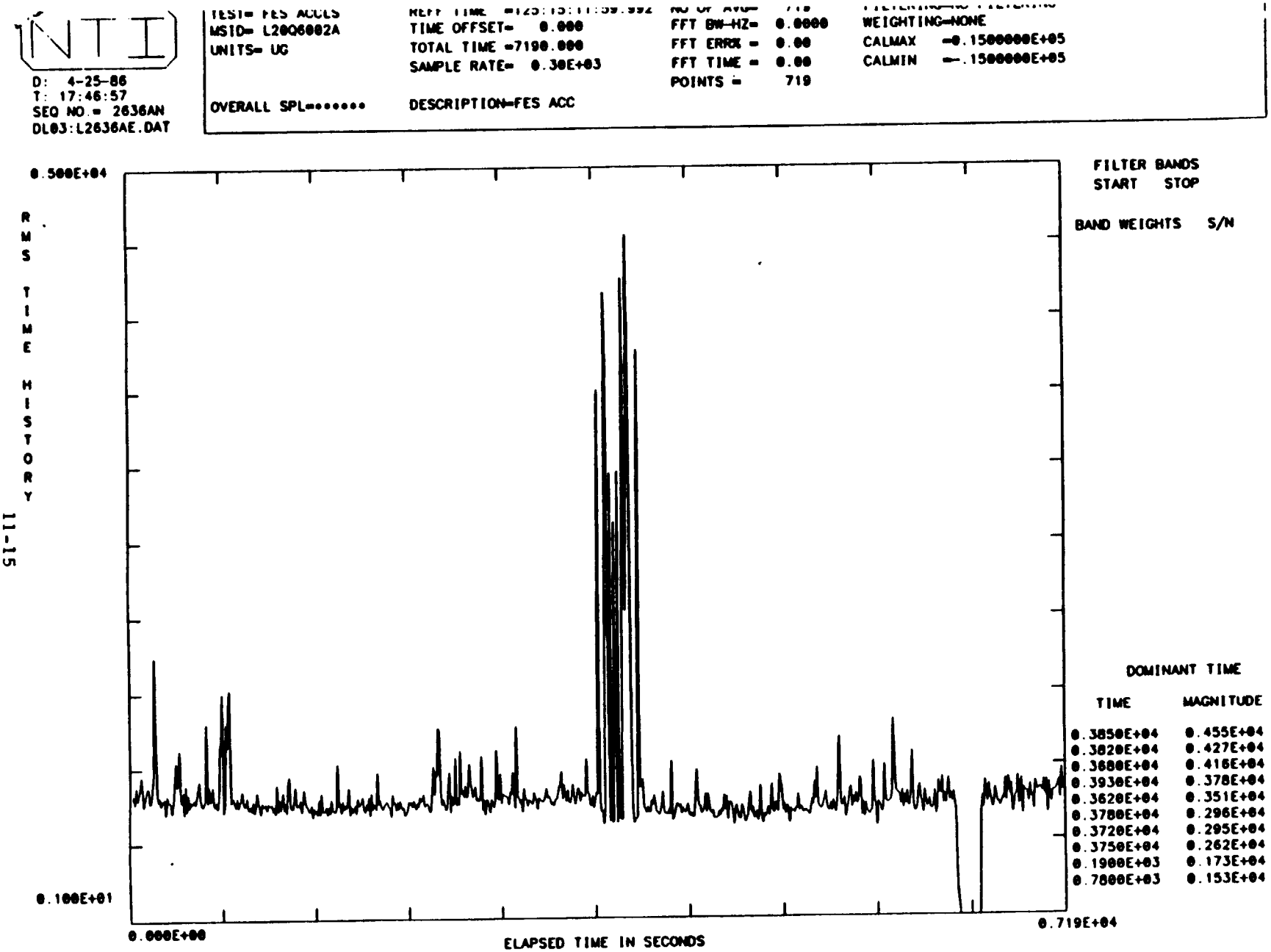

NTI
D: 4-25-86
T: 17:46:57
SEQ NO.= 2636AN
DL03:L2636AE.DAT
TEST= FES ACCLS
MSID= L20Q6002A
UNITS= UG
OVERALL SPL=******
TIME OFFSET= 0.000
TOTAL TIME =7190.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 719
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
0.500E+04
0.100E+01
RMS TIME HISTORY
0.000E+00
0.719E+04
ELAPSED TIME IN SECONDS
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.3850E+04 0.455E+04
0.3820E+04 0.427E+04
0.3680E+04 0.416E+04
0.3930E+04 0.378E+04
0.3620E+04 0.351E+04
0.3780E+04 0.296E+04
0.3720E+04 0.295E+04
0.3750E+04 0.262E+04
0.1900E+03 0.173E+04
0.7800E+03 0.153E+04

Figure 11.

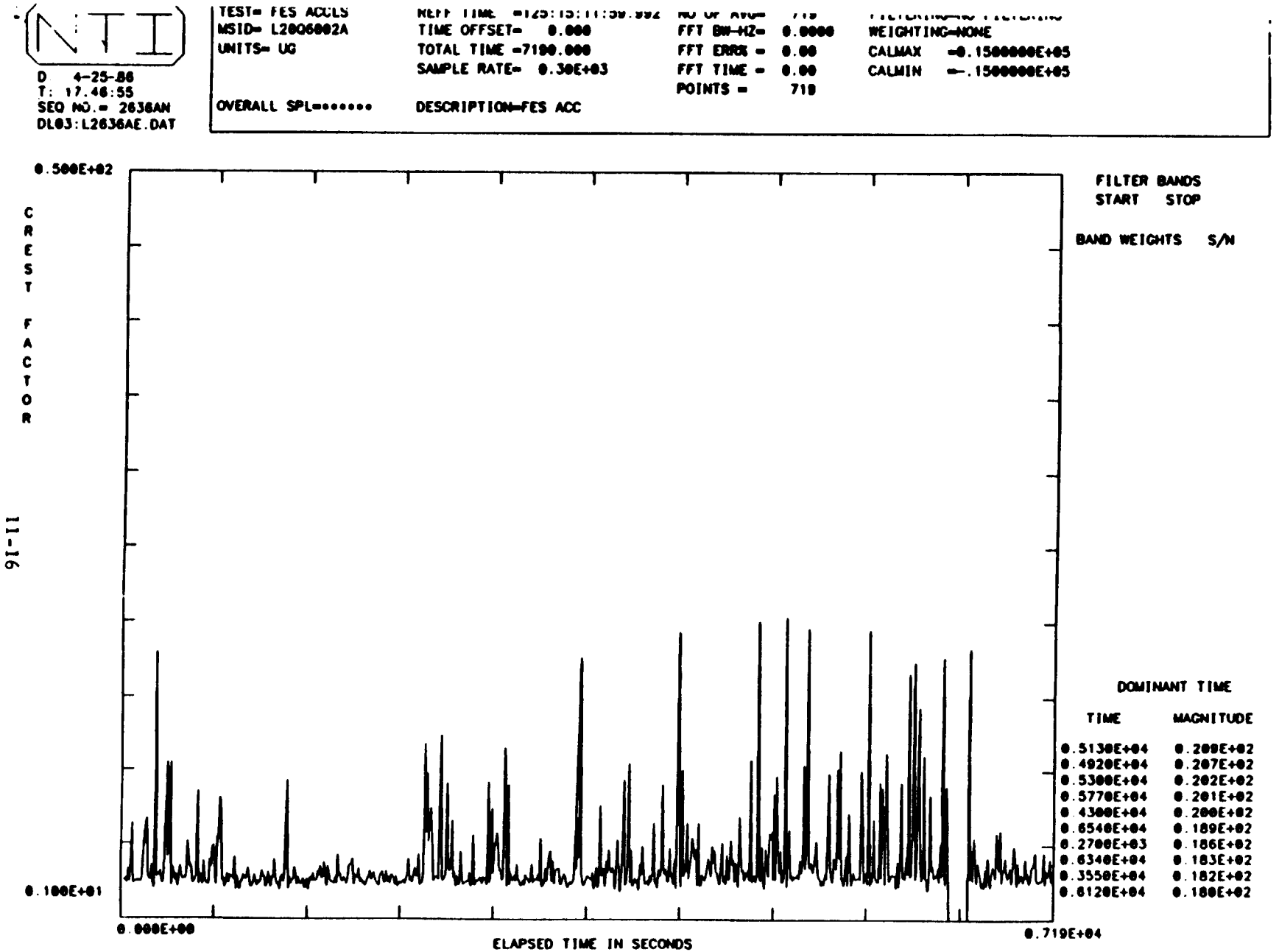

NTI
D 4-25-88
T: 17.46:55
SEQ NO.= 2636AN
DL03:L2636AE.DAT
TEST= FES ACCLS
MSID= L2006002A
UNITS= UG
OVERALL SPL=******
TIME OFFSET= 0.000
TOTAL TIME =7190.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 719
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
0.500E+02
CREST FACTOR
0.100E+01
0.000E+00
ELAPSED TIME IN SECONDS
0.719E+04
FILTER BANDS
START STOP
BAND WEIGHTS S/N
DOMINANT TIME
TIME MAGNITUDE
0.5130E+04 0.209E+02
0.4920E+04 0.207E+02
0.5300E+04 0.202E+02
0.5770E+04 0.201E+02
0.4300E+04 0.200E+02
0.6540E+04 0.189E+02
0.2700E+03 0.186E+02
0.6340E+04 0.183E+02
0.3550E+04 0.182E+02
0.6120E+04 0.180E+02

Figure 12.

events. You can see the roll maneuver very clearly in the RMS plot in Figure 11 and if you look at the same timeframe for the crest value in Figure 12 you really don't see anything, so the data reduction seems to be working.

The data shown in Figure 13 is the computer plot of the X, Y, and Z components of the acceleration RMS time history for the same timeframe. Figure 14 shows the crest factor for X, Y, and Z components for the same timeframe. So, this is the basic format for the presentation of our reduced data. In Figures 10 through 14 there is a total dropout of data that shown at about 6,400 seconds elapsed time. This is not considered significant but is mentioned to aid in understanding the data presentation.

To improve the usefulness of the data, we overlay the times when the reaction control system was either moderately active or very active as shown in Figure 15. Also included is a time overlay of the experiment operating modes. This is what we did for the FES experiment. Mode ten was when the cap was being removed from the crystal and mode eleven was when the crystal growing process was initiated. Until you overlay this RCS information for the whole mission the principal investigator does not have a complete story. I think when Dr. Lal saw this data he was quite interested to see that there was quite a bit of RCS activity at that particular time.

A plot of the crest value, Figure 16, for the same timeframe, doesn't show signifiant events because we were seeing broadband, long-term events. The format of the RCS data we will provide to users is shown in Figures 17 through 22. The thruster location is shown at the top center of each figure as F5L, F5R, etc., and represents locations as defined in Figure 6. There is a figure for each of six thruster locations, 2 forward, 2 aft right, and 2 aft left. The timeframe is the same for each figure; it starts at a GMT of 121:12 and is two hours long. Referring to the timeframe in Figure 16 this was the transition of the FES experiment from mode ten to mode eleven. There was signifi-

NTI

D: 5- 8-86
T: 17:15:38
SEQ NO.= 2636AE
SVL2:L2636AE.DAT

TEST=
MSID 1= L26Q6002A
MSID 2= L26Q6005A
MSID 3= L26Q6006A

UNITS = UG

REF TIME =17:15:12: 0.
TIME OFFSET= 0.000
TOTAL TIME =7170.000
SAMPLE RATE= 0.30E+03

DESCRIPTION=FES ACC

NO OF AVGS = 1
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 717

WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05

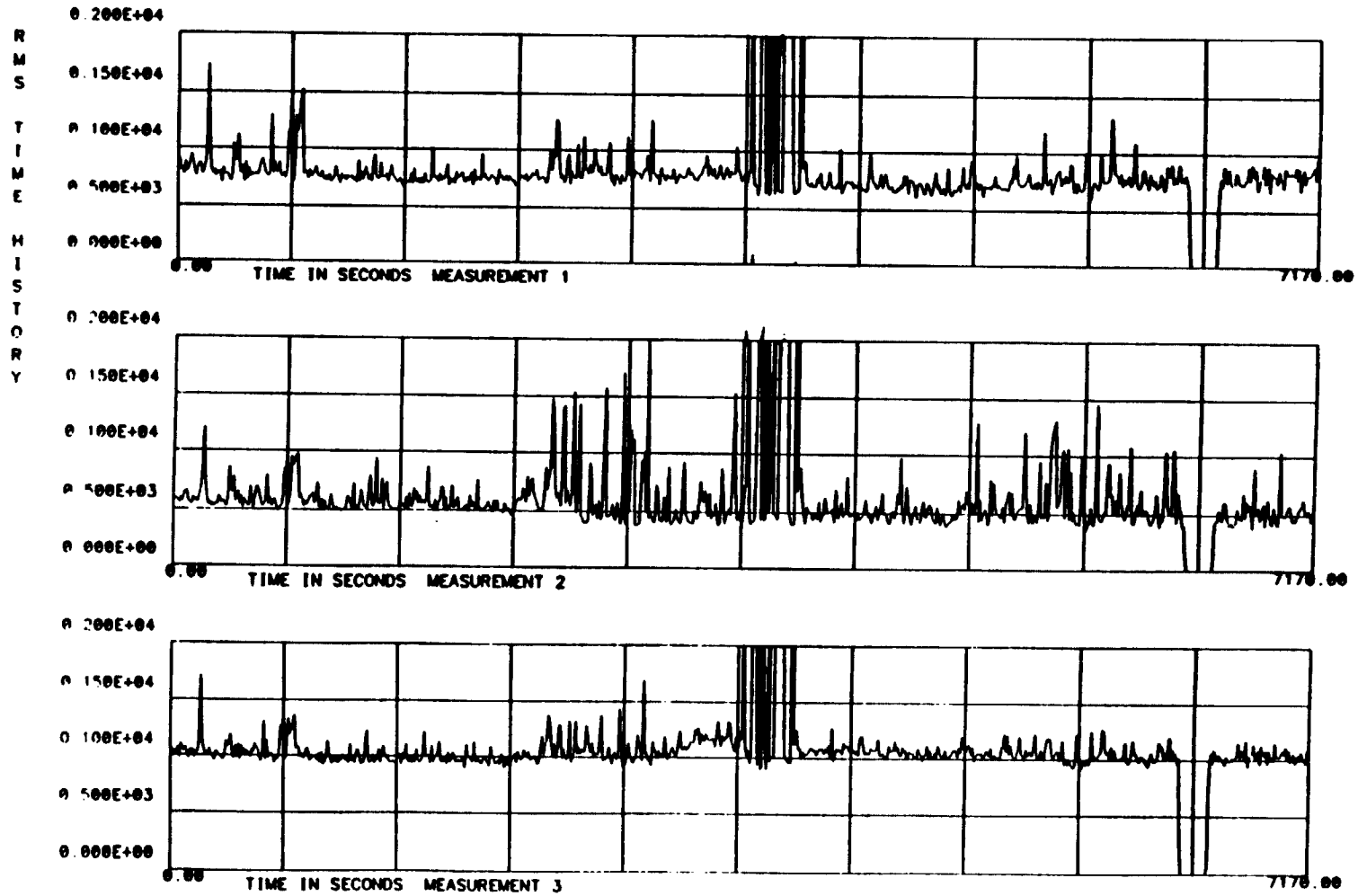


Figure 13.

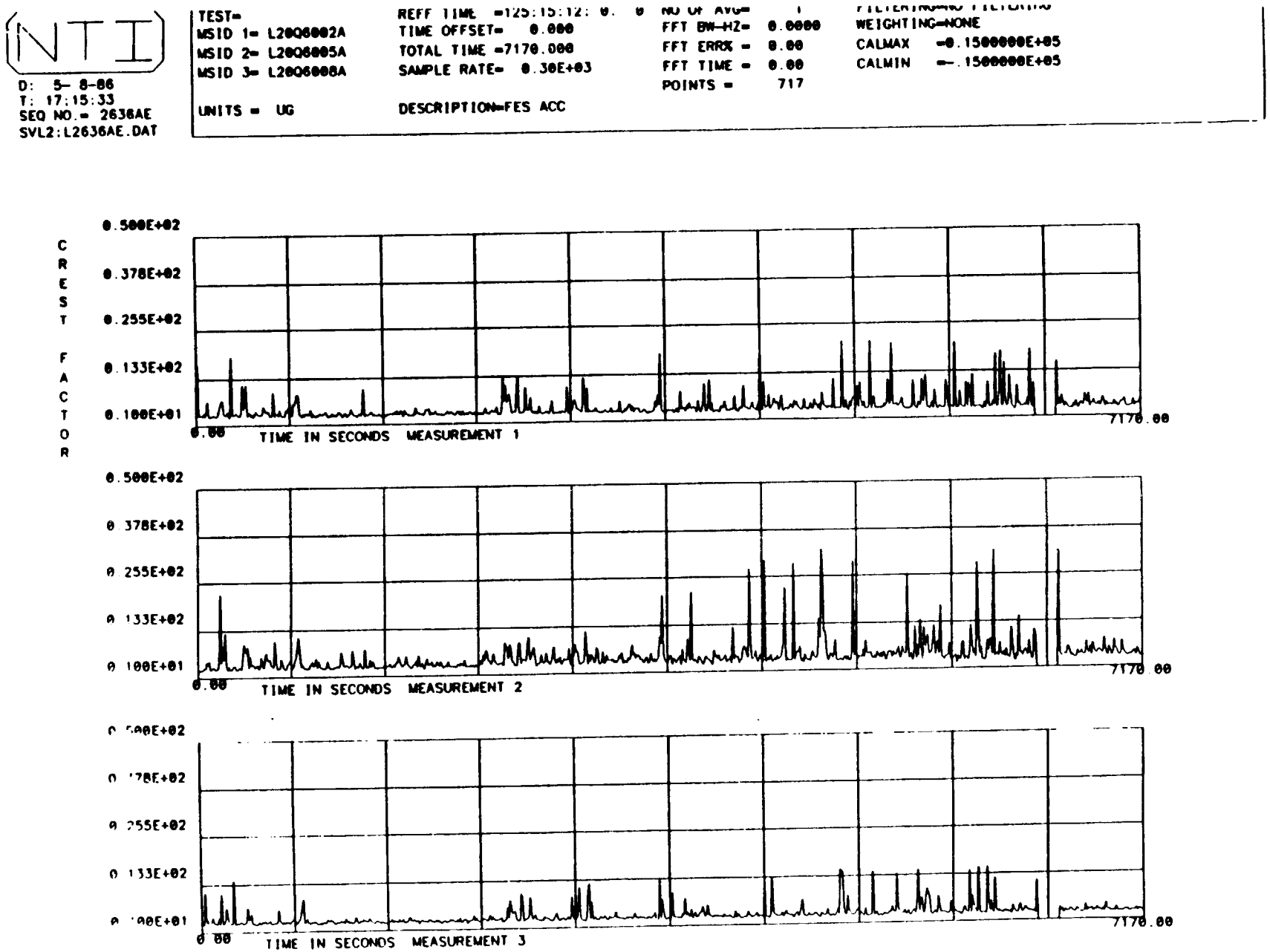


Figure 14.

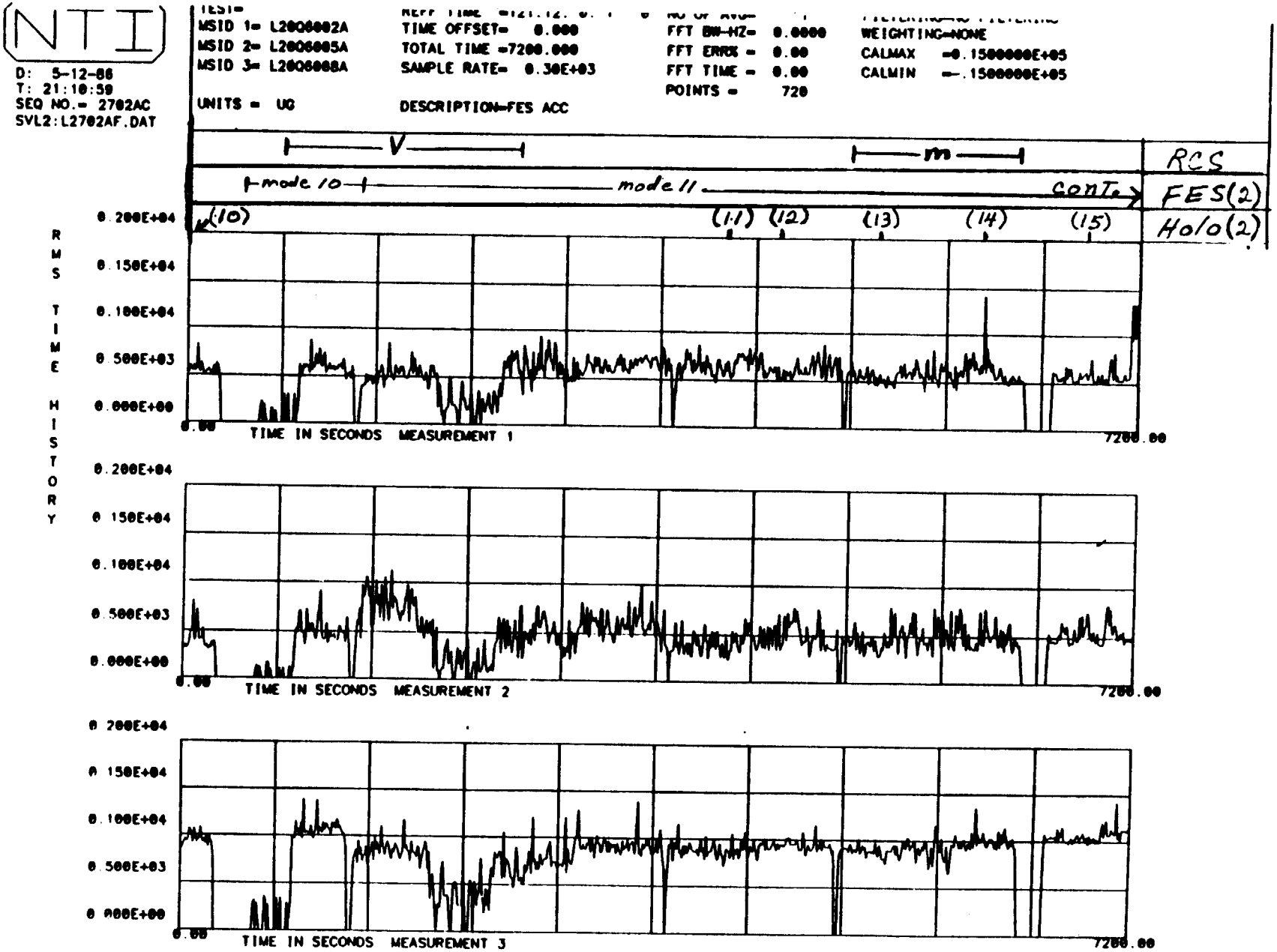

NTI
D: 5-12-86
T: 21:10:59
SEQ NO.= 2702AC
SVL2:L2702AF.DAT
MSID 1= L2QQ6Q82A
MSID 2= L2QQ6Q85A
MSID 3= L2QQ6Q88A
UNITS = UG
TIME OFFSET= 0.000
TOTAL TIME =7200.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 720
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
V
m
mode 10
mode 11
cont
RCS
FES(2)
Ho/o(2)
(10)
(11)
(12)
(13)
(14)
(15)
RMS TIME HISTORY
0.200E+04
0.150E+04
0.100E+04
0.500E+03
0.000E+00
TIME IN SECONDS MEASUREMENT 1
TIME IN SECONDS MEASUREMENT 2
TIME IN SECONDS MEASUREMENT 3
7200.00

Figure 15.

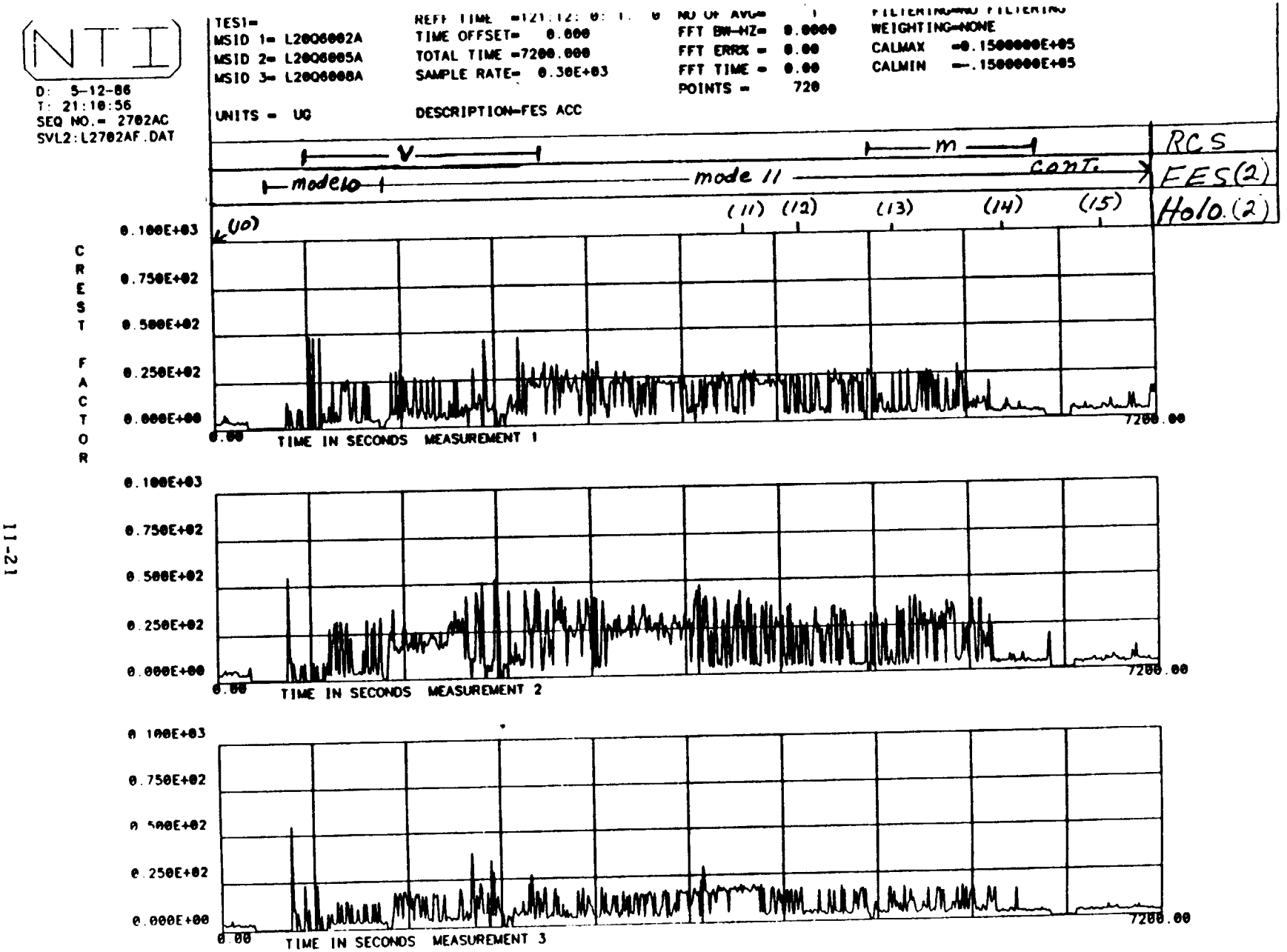
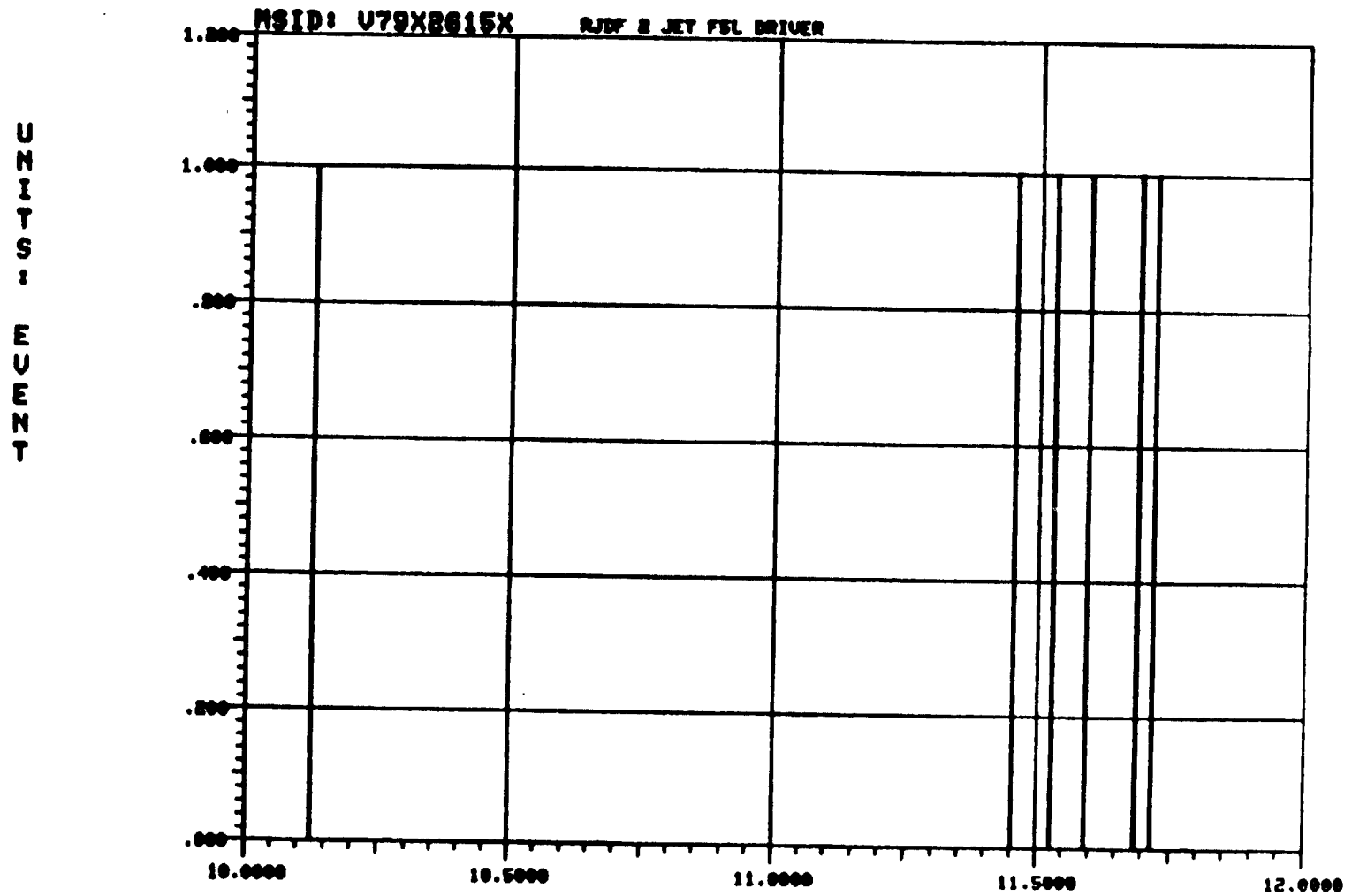

NTI
D: 5-12-86
T: 21:10:56
SEQ NO.= 2702AC
SVL2:L2702AF.DAT
TEST=
MSID 1= L20Q6002A
MSID 2= L20Q6005A
MSID 3= L20Q6008A
UNITS = UG
REFF TIME =121:12: 0: 1. 0
TIME OFFSET= 0.000
TOTAL TIME =7200.000
SAMPLE RATE= 0.30E+03
NO OF AVG= 1
FFT BW-HZ= 0.0000
FFT ERRX = 0.00
FFT TIME = 0.00
POINTS = 720
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
DESCRIPTION=FES ACC
V
m
mode10
mode 11
cont.
RCS
FES(2)
Holo.(2)
(10)
(11)
(12)
(13)
(14)
(15)
CREST FACTOR
0.100E+03
0.750E+02
0.500E+02
0.250E+02
0.000E+00
0.00
7200.00
TIME IN SECONDS MEASUREMENT 1
TIME IN SECONDS MEASUREMENT 2
TIME IN SECONDS MEASUREMENT 3

Figure 16.

STS DATA BASE: SL30121
LAST UPDATE: 05/08/86 08:50:35

DATE: 05/12/86
TIME: 11:07:00



PAGE 2

Figure 17.

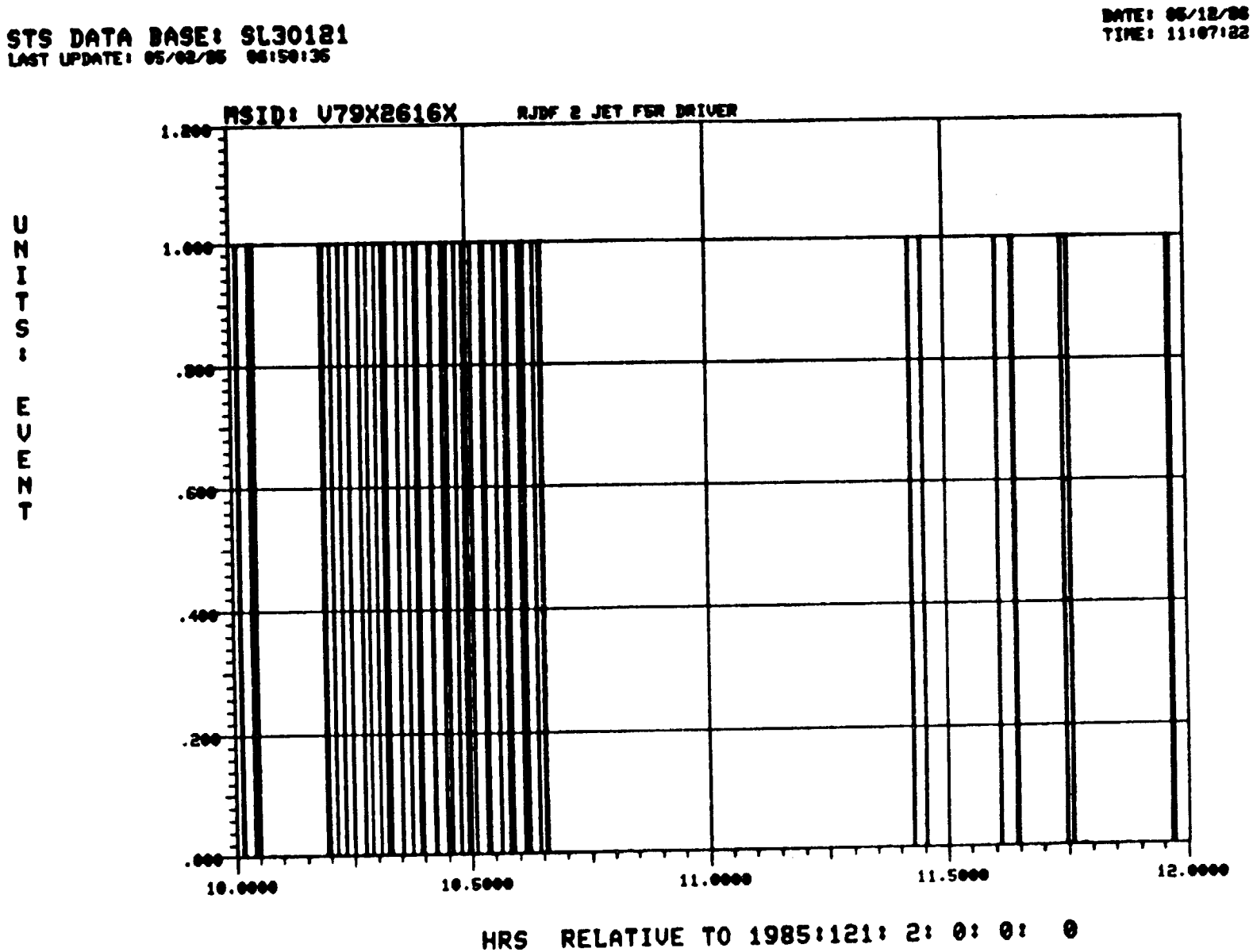

STS DATA BASE: SL30121
LAST UPDATE: 05/02/85 08:50:35
DATE: 05/12/85
TIME: 11:07:22
MSID: V79X2616X
RJDF 2 JET FSR DRIVER
UNITS: EVENT
1.200
1.000
.800
.600
.400
.200
.000
10.0000
10.5000
11.0000
11.5000
12.0000
HRS RELATIVE TO 1985:121: 2: 0: 0: 0
PAGE 3

Figure 18.

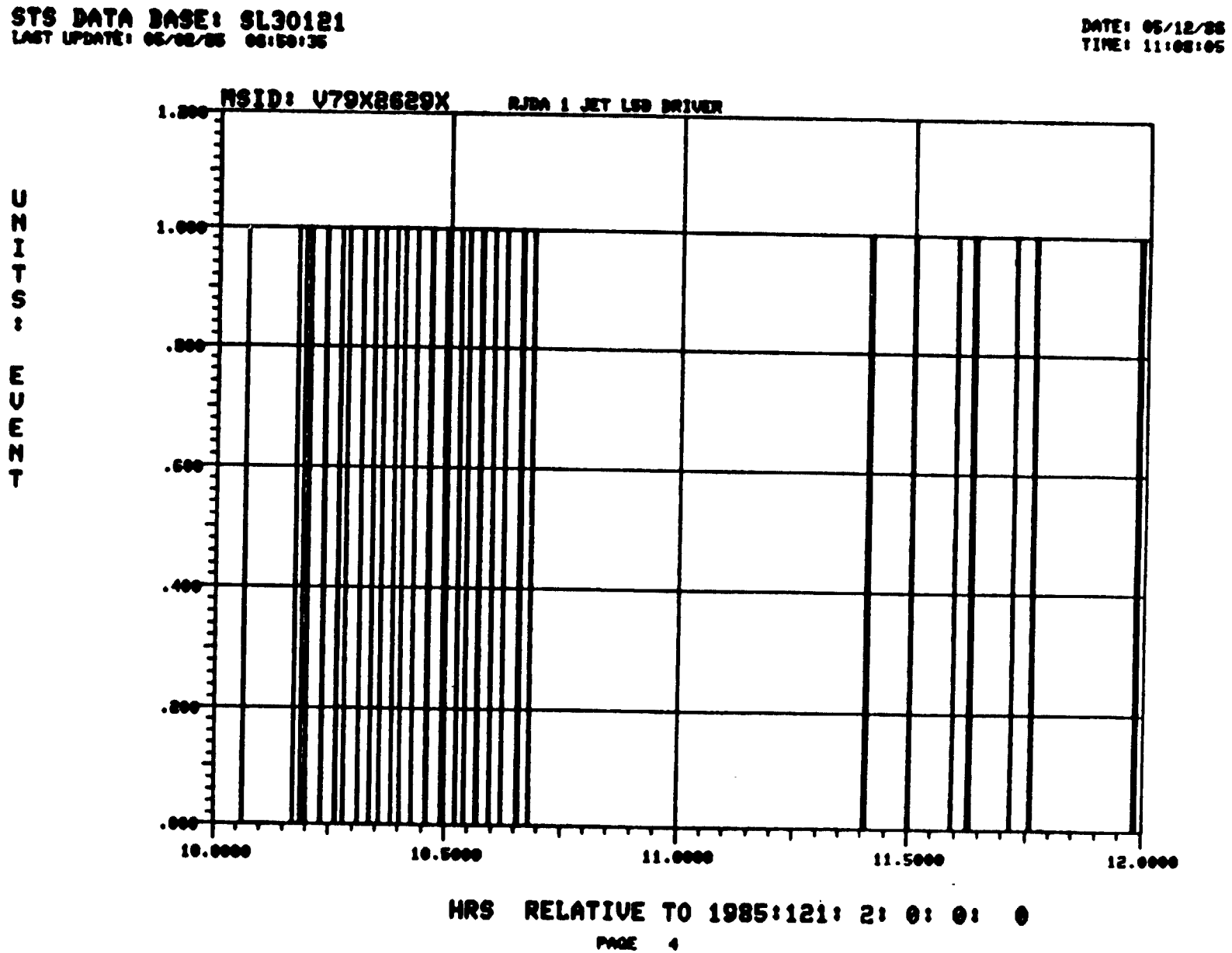


Figure 19.

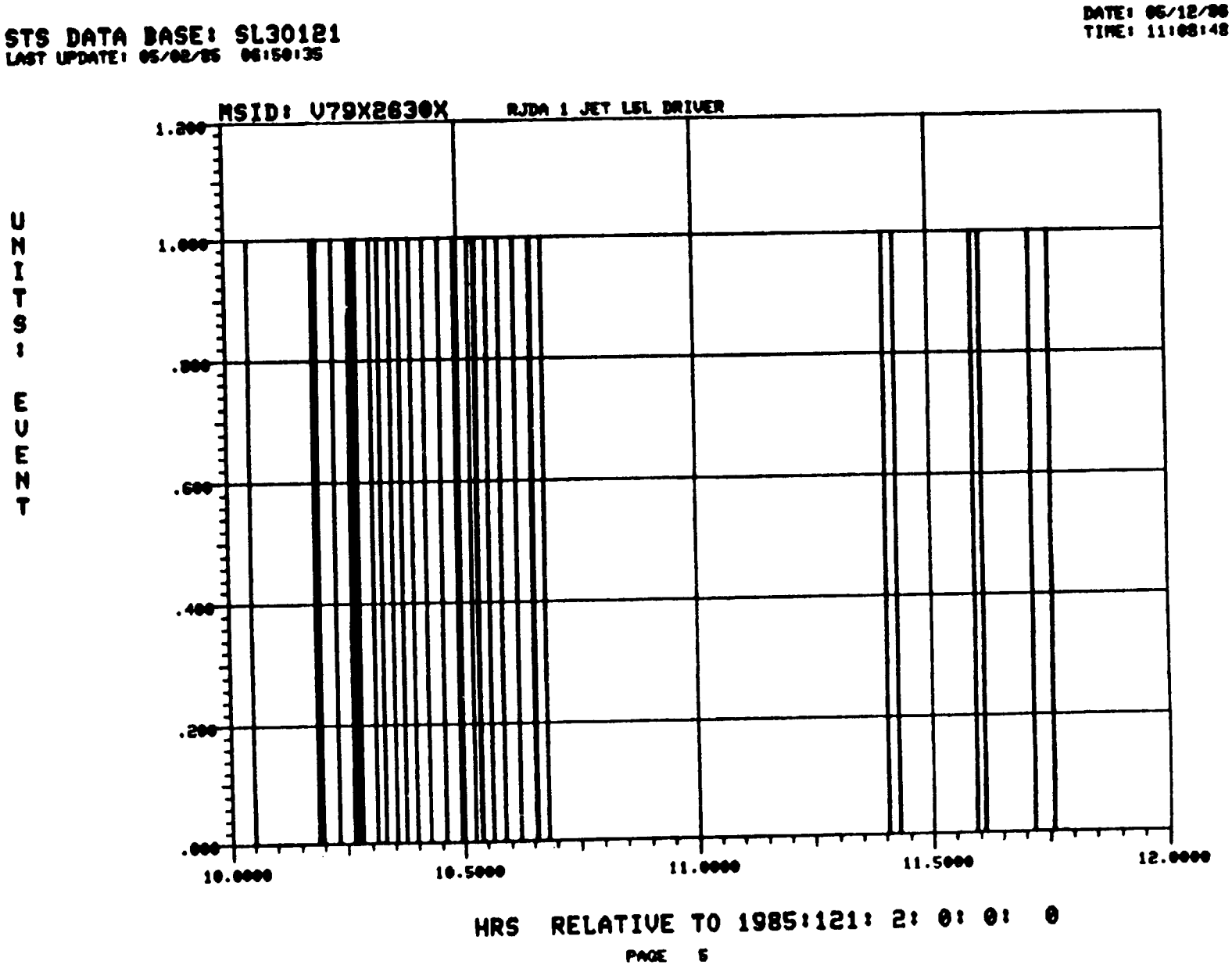

STS DATA BASE: SL30121
LAST UPDATE: 05/02/85 06:50:35
DATE: 05/12/85
TIME: 11:08:48
MSID: V79X2630X
RJDA 1 JET LSL DRIVER
UNITS: EVENT
1.200
1.000
.800
.600
.400
.200
.000
10.0000
10.5000
11.0000
11.5000
12.0000
HRS RELATIVE TO 1985:121: 2: 0: 0: 0
PAGE 5

Figure 20.

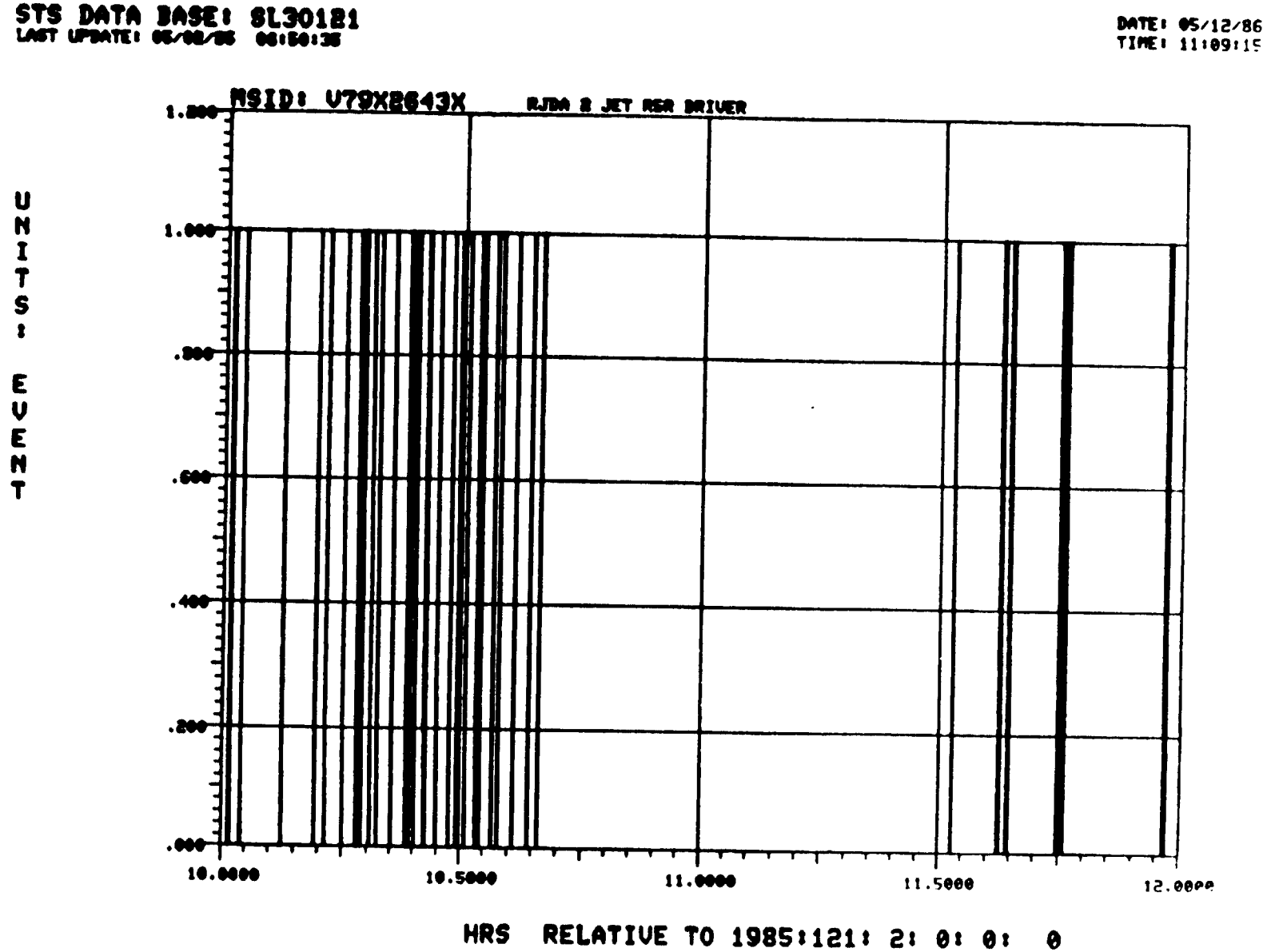

STS DATA BASE: SL30121
LAST UPDATE: 05/08/86 06:50:35
DATE: 05/12/86
TIME: 11:09:15
MSID: V79X8643X
RJDA 2 JET RSR DRIVER
UNITS: EVENT
1.200
1.000
.800
.600
.400
.200
.000
10.0000
10.5000
11.0000
11.5000
12.0000
HRS RELATIVE TO 1985:121: 2: 0: 0: 0
PAGE 6

Figure 21.

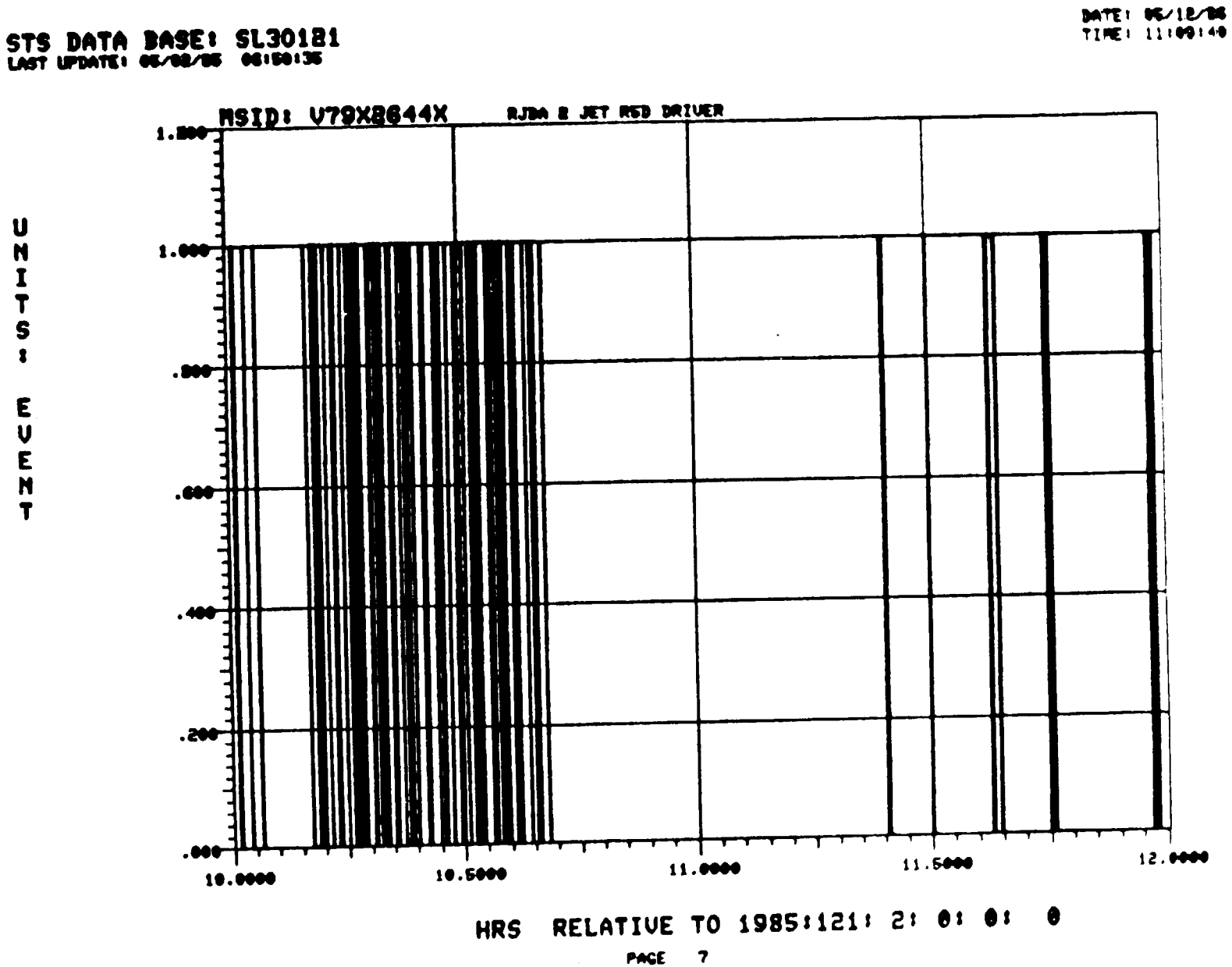

STS DATA BASE: SL30181
LAST UPDATE: 05/08/85 06:50:35
DATE: 05/12/85
TIME: 11:09:40
MSID: V79X8644X
RJBA 8 JET RCS DRIVER
UNITS: EVENT
1.000
.800
.600
.400
.200
.000
10.0000
10.5000
11.0000
11.5000
12.0000
HRS RELATIVE TO 1985:121: 2: 0: 0: 0
PAGE 7

Figure 22.

cant activity during that timeframe, and I think these six figures show the source. Of the six RCS firings we picked there was only one that was not very active during this time period. You can correlate these RCS firings with the periods identified as a very active RCS time and as a moderately active time in Figure 16. When you look at the g effects, it becomes really important, not only that these lines are fairly close together, but when you get a broad line it means that particular RCS engine is firing very rapidly. It only fires for about 80 milli seconds, I believe, but it is firing very rapidly to try to maintain its proper attitude.

Another area where we identified very pronounced activity is shown in Figures 23 and 24. I can not say that was definitely an RCS engine but it sure looks like it. If we look at the crest value, again the disturbance doesn't show up. The set of thruster firings are shown again for the six locations (Figures 25 through 30). If you look at the first firing it was relatively benign at the time of the pronounced disturbance in Figure 23. Looking at the other five examples (Figures 26 through 30) of the RCS engines, two in the front, two in the aft left, two in the aft right, we see fairly active firing during the period of interest. Other activities may have supplemented the disturbances in X, Y, and Z, but the RCS firings seem to fit the timeframe of interest. This was at a relatively critical stage in the FES crystal growth process. I have not yet superimposed any of the substeps within mode eleven, but that particular timeframe was a fairly critical period.

I think Hans Hamacher mentioned in his talk that not every time that the RCS's are firing is there a bad environment on the Shuttle or Space Station, or in this case, the Spacelab. Well here is another event that I thought had a relatively significant effect (Figure 31). Figure 32 is a good example of the crest factor and how it does not show you the broad events. There are some definite events shown in the crest factor after the RMS has levelled off and I do believe that these are definite events that are happening throughout the mission. It could be some of the treadmill events that have been identified earlier. Some of

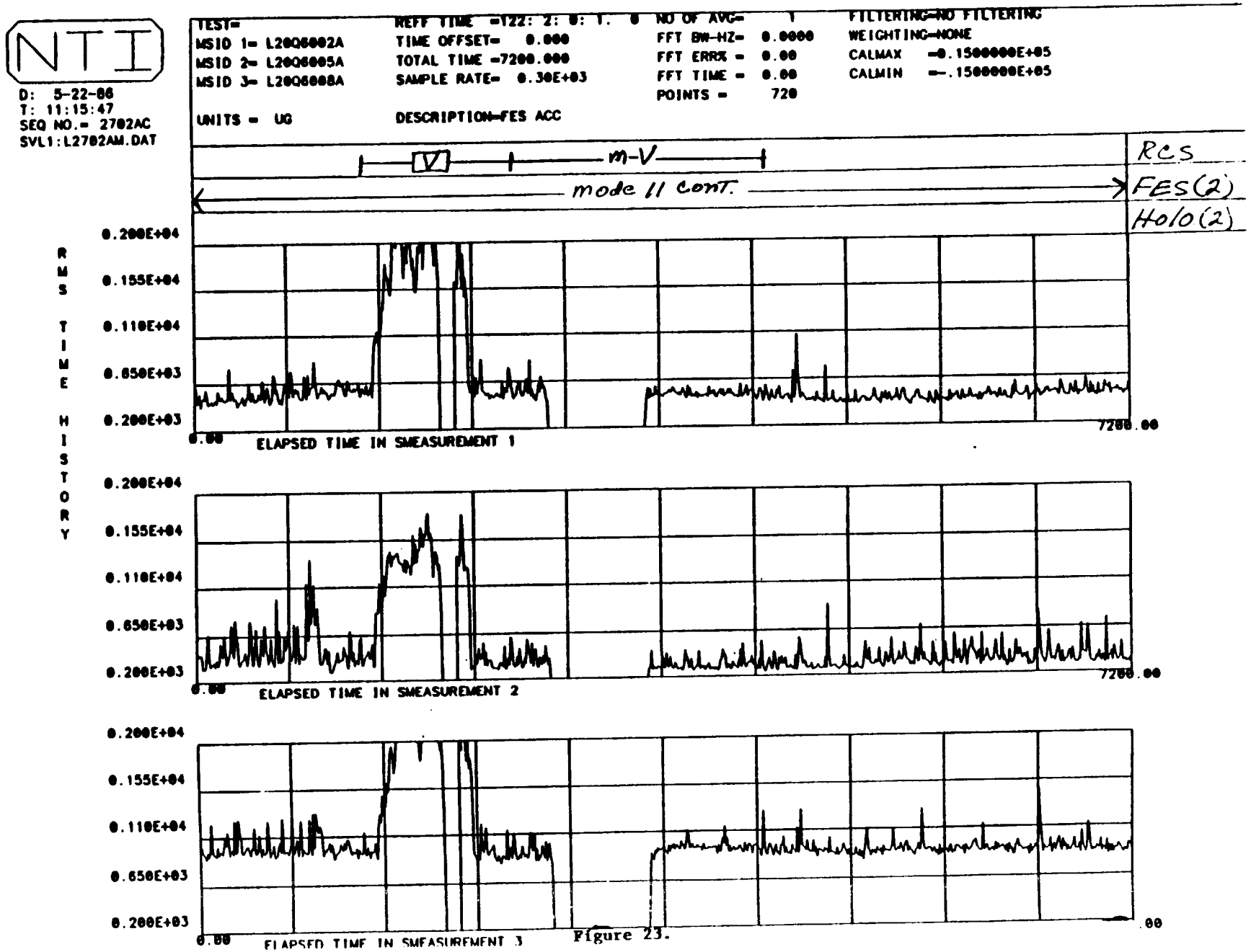

NTI
D: 5-22-86
T: 11:15:47
SEQ NO.= 2702AC
SVL1:L2702AM.DAT
TEST=
MSID 1= L2QQ6002A
MSID 2= L2QQ6005A
MSID 3= L2QQ6008A
UNITS = UG
REFF TIME =122: 2: 0: 1. 0
TIME OFFSET= 0.000
TOTAL TIME =7200.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
NO OF AVG= 1
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 720
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
m-V
mode 11 cont.
RCS
FES(2)
Holo(2)
RMS TIME HISTORY
0.200E+04
0.155E+04
0.110E+04
0.650E+03
0.200E+03
0.00
7200.00
ELAPSED TIME IN SMEASUREMENT 1
ELAPSED TIME IN SMEASUREMENT 2
ELAPSED TIME IN SMEASUREMENT 3

Figure 23.

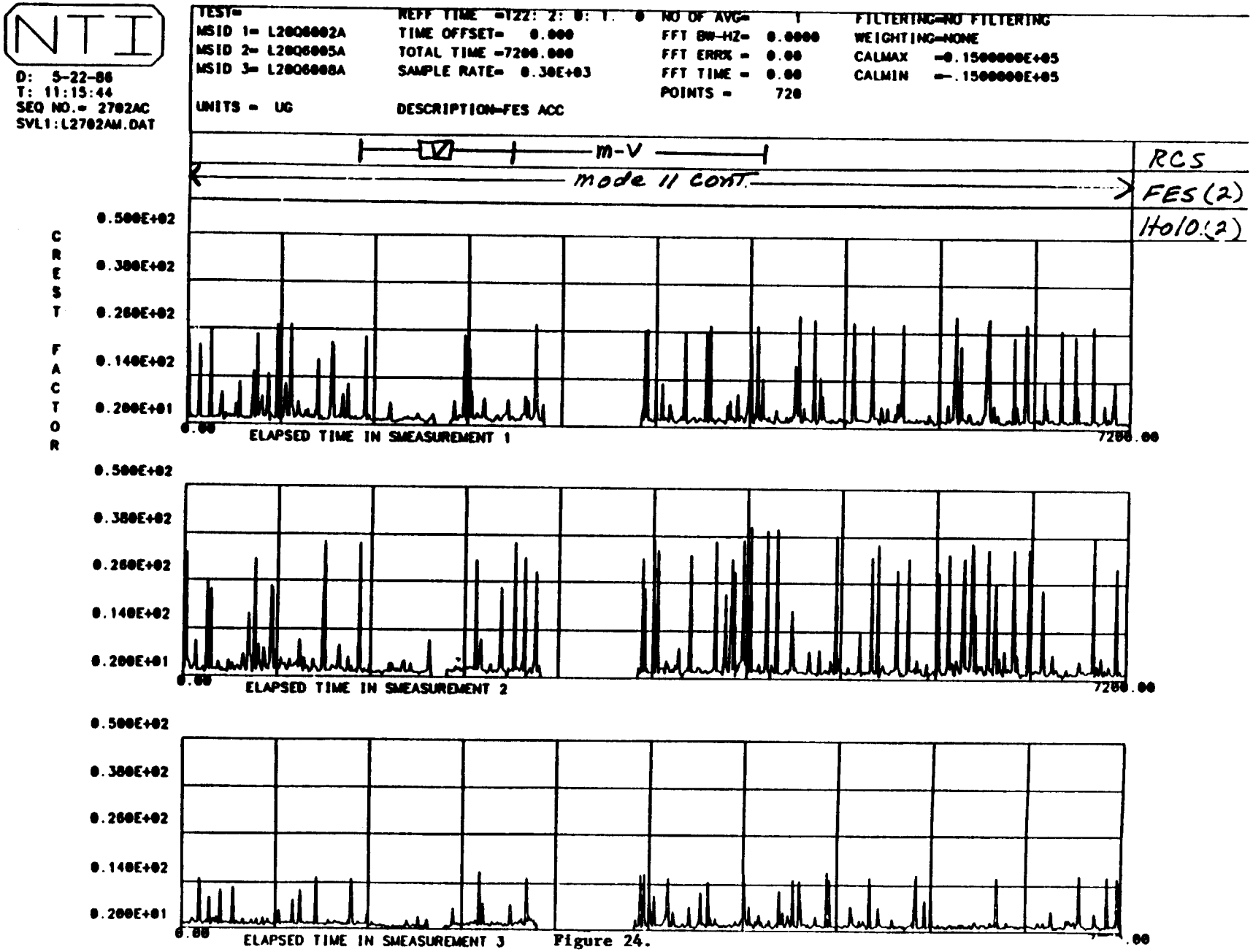


Figure 24.

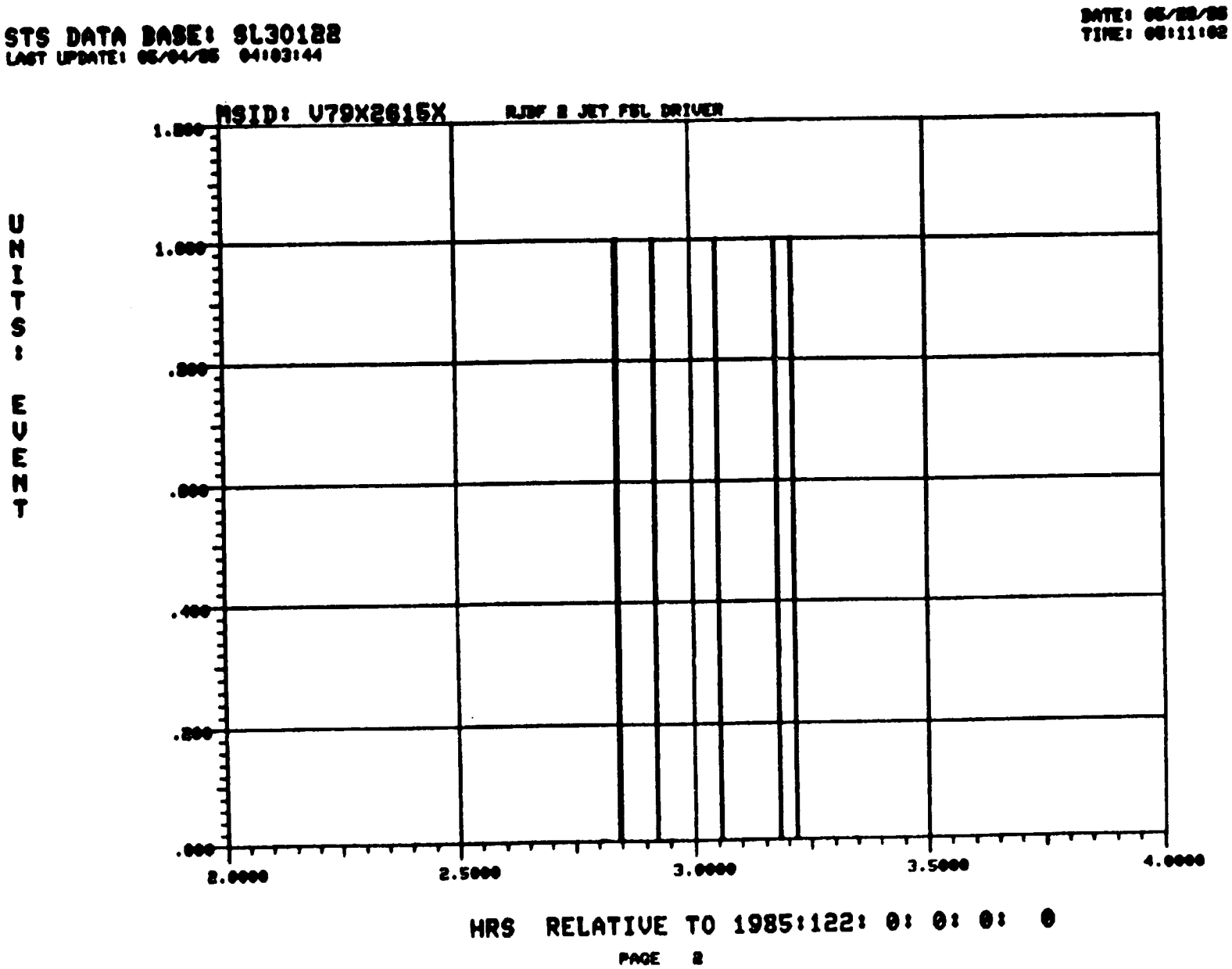

STS DATA BASE: SL30182
LAST UPDATE: 05/04/85 04:03:44
DATE: 05/22/85
TIME: 08:11:02
RSID: V79X2615X
RJDF B JET FSL DRIVER
UNITS: EVENT
1.200
1.000
.800
.600
.400
.200
.000
2.0000
2.5000
3.0000
3.5000
4.0000
HRS RELATIVE TO 1985:122: 0: 0: 0: 0
PAGE 8

Figure 25.

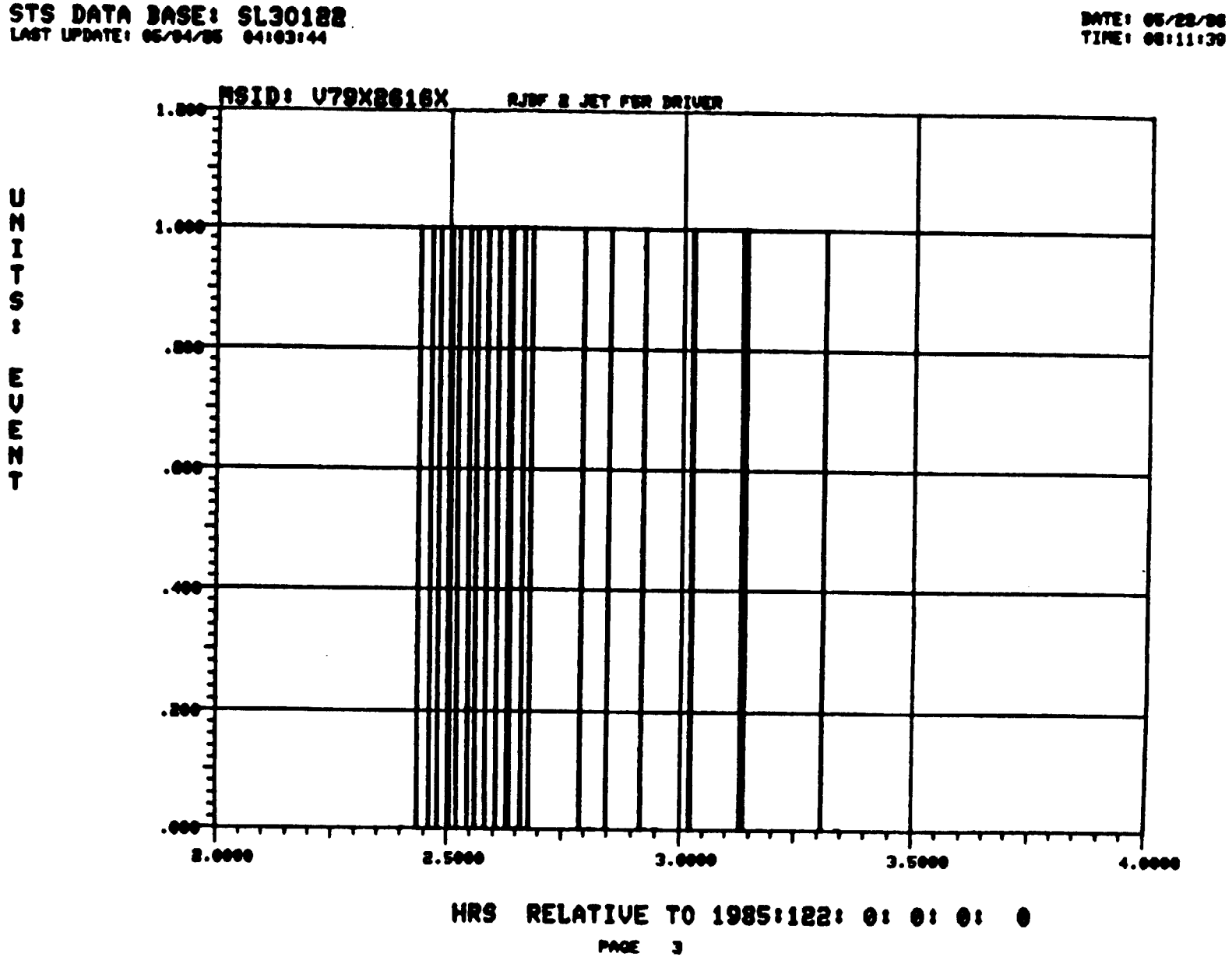

STS DATA BASE: SL30188
LAST UPDATE: 05/04/86 04:03:44
DATE: 05/22/86
TIME: 08:11:39
MSID: V79X8616X
RJBF 2 JET FOR DRIVER
UNITS: EVENT
1.000
.800
.600
.400
.200
.000
2.0000
2.5000
3.0000
3.5000
4.0000
HRS RELATIVE TO 1985:122: 0: 0: 0: 0
PAGE 3

Figure 26.

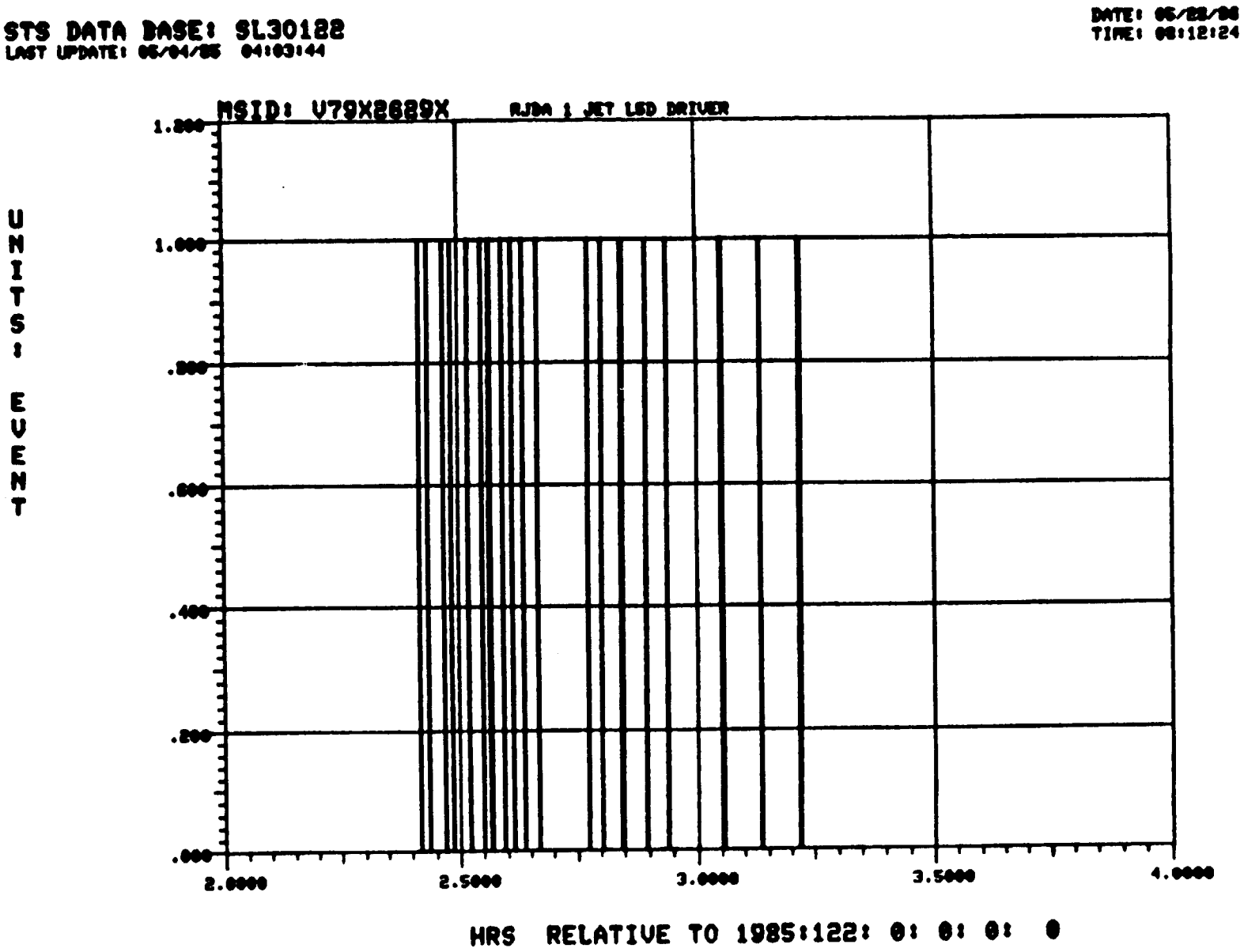

STS DATA BASE: SL30122
LAST UPDATE: 05/04/85 04:03:44
DATE: 05/22/85
TIME: 08:12:24
MSID: V79X2689X
RJDA 1 JET LSD DRIVER
UNITS: EVENT
1.000
.800
.600
.400
.200
.000
2.0000
2.5000
3.0000
3.5000
4.0000
HRS RELATIVE TO 1985:122: 0: 0: 0: 0
PAGE 4

Figure 27.

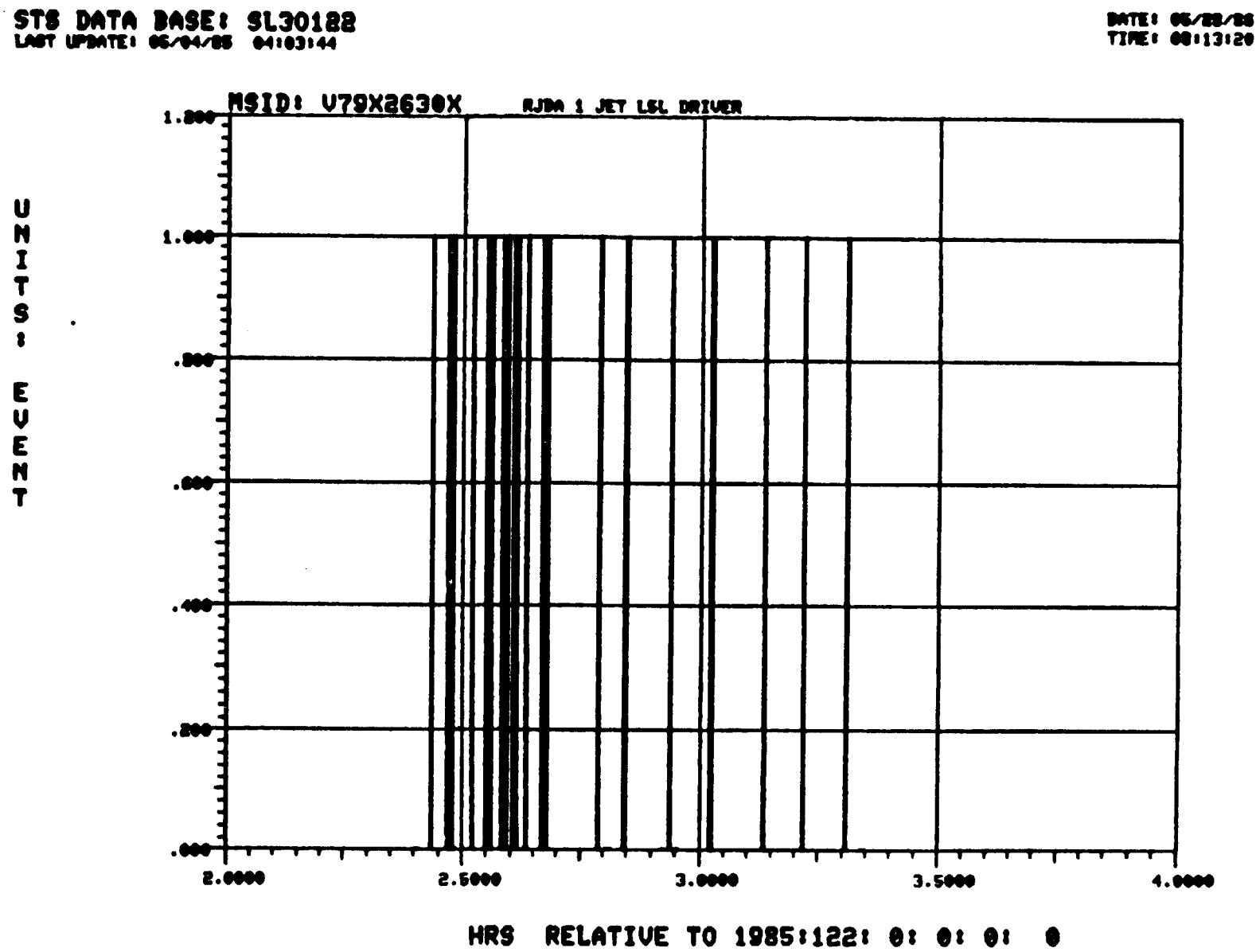
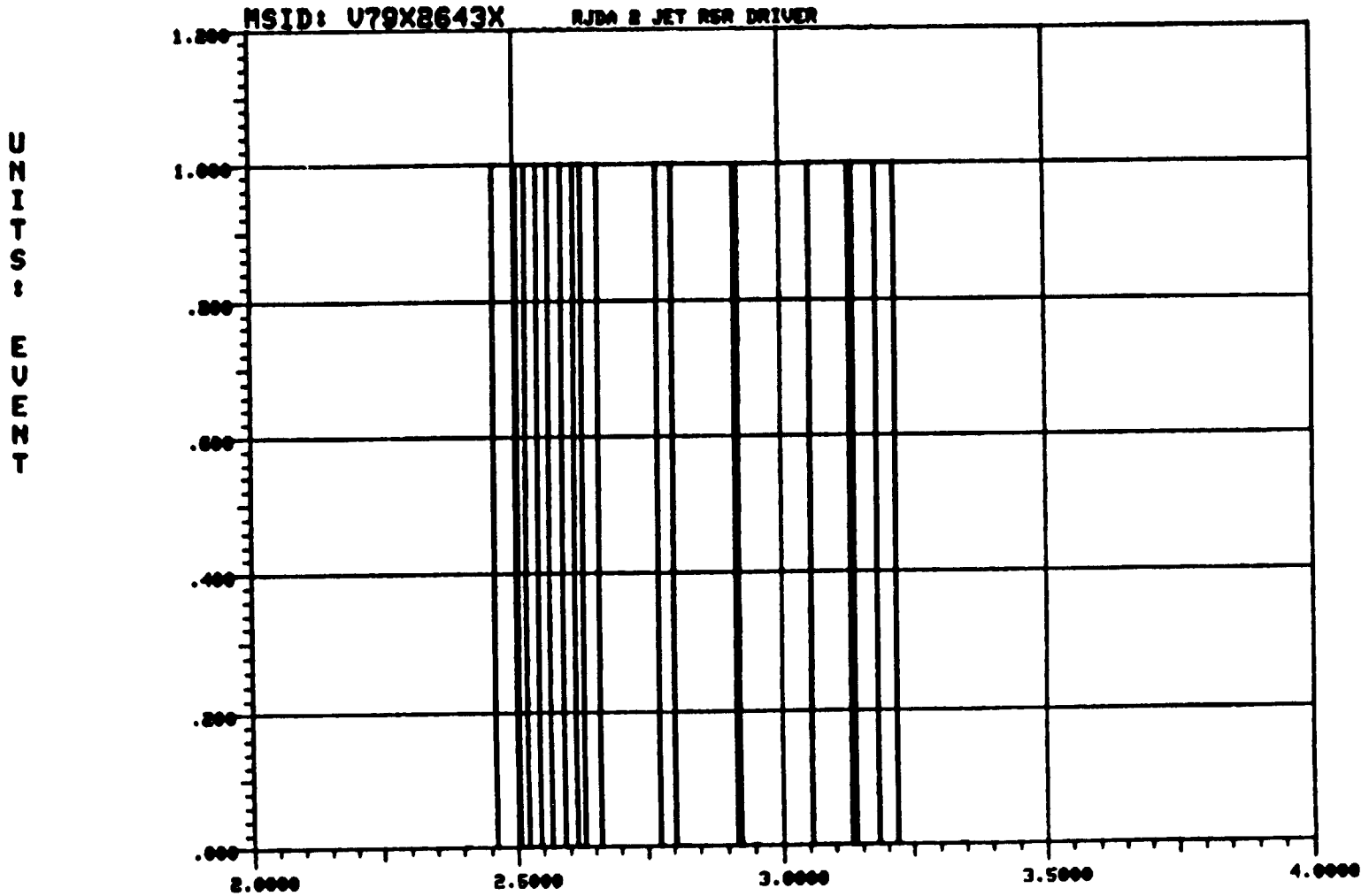


Figure 28.

STS DATA BASE: SL30128
LAST UPDATE: 05/04/85 04:03:44

DATE: 05/08/85
TIME: 08:14:24



PAGE 8

Figure 29.

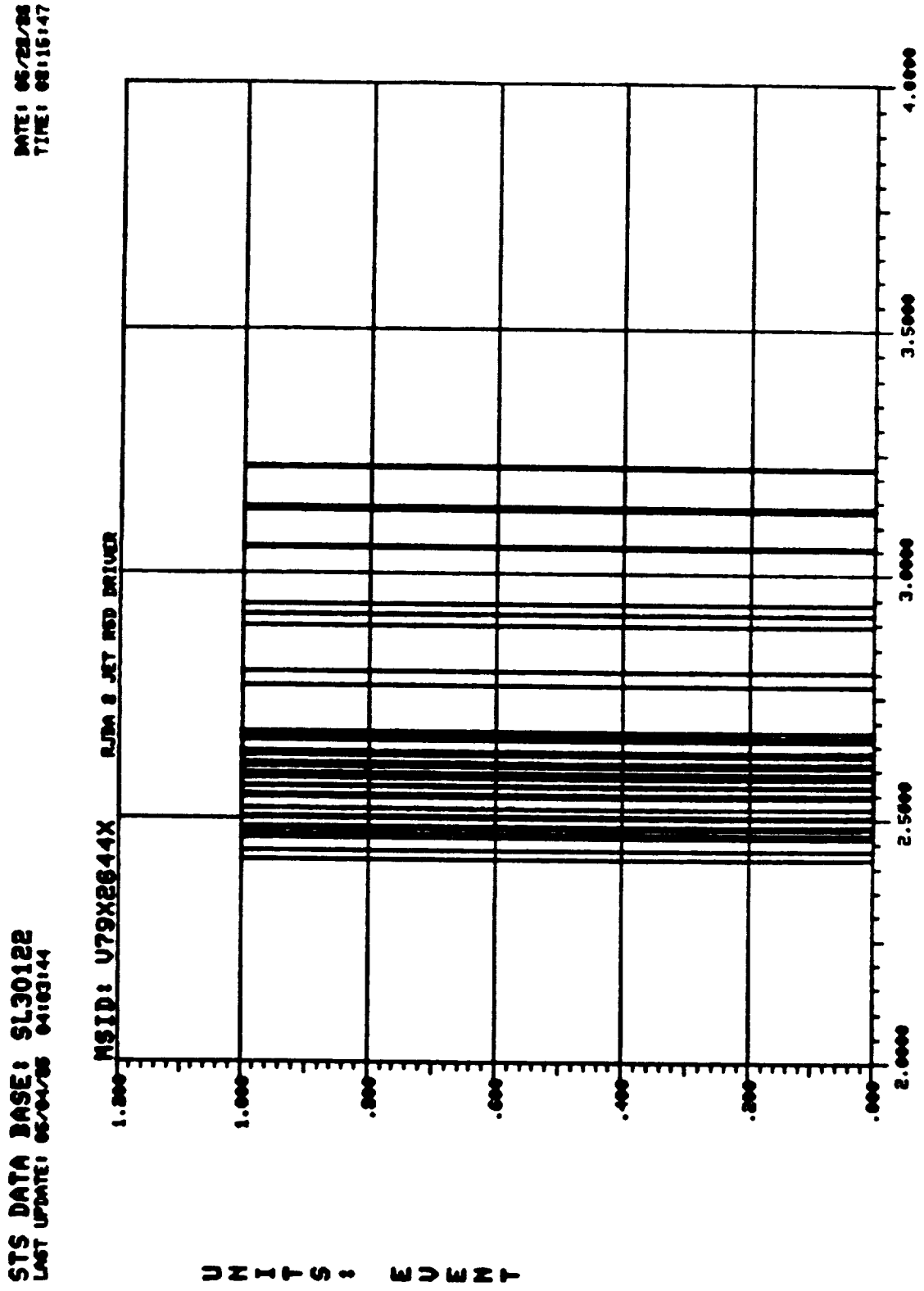


Figure 30.

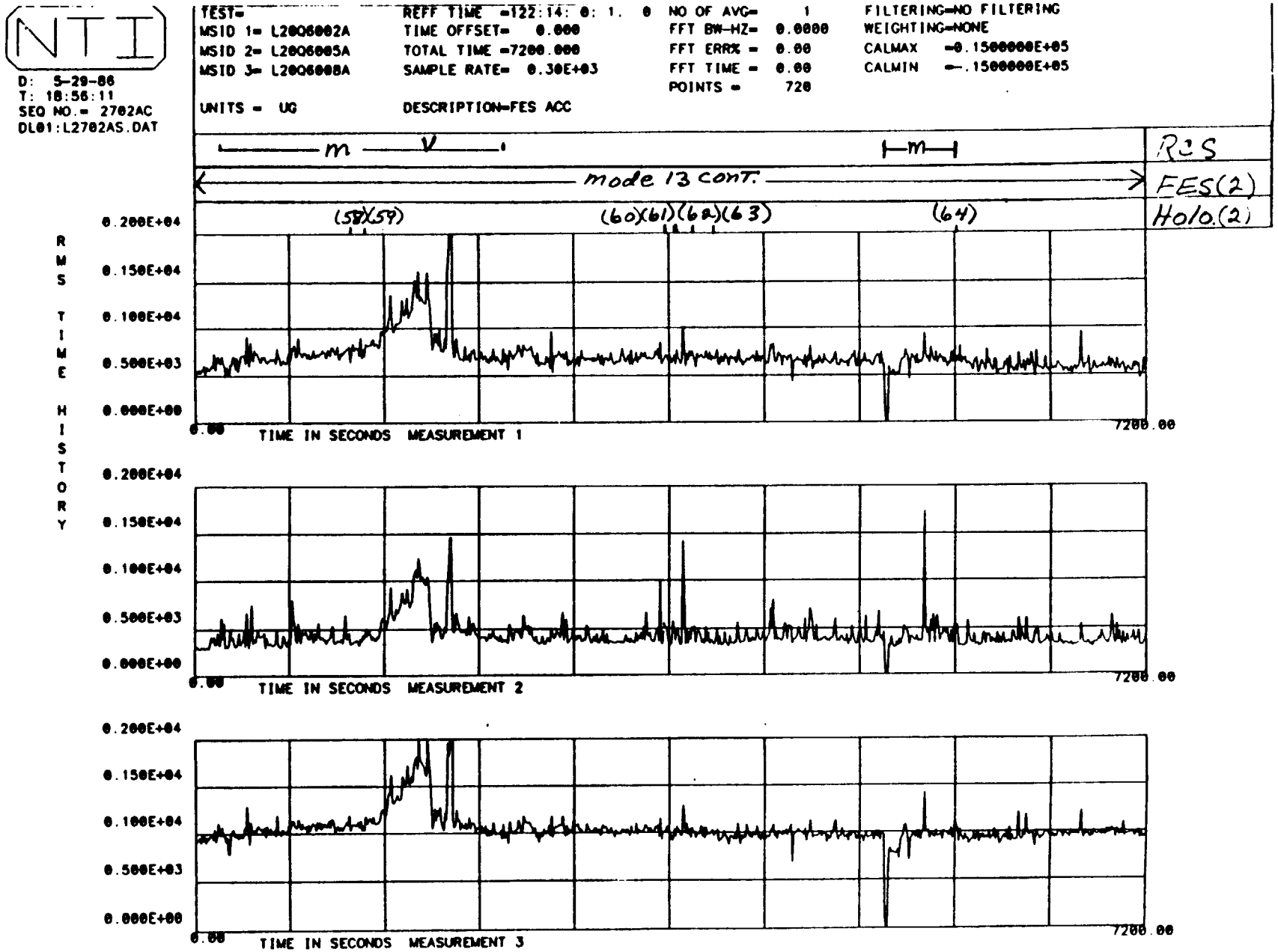

NTI
D: 5-29-86
T: 18:56:11
SEQ NO.= 2702AC
DL01:L2702AS.DAT
TEST=
MSID 1= L20Q6002A
MSID 2= L20Q6005A
MSID 3= L20Q6008A
UNITS = UG
REFF TIME =122:14: 0: 1. 0
TIME OFFSET= 0.000
TOTAL TIME =7200.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
NO OF AVG= 1
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 720
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
m v m
mode 13 cont.
R.S
FES(2)
Holo.(2)
(58)(59)
(60)(61)(62)(63)
(64)
RMS TIME HISTORY
0.200E+04
0.150E+04
0.100E+04
0.500E+03
0.000E+00
0.00
TIME IN SECONDS MEASUREMENT 1
7200.00
TIME IN SECONDS MEASUREMENT 2
TIME IN SECONDS MEASUREMENT 3

Figure 31.

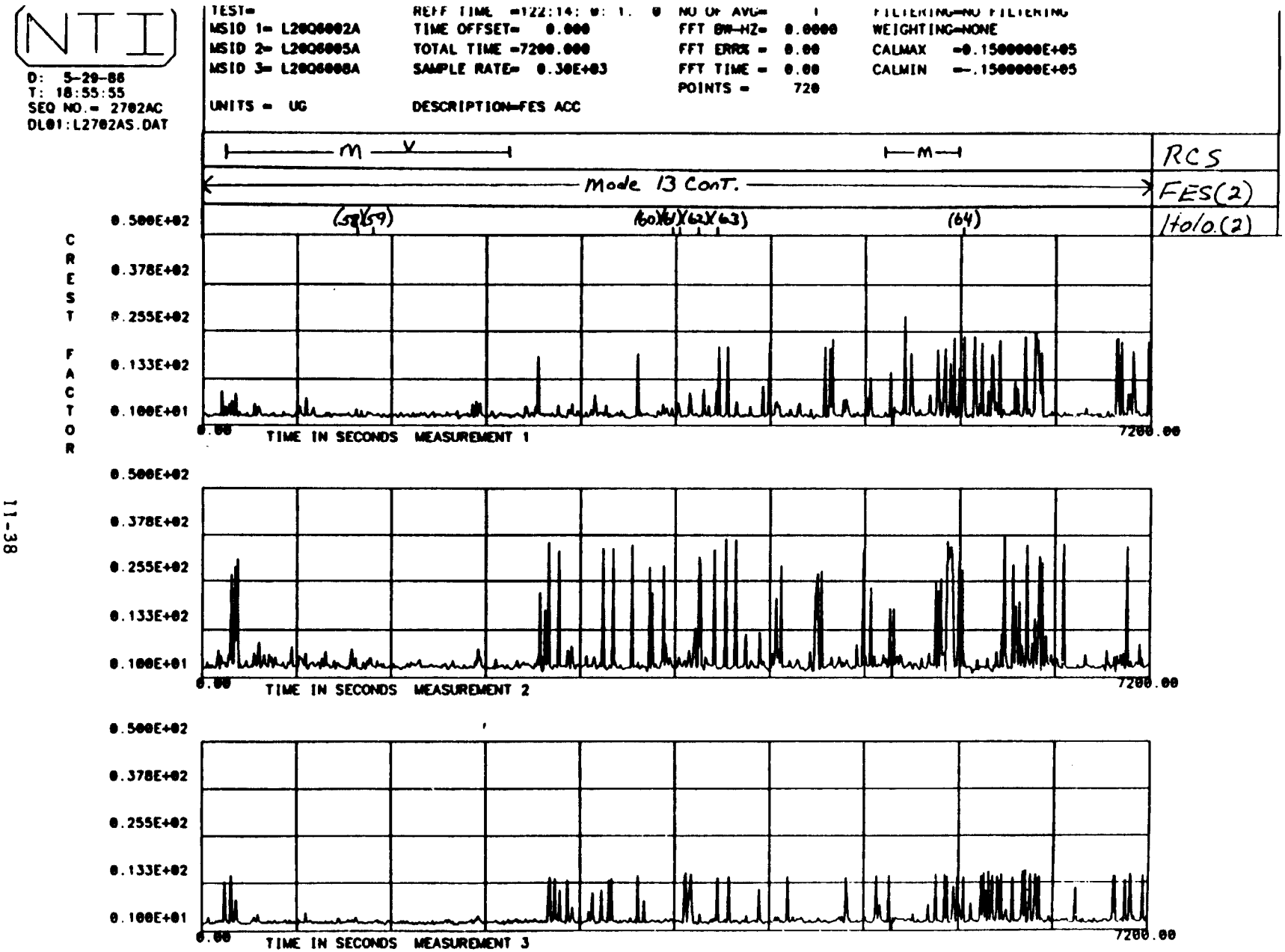


Figure 32.

our next steps will be to try to identify the most interesting areas, especially for the FES. You see in Figure 32 the crest is about two and a half. The crest factor is unitless. You are really looking at a relative effect, like there is some meaning between one peak and the size of another peak, but it has no meaning in absolute terms.

There was something going on in a 12-hour cycle. It may be just happenstance, but a disturbance we looked at was at exactly 122:2 and another was at 122:14 reference time. We looked ahead at the 123:2 time frame and there was another peak. At later mission times, the disturbance disappeared from the 12-hour cycle. So there were three cycles of twelve hours where something interesting was going on.

During some time periods the RCS thrusters were very active (Figures 33 and 34) and we had a pretty benign type of atmosphere, as far as g-level is concerned. It is like Hans Hamacher said, sometimes you are going to see some of these effects and sometimes you are not. I don't understand it, but we intend to look at this much closer than we have so far. Another interesting event is shown in Figure 35. This is raw data spread over a 10-second time period. So raw data can be very useful too. It doesn't look quite as bad as when we plotted it in a two-hour timeframe. I wanted to point out that this type of event is something that Rudy Ruff has been looking into more than we have. But this agrees with some other things that were said today and this type of event seems to be very prevalent. Figure 36 is a PSD plot, or spectrum level, and you can see that 17-Hz factor that has been discussed. The dominant frequency is shown at 17.1 Hz. Somebody was talking about 17.4 Hz being a fan of some kind, but we see the 17 Hz very predominantly throughout the whole mission. Figure 37 shows a timeframe about 40 seconds downstream where we saw another event that appears to be a real event. We did a power spectrum on it (Figure 38), and that peak had shifted by a factor of two, up to about 34 Hz, and the 17 Hz is not showing up at all. So there may have been something cutting in or out or it could be a node that we are seeing. We feel that the recurring 17 Hz disturbance is definitely worth looking into further.

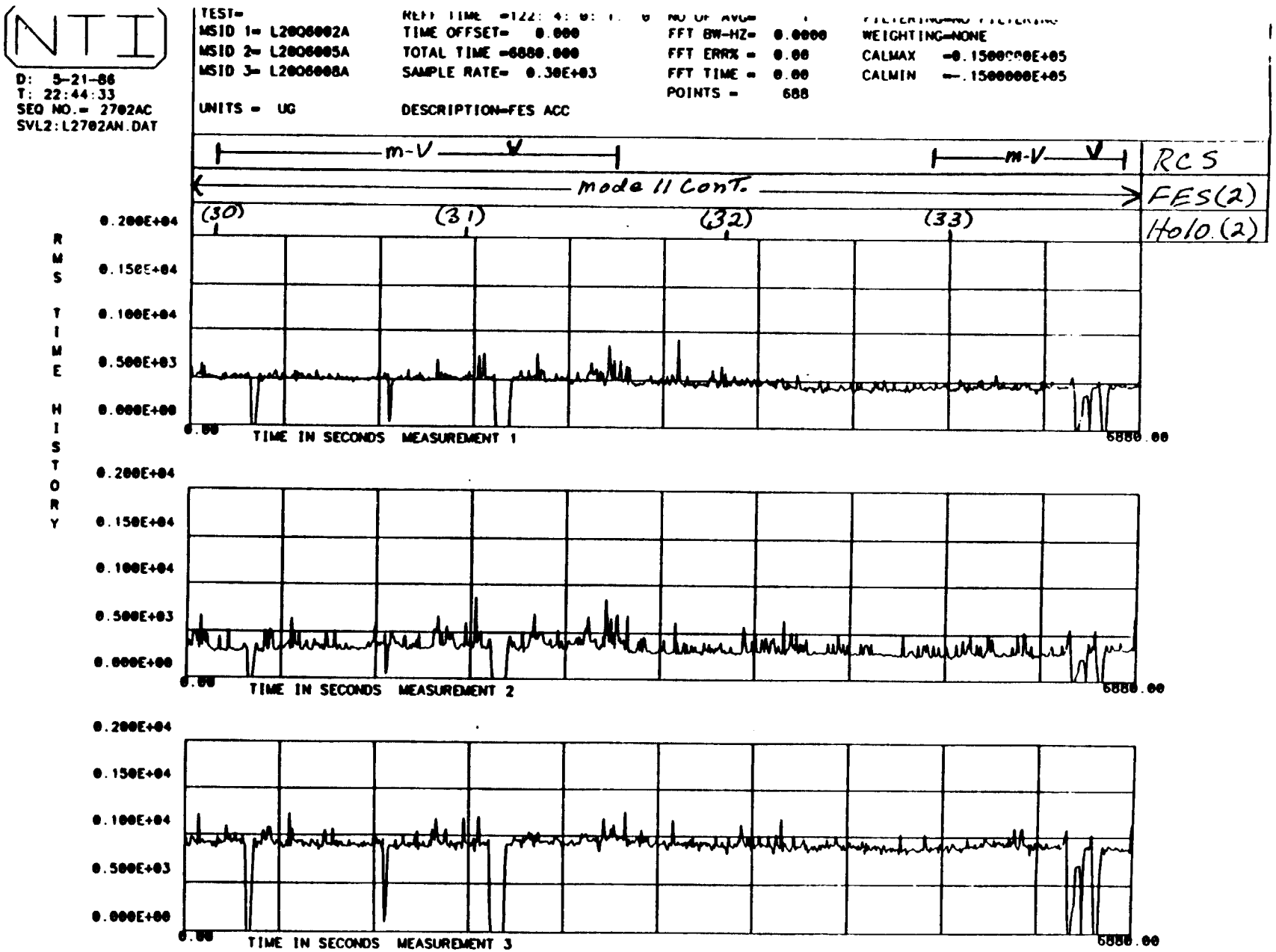

NTI
D: 5-21-86
T: 22:44:33
SEQ NO.= 2702AC
SVL2:L2702AN.DAT
TEST=
MSID 1= L2QQ6002A
MSID 2= L2QQ6005A
MSID 3= L2QQ6008A
UNITS = UG
TIME OFFSET= 0.000
TOTAL TIME =6880.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 688
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
m-V
m-V
RCS
mode 11 Cont.
FES(2)
Holo.(2)
(30)
(31)
(32)
(33)
RMS TIME HISTORY
0.200E+04
0.150E+04
0.100E+04
0.500E+03
0.000E+00
0.00
TIME IN SECONDS MEASUREMENT 1
6880.00
TIME IN SECONDS MEASUREMENT 2
TIME IN SECONDS MEASUREMENT 3

Figure 33.

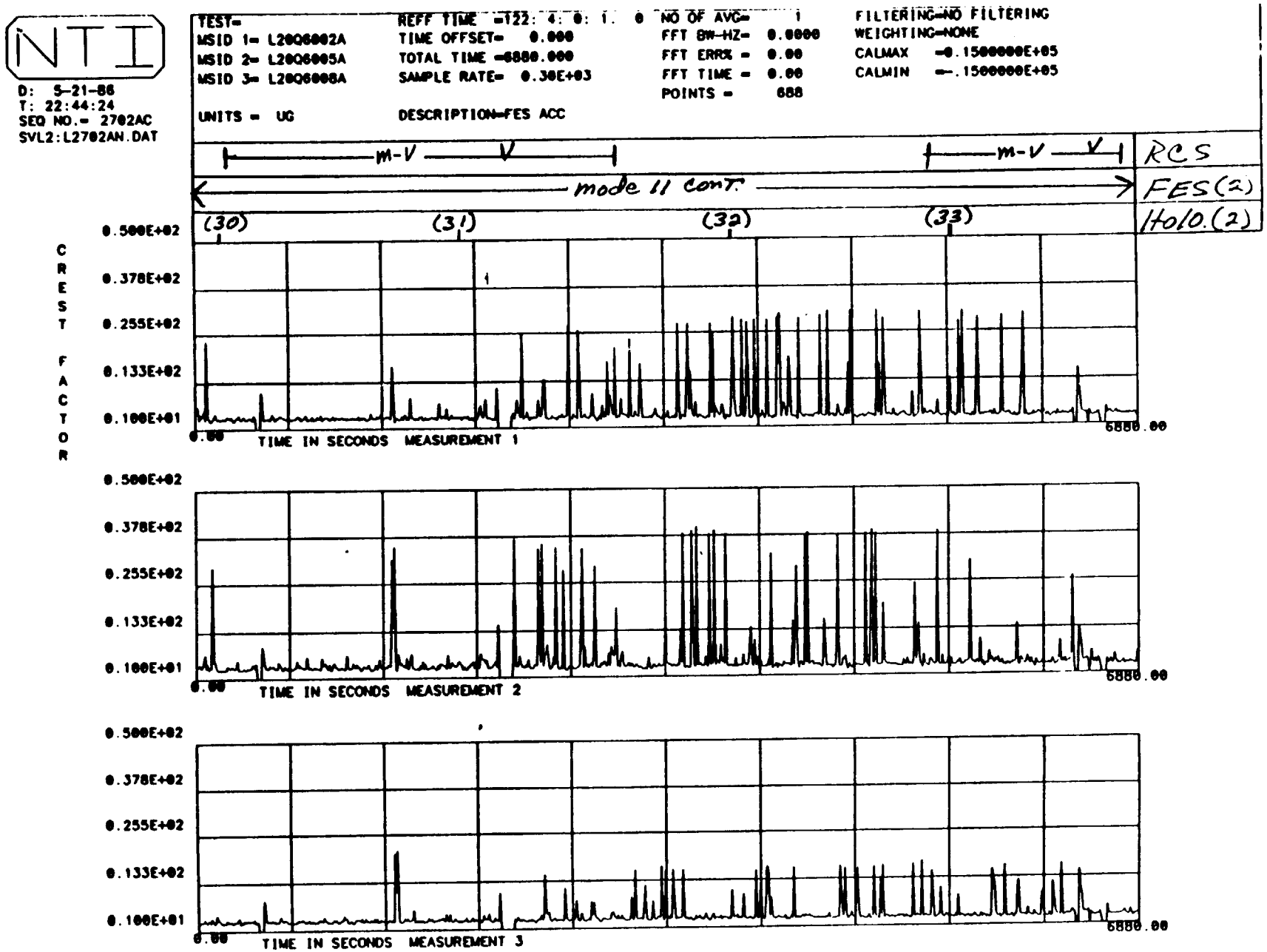
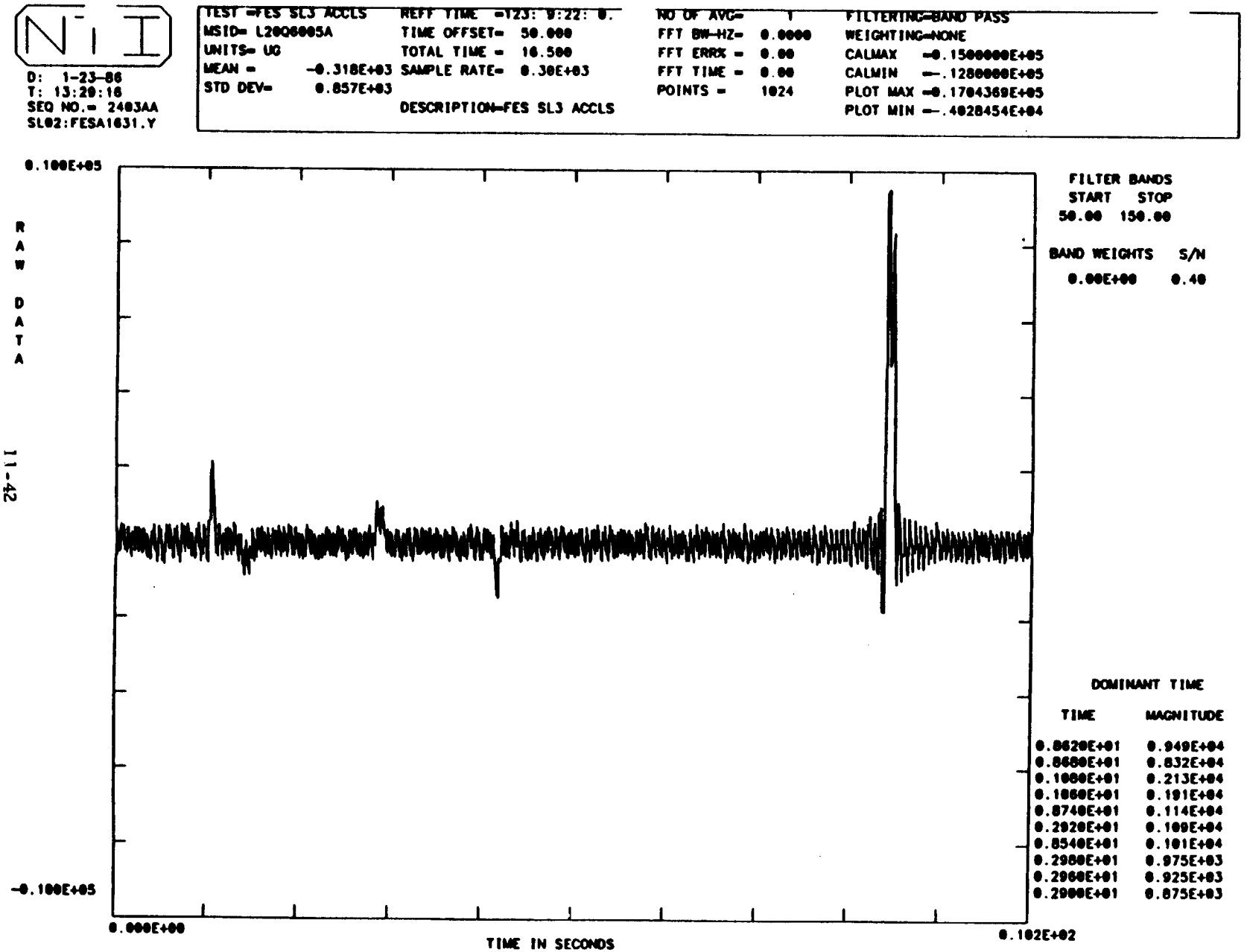

NTI
D: 5-21-86
T: 22:44:24
SEQ NO.= 2702AC
SVL2:L2702AN.DAT
TEST=
MSID 1= L20Q6002A
MSID 2= L20Q6005A
MSID 3= L20Q6008A
UNITS = UG
REFF TIME =122: 4: 0: 1. 0
TIME OFFSET= 0.000
TOTAL TIME =6880.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES ACC
NO OF AVG= 1
FFT BW-HZ= 0.0000
FFT ERR% = 0.00
FFT TIME = 0.00
POINTS = 688
FILTERING=NO FILTERING
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1500000E+05
m-V
V
m-V
V
RCS
mode II cont.
FES(2)
Holo.(2)
(30)
(31)
(32)
(33)
CREST FACTOR
0.500E+02
0.378E+02
0.255E+02
0.133E+02
0.100E+01
0.00
TIME IN SECONDS MEASUREMENT 1
6880.00
0.500E+02
0.378E+02
0.255E+02
0.133E+02
0.100E+01
0.00
TIME IN SECONDS MEASUREMENT 2
6880.00
0.500E+02
0.378E+02
0.255E+02
0.133E+02
0.100E+01
0.00
TIME IN SECONDS MEASUREMENT 3
6880.00

Figure 34.



11-42

Figure 35.

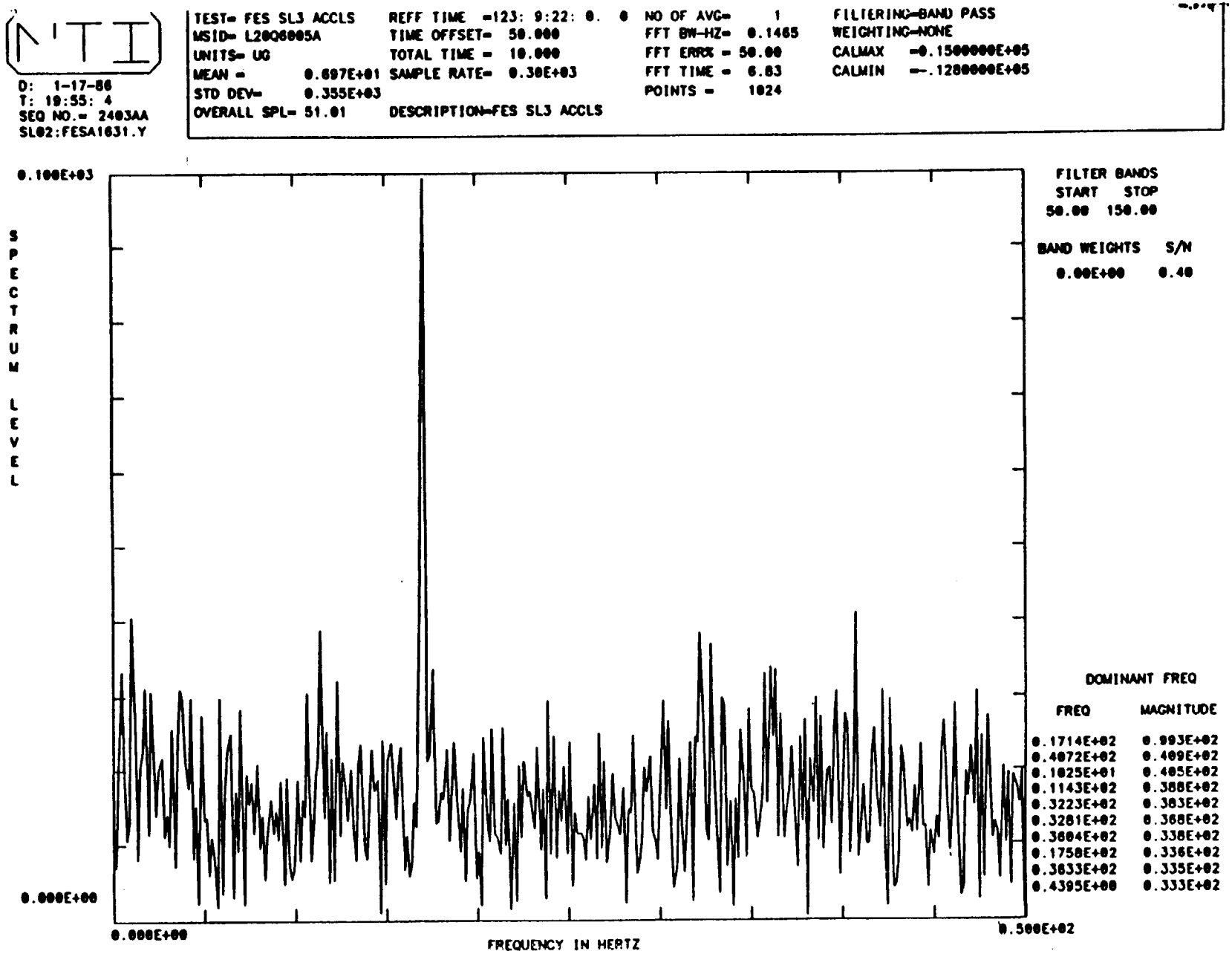

NTI
D: 1-17-86
T: 19:55: 4
SEQ NO.= 2403AA
SL02:FESA1631.Y
TEST= FES SL3 ACCLS
MSID= L20Q6005A
UNITS= UG
MEAN = 0.697E+01
STD DEV= 0.355E+03
OVERALL SPL= 51.01
REFF TIME =123: 9:22: 0. 0
TIME OFFSET= 50.000
TOTAL TIME = 10.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES SL3 ACCLS
NO OF AVG= 1
FFT BW-HZ= 0.1465
FFT ERR% = 50.00
FFT TIME = 6.83
POINTS = 1024
FILTERING=BAND PASS
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1200000E+05
0.100E+03
SPECTRUM LEVEL
0.000E+00
0.000E+00
FREQUENCY IN HERTZ
0.500E+02
FILTER BANDS
START STOP
50.00 150.00
BAND WEIGHTS S/N
0.00E+00 0.40
DOMINANT FREQ
FREQ MAGNITUDE
0.1714E+02 0.993E+02
0.4072E+02 0.409E+02
0.1025E+01 0.405E+02
0.1143E+02 0.388E+02
0.3223E+02 0.383E+02
0.3281E+02 0.368E+02
0.3604E+02 0.338E+02
0.1758E+02 0.336E+02
0.3633E+02 0.335E+02
0.4395E+00 0.333E+02

Figure 36.

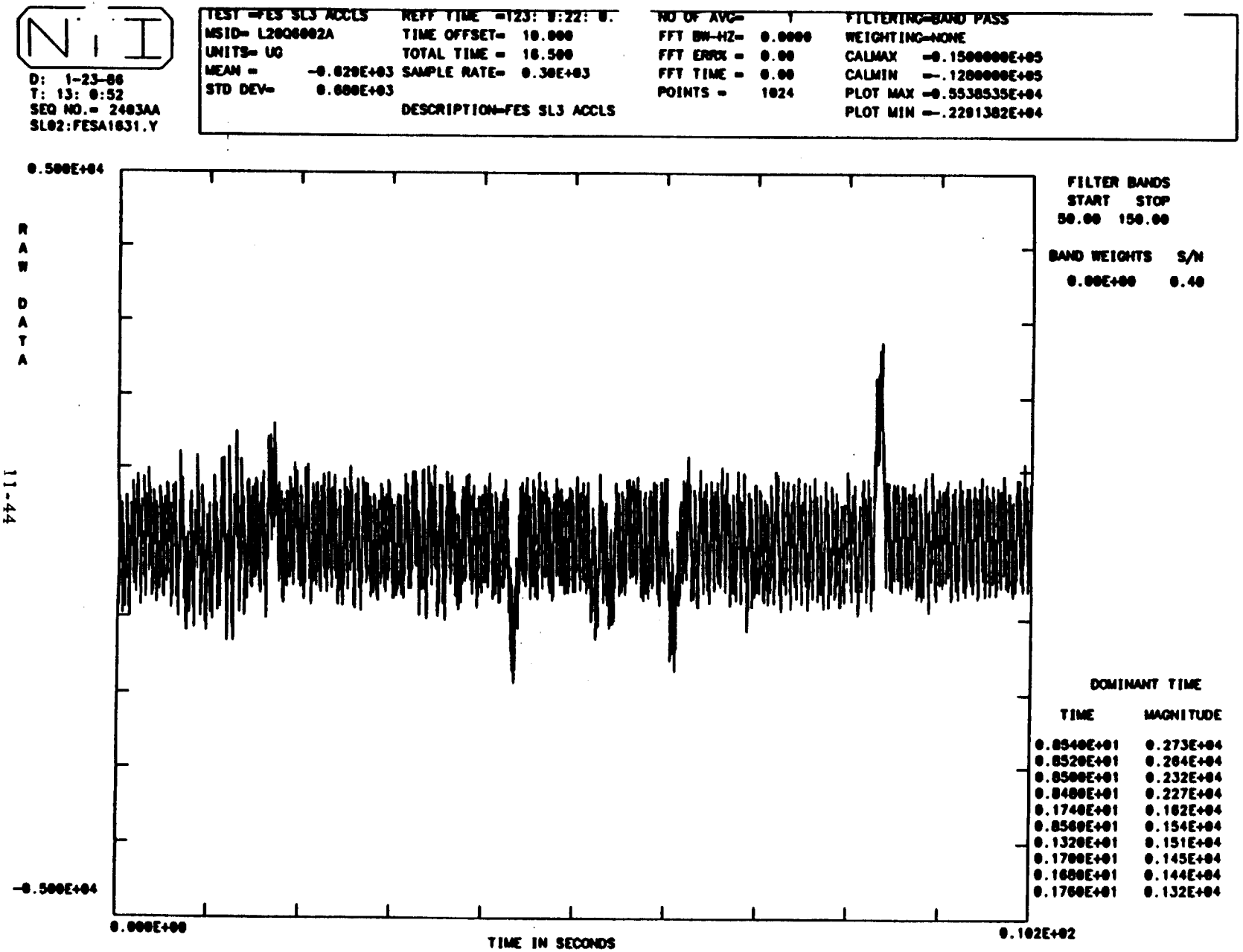


Figure 37.

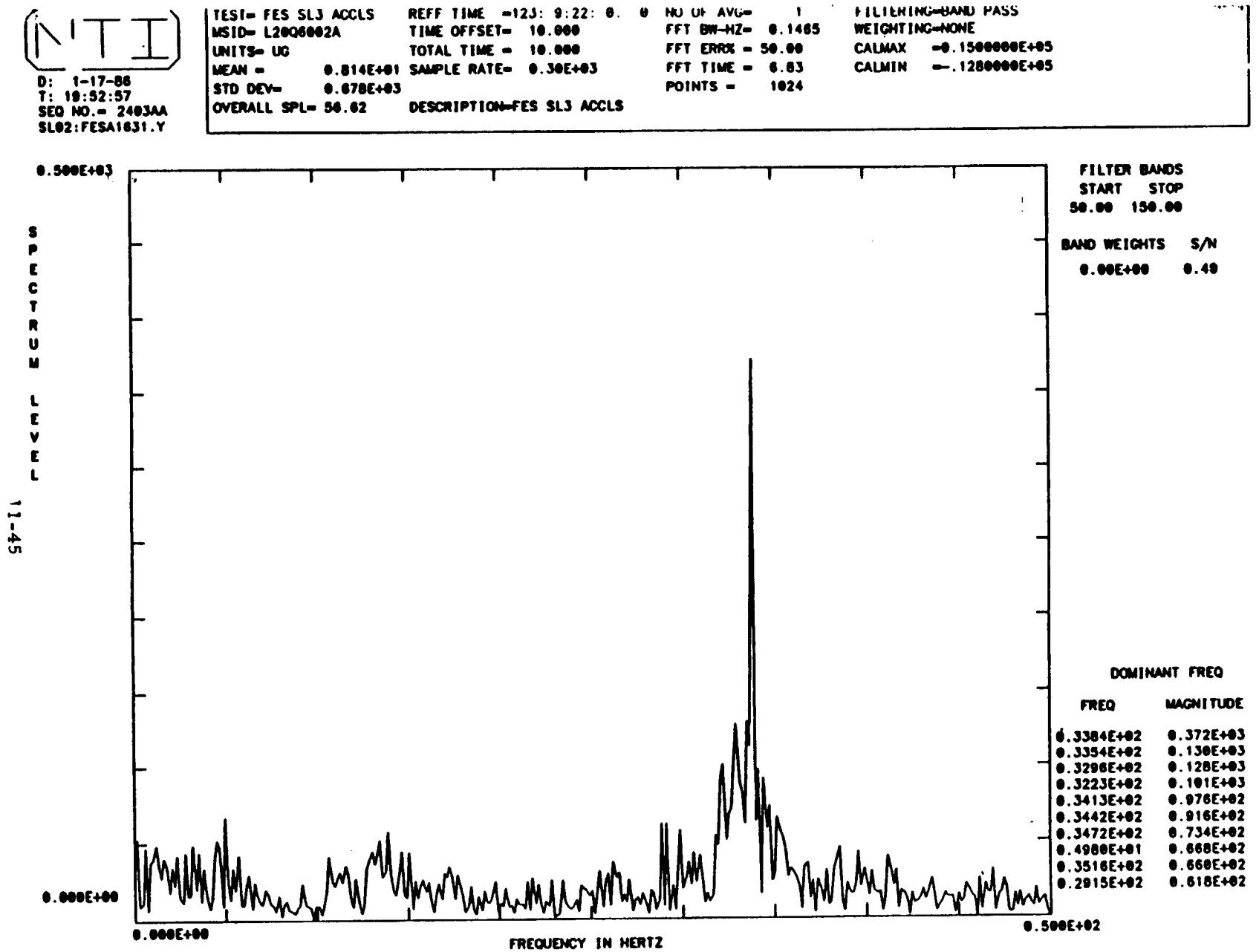

NTI
D: 1-17-86
T: 10:52:57
SEQ NO.= 2403AA
SL02:FESA1631.Y
TEST= FES SL3 ACCLS
MSID= L20Q6002A
UNITS= UG
MEAN = 0.814E+01
STD DEV= 0.678E+03
OVERALL SPL= 56.62
REFF TIME =123: 9:22: 0. 0
TIME OFFSET= 10.000
TOTAL TIME = 10.000
SAMPLE RATE= 0.30E+03
DESCRIPTION=FES SL3 ACCLS
NO OF AVG= 1
FFT BW-HZ= 0.1465
FFT ERR% = 50.00
FFT TIME = 6.83
POINTS = 1024
FILTERING=BAND PASS
WEIGHTING=NONE
CALMAX =0.1500000E+05
CALMIN =-.1280000E+05
0.500E+03
SPECTRUM LEVEL
0.000E+00
0.000E+00
FREQUENCY IN HERTZ
0.500E+02
FILTER BANDS
START STOP
50.00 150.00
BAND WEIGHTS S/N
0.00E+00 0.49
DOMINANT FREQ
FREQ MAGNITUDE
0.3384E+02 0.372E+03
0.3354E+02 0.130E+03
0.3296E+02 0.128E+03
0.3223E+02 0.101E+03
0.3413E+02 0.976E+02
0.3442E+02 0.916E+02
0.3472E+02 0.734E+02
0.4980E+01 0.668E+02
0.3516E+02 0.660E+02
0.2915E+02 0.618E+02

Figure 38.

One of the most interesting things to Dr. Lal is to review the holograms, select the interesting areas, expand those areas, and relate the data back to the asymmetry that they see in some of their holograms. We can not do that right now. The FES experiment people have started reducing their data from cell three first, because of some interesting things on that crystal. We have started from the beginning of the mission. So we will be able to do that later and we will be comparing some of our data to their data.

Question: In your time history plot, and also in the power spectral density, you seem to have background when you don't see the events. Are they seismic or is it electronics noise, and what is the level of that?

Arnett: Well the levels were all indicated on the RMS charts. We are seeing an awful lot of things that are coming up and giving a two-milli g disturbance, two to five, two to seven. In that basic range we are seeing a lot of disturbances.

Question: The background that you see is about 2 milli-g's?

Arnett: No, I thought that you were talking about events that we could really pull out.

Question: Not events, away from events, what is the background? Is it electronics noise?

Arnett: The background is down pretty low. I guess I really haven't tried to look at exactly what our background is. I guess what you are identifying as the background has been running around 10^{-3}.

Question: Eliminating these events, what would be the background noise level? If you can eliminate those events, what would be the background noise level?

Arnett: What is this g level here? It's running at somewhere around 1.5 times 10^{-4} up to the 10^{-3} range, just about exactly where the other people have been finding it to lie, and I think if you went back to one of the other viewgraphs you could see that a little bit better. I can show you after the talk if you would like.