Strong Motion Records from the 23 December 1985, M_S6.9 Nahanni, NWT, and some associated earthquakes.

by

Weichert D.H., R.J. Wetmiller*, R.B. Horner, P.S. Munro*, and P.N. Mork**

Pacific Geoscience Centre
Geological Survey of Canada
P.O. Box 6000
Sidney, B.C., V8L 4B2
Canada

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* Geological Survey of Canada, Geophysics Division, 1 Observatory Crs. Ottawa.
**U.S. Geological Survey, 345 Middlefield Road, Menlo Park, Cal., 94025.

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ABSTRACT

A magnitude M_S6.6 earthquake occurred on 5 October 1985 in the North Nahanni River area of the Northwest Territories of Canada. During the aftershock survey three accelerographs were installed near the center of the activity. The instruments were triggered by a large number of aftershocks, including a second large earthquake, M_S6.9, that occurred on 23 December 1985 close to the location of the October event. Accelerations recorded from this earthquake at distances from 8 to 30 km have a general level of 10 to 30 % g lasting about 10 to 12 s. One record exhibits several horizontal acceleration cycles on the order of 60 to 120 % g (gravity), and a vertical peak that exceeded the width of the film and therefore must have exceeded 2 g, all with dominant frequencies of about 8 to 10 Hz.

In this report we present copies of the three strong motion film records from the 23 December earthquake and nine accelerograms from three smaller events that resulted in significant acceleration on the order of 10 % g. Of these records, six were considered to be of sufficient significance to have the original films digitized commercially and processed with the standard strong motion package of the U.S. National Strong Motion Data Center of the U.S. Geological Survey. For these records we present here plots of instrument-corrected, anti-aliased and filtered accelerations, velocities and displacements, as well as Fourier amplitude spectra of acceleration, and the velocity response spectra.

RESUME

Un séisme de magnitude M_S6,6 a eu lieu le 5 octobre 1985 dans la région de la rivière Nahanni-Nord dans les Territoires du Nord-Ouest au Canada. Pendant le levé des répliques, trois accélérographes furent installés près de la région épicentrale. Les instruments ont enregistré un grand nombre de répliques, y compris un deuxième grand tremblement de magnitude M_S6,9 qui eut lieu le 23 décembre 1985 proche de l'événement d'octobre. Les accélérographes ont été installés à des distances variant entre 8 et 30 kilomètres de l'épicentre. En général, les accélérations enregistrées lors de ce deuxième séisme s'étendent de 10 à 30 % de g et durent de 10 à 12 secondes, mais il y a quelques cycles d'accélération horizontale qui s'étendent de 60 à 120 % de g et une impulsion d'accélération verticale maximum qui excède la largeur du film et, donc, qui doit excéder 200 % de g. Tous ces cycles spéciaux ont des fréquences dominantes de près de 8 à 10 Hz.

Ce rapport inclut des copies des trois films produits durant l'événement du 23 décembre et trois film de chacun des trois autres événements qui ont produit des accélérations de l'ordre de 10 % de g. Les films originales ont été commercialement traduits en numérique et ont été traités par la méthode standard pour secousses fortes du Centre national de données de secousses fortes de la Commission géologique des États-Unis. Nous reproduisons ici les accélérogrammes corrigés pour les effets d'instrumentation et de filtre de type anti-alias et les traces d'accélération, de vélocité et de déplacement corrigées et filtrées. Enfin, on trouvera des traces des spectres d'amplitude Fourier d'accélération et des spectres de réponse en vélocité.

INTRODUCTION

On 5 October 1985, a magnitude M_S6.6 earthquake occurred in the North Nahanni River area of the Northwest Territories, Canada, near 62.2°N, 124.2°W. The earthquake occurred in a largely uninhabitated area, about 110 to 160 km, respectively, from the nearest settlements of Wrigley and Fort Simpson, where the intensity was estimated as V. In the epicentral area significant landslides indicated intensities VIII to X, and the earthquake was felt to distances of about 1500 km to the southeast. Aftershocks following the earthquake were monitored by an aftershock program from 13 to 17 October. During this field work (Wetmiller et al., in preparation, 1986), three accelerographs were installed near the center of the seismic activity. To the end of 1985 the accelerographs were triggered by 57 earthquakes.

On 23 December 1985 a second large earthquake of M_S6.9 occurred at nearly the same location as the October event. Despite the holiday season and the severe weather conditions at that time, a second aftershock program was undertaken, during which the records of two accelerographs were recovered. The third instrument was only found after an intensive search on 29 January.

Shortest hypocentral distances of the accelerographs from the 23 December earthquake appear to be 8 km to 10 km, or less; at one site peak horizontal acceleration reached 1.25 g, and peak vertical acceleration was off-scale and must have exceeded 2 g. This record presented considerable difficulties to the digitizer and caused considerable delay in publication of this record set.

The objective of this report is to present all digitized records and plots of the usual processing stages of the strong motion records, together with available relevant data on the earthquakes, and site and instrument parameters. A complete tabulation of all aftershocks that triggered the instruments, together with copies of all but the most trivial records and parameters, is scheduled for a later time.

SITE INSTALLATION AND INSTRUMENTATION

Eight days after the 5 October earthquake, a field party installed three Kinemetrics SMA-1, 1 g-full-scale accelerographs, equipped with TCG-1 time code generators, close to the center of the seismic activity. The instrument sites and epicentres of three of the four events discussed herein are shown in Figure 0.1. All instruments were bolted to bedrock, a competent Devonian limestone. All sites were at or near local high points, at elevations of 800 to over 1000 m. The regional relief was about 500 m from the flat topped mountains into the river valleys. Table 1 gives site locations, installation dates and accelerograph constants. Power in addition to the internal batteries was provided by 12-volt heavy duty car batteries; instruments and batteries were left unprotected. This is probably as close to a 'free-field' installation as is possible.

The initial set of film records was recovered in early January during another field trip. Only sites 1 and 2 were found, films recovered, time code generators reset and errors noted. Extreme weather conditions at this

time (-40°C, high winds) resulted in time correction determinations of only ± 0.2s. Site 3 was found and serviced on a subsequent field trip on 29 January. The accelerographs appear to have operated normally and battery power held up despite the exposure to the unusually harsh conditions. The only noticable malfunction was an intermittent loss of damping of the vertical accelerometer at site 2 (instrument no. 1296). For some triggers the vertical trace appears perfectly normal, but oscillates wildly in others. Unfortunately, for the large event of 23 December the vertical trace is useless, because of the large uncertainty involved in making instrument corrections for the small and poorly known remaining damping.

Instrument No. 5028 at site 1 has no reference traces (cf. Fig. F.1-4) because the corresponding mirrors were damaged and removed. On the other hand, instrument No. 1296, at site 2 was retrofitted with reference trace mirrors in 1982.

EARTHQUAKE PARAMETERS

Table 2 lists the epicentres and magnitudes of the four events of which records are included in this report. Figure 0.1 shows their locations with respect to the accelerograph sites. These epicentres have been determined directly from the SMA records. The 23 December epicentre was calculated giving a zero weight to the S-P interval at site 2, since its S onset is not as clear as that of the other two sites (Weichert et al., 1986). Absolute time control for the three instruments was possible only by interpolating between time corrections done in October and January. Considering the length of the time interval and the extremely low temperatures at which the instruments were operating, the estimated corrections (6s for site 1, 28 s for site 2 and 4s for site 3) must be viewed with some caution. However, the corrected SMA times and the subsequently calculated epicentres are compatible with data for the events from the Canadian seismograph network.

The epicentre for the 23 December 05:48 event cannot be accurately determined by either SMA or by network data because it is overwritten by the coda of the main event. The available data suggest that this event occurred close to the main shock. We have assigned it to this location but enclosed its epicentre in brackets in Table 2.

The trend of the epicentres of the 09 November, 23 December and 25 December events along a NNW-SSE'ly direction agrees well with the distribution of aftershocks as determined by Wetmiller et al. (1986, in preparation).

Preliminary joint epicenter determinations combining field data with network data indicate that a bias in epicenters of about 5 km may be possible. Final epicenter locations will be given by Wetmiller et al. (in preparation, 1986). Nevertheless, the aftershock trend agrees well with the available focal mechanism solutions which has a strike of 175°±40; dip of 40°±20° and rake of 90°+20° (Wetmiller et al., in preparation, 1986). Focal depths of most aftershocks vary from 5 to 15 km, with the main shock of December 23 probably near 6 km.

DATA AND DATA PROCESSING

The three accelerographs triggered on 57 events from the installation date to 31 December 1985. Many events triggered only one or two accelerographs and the majority of recordings are small and not very useful for ground motion studies. The trigger threshold had been lowered to about 1/2 % g in order to increase the likelihood of triggering on first P-onsets. The complete set of analog film records with associated documentation will be published in a future Open File Report. Only six film records were considered to be of sufficient significance to be digitized, i.e. a peak acceleration of about 10 % g and duration of more than 2 s. They include all 3 station records for the 23 December event and one additional event on each accelerograph. Table 2 shows the status of the records from these events, and the epicentres and magnitudes where available. The location of the 23 December 05:48 event can only be poorly determined from the strong motion S-phases.

The relevant sections of the film records from all three stations for four events are reproduced in Figures F.1 to F.4. Digitization was done commercially on a computer-based laser-beam trace following system. Manual intervention by the operator normally resolves ambiguous record sections. However, the record at site 1 from the 23 December 05:16 event presented considerable difficulties and resulted in misidentification and loss of several large peaks. (see Weichert et al., 1986). The largest acceleration peaks occur in the areas marked by arrows in Figure F.2. Acceleration at this time was strong enough to offset the time code trace by about 0.1 mm, recognizable in the reproduction, presumably by pushing the film physically sideways by this amount. A horizontal acceleration spike with the correct polarity (eastward) to cause this shift can be identified. Another peak, near the upper arrow in this Figure, is completely missing from the record although the upgoing sides of this peak can be uniquely followed partway on suitable enlargements. (cf. Weichert et al., 1986; EOS cover photo, 1986). A lower bound for the peak value can only be estimated with about 10 % accuracy by comparison with the rate of trace darkening near some of the other large peaks and assuming a similar pattern for the missing peak. This procedure leads to about 2¼ g for this vertical component peak.

All digital records described herein have been processed with the AGRAM computer program package of the United States Geological Survey in Menlo Park (Converse, 1984). Corrected acceleration, velocity and displacement histories are reproduced here as Figures 1.2.C.L to 3.4.C.T, where the Figure number's first digit refers to site number, the second digit refers to event number in Table 2, C indicates instrumented corrections and L, V, T designate the instrument component. The next set of Figures, 1.2.F... and up displays the Fourier amplitude spectra of acceleration. The final set of Figures marked 1.2.R... gives the pseudo-relative velocity response spectra. The vertical component at site 2 from the large 23 Dec. event has not been processed because it was undamped during this event.

Digitized data can be obtained separately, at the user's expense, from the Director, Geophysics Division, Geological Survey of Canada, 1 Observatory Crescent, Department of Energy, Mines and Resources, Ottawa, Ontario, K1A 0E4.

Table 1. Nahanni Strong Motion Accelerograph Installations

	Site 1 (Iverson)	Site 2 (Slide Mountain)	Site 3 (Battlement Creek)
Site Location:			
Latitude N	62°12.11' (62.2018°)	62°13.95' (62.2335°)	62°07.57' (62.1262°)
Longitude W	124°22.20' (124.3700°)	124°10.05' (124.1675°)	123°49.99') (123.8332°)
Elevation:	792 m	914 m	1067 m
Installation:			
Date	13 Oct. 85	13 Oct. 85	13 Oct. 85
Time	21:25 UT	22:52 UT	23:50 UT
SMA-1 No.	5028	1296	5917
Trigger sensitivity	0.0049 g	0.0052	0.0040
Fixed reference traces	Yes; missing on film (misaligned)	Yes; retrofit by Kinemetrics 2/82	Yes; original equipment
Foundation:	Bedrock	Bedrock	Bedrock
Accelerograph Constants:			

Component	L	V	T	L	V	T	L	V	T
Sensitivity [mm/g]	19.4	18.2	17.8	18.8	17.8	17.8	17.0	18.4	18.7
Natural freqn. [Hz]	25.4	25.2	26.3	24.7	26.1	26.4	26.4	25.8	25.7
Damping	60 % critical all components								
Orientation (degree)	10	up	280	330	up	240	360	up	270

Table 2. Digitized Nahanni Strong Motion Records.
D - digitized, F - film record only.

Date / UT 1985	Epicentre deg.N/deg.W	Magnitude	Record Status, Site No. 1	2	3
Nov. 9 04:46^m	*62.21 124.27	m_N4.6 m_b4.8	F	D	F
Dec.23 05 16	62.19 124.24	M_S6.9 m_b6.4	D	D	D
Dec. 23 05 48	**62.19 124.24	m_b5.5	D	F	F
Dec. 25 15 42	*62.02 124.13	m_b5.7 M_N5.0	F	F	D

*Epicentres from SMA-1 records.

**Poor solution, assumed to be same as Dec. 23 05:16 event.

FIGURE CAPTIONS

No. 0.1 Strong motion stations and earthquake locations. Arrows at stations indicate horizontal accelerometer axes. The epicentre of the Dec. 23 05:48 event is thought to be close to the location of the Dec. 23 05:16 event.

F.1 Film records for the 1985 Nov. 09 earthquake.

F.2 Film records for the 1985 Dec. 23 05:16 earthquake.

F.3 Film records for the 1985 Dec. 23 05:48 earthquake.

F.4 Film records for the 1985 Dec. 25 earthquake.

1.2.. Processed digital records and spectra: First digit designates
..C.L Site No., second digit earthquake
..C.L First letter designates plot type: C - instrument corrected, anti-aliased and filtered acceleration, velocity and displacement.
F - Fourier amplitude of acceleration
R - Relative velocity spectrum.
Second letter G or N denotes logarithmic or linear abscissa scale, but only the logarithmic plots are included here.
Third letter designates component. Azimuth given on figure.

REFERENCES

Converse, A., 1984. AGRAM: a series of computer programs for processing digitized strong-motion accelerograms, Vers. 2.0. United States Department of the Interio, Geological Survey, Menlo Park, Open-file report 84-525.

Weichert, D.H., R.J. Wetmiller and P.S. Munro, 1986. Vertical earthquake acceleration exceeding 2g ? The case of the missing peak. Bull. Seism. Soc. of America, in press.

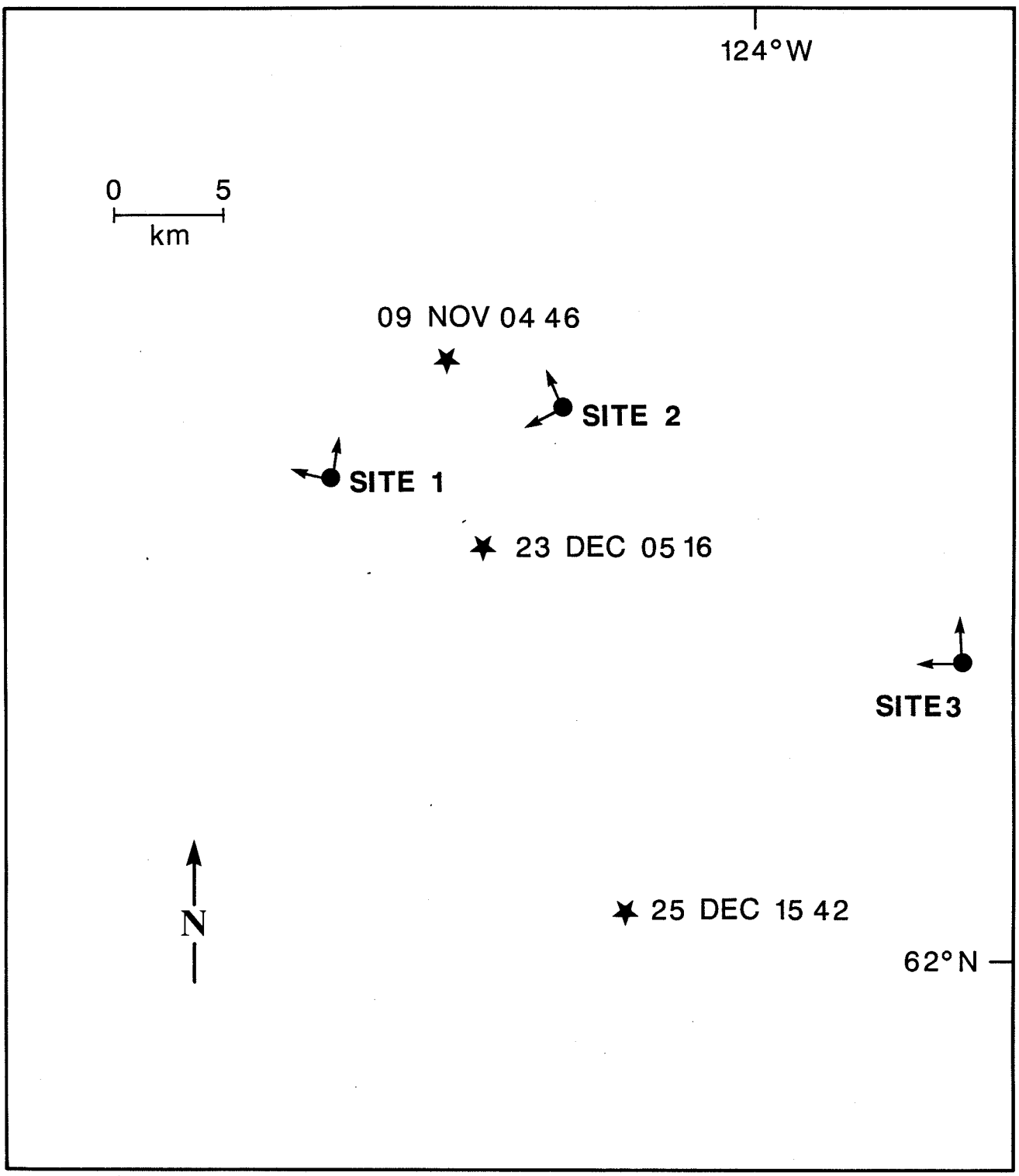
124°W
0
5
km
09 NOV 04 46
SITE 2
SITE 1
23 DEC 05 16
SITE3
N
25 DEC 15 42
62°N

fig 0.1

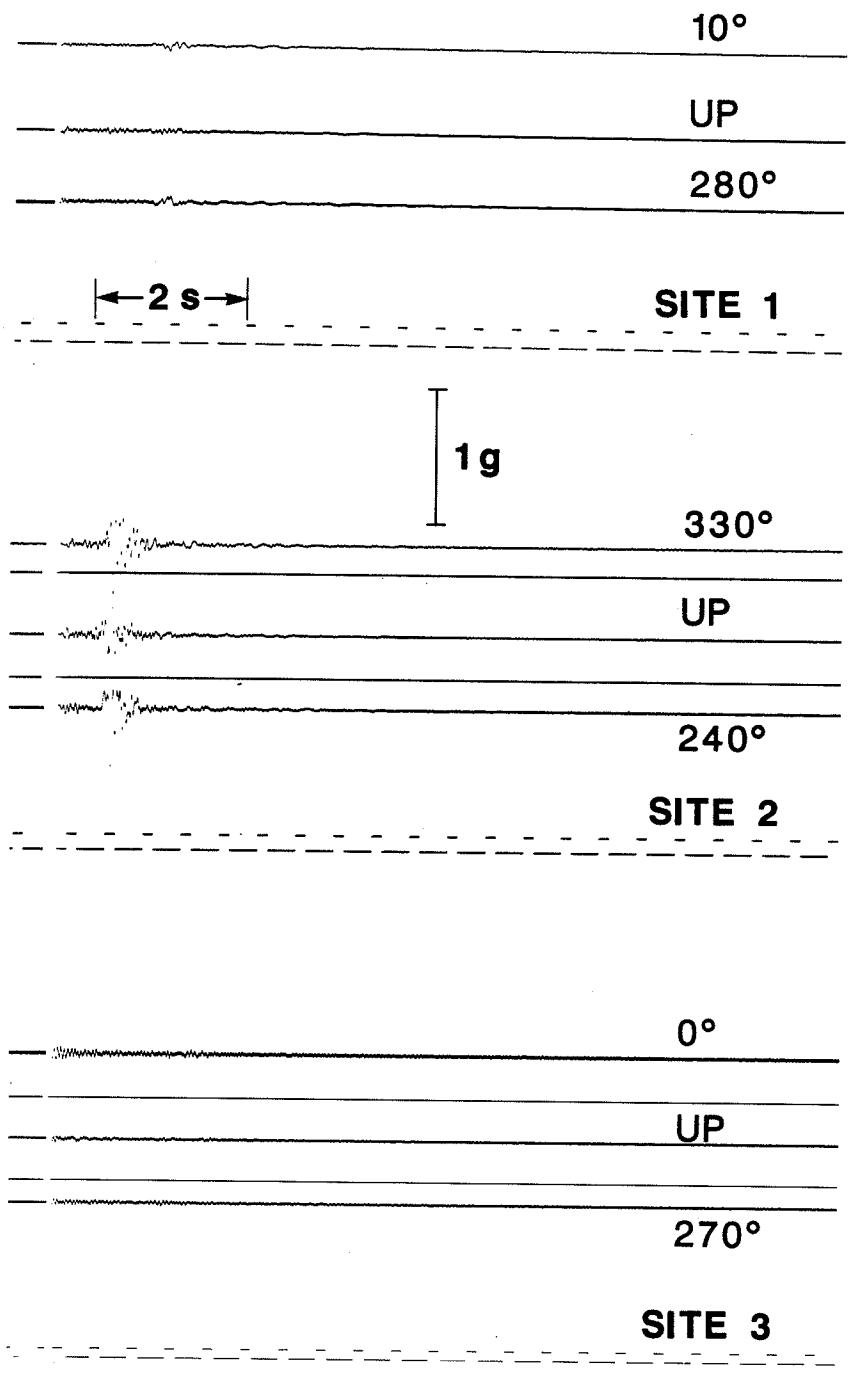

fig F.1

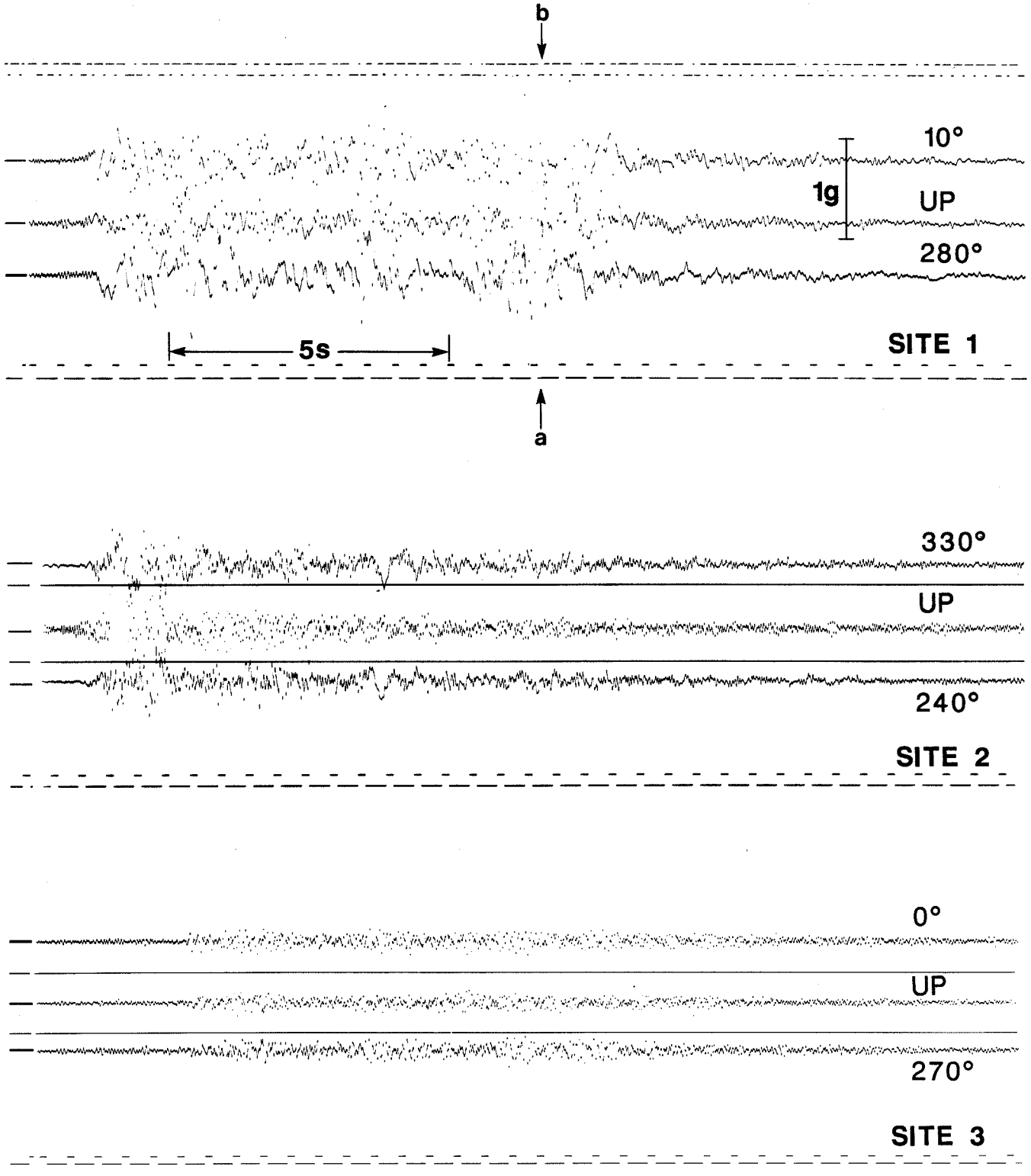

fig F.2

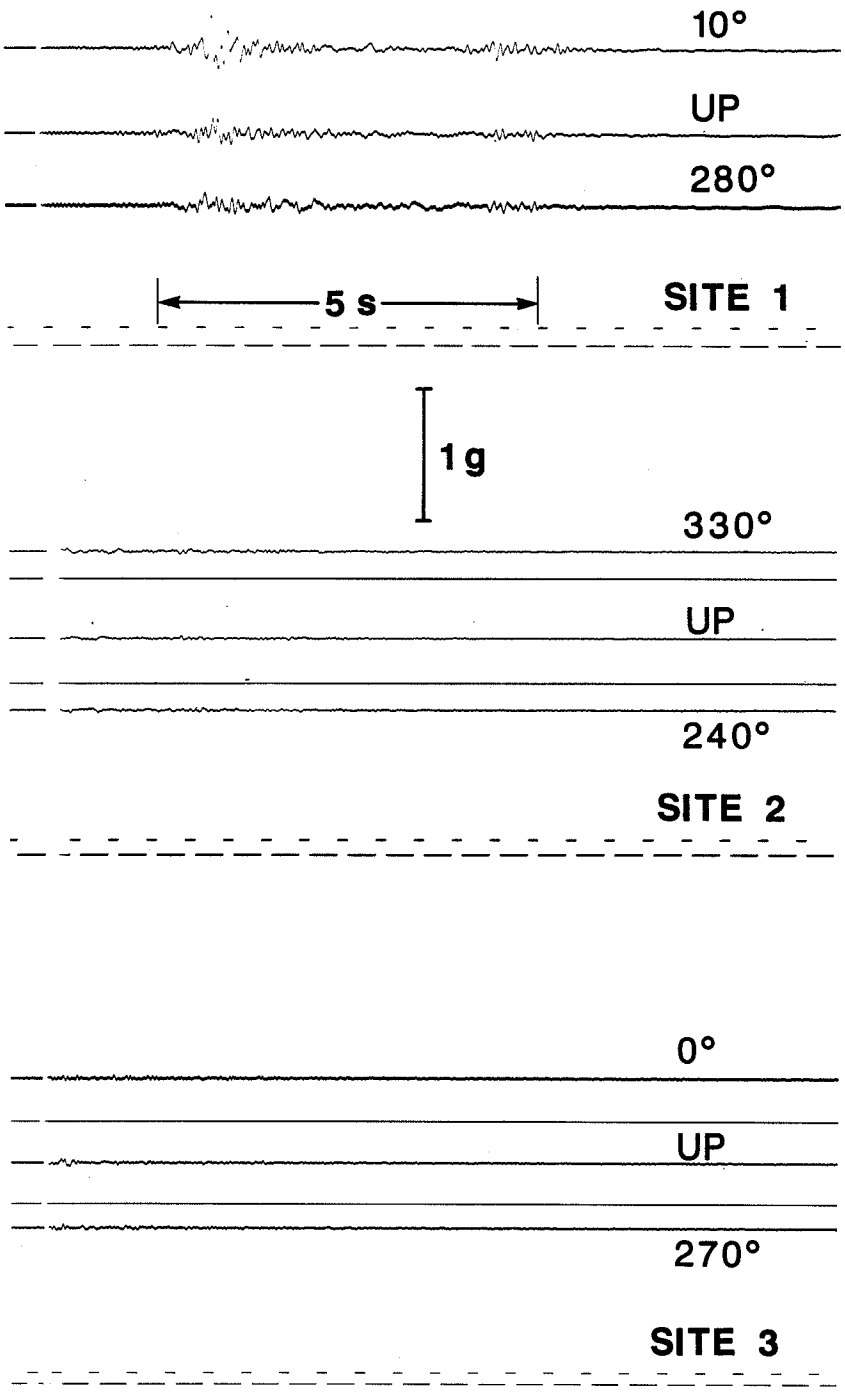

fig F.3

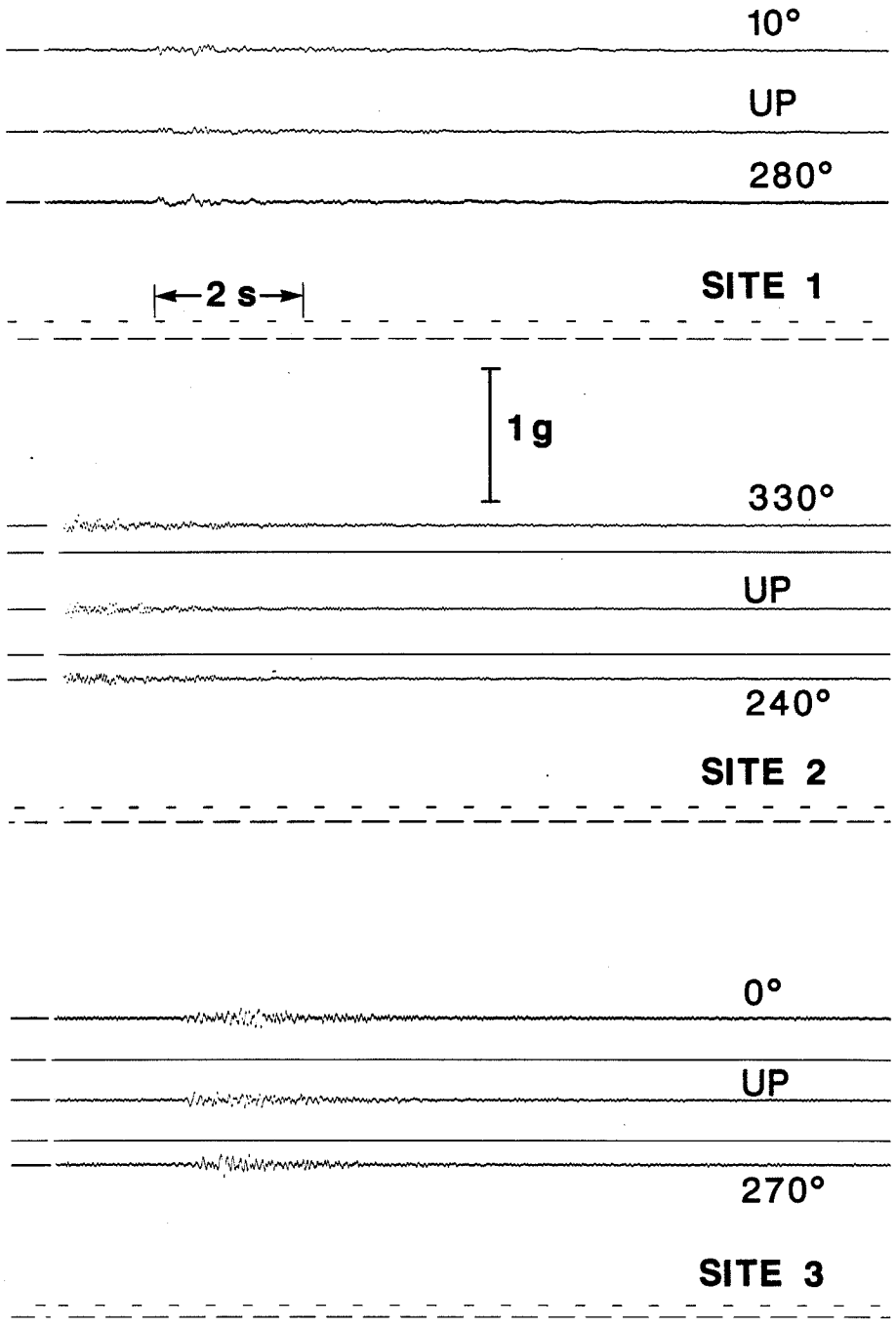

fig F.4

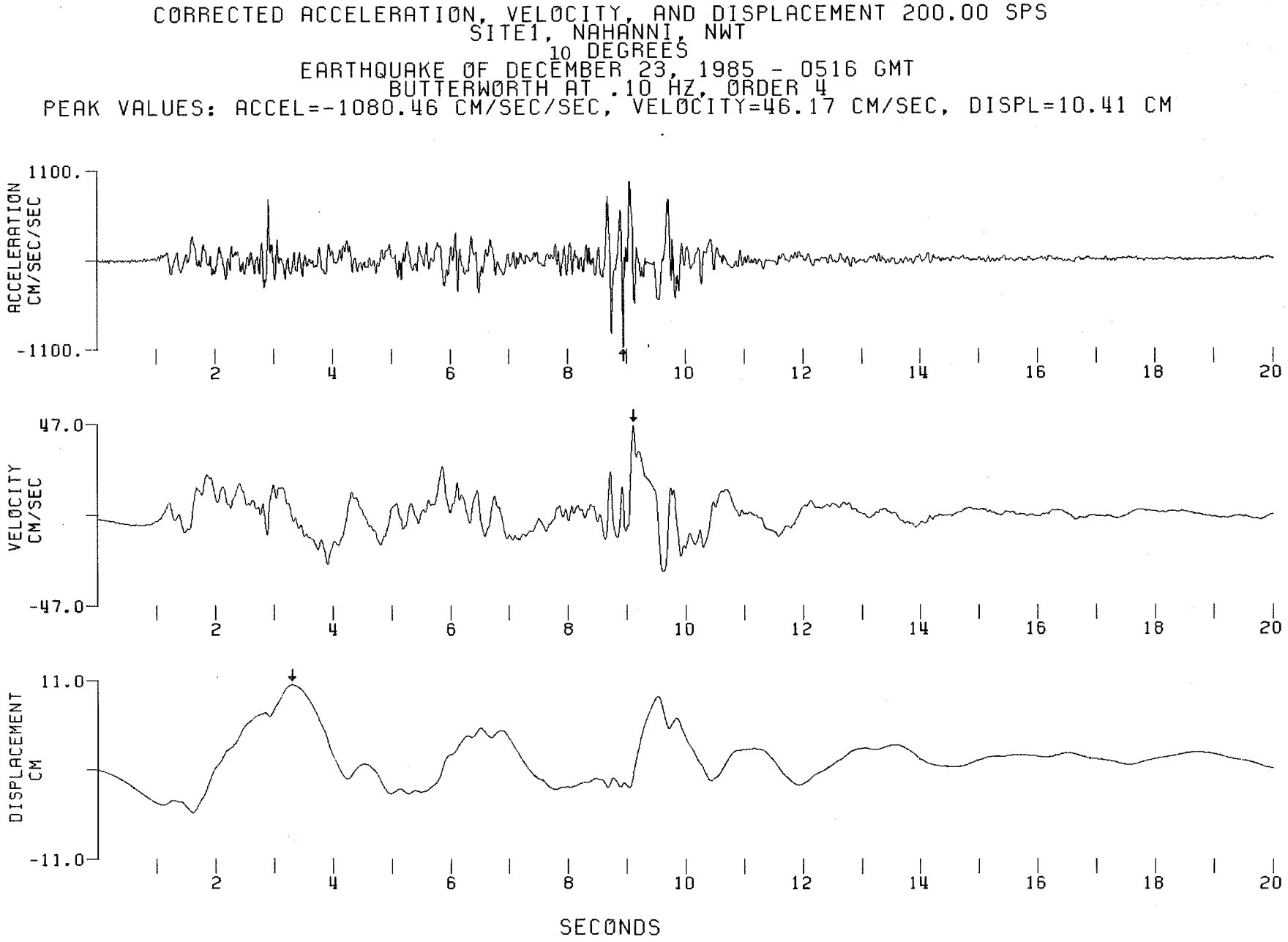
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
10 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0516 GMT
BUTTERWORTH AT .10 HZ, ORDER 4
PEAK VALUES: ACCEL=-1080.46 CM/SEC/SEC, VELOCITY=46.17 CM/SEC, DISPL=10.41 CM
ACCELERATION CM/SEC/SEC
1100.
-1100.
VELOCITY CM/SEC
47.0
-47.0
DISPLACEMENT CM
11.0
-11.0
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.2.C.L

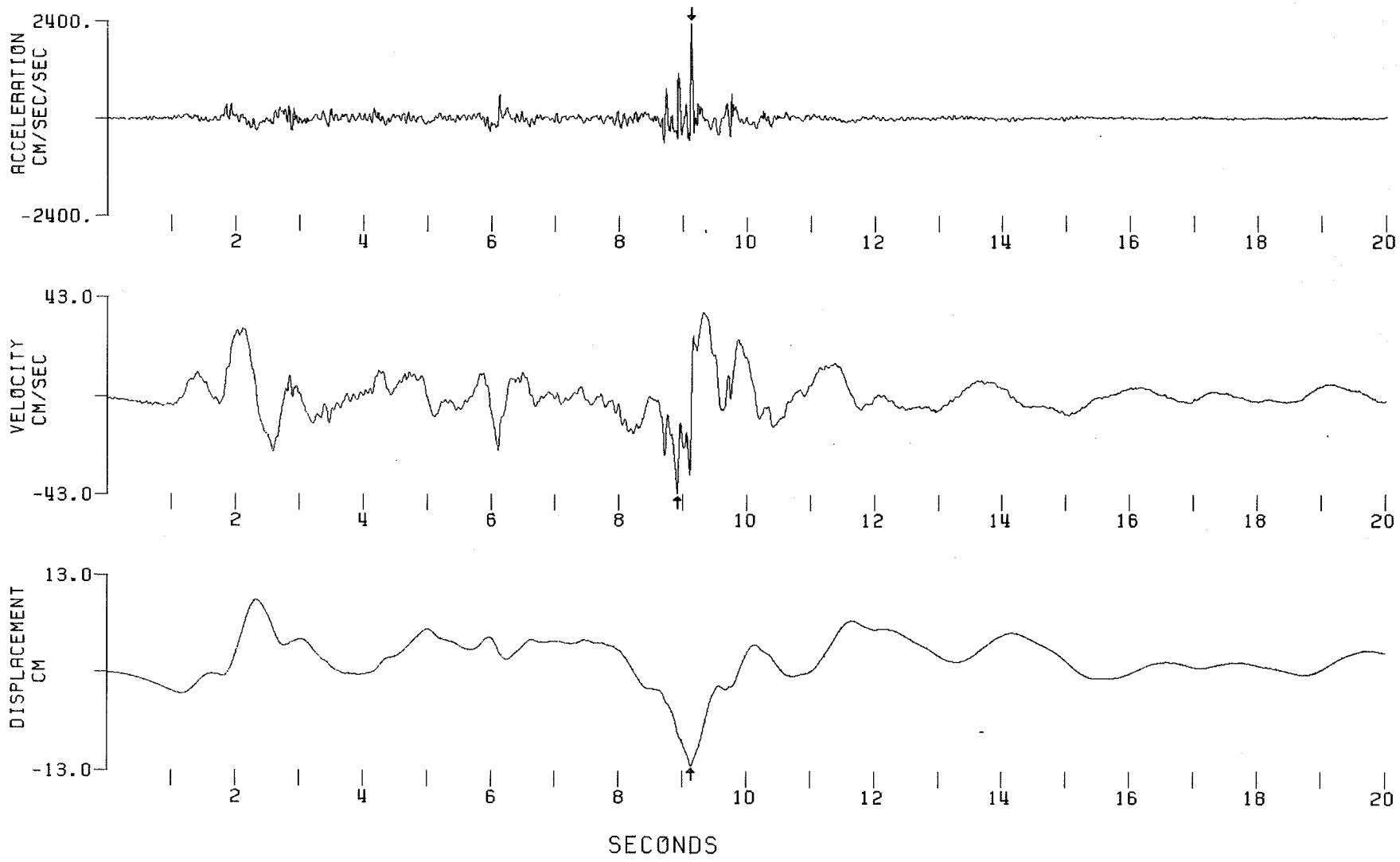
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 23, 1985 - 0516 GMT
BUTTERWORTH AT .10 HZ, ORDER 4
PEAK VALUES: ACCEL=2322.38 CM/SEC/SEC, VELOCITY=-42.86 CM/SEC, DISPL=-12.28 CM
ACCELERATION CM/SEC/SEC
2400.
-2400.
VELOCITY CM/SEC
43.0
-43.0
DISPLACEMENT CM
13.0
-13.0
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.2.C.V

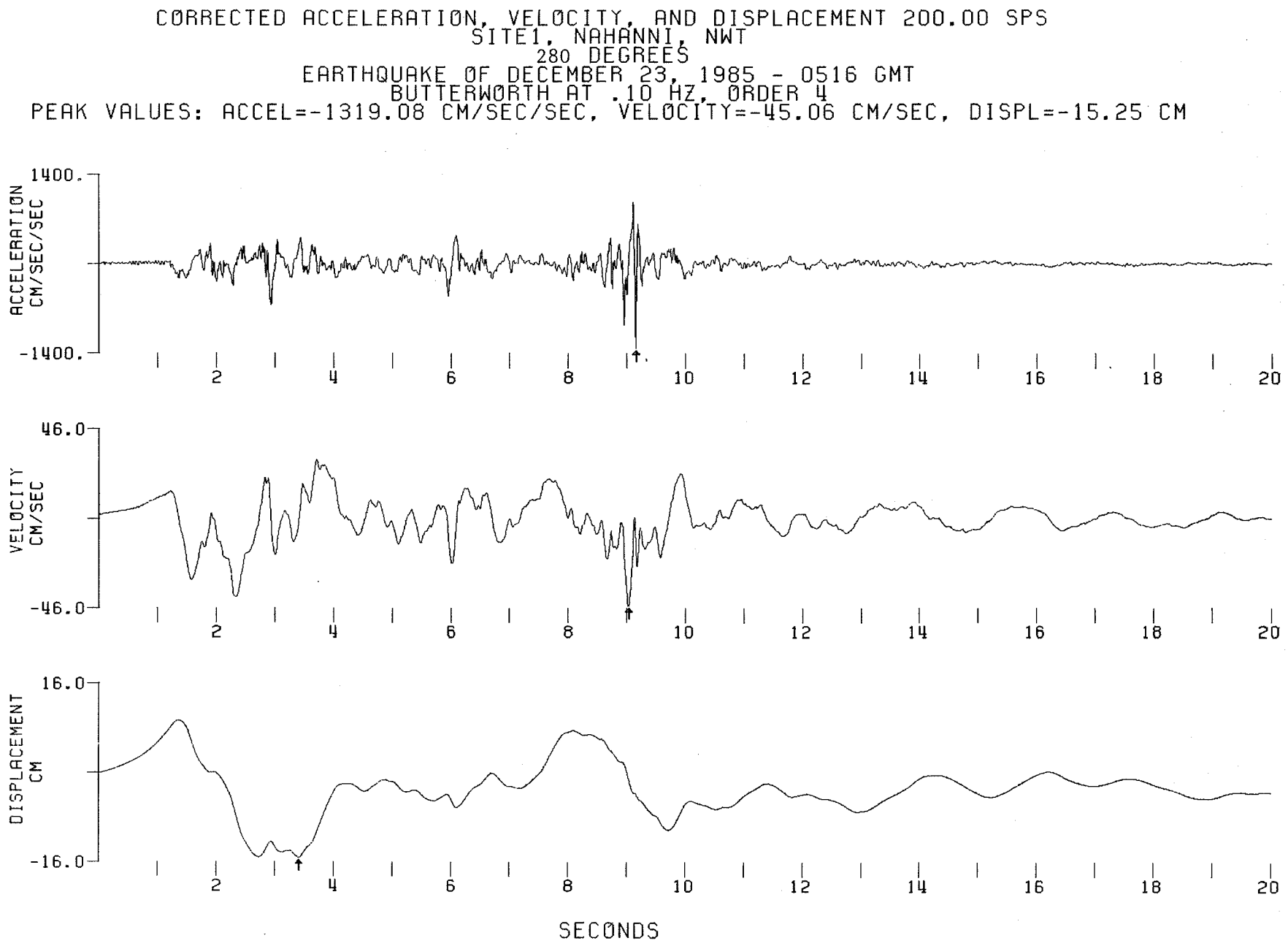
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
280 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0516 GMT
BUTTERWORTH AT .10 HZ, ORDER 4
PEAK VALUES: ACCEL=-1319.08 CM/SEC/SEC, VELOCITY=-45.06 CM/SEC, DISPL=-15.25 CM
ACCELERATION CM/SEC/SEC
1400.
-1400.
VELOCITY CM/SEC
46.0
-46.0
DISPLACEMENT CM
16.0
-16.0
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.2.C.T

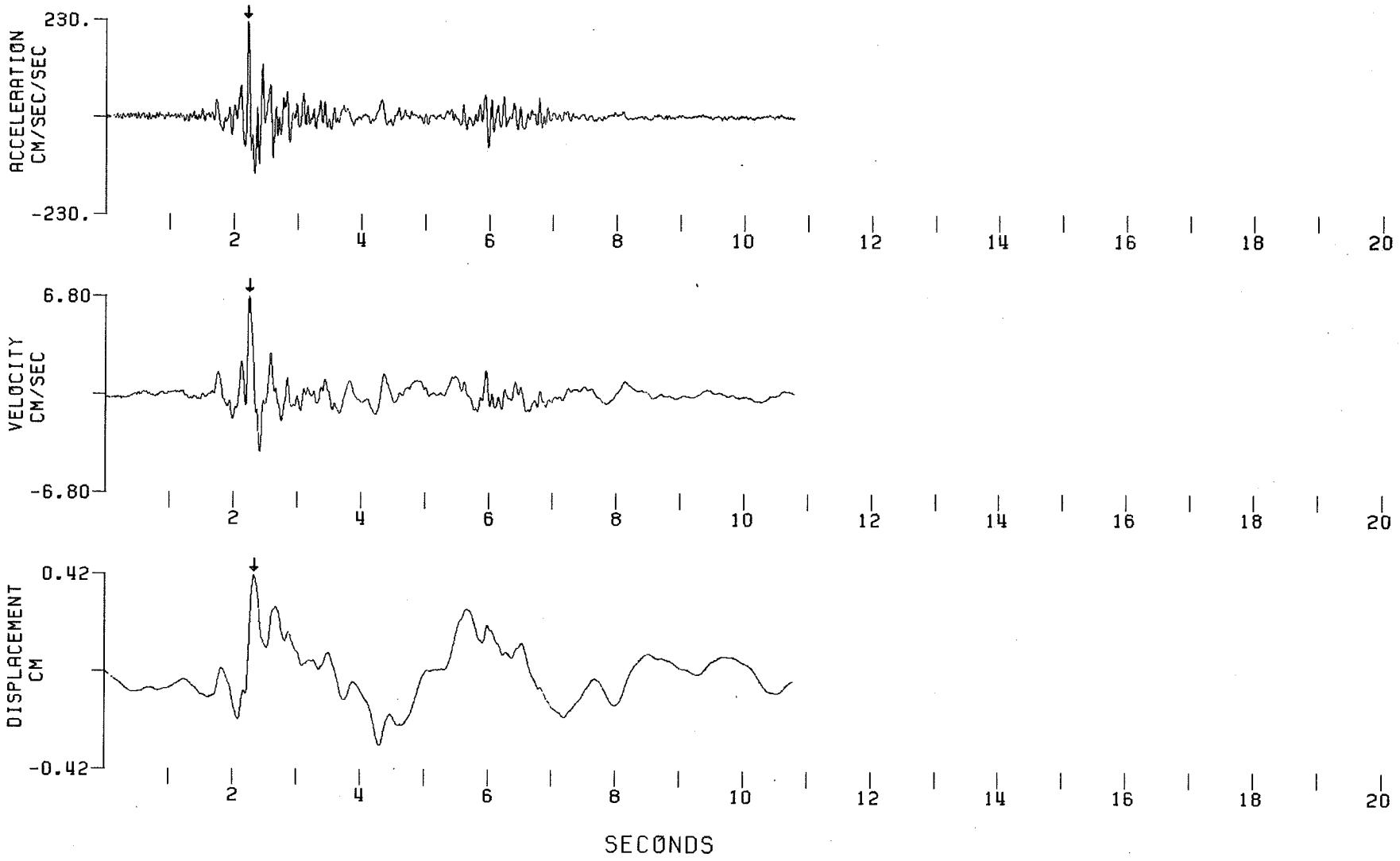
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
10 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0548 GMT
BUTTERWORTH AT .25 HZ, ORDER 4
PEAK VALUES: ACCEL=224.13 CM/SEC/SEC, VELOCITY=6.78 CM/SEC, DISPL=0.41 CM
ACCELERATION CM/SEC/SEC
230.
-230.
VELOCITY CM/SEC
6.80
-6.80
DISPLACEMENT CM
0.42
-0.42
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.3.C.L

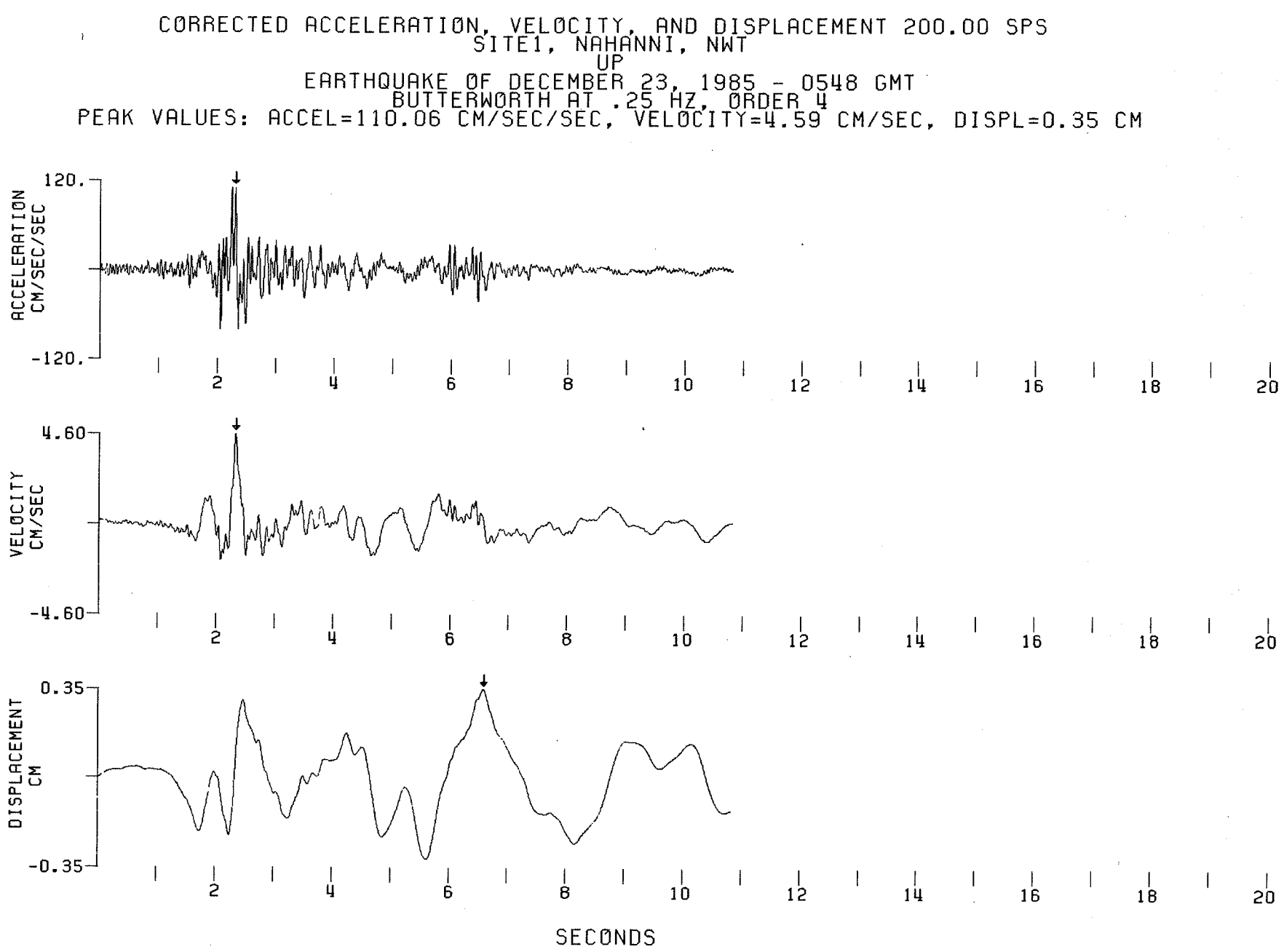
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 23, 1985 - 0548 GMT
BUTTERWORTH AT .25 HZ, ORDER 4
PEAK VALUES: ACCEL=110.06 CM/SEC/SEC, VELOCITY=4.59 CM/SEC, DISPL=0.35 CM
ACCELERATION CM/SEC/SEC
120.
-120.
VELOCITY CM/SEC
4.60
-4.60
DISPLACEMENT CM
0.35
-0.35
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.3.C.V

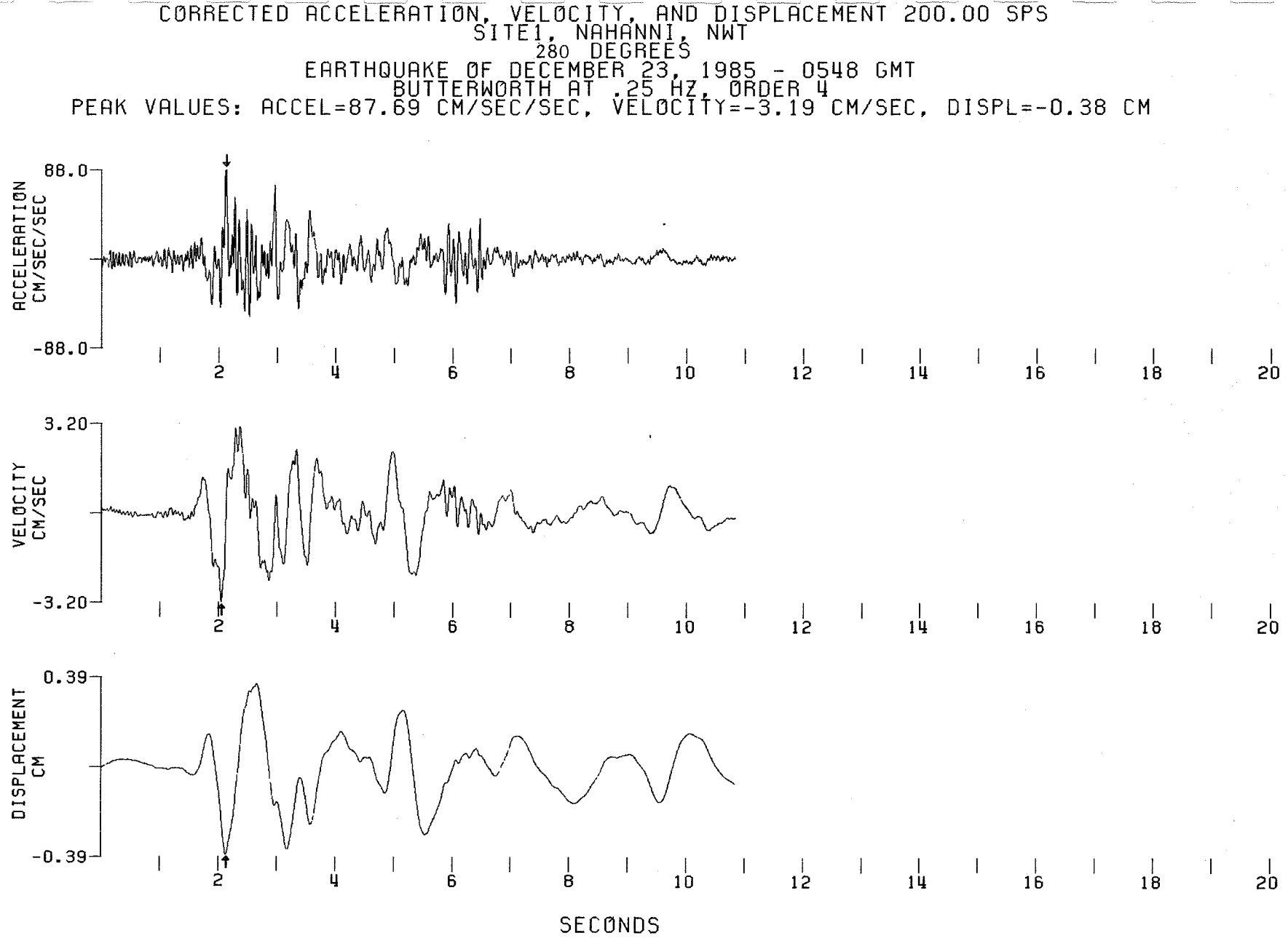
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE1, NAHANNI, NWT
280 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0548 GMT
BUTTERWORTH AT .25 HZ, ORDER 4
PEAK VALUES: ACCEL=87.69 CM/SEC/SEC, VELOCITY=-3.19 CM/SEC, DISPL=-0.38 CM
ACCELERATION CM/SEC/SEC
88.0
-88.0
VELOCITY CM/SEC
3.20
-3.20
DISPLACEMENT CM
0.39
-0.39
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 1.3.C.T

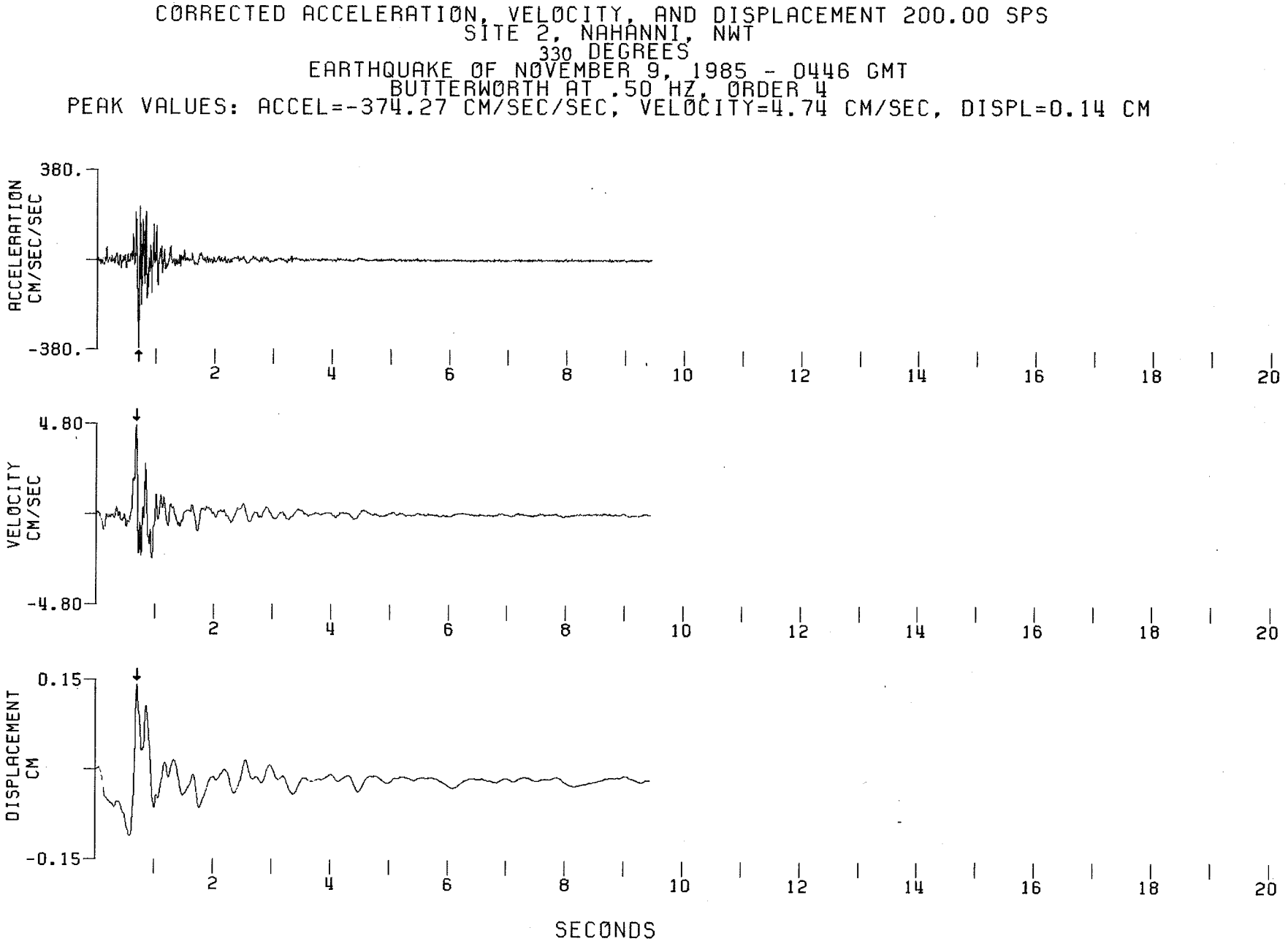
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 2, NAHANNI, NWT
330 DEGREES
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
PEAK VALUES: ACCEL=-374.27 CM/SEC/SEC, VELOCITY=4.74 CM/SEC, DISPL=0.14 CM
ACCELERATION CM/SEC/SEC
380.
-380.
VELOCITY CM/SEC
4.80
-4.80
DISPLACEMENT CM
0.15
-0.15
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 2.1.C.L

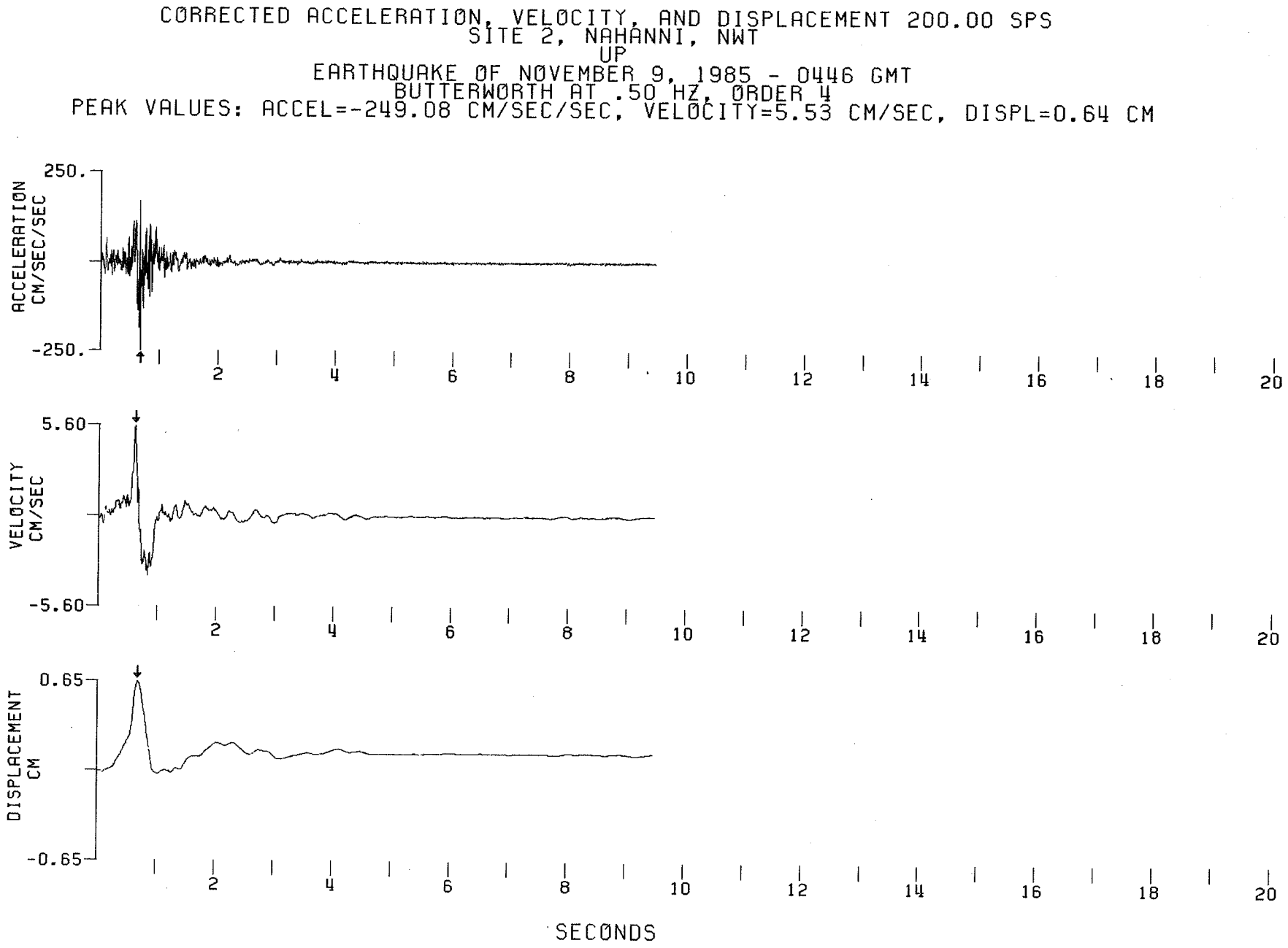
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 2, NAHANNI, NWT
UP
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
PEAK VALUES: ACCEL=-249.08 CM/SEC/SEC, VELOCITY=5.53 CM/SEC, DISPL=0.64 CM
ACCELERATION CM/SEC/SEC
250.
-250.
VELOCITY CM/SEC
5.60
-5.60
DISPLACEMENT CM
0.65
-0.65
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 2.1.C.V

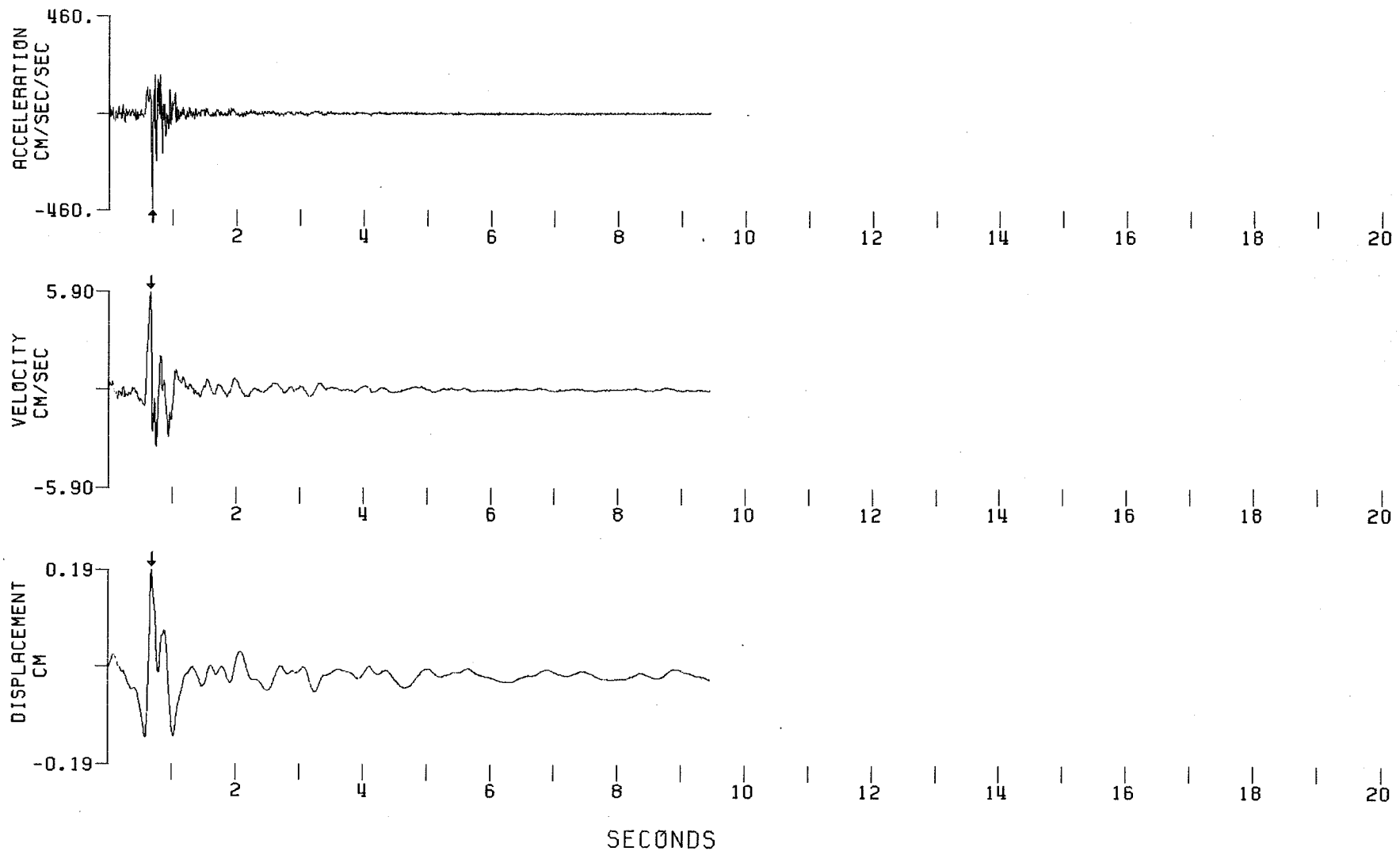
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 2, NAHANNI, NWT
240 DEGREES
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
PEAK VALUES: ACCEL=-450.96 CM/SEC/SEC, VELOCITY=5.86 CM/SEC, DISPL=0.19 CM
460.
ACCELERATION CM/SEC/SEC
-460.
5.90
VELOCITY CM/SEC
-5.90
0.19
DISPLACEMENT CM
-0.19
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 2.1.C.T

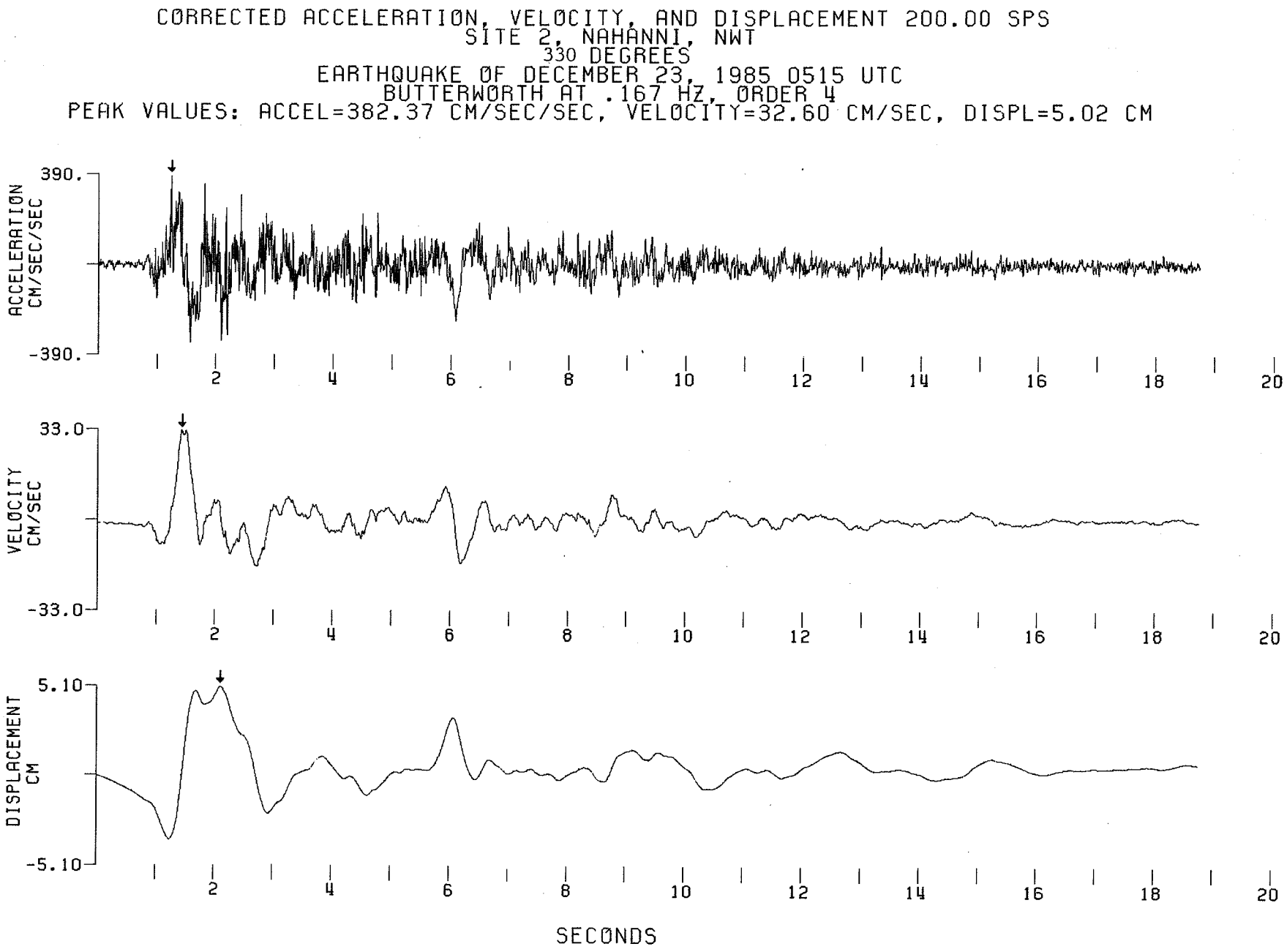
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 2, NAHANNI, NWT
330 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
PEAK VALUES: ACCEL=382.37 CM/SEC/SEC, VELOCITY=32.60 CM/SEC, DISPL=5.02 CM
ACCELERATION CM/SEC/SEC
390.
-390.
VELOCITY CM/SEC
33.0
-33.0
DISPLACEMENT CM
5.10
-5.10
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 2.2.C.L

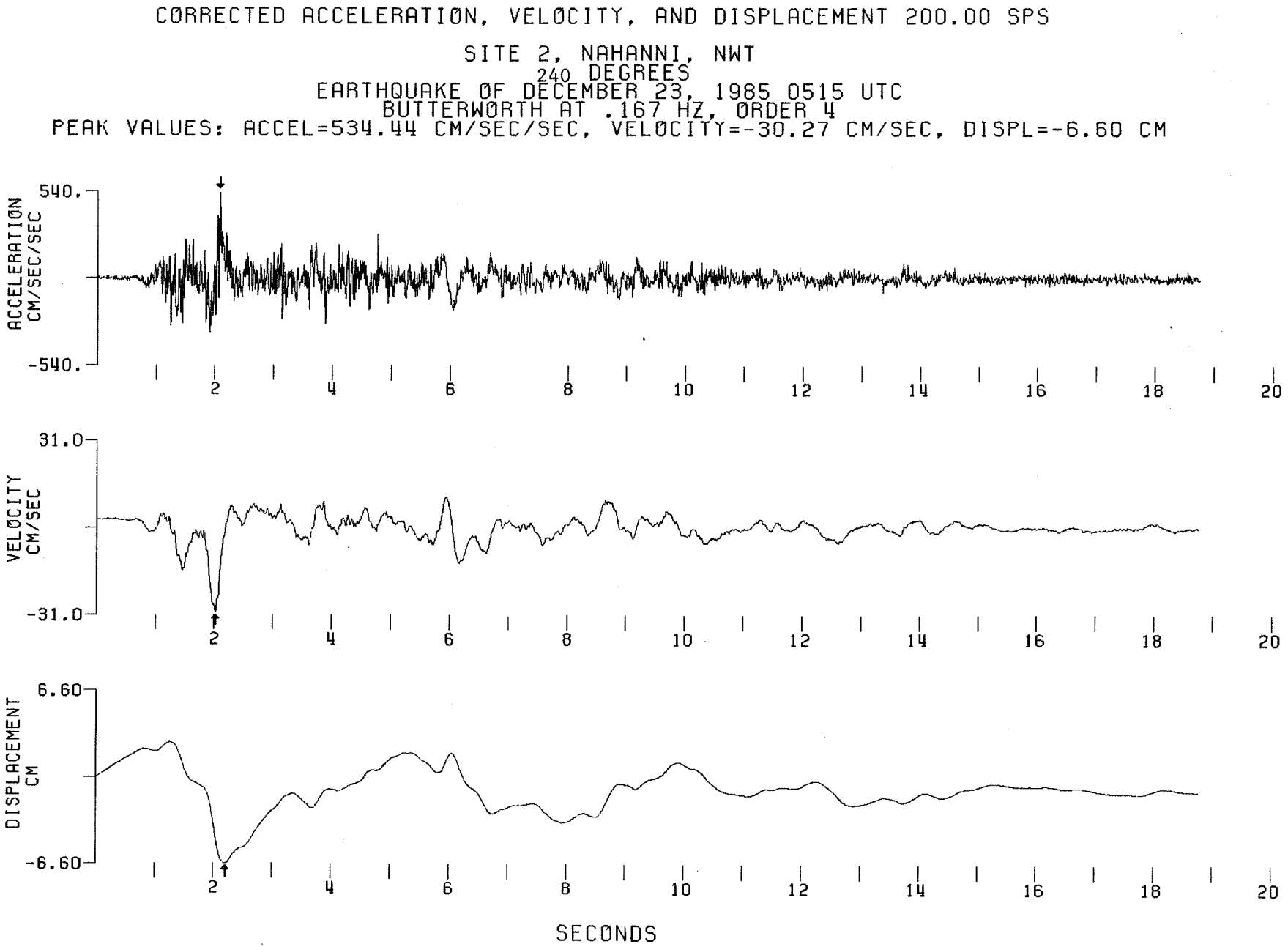
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 2, NAHANNI, NWT
240 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
PEAK VALUES: ACCEL=534.44 CM/SEC/SEC, VELOCITY=-30.27 CM/SEC, DISPL=-6.60 CM
ACCELERATION CM/SEC/SEC
540.
-540.
VELOCITY CM/SEC
31.0
-31.0
DISPLACEMENT CM
6.60
-6.60
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 2.2.C.T

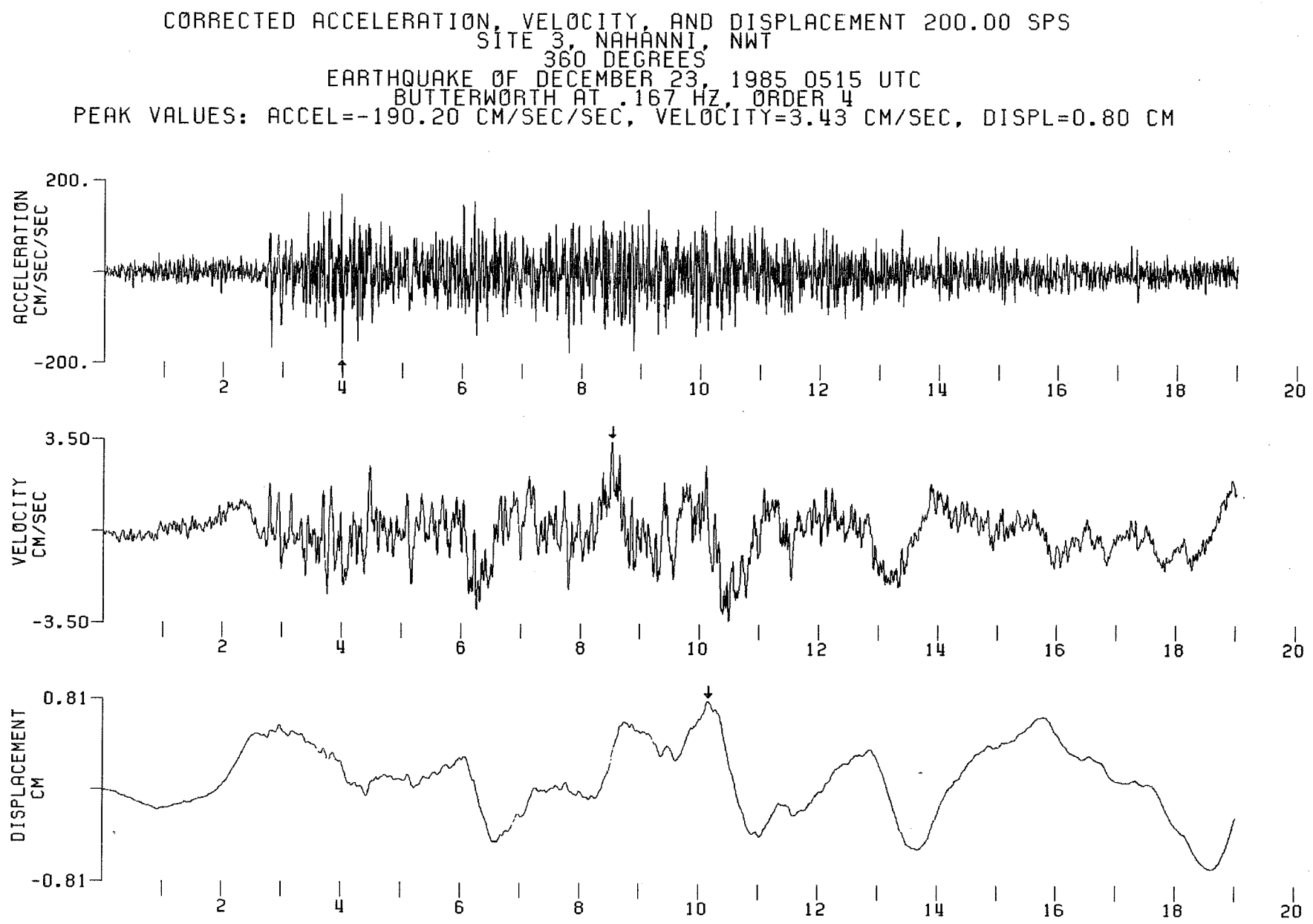
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
360 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
PEAK VALUES: ACCEL=-190.20 CM/SEC/SEC, VELOCITY=3.43 CM/SEC, DISPL=0.80 CM
ACCELERATION CM/SEC/SEC
200.
-200.
VELOCITY CM/SEC
3.50
-3.50
DISPLACEMENT CM
0.81
-0.81
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.2.C.L

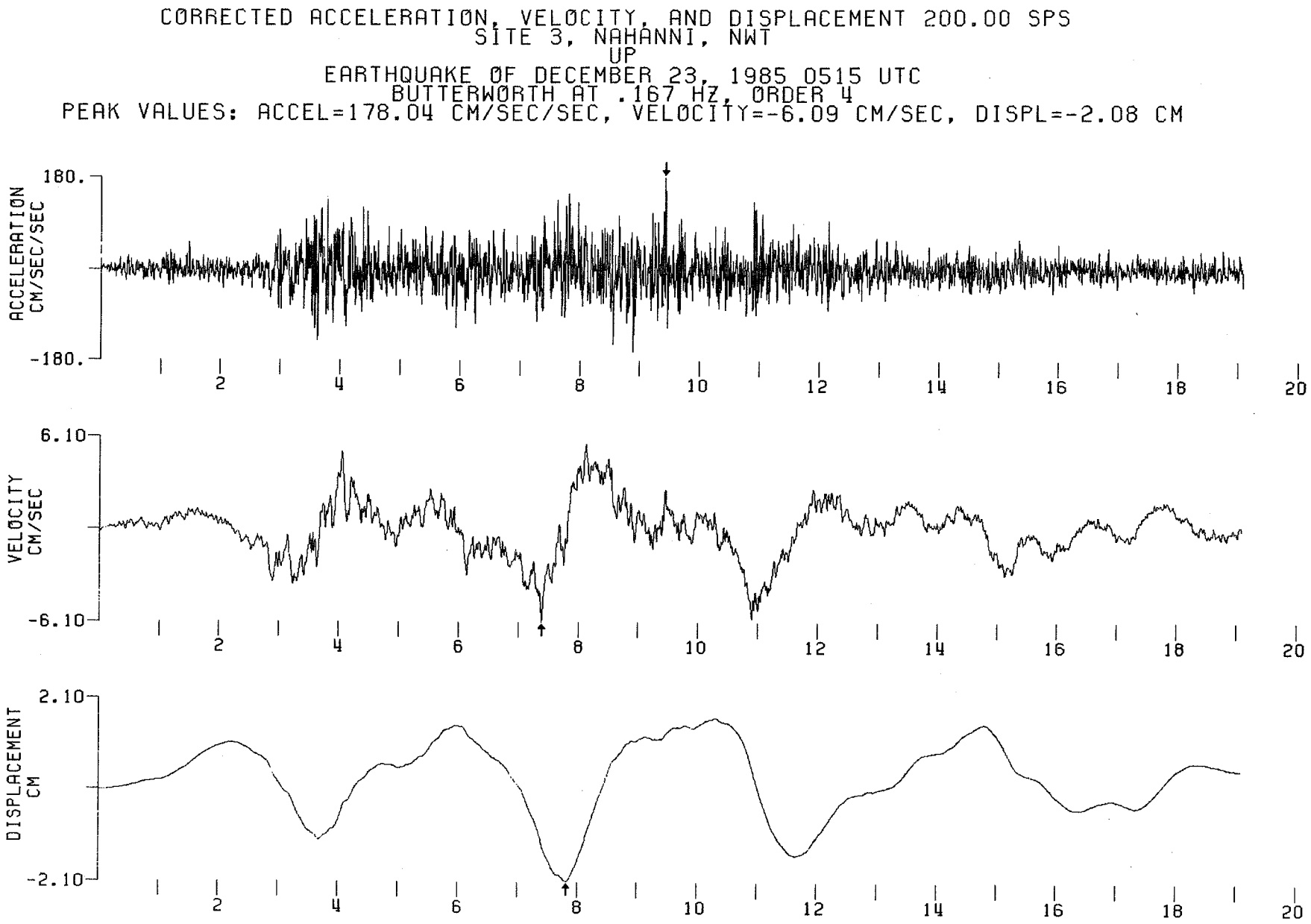
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
PEAK VALUES: ACCEL=178.04 CM/SEC/SEC, VELOCITY=-6.09 CM/SEC, DISPL=-2.08 CM
ACCELERATION CM/SEC/SEC
180.
-180.
VELOCITY CM/SEC
6.10
-6.10
DISPLACEMENT CM
2.10
-2.10
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.2.C.V

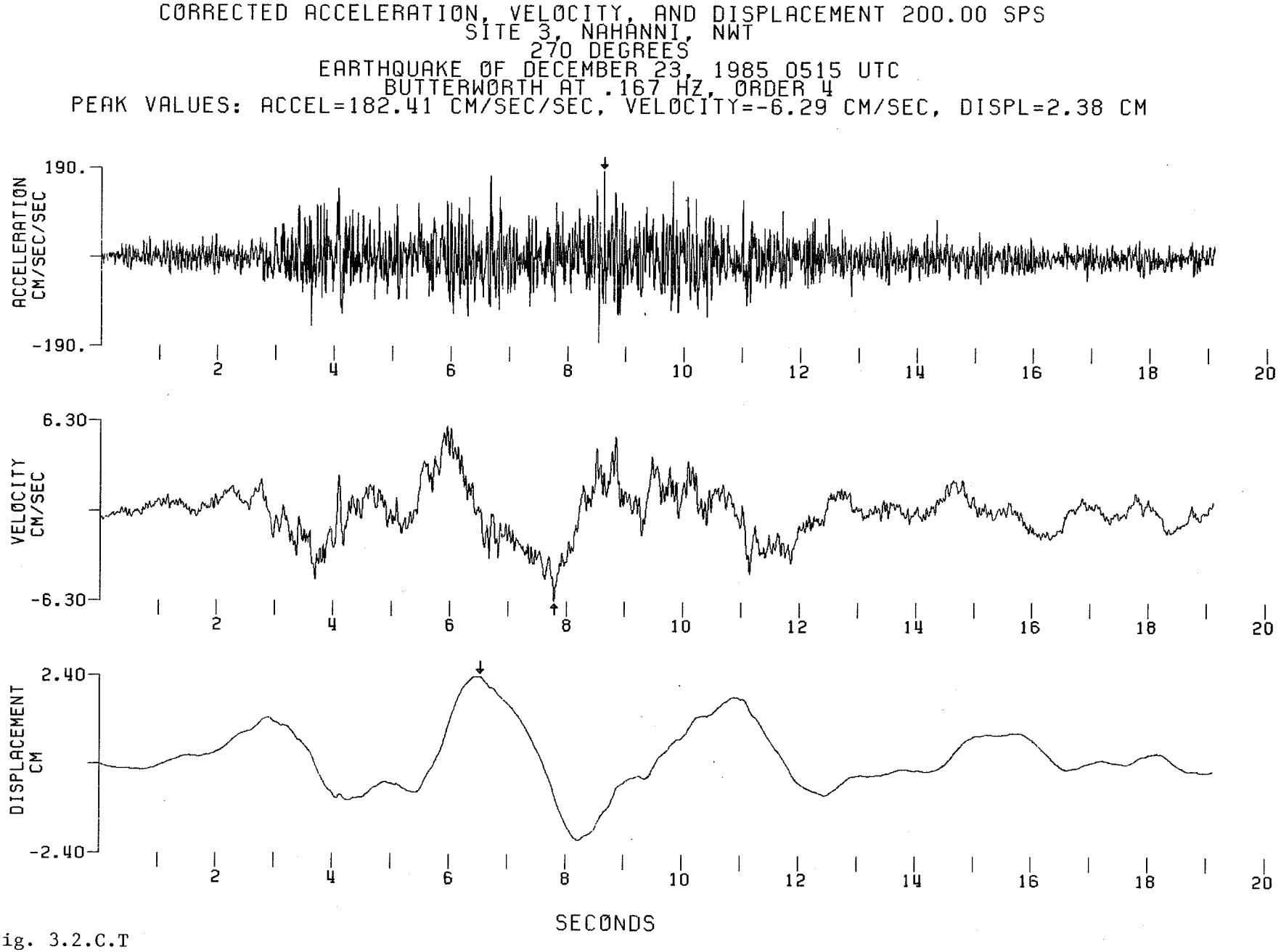
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
270 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
PEAK VALUES: ACCEL=182.41 CM/SEC/SEC, VELOCITY=-6.29 CM/SEC, DISPL=2.38 CM
ACCELERATION CM/SEC/SEC
190.
-190.
VELOCITY CM/SEC
6.30
-6.30
DISPLACEMENT CM
2.40
-2.40
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.2.C.T

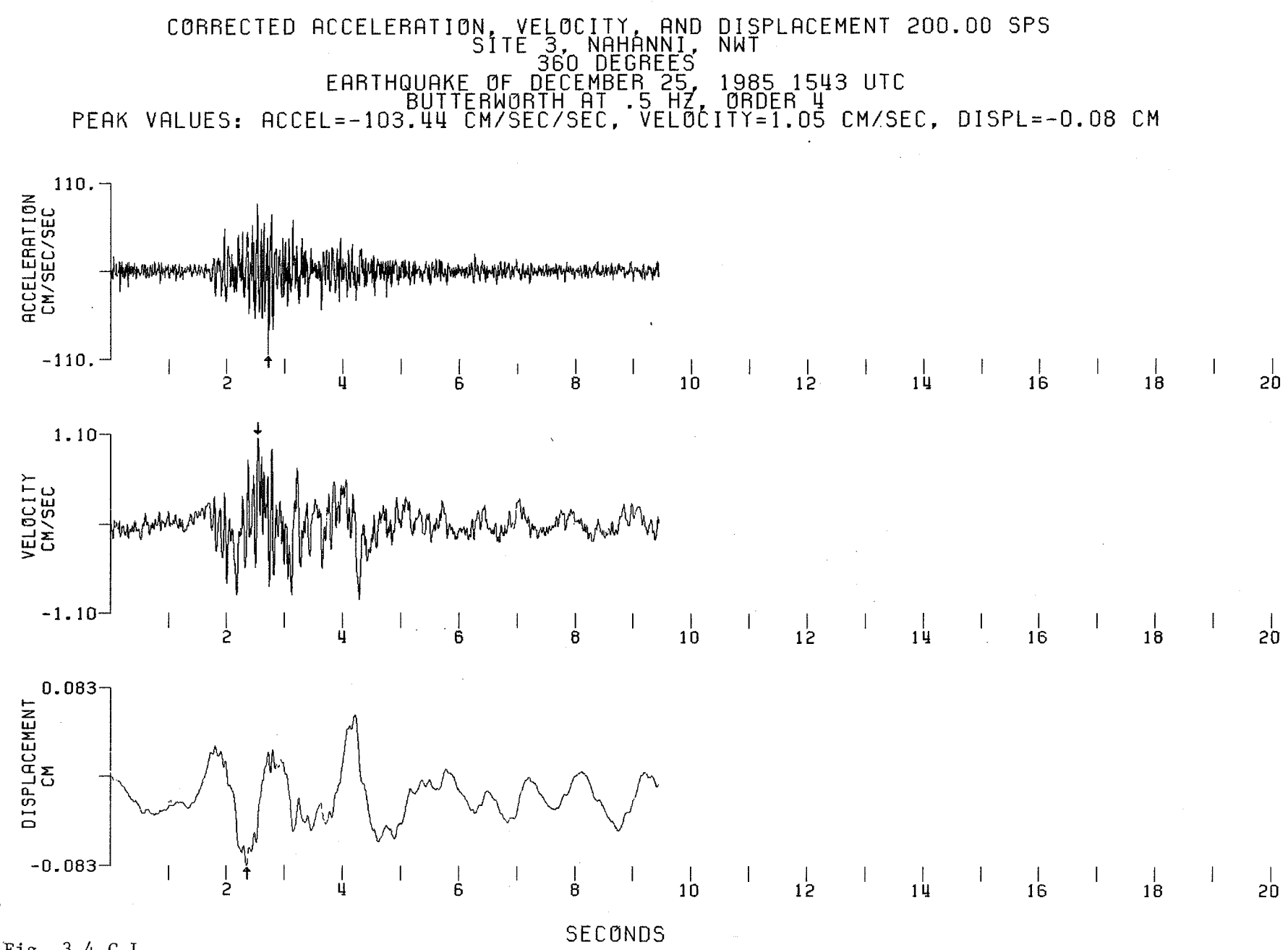
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
360 DEGREES
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
PEAK VALUES: ACCEL=-103.44 CM/SEC/SEC, VELOCITY=1.05 CM/SEC, DISPL=-0.08 CM
ACCELERATION CM/SEC/SEC
110.
-110.
VELOCITY CM/SEC
1.10
-1.10
DISPLACEMENT CM
0.083
-0.083
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.4.C.L

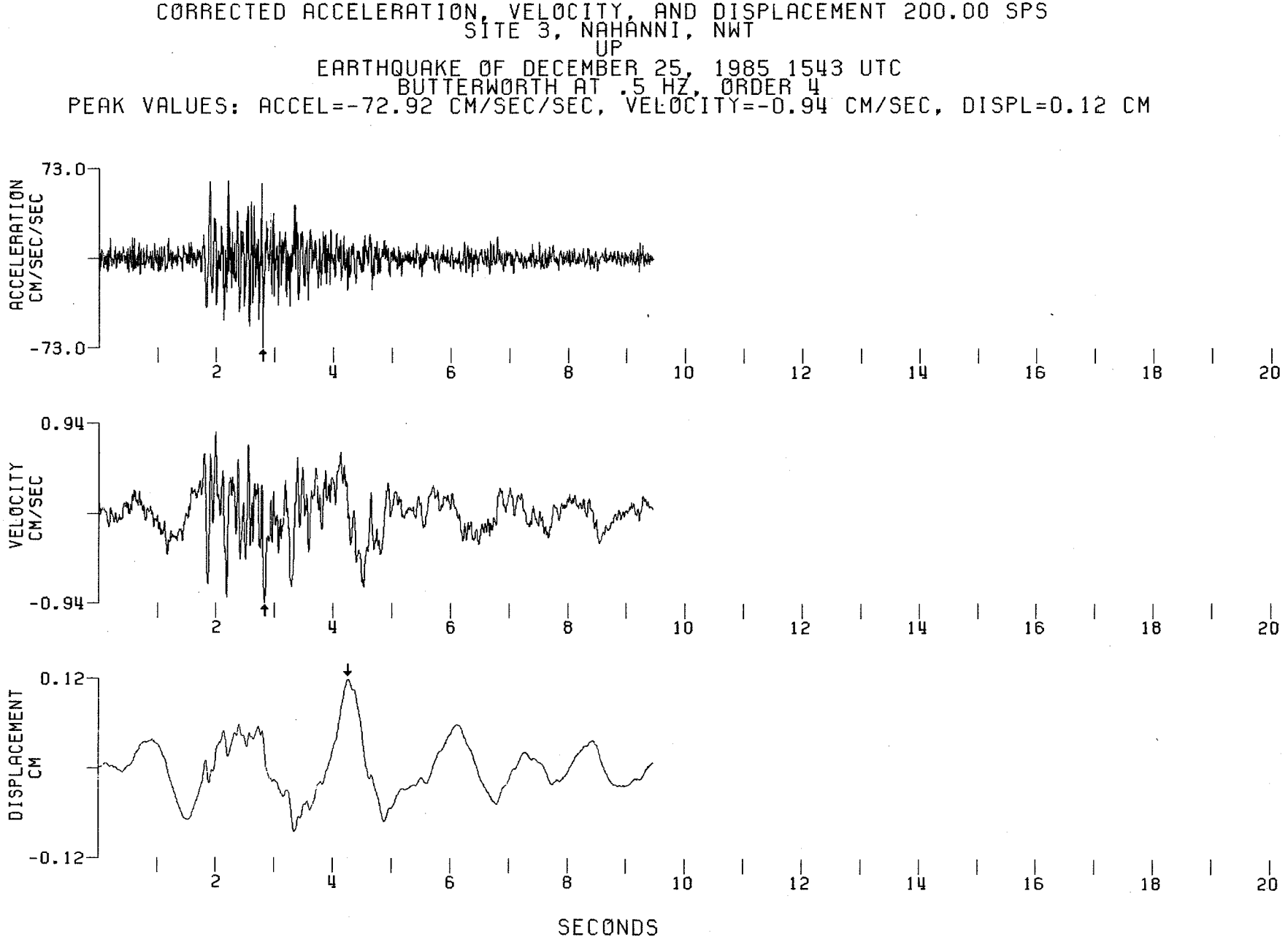
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
PEAK VALUES: ACCEL=-72.92 CM/SEC/SEC, VELOCITY=-0.94 CM/SEC, DISPL=0.12 CM
ACCELERATION CM/SEC/SEC
73.0
-73.0
VELOCITY CM/SEC
0.94
-0.94
DISPLACEMENT CM
0.12
-0.12
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.4.C.V

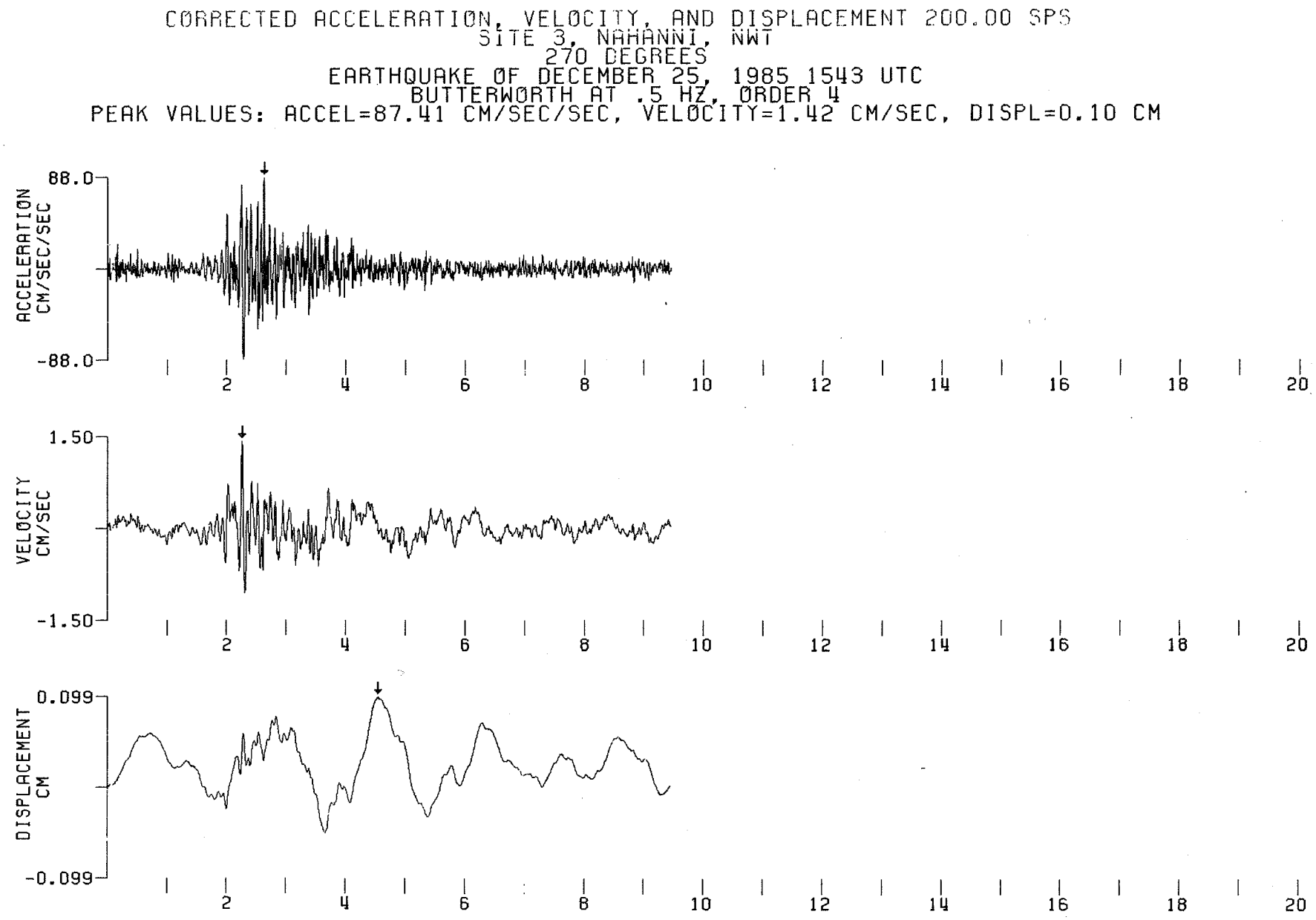
CORRECTED ACCELERATION, VELOCITY, AND DISPLACEMENT 200.00 SPS
SITE 3, NAHANNI, NWT
270 DEGREES
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
PEAK VALUES: ACCEL=87.41 CM/SEC/SEC, VELOCITY=1.42 CM/SEC, DISPL=0.10 CM
ACCELERATION CM/SEC/SEC
88.0
-88.0
VELOCITY CM/SEC
1.50
-1.50
DISPLACEMENT CM
0.099
-0.099
2
4
6
8
10
12
14
16
18
20
SECONDS

Fig. 3.4.C.T

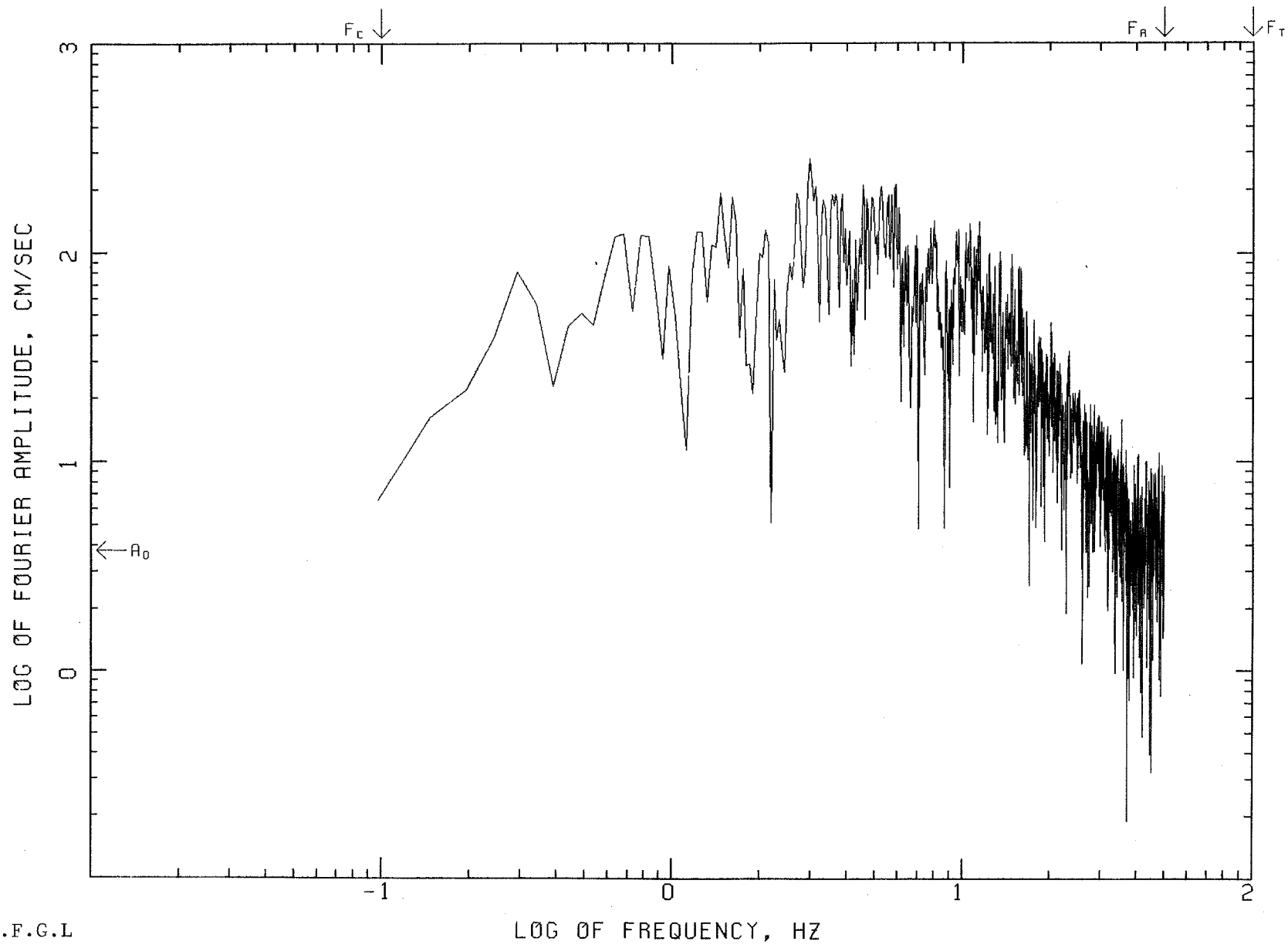
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE1, NAHANNI, NWT
10 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0516 GMT
BUTTERWORTH AT .10 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FA
FT
AO
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
3
2
1
0
-1
0
1
2

Fig. 1.2.F.G.L

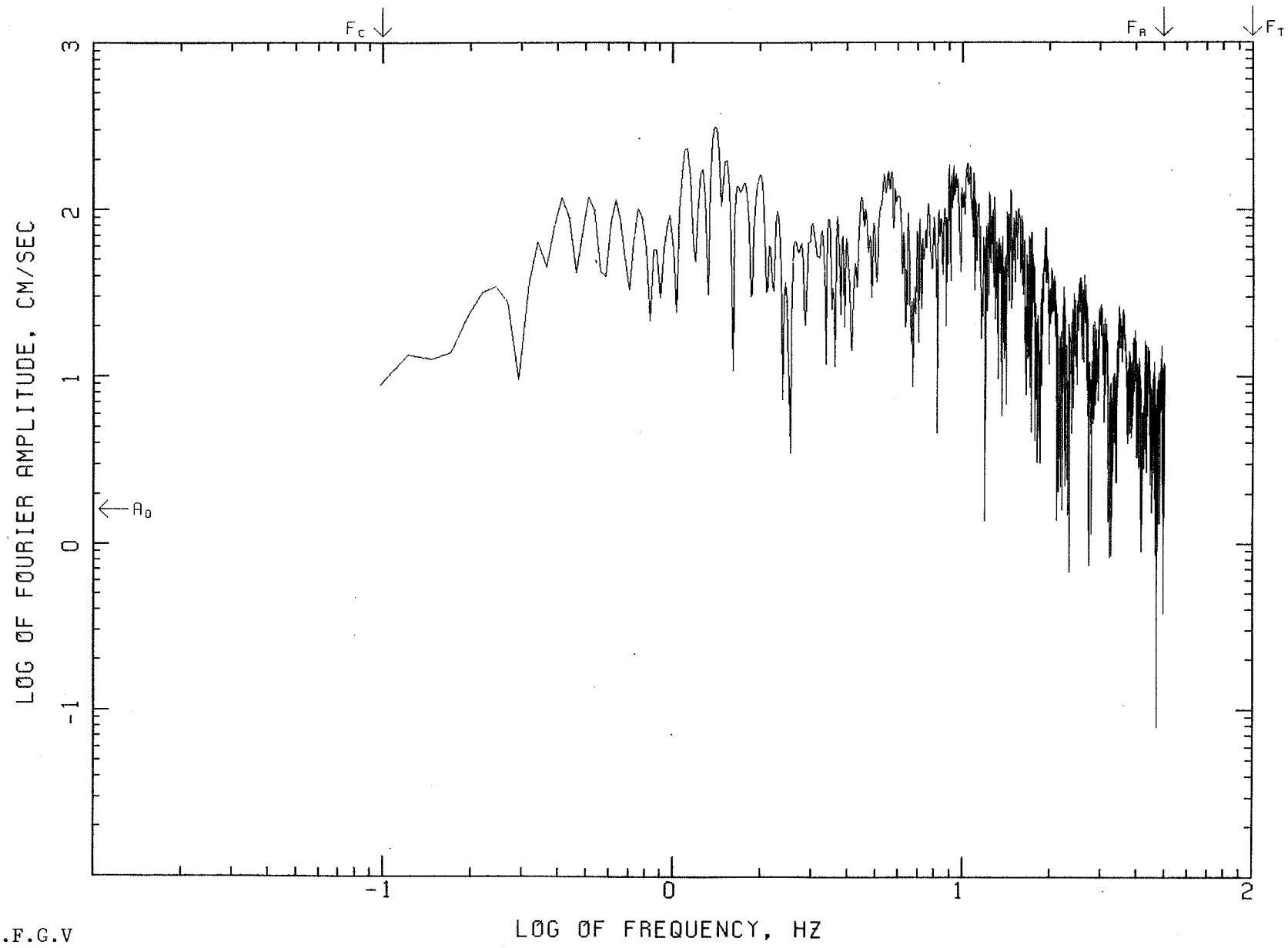
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE1, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 23, 1985 - 0516 GMT
BUTTERWORTH AT .10 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
A_0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
3
2
1
0
-1
-1
0
1
2

Fig. 1.2.F.G.V

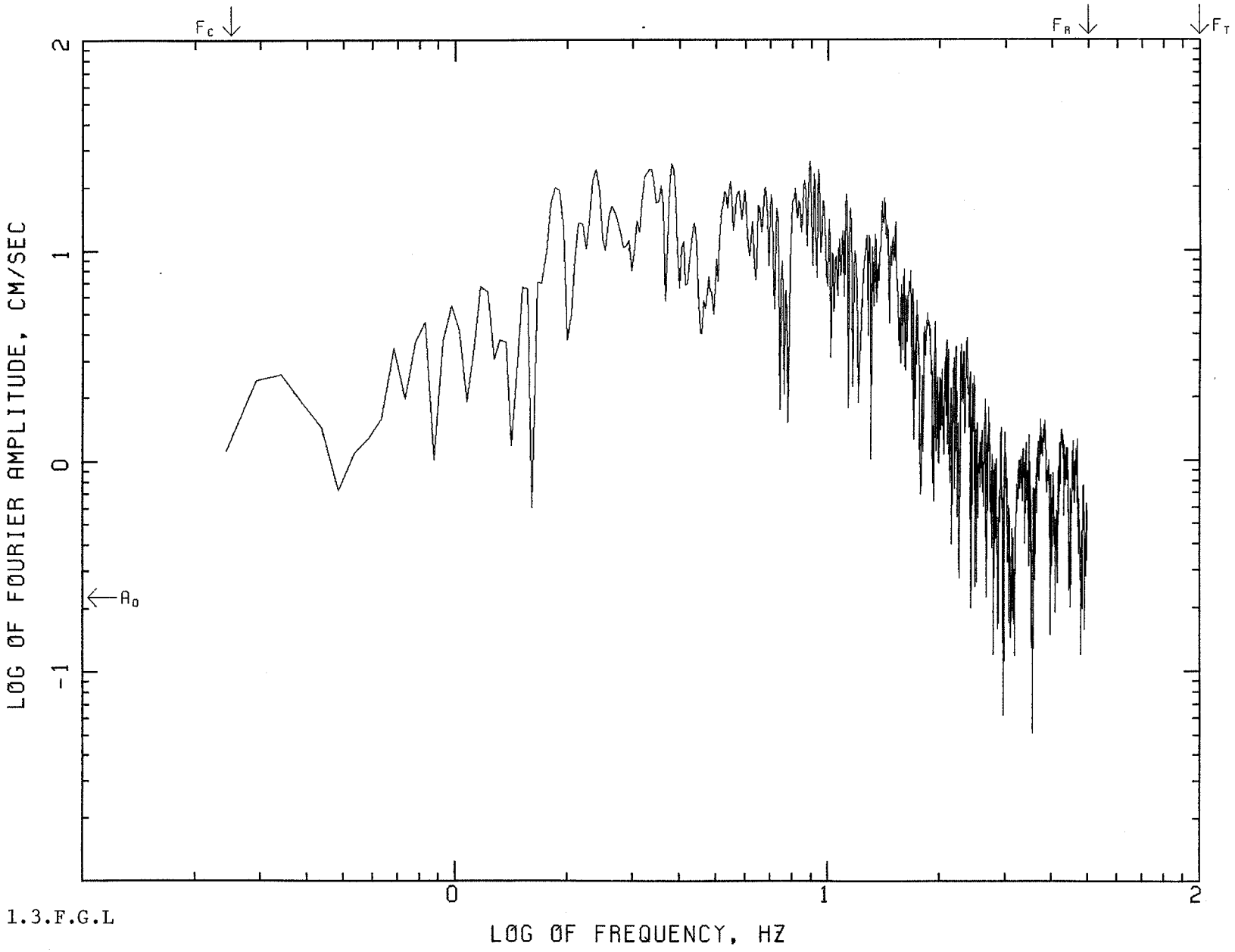
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE1, NAHANNI, NWT
10 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0548 GMT
BUTTERWORTH AT .25 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
A0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
-1
0
1
2

Fig. 1.3.F.G.L

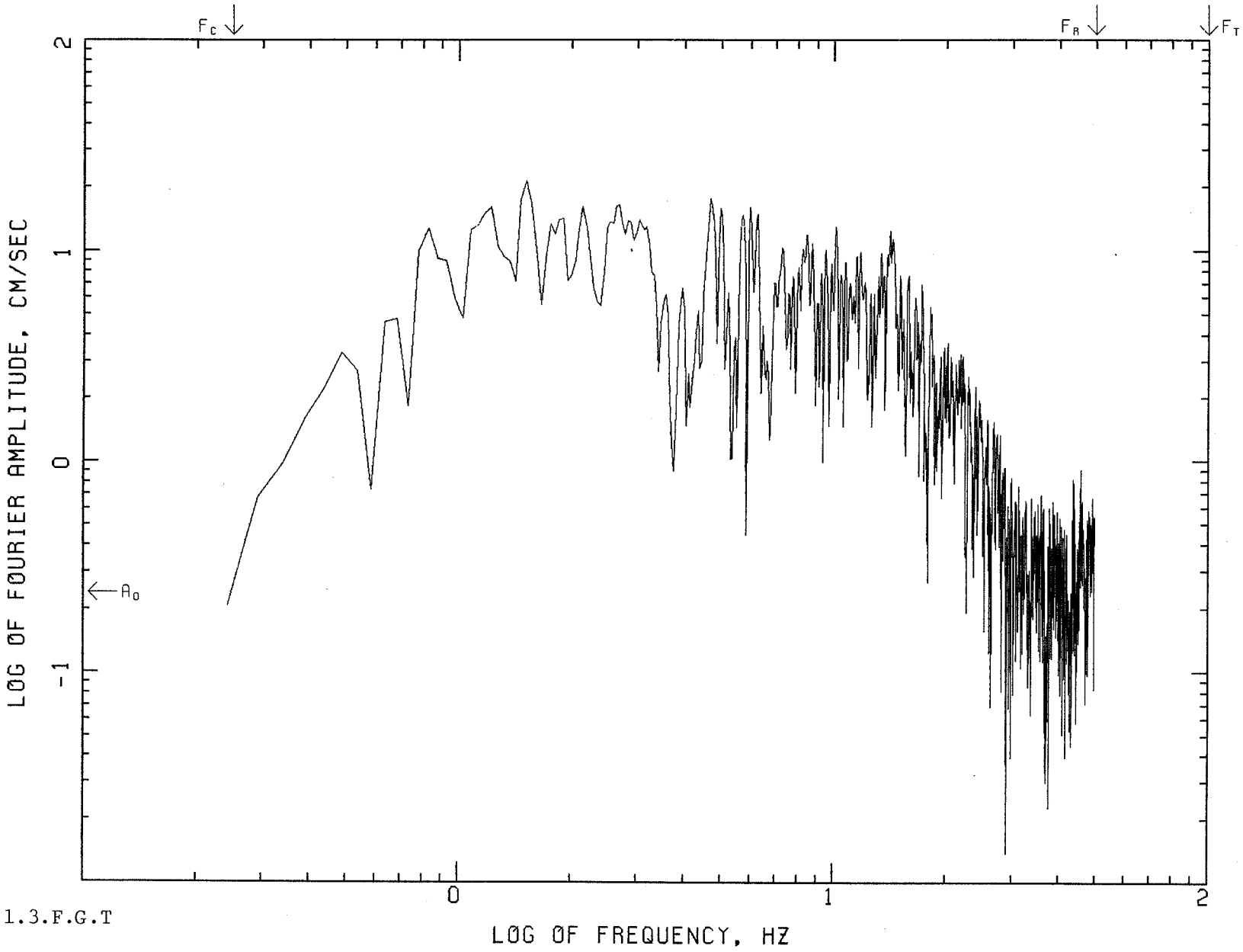
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE1, NAHANNI, NWT
280 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 - 0548 GMT
BUTTERWORTH AT .25 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
A0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
-1
0
1
2

Fig. 1.3.F.G.T

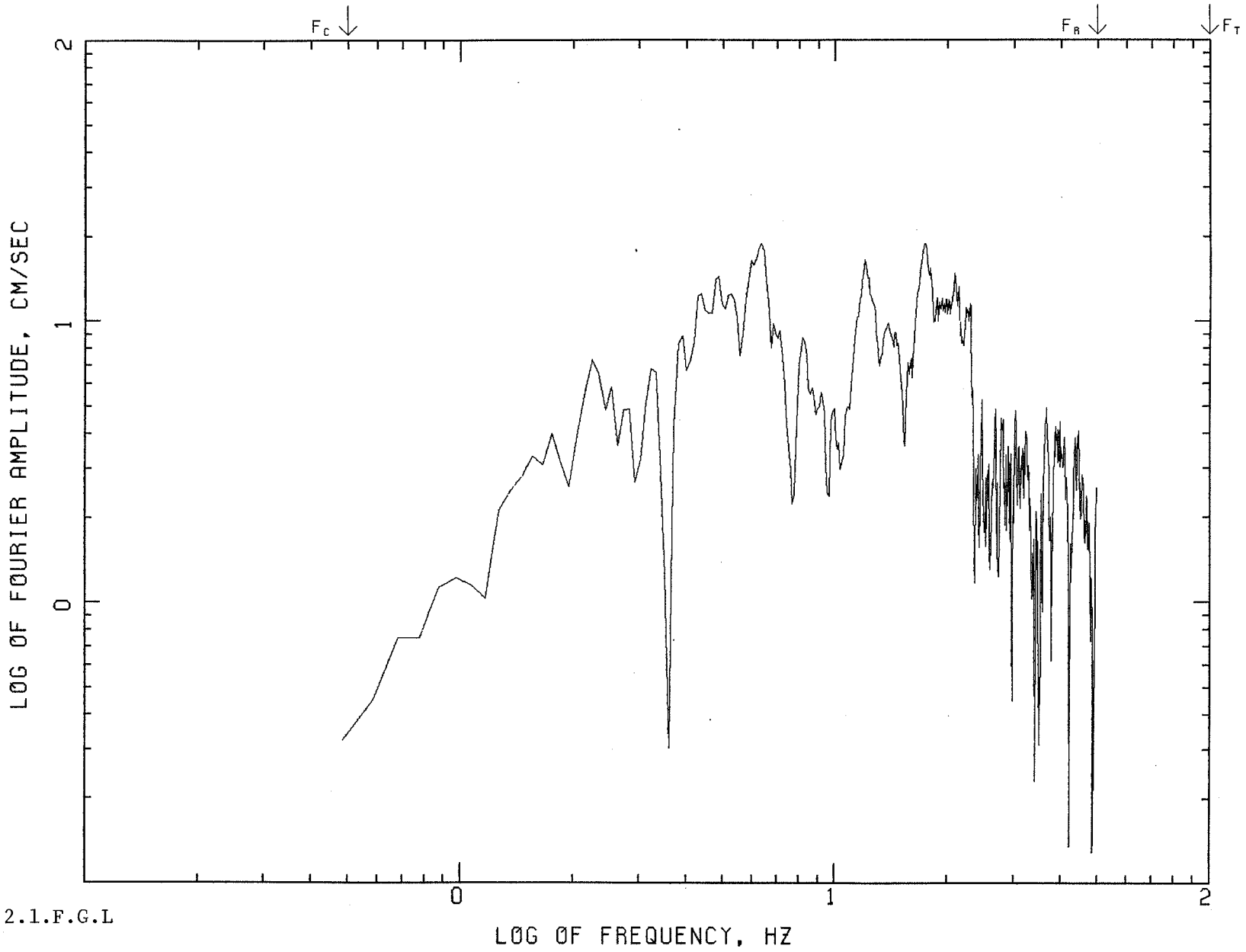
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 2, NAHANNI, NWT
330 DEGREES
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
2
1
0
LOG OF FOURIER AMPLITUDE, CM/SEC
0
1
2
LOG OF FREQUENCY, HZ

Fig. 2.1.F.G.L

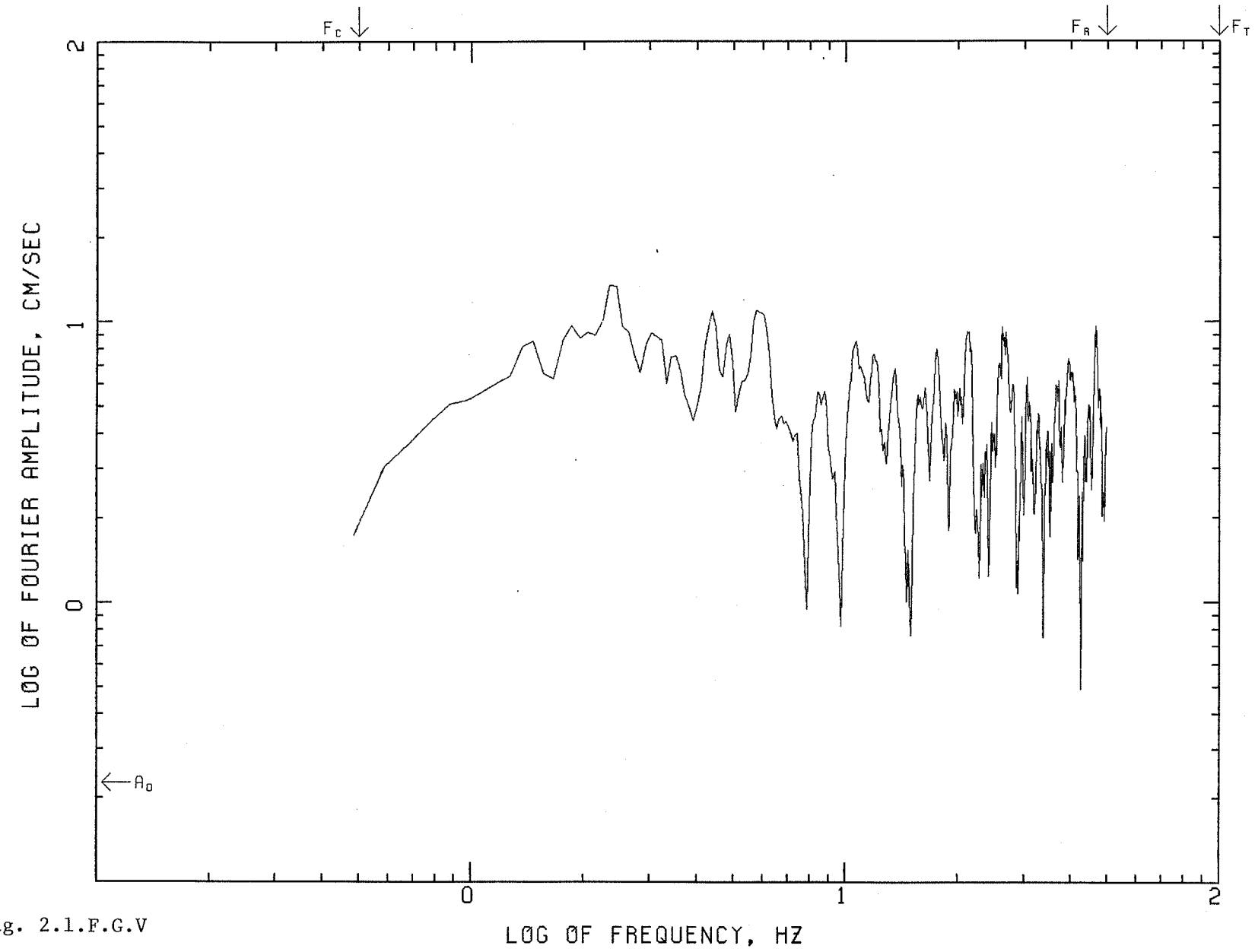
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 2, NAHANNI, NWT
UP
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
A_0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
0
1
2

Fig. 2.1.F.G.V

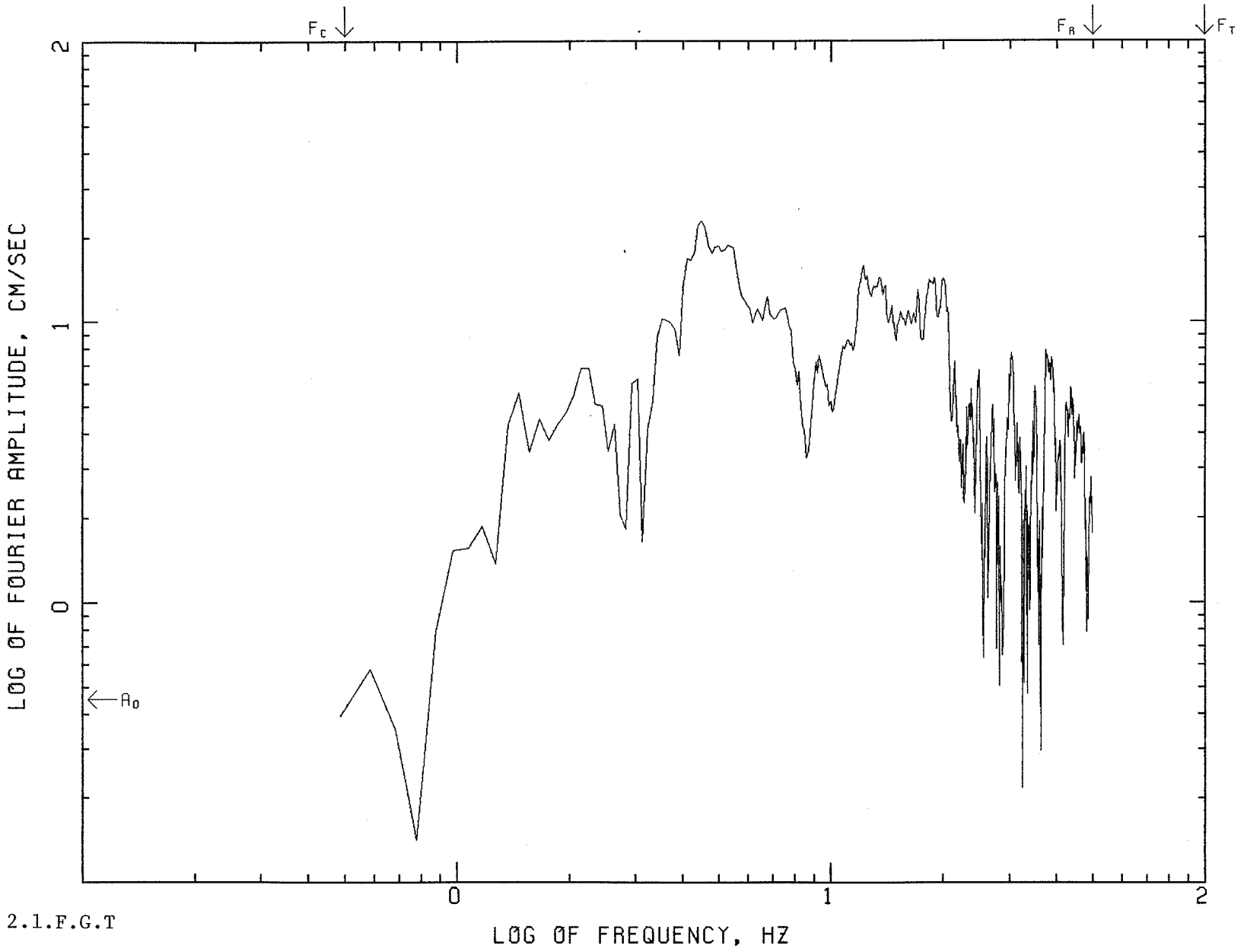
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 2, NAHANNI, NWT
240 DEGREES
EARTHQUAKE OF NOVEMBER 9, 1985 - 0446 GMT
BUTTERWORTH AT .50 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
A0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
0
1
2

Fig. 2.1.F.G.T

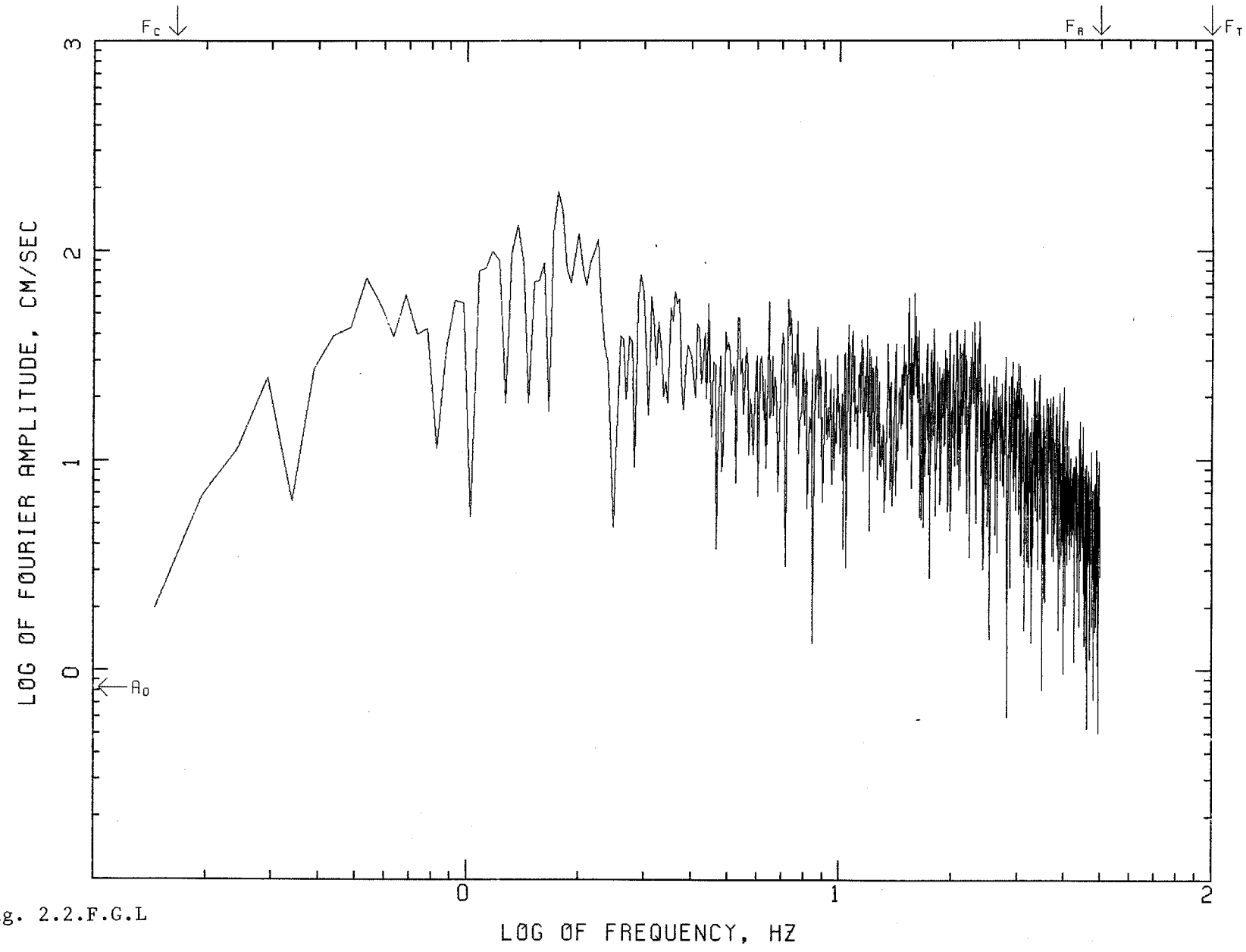
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 2, NAHANNI, NWT
330 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
A_0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
3
2
1
0
0
1
2

Fig. 2.2.F.G.L

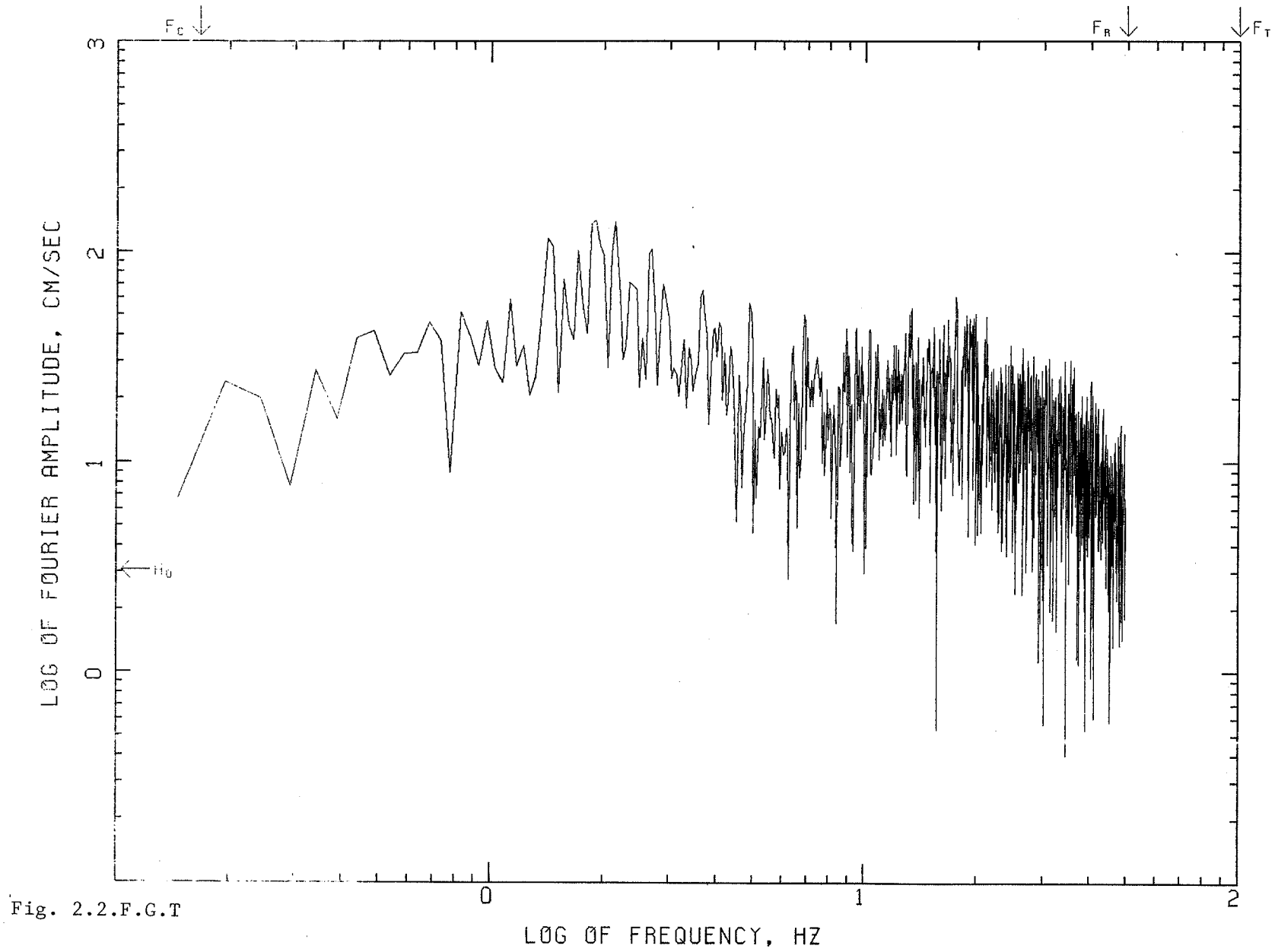
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 2, NAHANNI, NWT
240 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
H_0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
3
2
1
0
0
1
2

Fig. 2.2.F.G.T

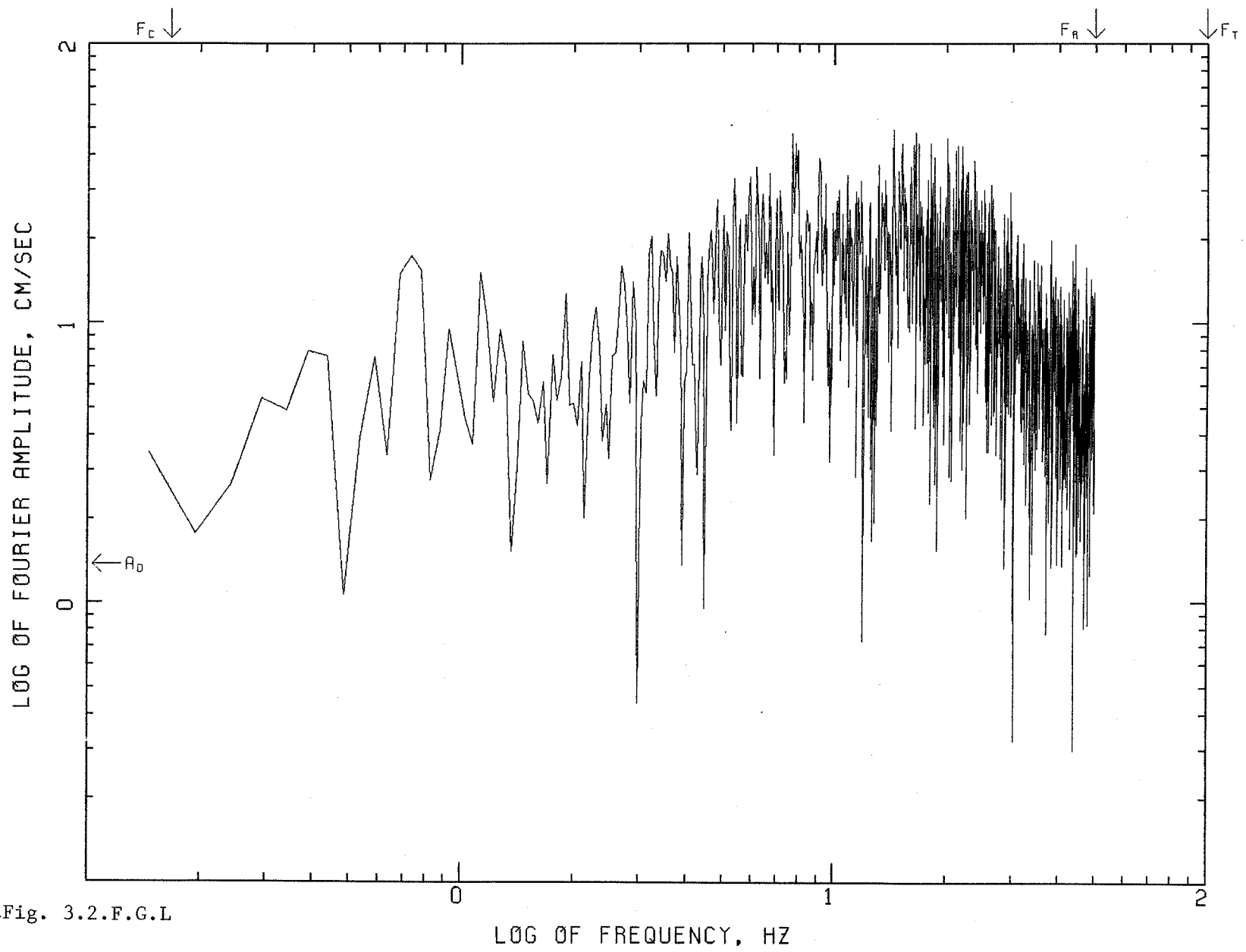
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
360 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
A_D
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
0
1
2

Fig. 3.2.F.G.L

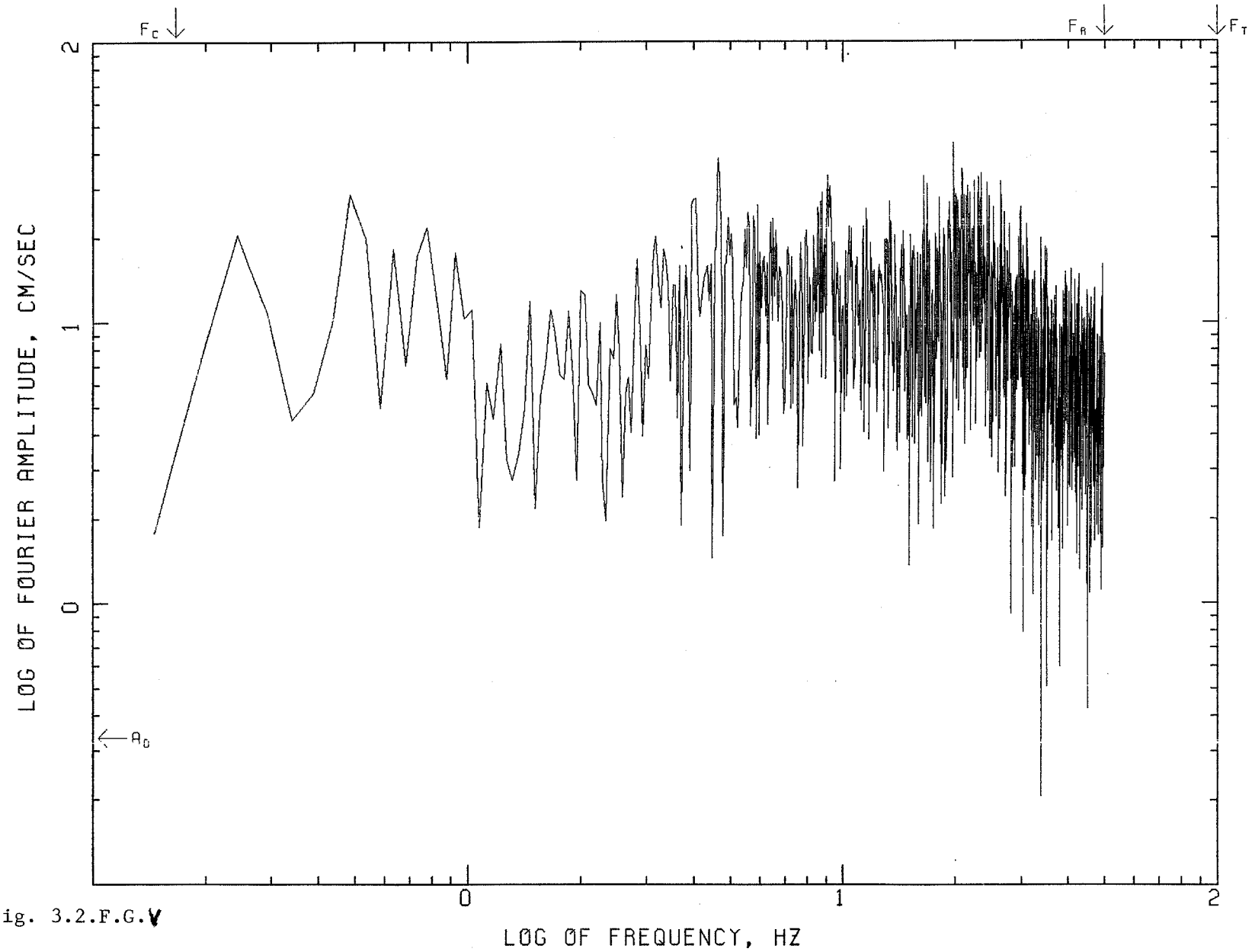
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 Hz, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
F_C
F_R
F_T
A_0
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
0
1
2

Fig. 3.2.F.G.V

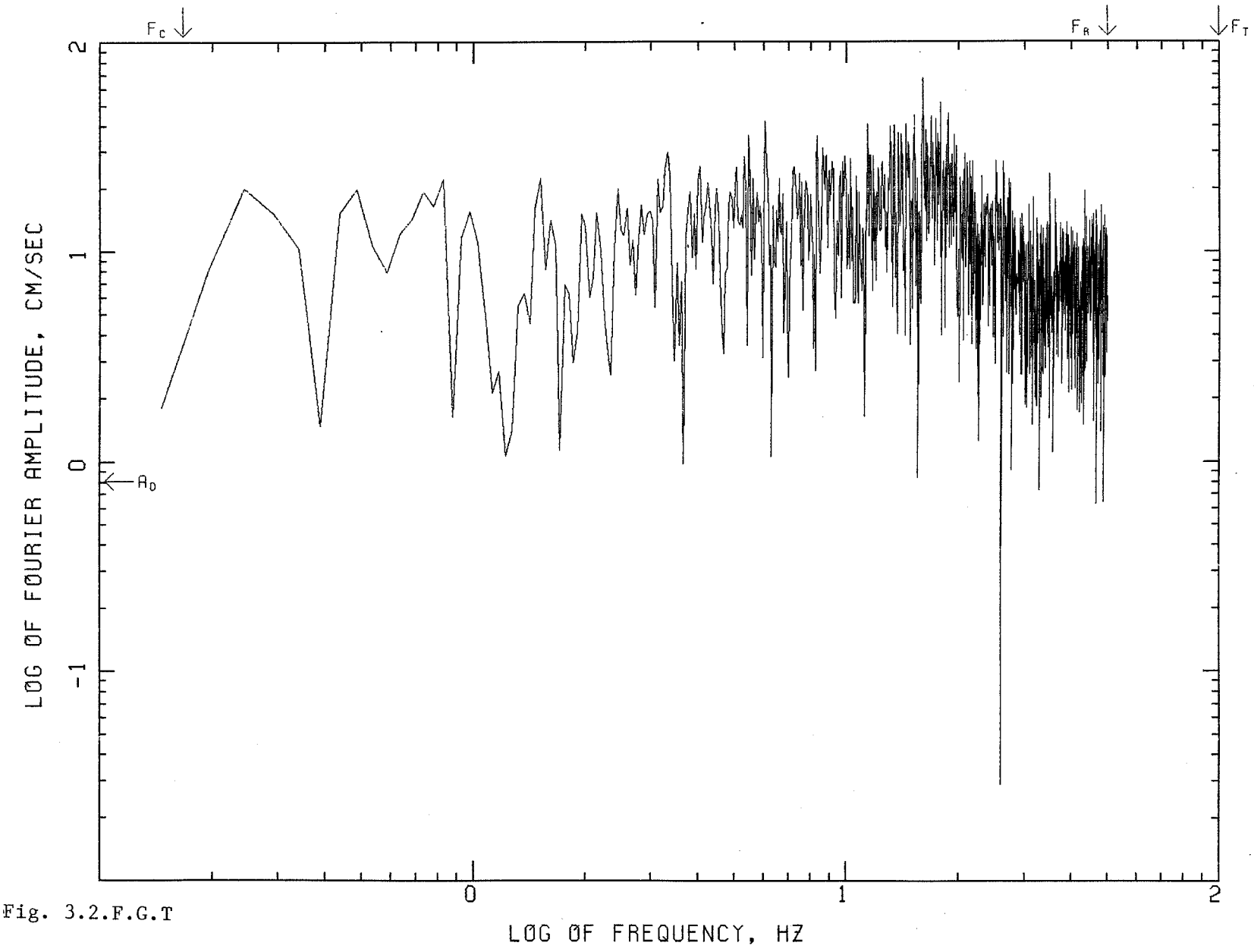
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
270 DEGREES
EARTHQUAKE OF DECEMBER 23, 1985 0515 UTC
BUTTERWORTH AT .167 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
AD
2
1
0
-1
0
1
2
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ

Fig. 3.2.F.G.T

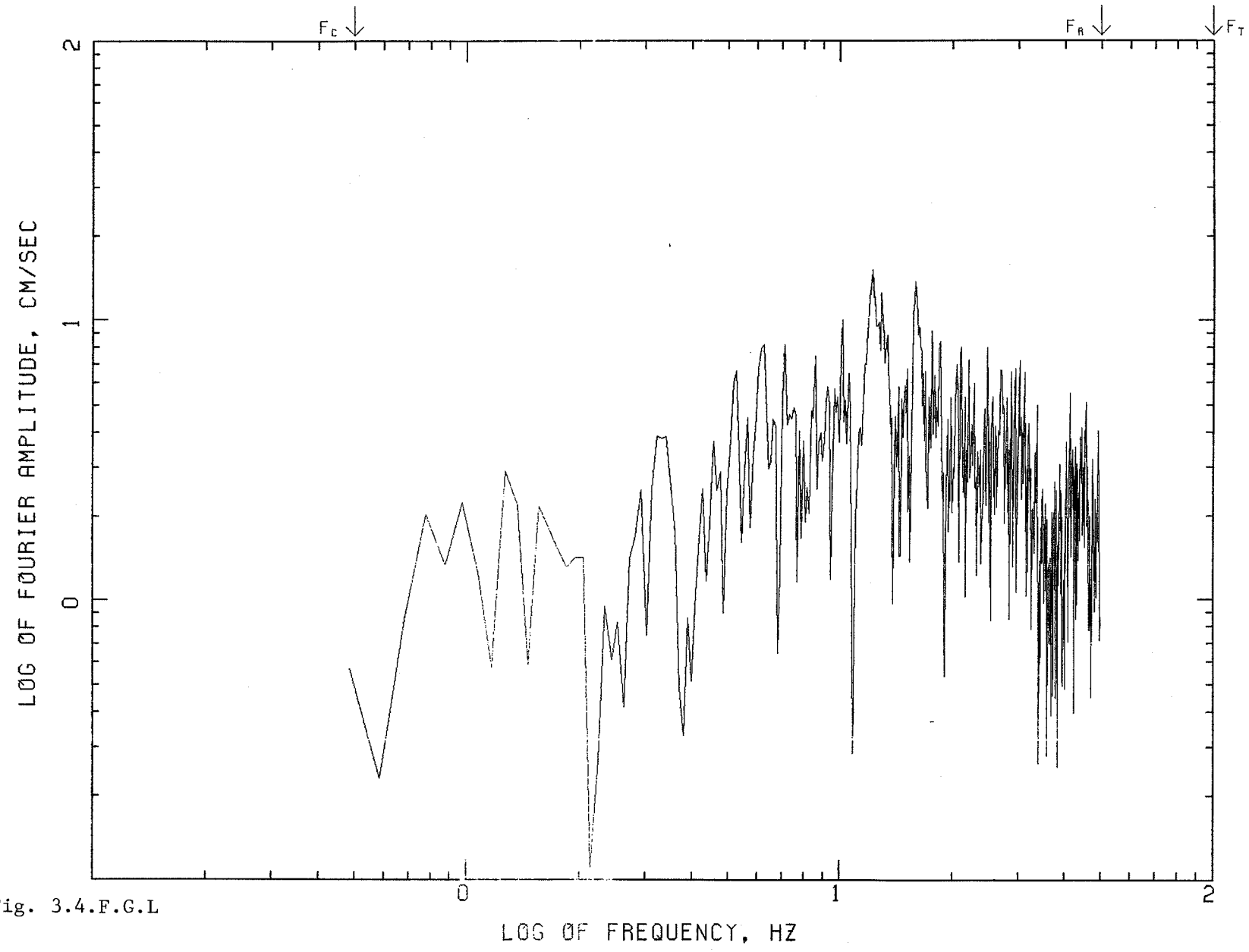
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
360 DEGREES
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
0
1
2

Fig. 3.4.F.G.L

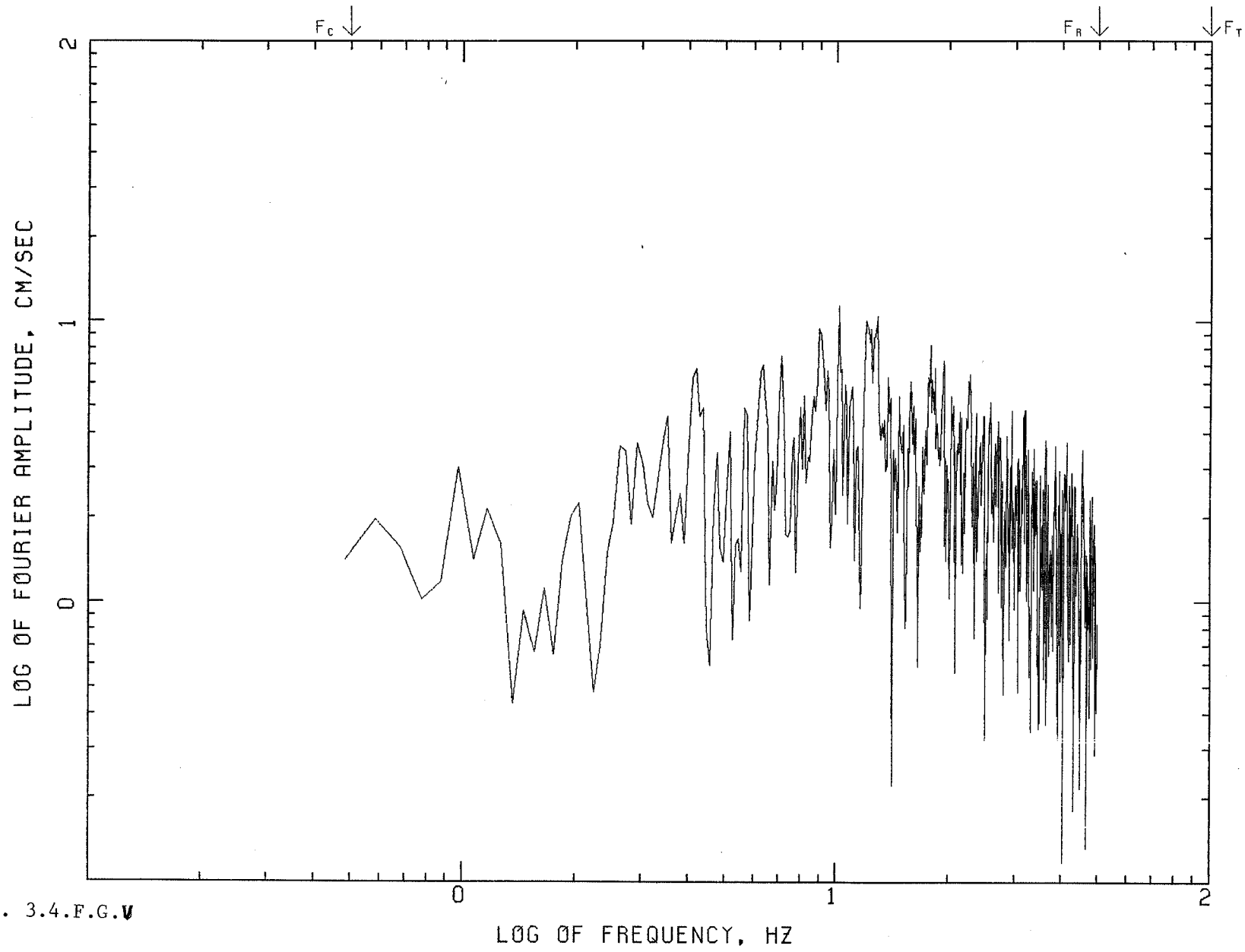
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
UP
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
2
1
0
LOG OF FOURIER AMPLITUDE, CM/SEC
0
1
2
LOG OF FREQUENCY, HZ

Fig. 3.4.F.G.V

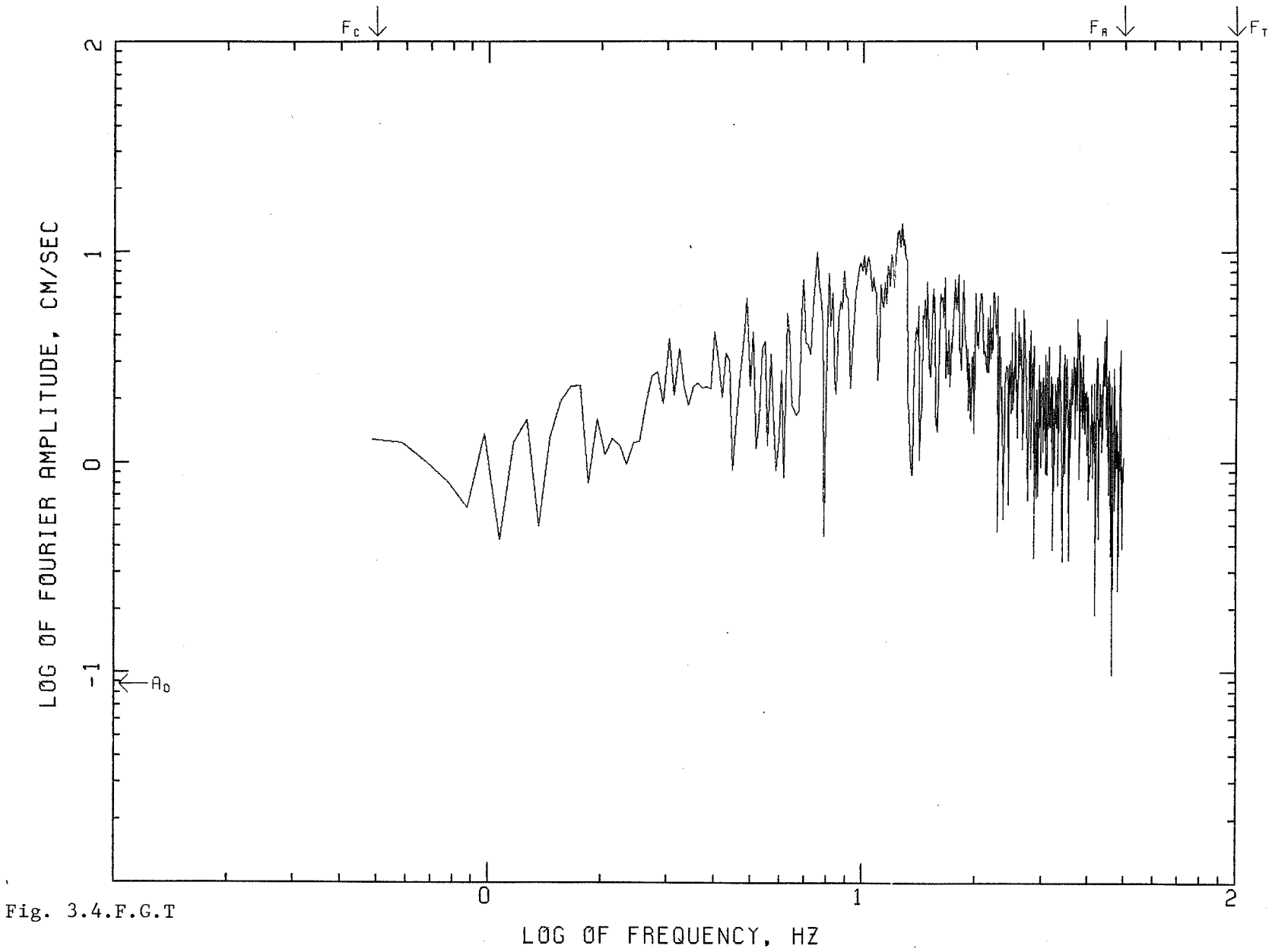
FOURIER AMPLITUDE SPECTRUM OF ACCELERATION
SITE 3, NAHANNI, NWT
270 DEGREES
EARTHQUAKE OF DECEMBER 25, 1985 1543 UTC
BUTTERWORTH AT .5 HZ, ORDER 4
COMPUTING OPTIONS= ZCROSS,NONOISE
Fc
FR
FT
AD
LOG OF FOURIER AMPLITUDE, CM/SEC
LOG OF FREQUENCY, HZ
2
1
0
-1
0
1
2

Fig. 3.4.F.G.T

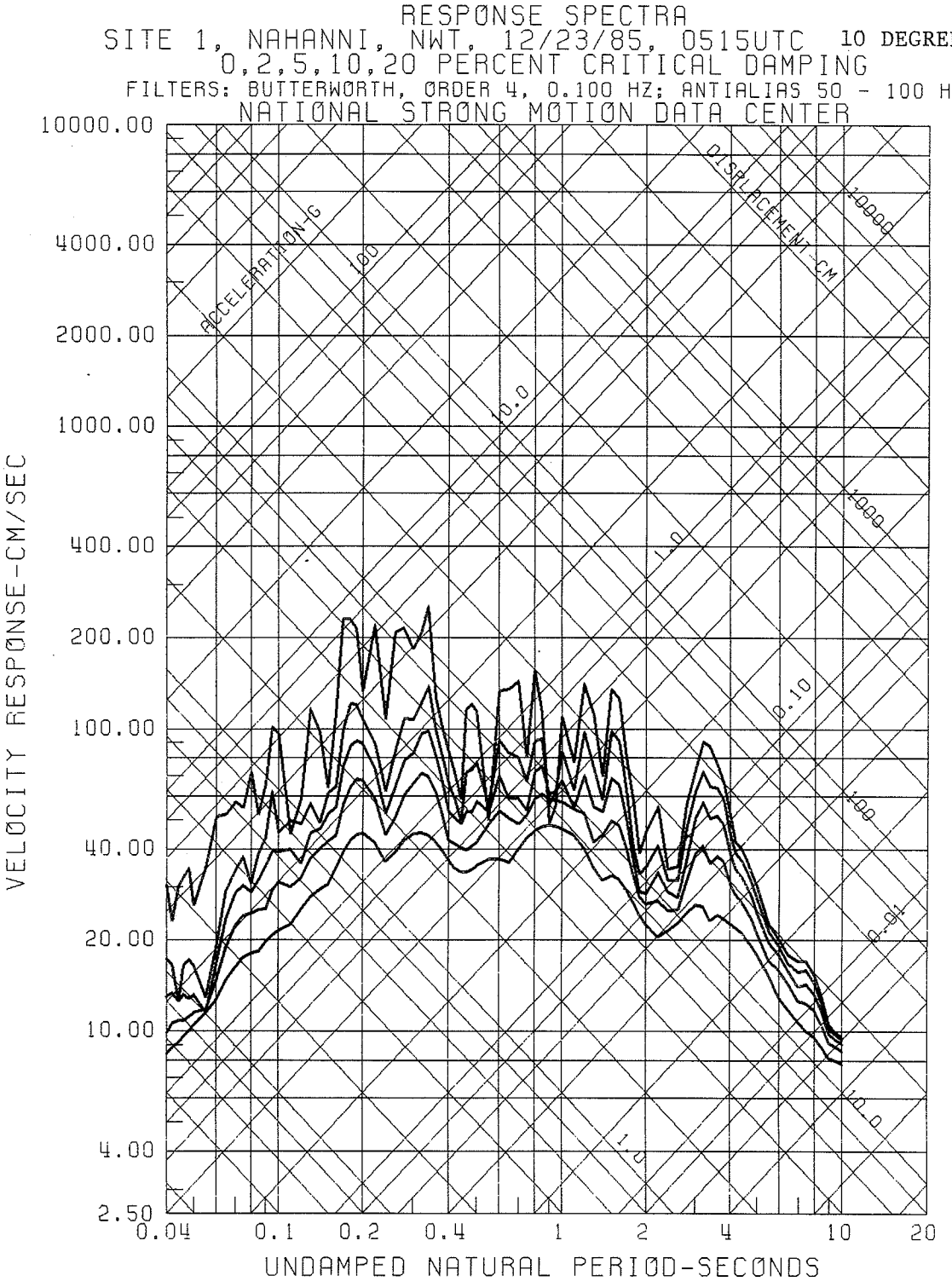
RESPONSE SPECTRA
SITE 1, NAHANNI, NWT, 12/23/85, 0515UTC 10 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.100 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
10000.00
4000.00
2000.00
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.50
0.04
0.1
0.2
0.4
1
2
4
10
20
100
10.0
1.0
0.10
0.01
1000
10000

Fig. 1.2.R.G.L

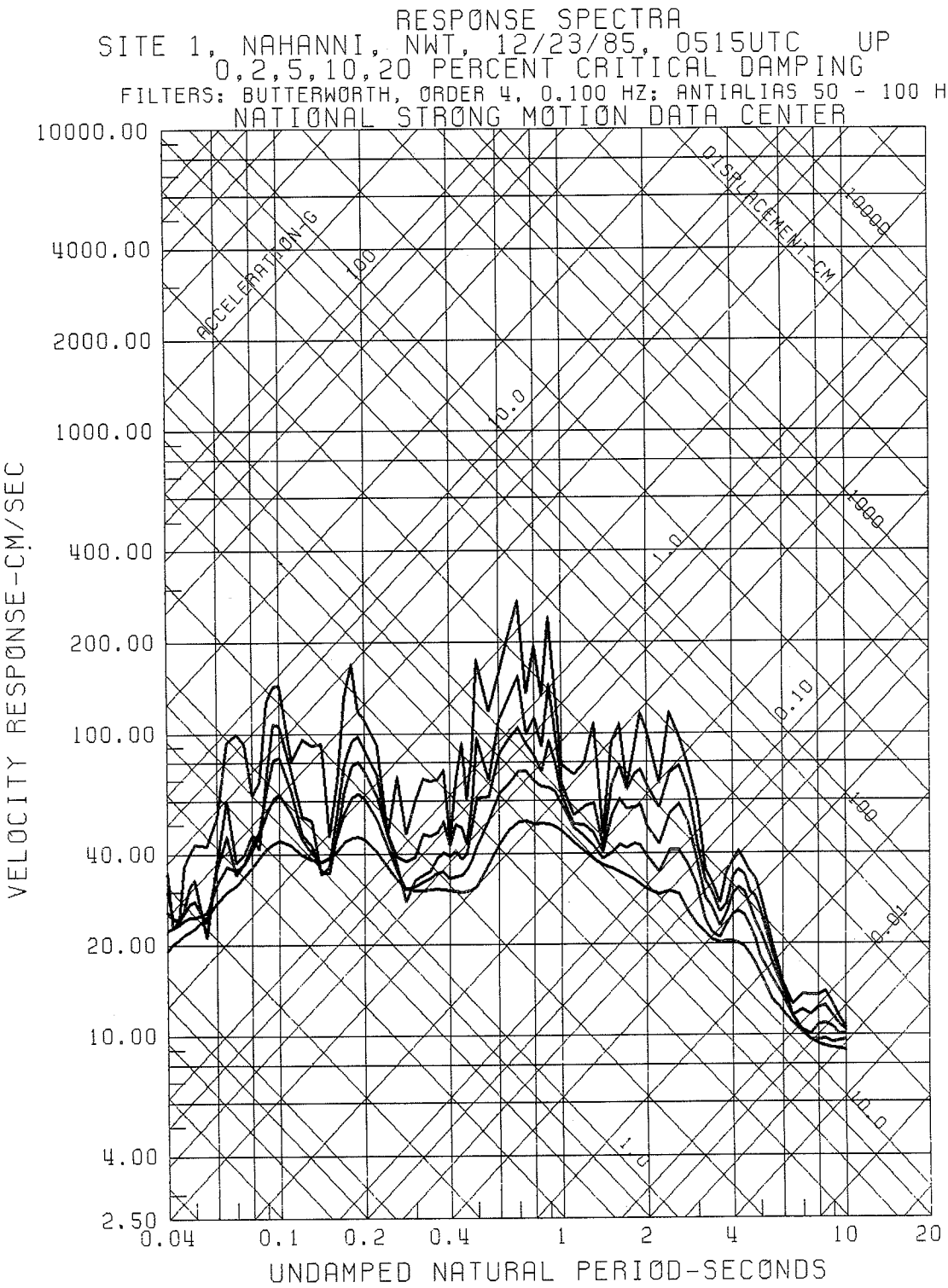
RESPONSE SPECTRA
SITE 1, NAHANNI, NWT, 12/23/85, 0515UTC UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.100 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
10000.00
4000.00
2000.00
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.50
0.04
0.1
0.2
0.4
1
2
4
10
20

Fig. 1.2.R.G.V

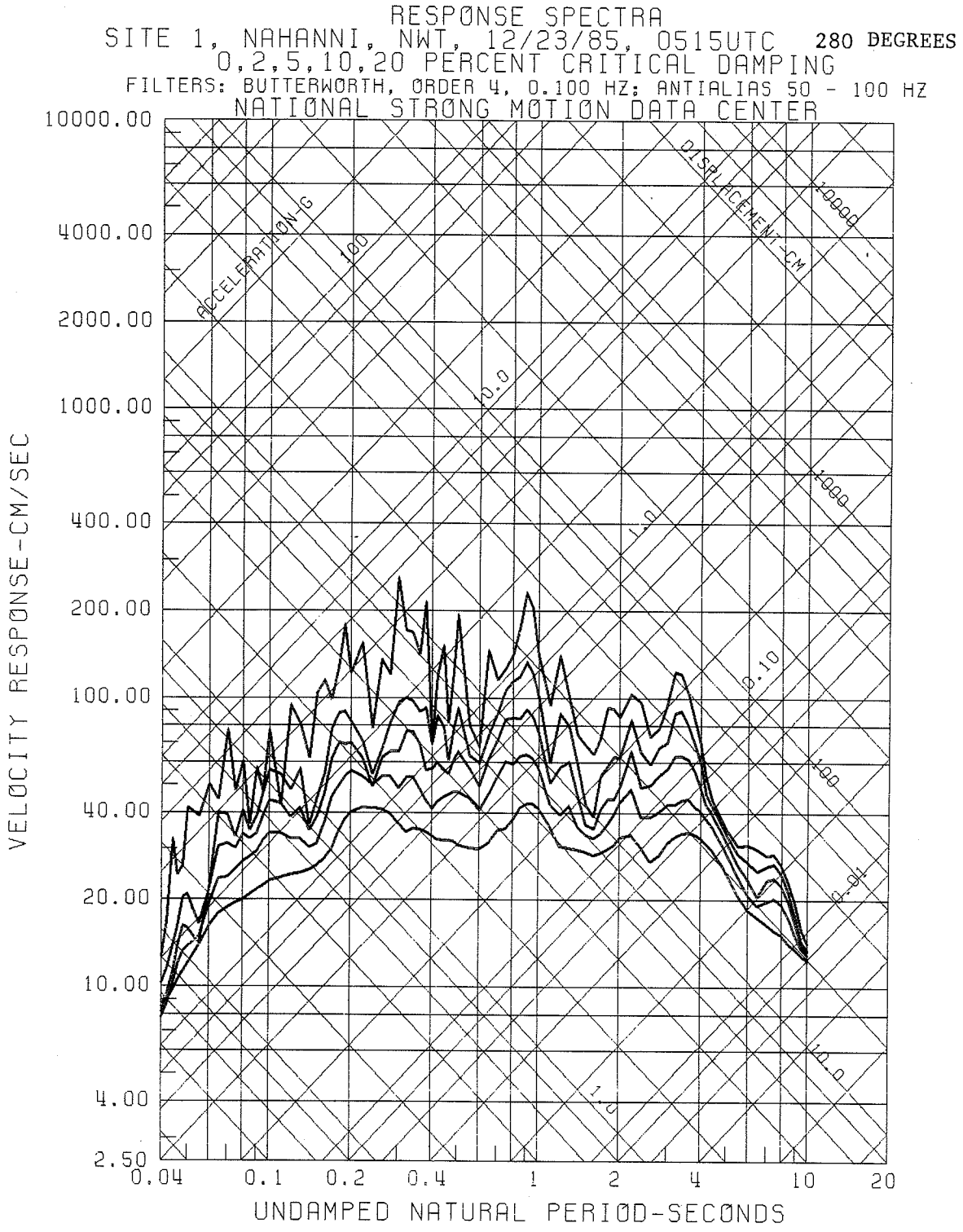
RESPONSE SPECTRA
SITE 1, NAHANNI, NWT, 12/23/85, 0515UTC 280 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.100 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
10000.00
4000.00
2000.00
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.50
0.04
0.1
0.2
0.4
1
2
4
10
20

Fig. 1.2.R.G.T

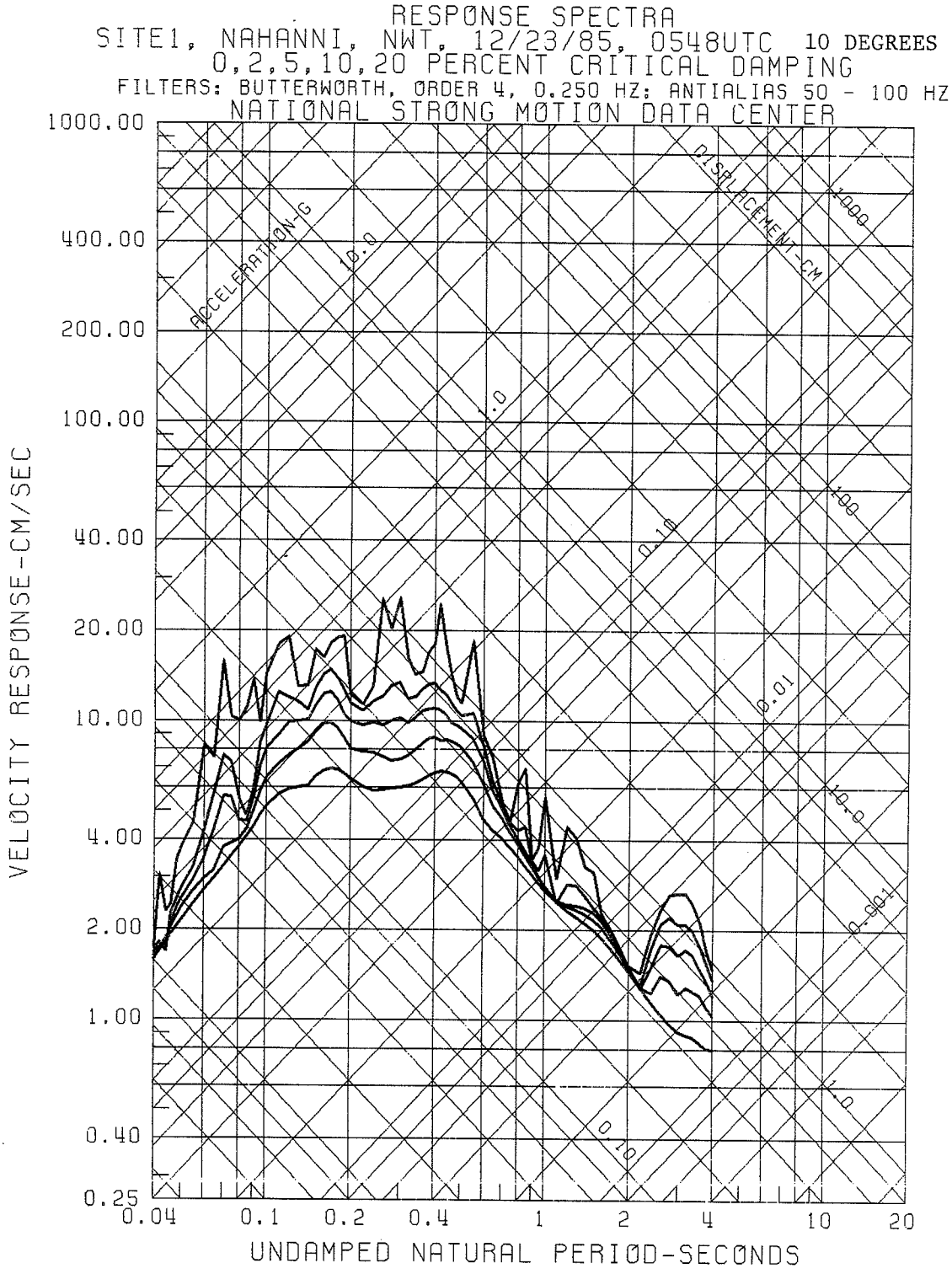
RESPØNSE SPECTRA
SITE1, NAHANNI, NWT, 12/23/85, 0548UTC 10 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWØRTH, ØRDER 4, 0.250 HZ; ANTIALIAS 50 - 100 HZ
NATIØNAL STRØNG MØTIØN DATA CENTER
VELØCITY RESPØNSE-CM/SEC
UNDAMPED NATURAL PERIØD-SECØNDS
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
ACCELERATION-G
10.0
1.0
0.1
0.10
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10
0.01

Fig. 1.3.R.G.L

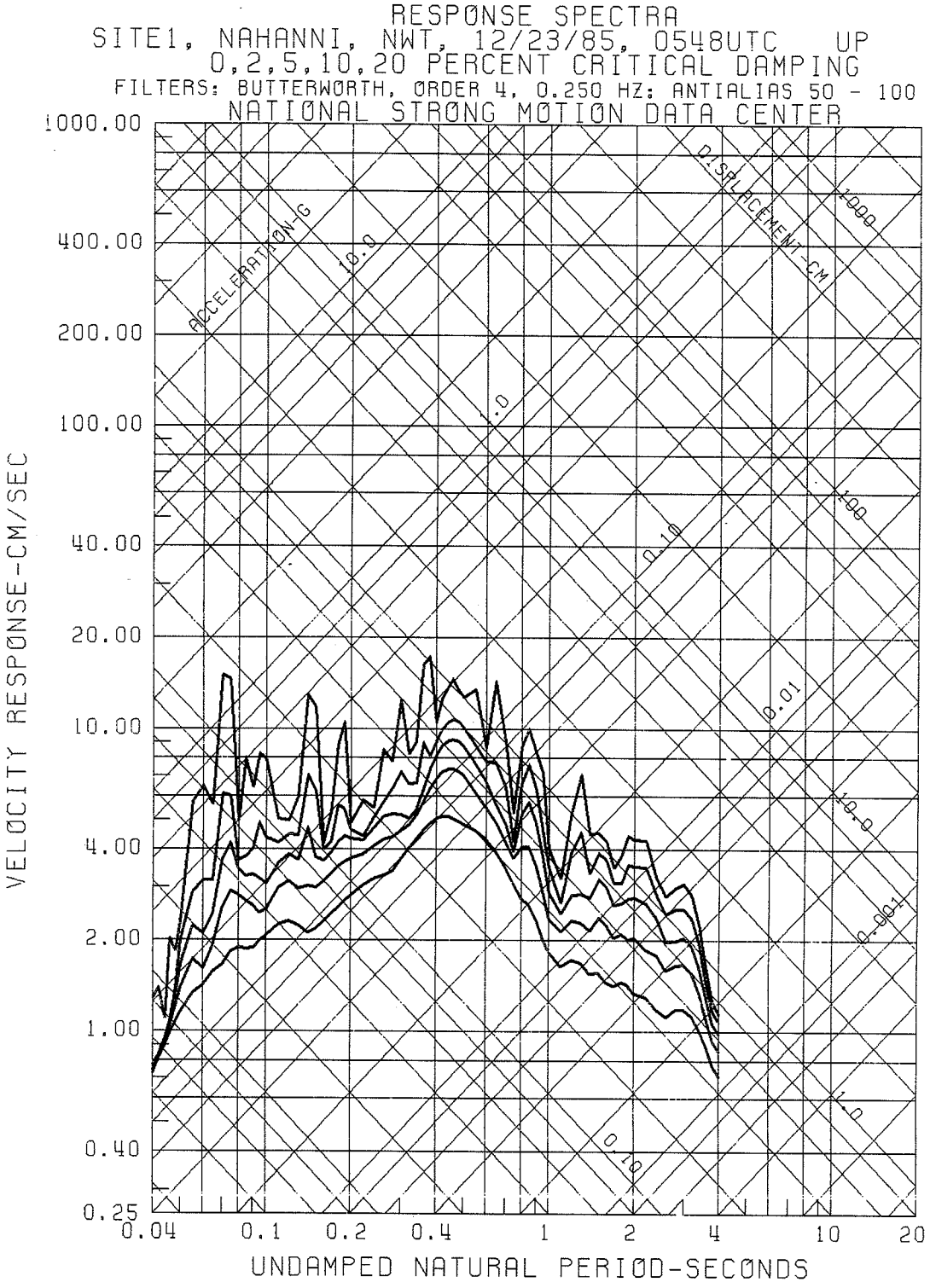
RESPØNSE SPECTRA
SITE1, NAHANNI, NWT, 12/23/85, 0548UTC UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWØRTH, ØRDER 4, 0.250 HZ; ANTIALIAS 50 - 100 HZ
NATIØNAL STRØNG MØTIØN DATA CENTER
VELØCITY RESPØNSE-CM/SEC
UNDAMPED NATURAL PERIØD-SECØNDS
ACCELERATIØN-G
DISPLACEMENT-CM
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
10.0
1.0
0.10
0.01
100
10.0
1.0
0.10

Fig. 1.3.R.G.V

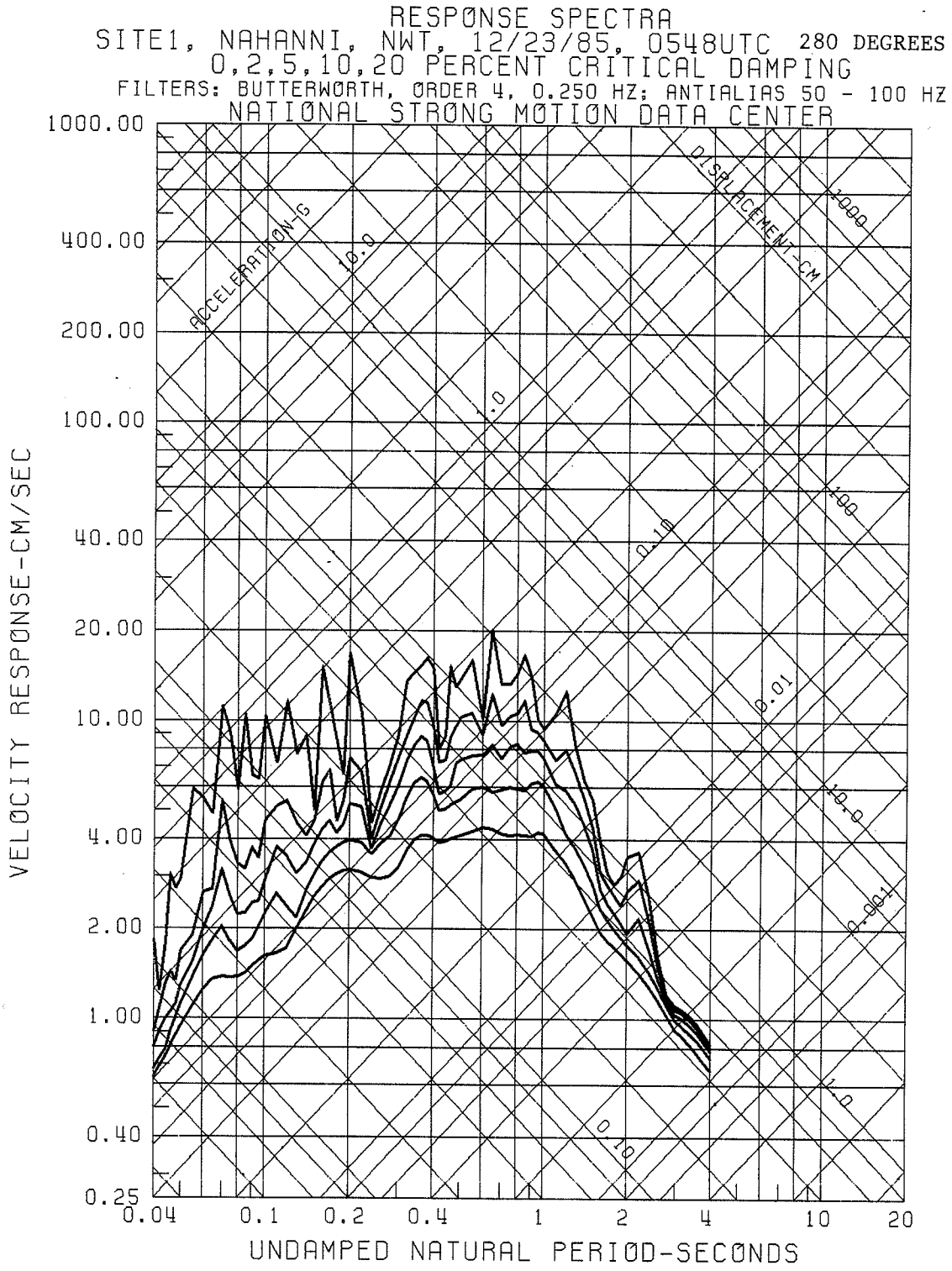
RESPONSE SPECTRA
SITE1, NAHANNI, NWT, 12/23/85, 0548UTC 280 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.250 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
10.0
1.0
0.10
0.01
0.001
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10

Fig. 1.3.R.G.T

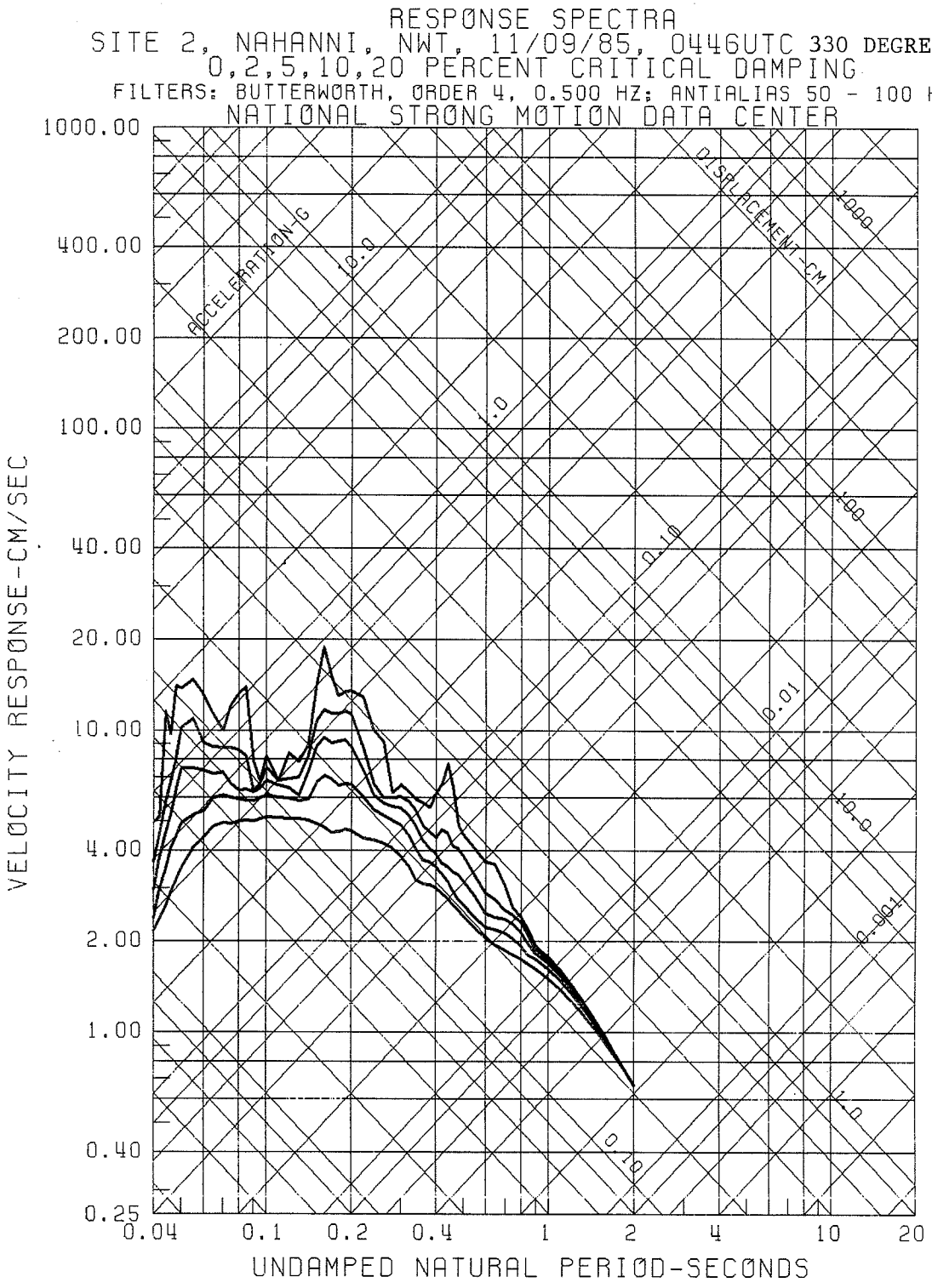
RESPONSE SPECTRA
SITE 2, NAHANNI, NWT, 11/09/85, 0446UTC 330 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10
0.01
0.001

Fig. 2.1.R.G.L

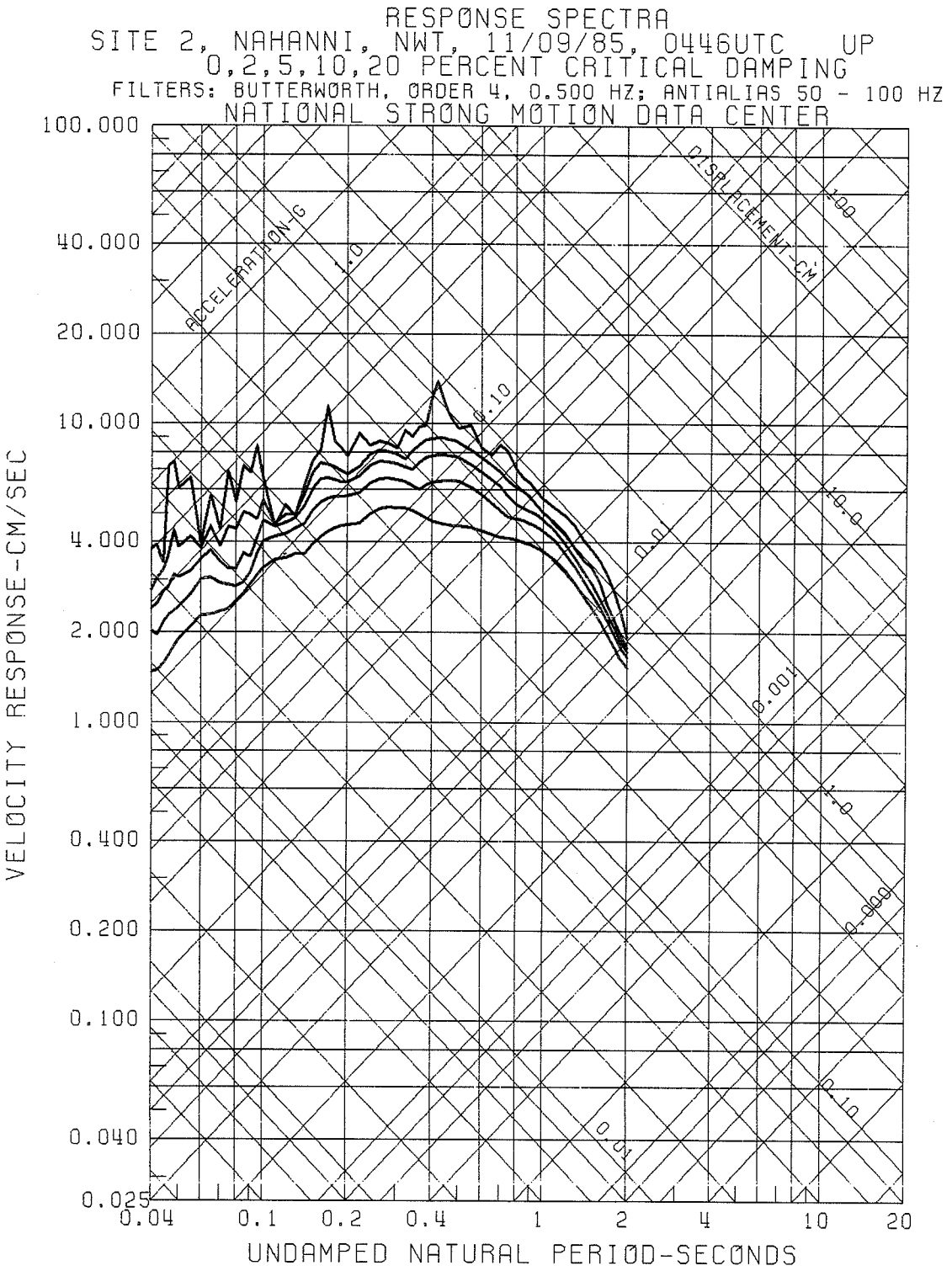
RESPONSE SPECTRA
SITE 2, NAHANNI, NWT, 11/09/85, 0446UTC UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
100.000
40.000
20.000
10.000
4.000
2.000
1.000
0.400
0.200
0.100
0.040
0.025
0.04
0.1
0.2
0.4
1
2
4
10
20
1.0
0.10
0.01
0.001
100
10.0
1.0
0.100
0.10
0.01

Fig. 2.1.R.G.V

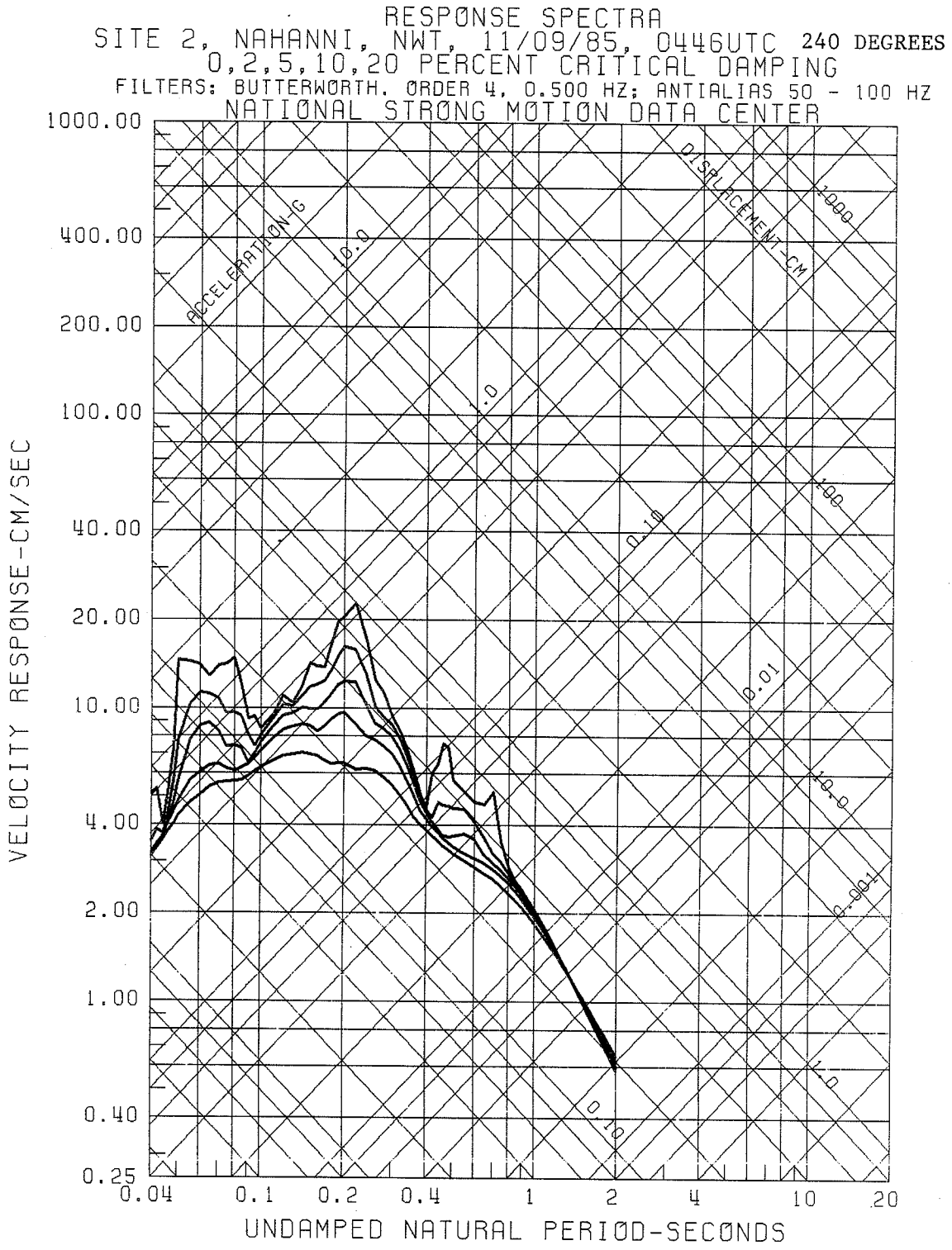
RESPONSE SPECTRA
SITE 2, NAHANNI, NWT, 11/09/85, 0446UTC 240 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH. ORDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
10.0
1.0
0.10
0.01
0.001
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10

Fig. 2.1.R.G.T

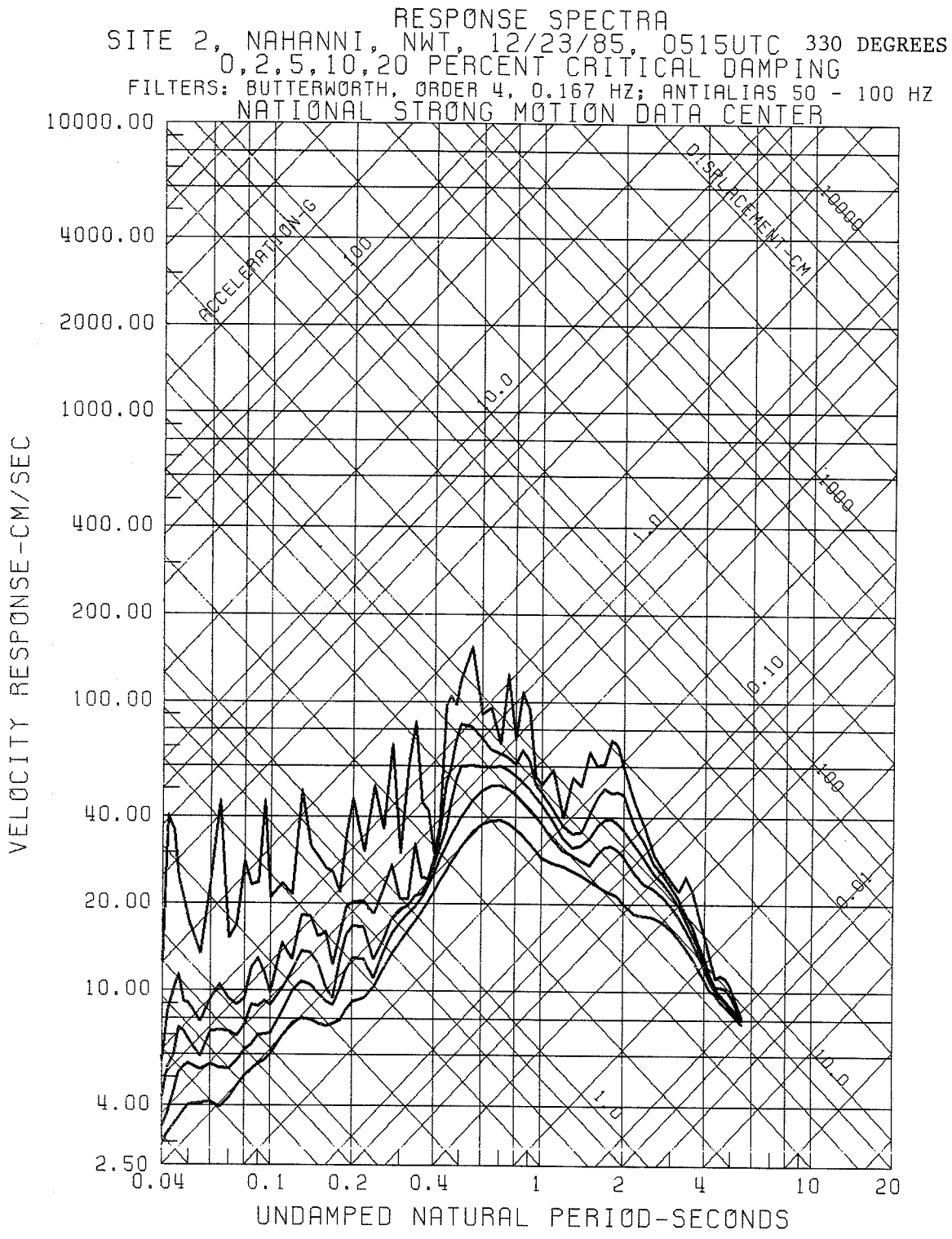
RESPONSE SPECTRA
SITE 2, NAHANNI, NWT, 12/23/85, 0515UTC 330 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.167 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
10000.00
4000.00
2000.00
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.50
0.04
0.1
0.2
0.4
1
2
4
10
20

Fig. 2.2.R.G.L

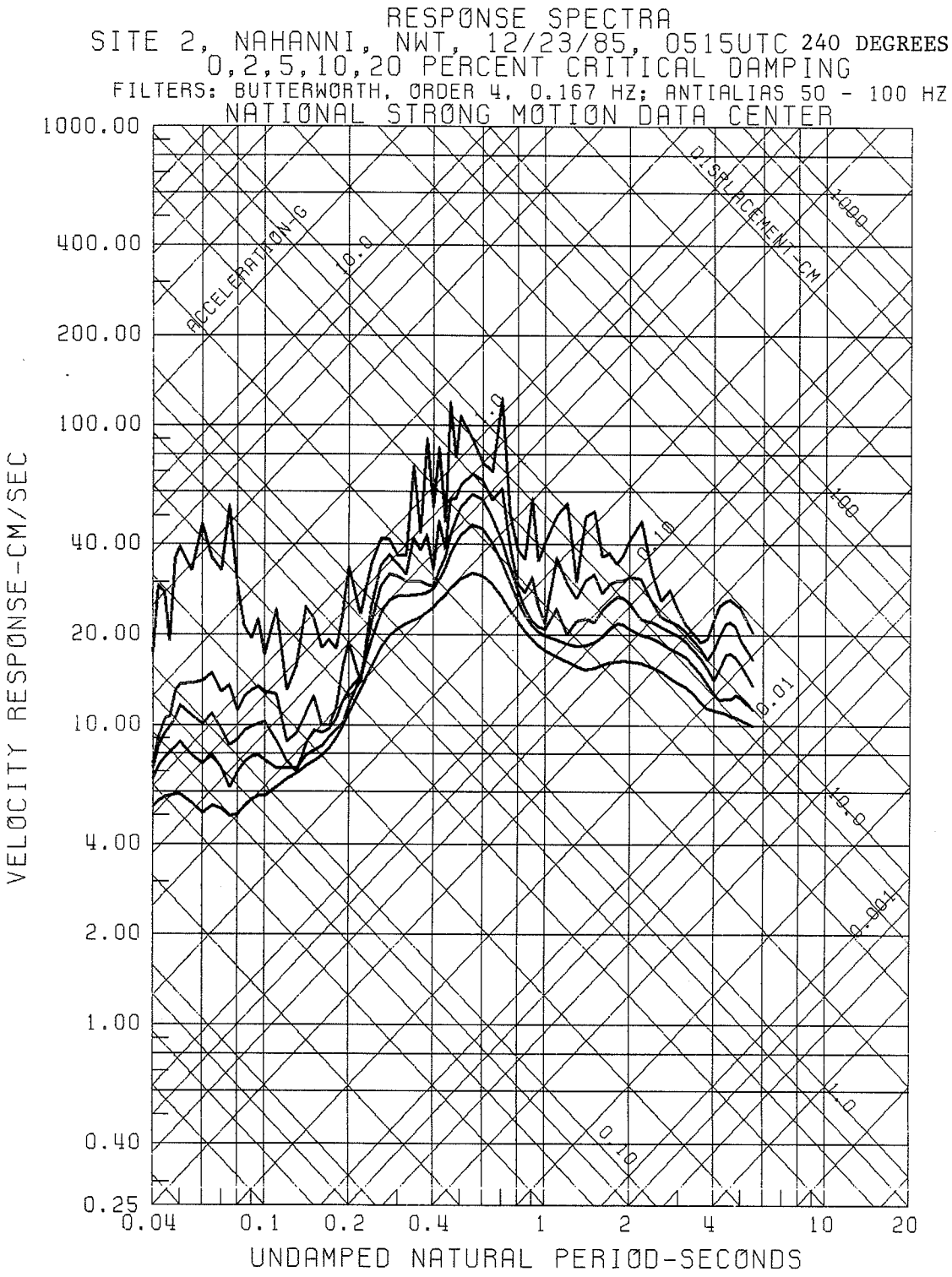
RESPONSE SPECTRA
SITE 2, NAHANNI, NWT, 12/23/85, 0515UTC 240 DEGREES
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.167 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
10.0
1.0
0.1
0.01
0.001
100
10.0
1.0
0.10
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20

Fig. 2.2.R.G.T

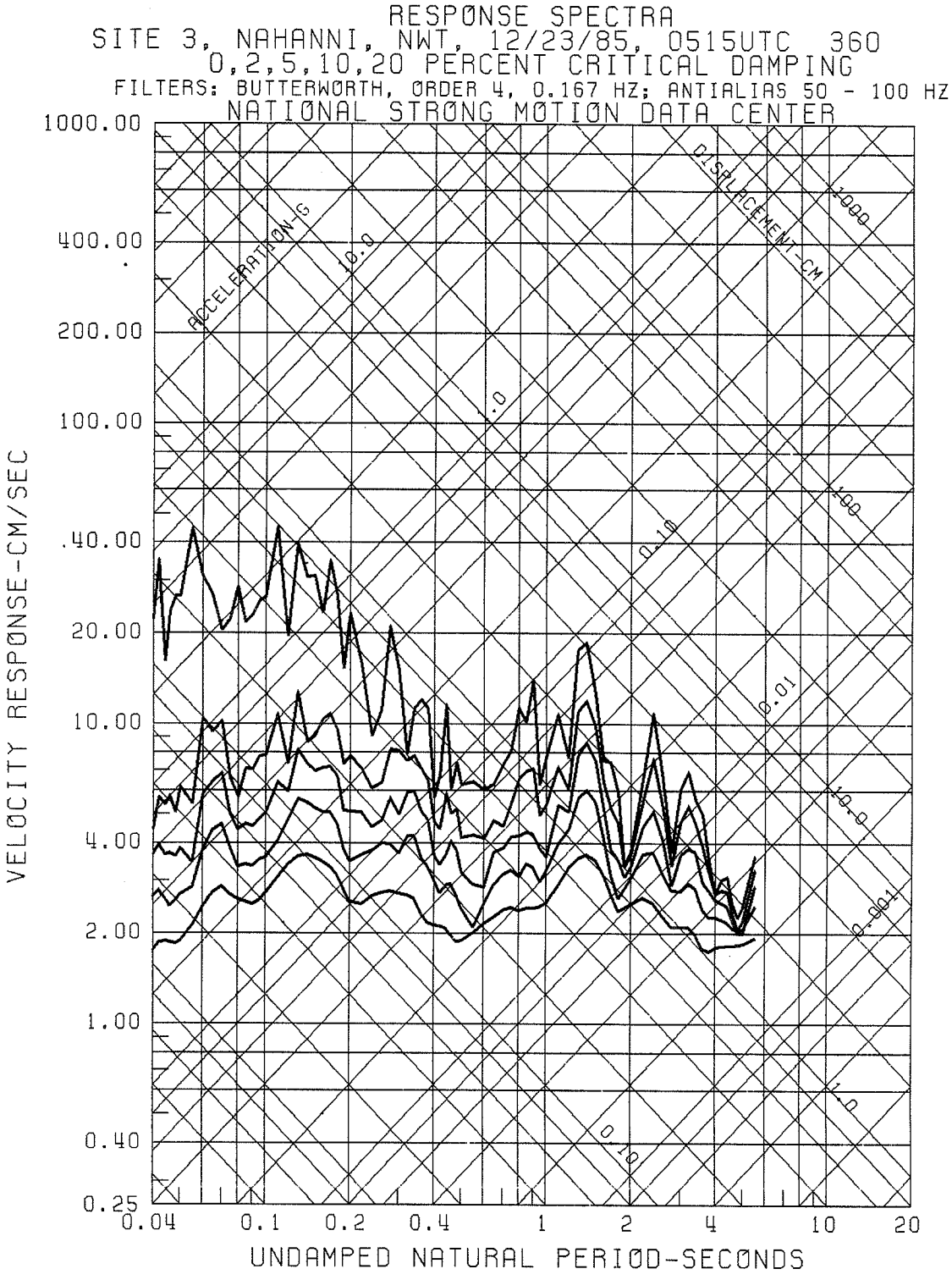
RESPONSE SPECTRA
SITE 3, NAHANNI, NWT, 12/23/85, 0515UTC 360
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.167 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
10.0
1.0
0.10
0.01
0.001
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10

Fig. 3.2.R.G.L

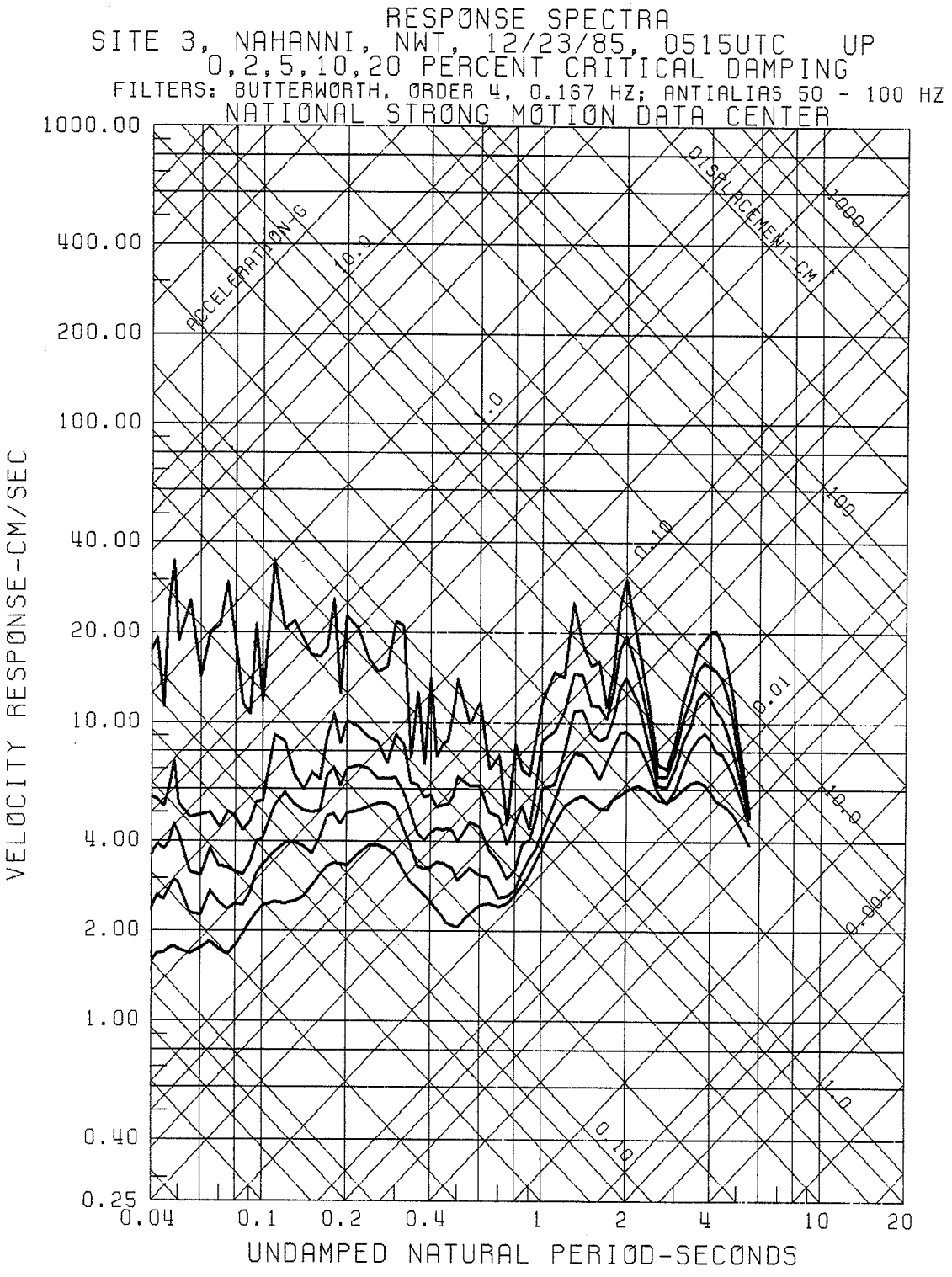
RESPØNSE SPECTRA
SITE 3, NAHANNI, NWT, 12/23/85, 0515UTC UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWØRTH, ØRDER 4, 0.167 HZ; ANTIALIAS 50 - 100 HZ
NATIØNAL STRØNG MØTIØN DATA CENTER
VELØCITY RESPØNSE-CM/SEC
UNDAMPED NATURAL PERIØD-SECØNDS
ACCELERATION-G
DISPLACEMENT-CM
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
10.0
1000
100
10.0
1.0
0.0
0.10
0.01
0.001

Fig. 3.2.R.G.V

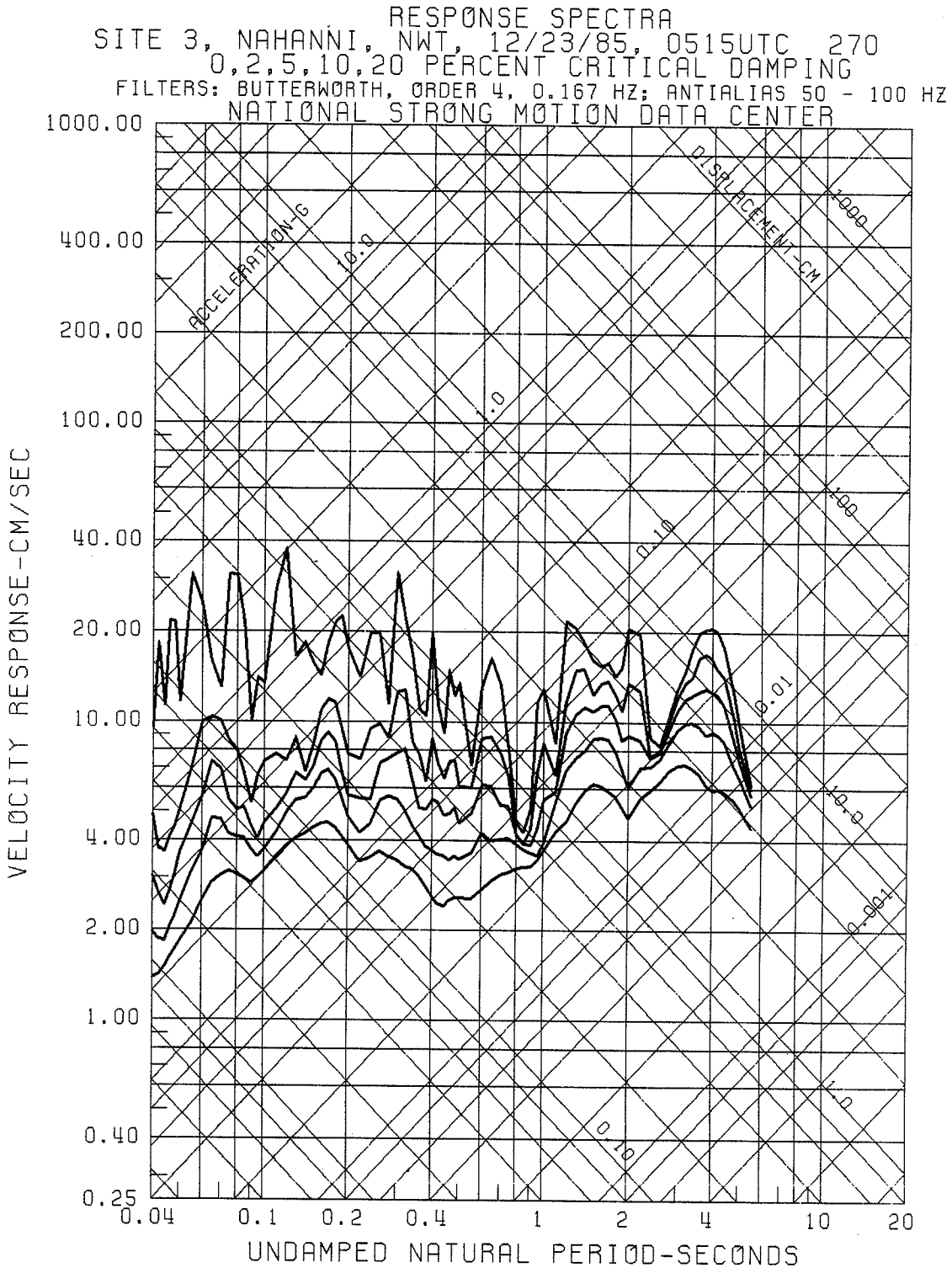
RESPONSE SPECTRA
SITE 3, NAHANNI, NWT, 12/23/85, 0515UTC 270
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.167 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
1000.00
400.00
200.00
100.00
40.00
20.00
10.00
4.00
2.00
1.00
0.40
0.25
0.04
0.1
0.2
0.4
1
2
4
10
20
ACCELERATION-G
10.0
1.0
0.10
0.01
DISPLACEMENT-CM
1000
100
10.0
1.0
0.10
0.001

Fig. 3.2.R.G.T

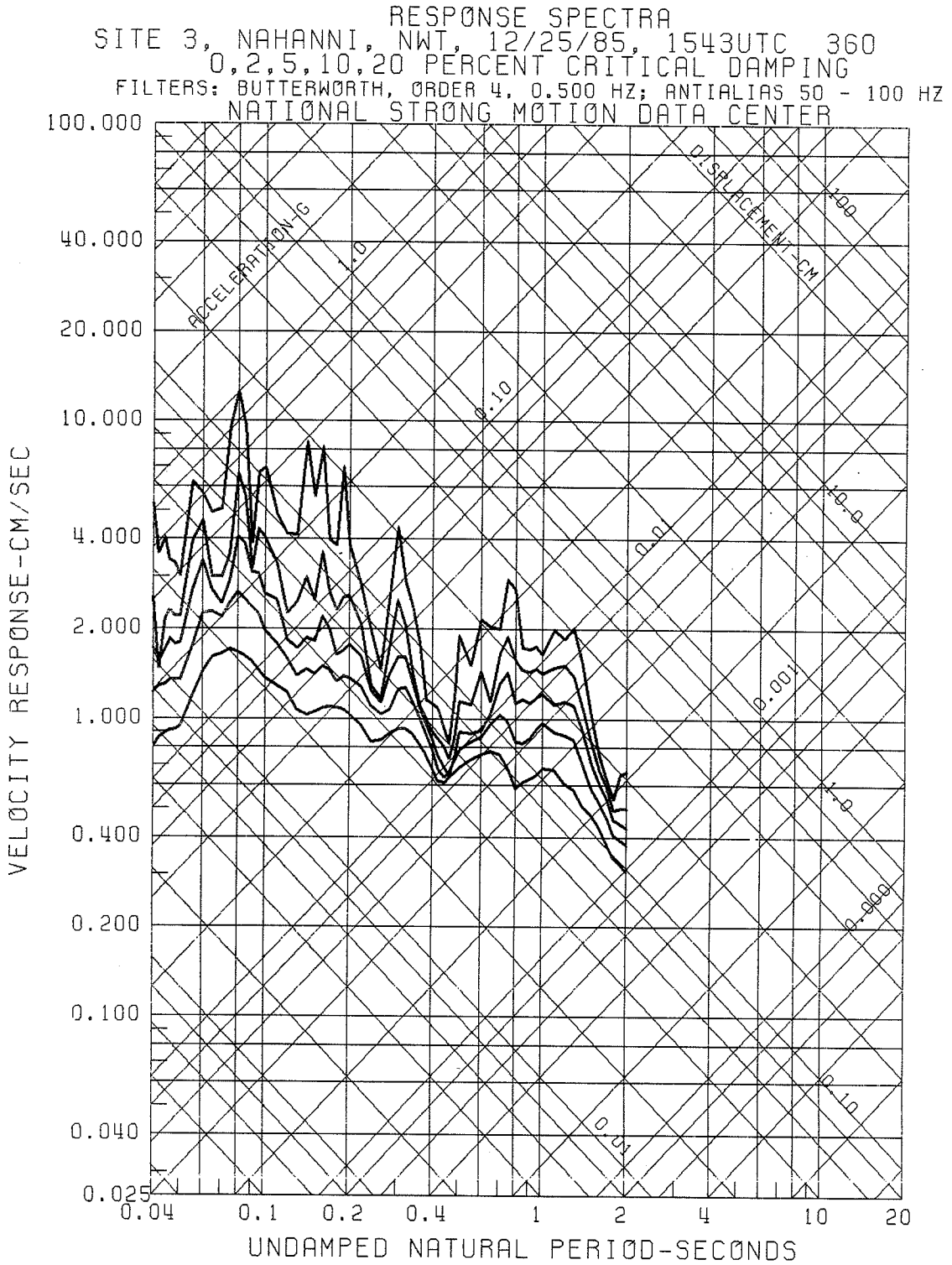
RESPØNSE SPECTRA
SITE 3, NAHANNI, NWT, 12/25/85, 1543UTC 360
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ØRDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIØNAL STRØNG MØTIØN DATA CENTER
VELØCITY RESPØNSE-CM/SEC
UNDAMPED NATURAL PERIØD-SECØNDS
ACCELERATION-G
DISPLACEMENT-CM
100.000
40.000
20.000
10.000
4.000
2.000
1.000
0.400
0.200
0.100
0.040
0.025
0.04
0.1
0.2
0.4
1
2
4
10
20
1.0
0.10
0.01
0.001
100
10.0
1.0
0.100
0.10
0.01

Fig. 3.4.R.G.L

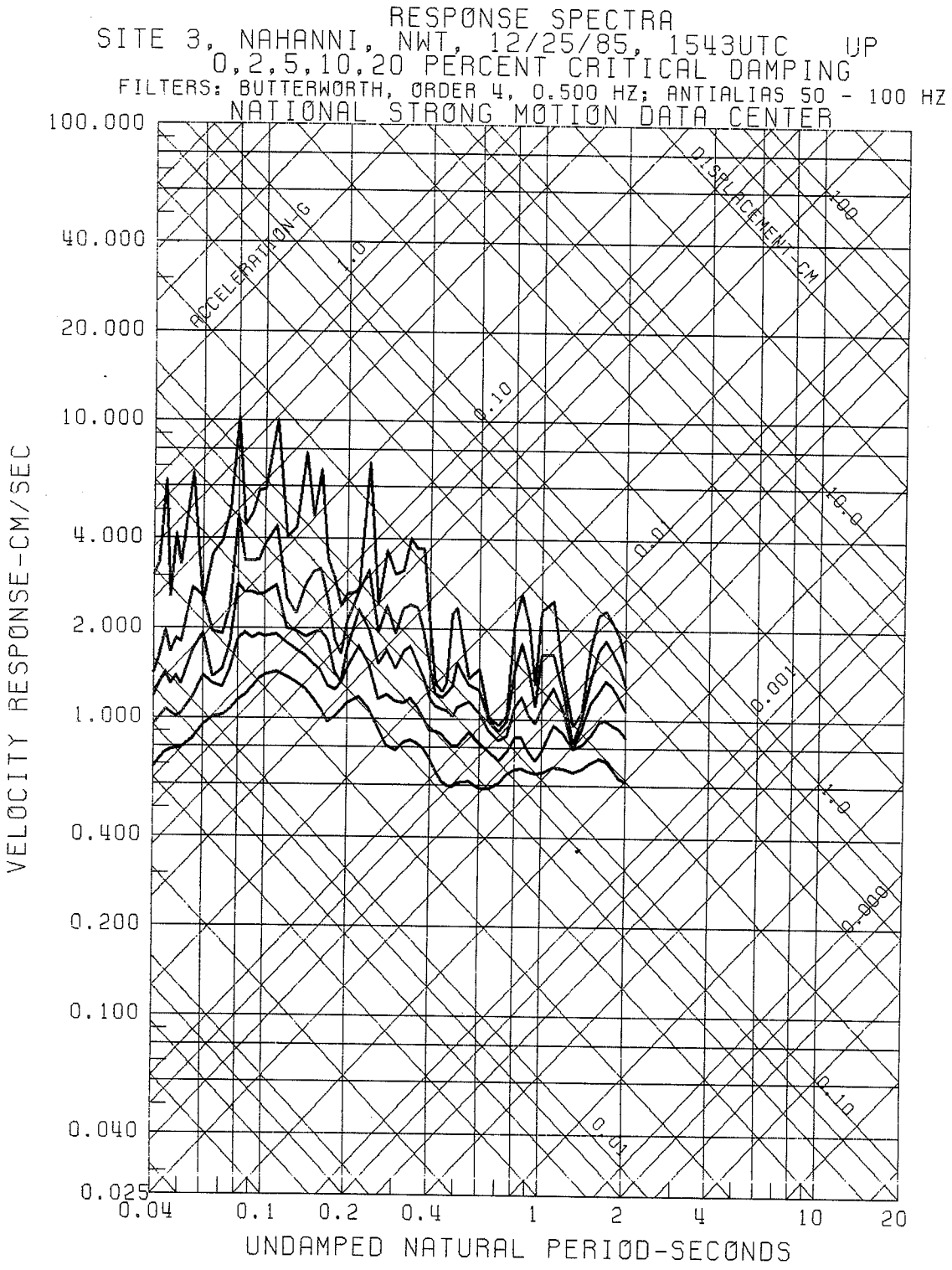
RESPØNSE SPECTRA
SITE 3, NAHANNI, NWT, 12/25/85, 1543UTC UP
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWØRTH, ØRDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIØNAL STRØNG MØTIØN DATA CENTER
VELOCITY RESPØNSE-CM/SEC
UNDAMPED NATURAL PERIØD-SECØNDS
ACCELERATION-G
DISPLACEMENT-CM
100.000
40.000
20.000
10.000
4.000
2.000
1.000
0.400
0.200
0.100
0.040
0.025
0.04
0.1
0.2
0.4
1
2
4
10
20

Fig. 3.4.R.G.V

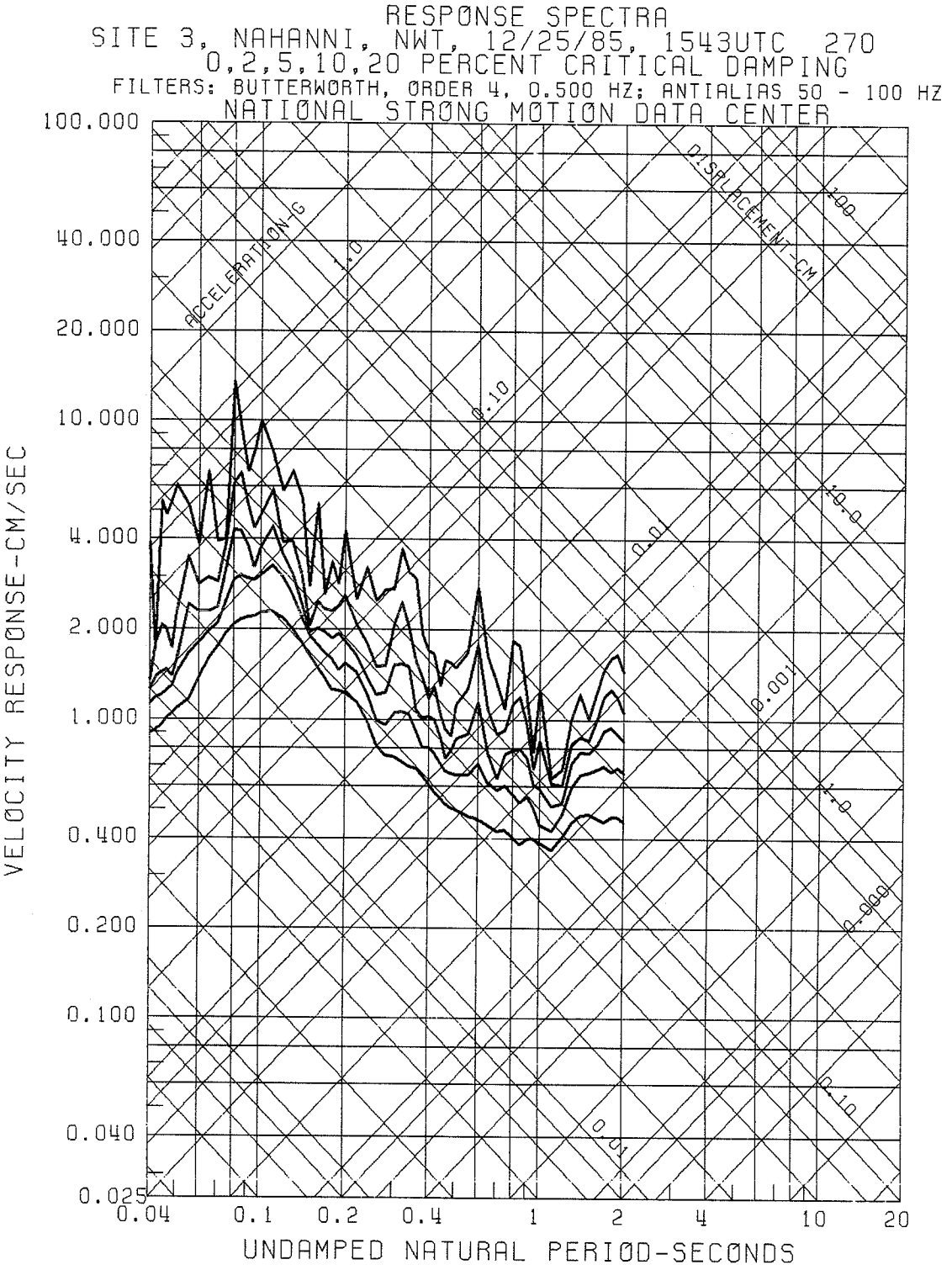
RESPONSE SPECTRA
SITE 3, NAHANNI, NWT, 12/25/85, 1543UTC 270
0,2,5,10,20 PERCENT CRITICAL DAMPING
FILTERS: BUTTERWORTH, ORDER 4, 0.500 HZ; ANTIALIAS 50 - 100 HZ
NATIONAL STRONG MOTION DATA CENTER
VELOCITY RESPONSE-CM/SEC
UNDAMPED NATURAL PERIOD-SECONDS
ACCELERATION-G
DISPLACEMENT-CM
100.000
40.000
20.000
10.000
4.000
2.000
1.000
0.400
0.200
0.100
0.040
0.025
0.04
0.1
0.2
0.4
1
2
4
10
20
1.0
0.10
0.01
0.001
100
10.0
1.0
0.100
0.10
0.01

Fig. 3.4.R.G.T