United States
Department of the Interior
U.S. Geological Survey

Programs SPEKTRA AND RPLOT

How to Display Seismic Amplitude Spectra and Spectral Ratios on the Eclipse

by Peter R. Stevenson

345 Middlefield Road
Menlo Park, California 94025

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

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Introduction

The program SPEKTRA computes and displays fourier spectral amplitudes of seismic time series. In addition spectral ratios may be computed and written to a text file for later use. The program RPLOT reads this file and plots the ratios.

The SPEKTRA program takes its input data from a SPRINT file, structured in a particular manner. The output consists of Tetronix plots of the Spectral amplitudes and the time series from which they are derived, and a file 'SPEKLIST' which contains the spectral ratios and can be read by RPLOT.

One thing should be mentioned in passing: SPEKTRA does not have the facility for removing the instrument response. Such a feature should be simple to implement, however.

Description of SPEKTRA use

The successful use of SPEKTRA depends on a large part in the way in which the input 'SPRINT' file is structured. This file is created either by using program WSPRINT or by using the [...] option in SISDS.*

The SPEKTRA program requires that the file be organized with three logical records per station set. The first two records contain the time series which will be used for the Spectral ratios. The third, longer record should encompass these two portions of the seismic trace and additionaly, should contain background noise as the first 128 samples of its time series. The spectrum of the background noise is plotted as a dashed line on the Spectral plots of the other two signals. In addition, the entire time series (which is contained in the third logical record) is plotted at the top of the spectral plots. The section of the seismic trace from which the Spectrum was computed is indicated with vertical dashed lines (see page 8).

The output of the SPEKTRA program is a text file named 'SPEKLIST'. It contains the spectral ratio of the first logical record spectrum to the spectrum of the second. It also contains ratios determined from spectral band averages.

* For instructions on the use of SISDS, see McHugh, C., Earthquake Processing on the Eclipse: A Beginner's Manual. U.S.G.S. Open-file report (1981)

Discussion of the Computations

The principle computations performed by the SPEKTRA program are those of computing the spectral amplitudes and calculating the spectral ratios.

The spectral amplitudes are computed in the standard way: that is, by calculating the Fast Fourier Transform (FFT) of the time series and then computing the complex modulus of the transform. The time domain data are tapered with a 10% cosine bell function prior to performing the FFT. The amplitude spectra may optionally be smoothed with a five point moving average.

The spectral ratio is calculated in two ways. In the first method, the spectrum with the most points is reduced by simple arithmetric averaging so that both spectra have the same number of points. Then the ratio is calculated.

In the second method, band-averaged spectra are calculated, and then the ratio of the averages of each of the bands is then computed. The bands are centered at 1/2, 1, 2, 4, 8, 16, and 32 Hz. That is

$$fc = 2^n \quad n = -1, 0, 1, \ldots 5$$

while the bad edges are computed by

$$fe = 2^{n-1/2} \quad n = -1, 0, 1, \ldots 6$$

The computational flow of SPEKTRA is presented below:

```
BEGIN:
    For each 'Station Set':
        For 3 'logical records':
            Read logical SPRINT record
            Taper time series (optional)
            FFT
            Compute Spectral Amplitudes
            Smooth Spectra (optional)
        For logical records # 1 and 2:
            Plot time series of record #3
            Plot Spectral Amplitudes
            Plot Noise Spectral amplitude (from record #3)
        Compute Spectral Ratio
        Write to 'SPEKLIST'
        Average Spectra by frequency bands
        Compute ratio of band averages
        Write to 'SPEKLIST'
END.
```

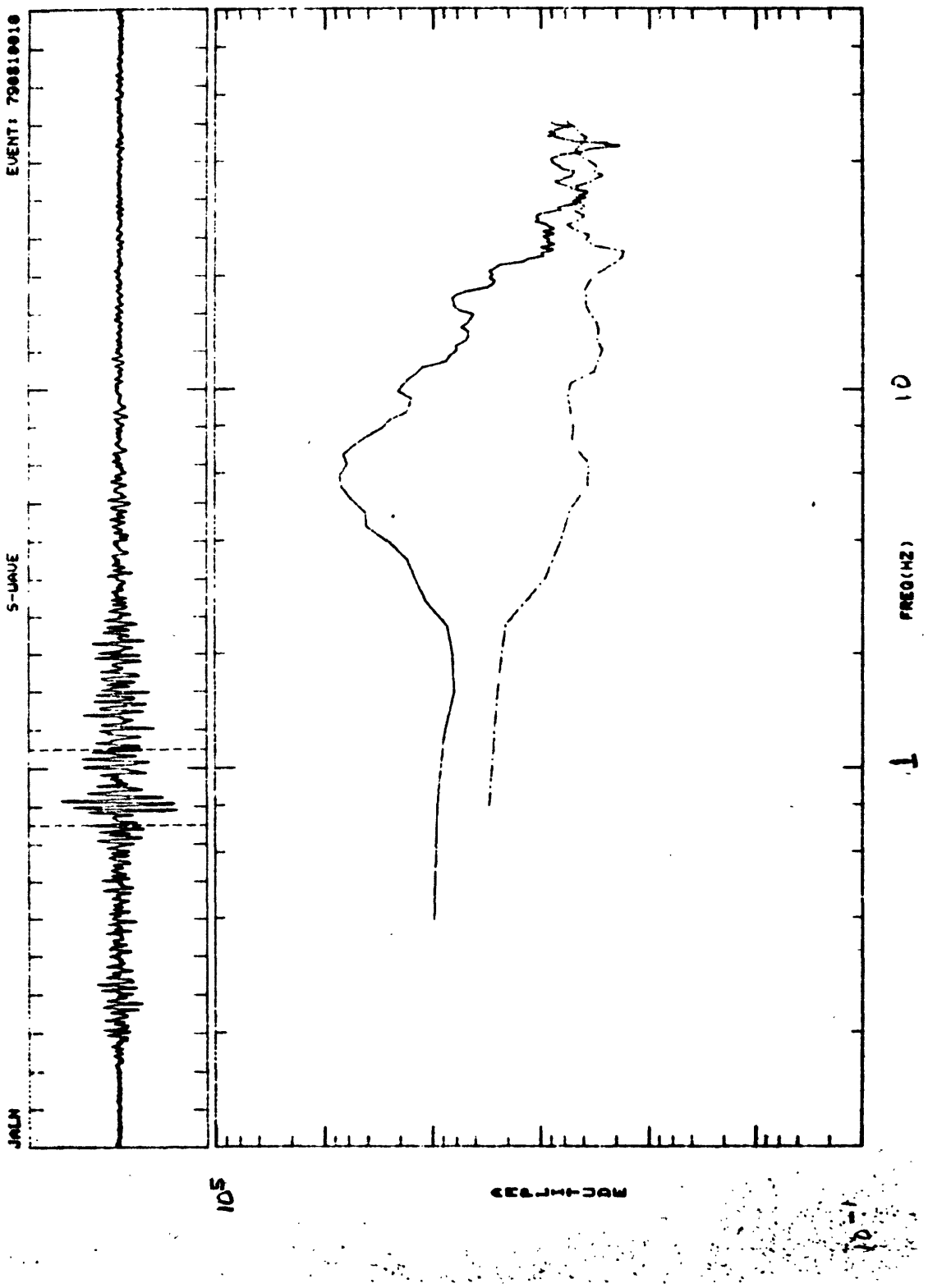
Desciption of RPLOT use

Rplot calculates spectral ratios for 3-component stations and displays them. The input to the program is the individual ratio values from the SPEKLIST file. The output is a semi-logarithmic plot of the averaged ratio values for the three components of the stations. These averages are computed in the following manner:

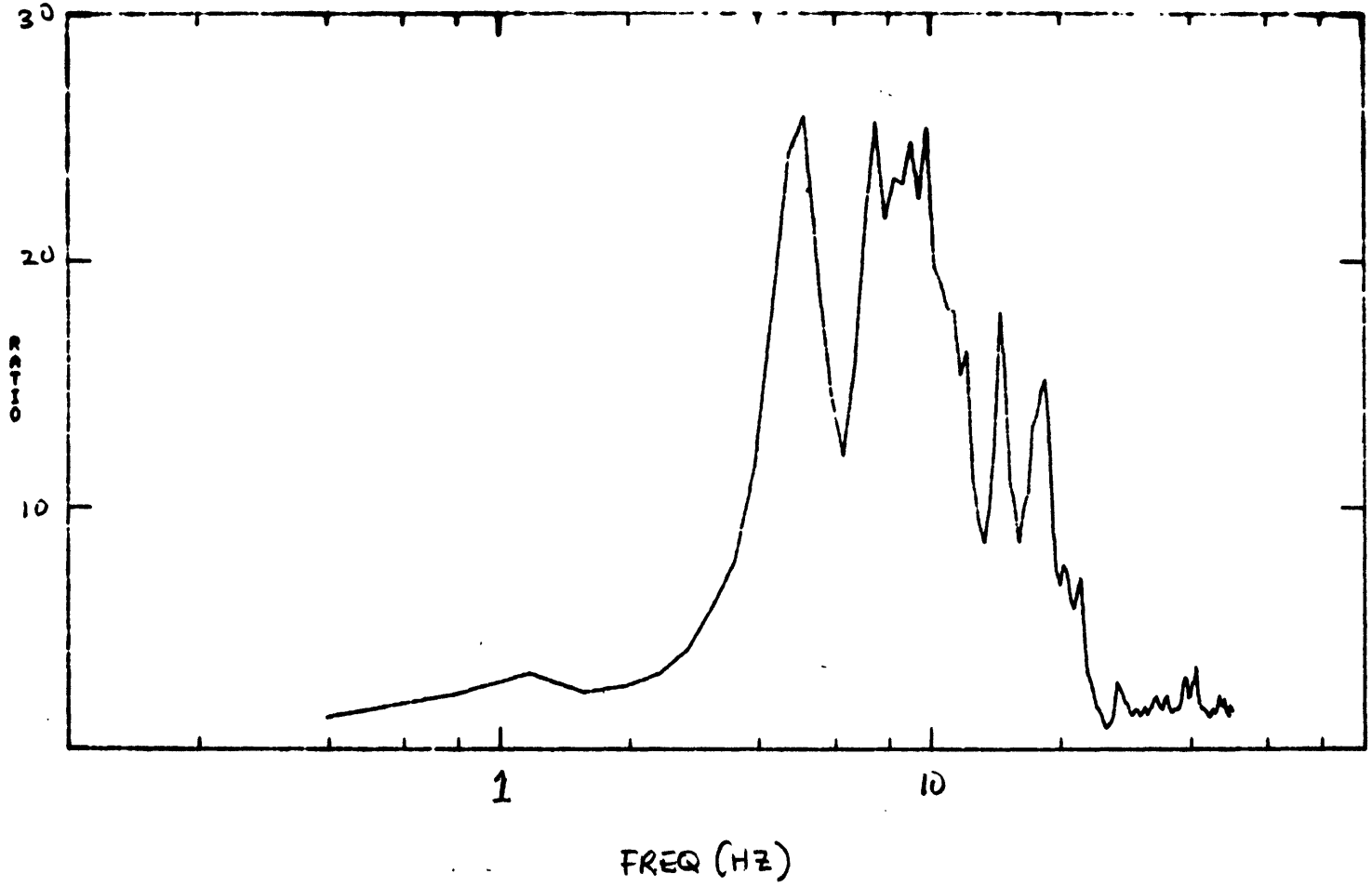
$$R(j) = ((N(j)^2 + E(j)^2)^{1/2} + Z(j)/2$$

Where R(j) corresponds to the spectral ratio at J*DF Hz, where DF is the frequency sample interval. The spectral ratios of each of the individual components for any given frequency J*DF are N(j), E(j), or Z(j) where N and E are the low gain horizontal components and Z is the low gain vertical component.

Example of SPECTRA #1,+



Example of ratio Plot



EXAMPLE OF RELEVANT WSPRINT COMMANDS


```
WSPRINT
WELCOME TO WSPRINT!
ARE YOU A NEW USER(Y=1)?1
THIS PROGRAM MAKES SPRINT FILES IN BATCH MODE.
IT WILL PROCESS UP TO 10 EVENTS AT A TIME.
IT WILL GENERATE SPRINT RECORDS FOR ONE OR MORE PIECES
OF A SEISMIC TRACE, ACCORDING TO A USER DEFINED
"STATION SET".  THIS STATION SET CONSISTS
OF INDIVIDUAL SPRINT RECORDS, EACH OF WHICH IS
DEFINED ACCORDING TO UNIQUE START AND DURATION TIMES.
THE START TIME IS DEFINED BY A MARKER PARAMETER
SUCH AS P-PHASE, OR ORIGIN TIME PLUS A CONSTANT
OFFSET.  THE DURATION OF THE RECORD IS DEFINED
ACCORDING TO A MULTIPLIER TIMES THE EARTHQUAKE
MAGNITUDE PLUS A CONSTANT TERM.
- - - - - - - - - - - - - - - - - - - - - - - - -
HOW MANY EVENTS?1
ENTER ID NUMBER!
79081001Ø
NAME OF FILE WHICH CONTAINS STATION NAMES?
OTHER
HOW MANY SPRINT RECORDS IN A STATION SET?3
DEFINE STATION RECORD #        1
START-TIME = MARKER-TIME + OFFSET
INPUT START MARKER(P,S,C,Ø,D)  S
INPUT START OFFSET  Ø
DURATION = MAG*MULTIPLIER + CONSTANT
INPUT MULTIPLIER  Ø
INPUT CONSTANT  2
DEFINE STATION RECORD #        2
START-TIME = MARKER-TIME + OFFSET
INPUT START MARKER(P,S,C,Ø,D)  Ø
INPUT START OFFSET  25
DURATION = MAG*MULTIPLIER + CONSTANT
INPUT MULTIPLIER  Ø
INPUT CONSTANT  3
DEFINE STATION RECORD #        3
START-TIME = MARKER-TIME + OFFSET
INPUT START MARKER(P,S,C,Ø,D)  P
INPUT START OFFSET  -1.5
DURATION = MAG*MULTIPLIER + CONSTANT
INPUT MULTIPLIER  Ø
INPUT CONSTANT  31
       3 SPRINT RECORDS PER SET
START-TIME = S-TIME +    .ØØØ
DURATION = MAG*    .ØØØ +  2.ØØØ
START-TIME = Ø-TIME + 25.ØØØ
DURATION = MAG*    .ØØØ +  3.ØØØ
START-TIME = P-TIME + -1.ØØØ
DURATION = MAG*    .ØØØ + 31.ØØØ
OK?(Y=1)1
NUMBER OF TRACES=      93 TDIG=     32.ØØØØ
STATION JALZ
STATION SET #          1
START-TIME=     21.27ØØ
STATION SET #          2
START-TIME=     32.5ØØØ
STATION SET #          3
START-TIME=     13.27ØØ
```

```
 STATION JALN
 STATION SET #          1
 START-TIME=      21.2700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      13.2700
 STATION JALE
 STATION SET #          1
 START-TIME=      21.2700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      13.2700
 STATION BSRZ
 STATION SET #          1
 START-TIME=      13.1700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      12.5700
 STATION BSRN
 STATION SET #          1
 START-TIME=      13.1700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      12.5700
 STATION BSRE
 STATION SET #          1
 START-TIME=      13.1700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      12.5700
 STATION HQRZ
 STATION SET #          1
 START-TIME=      16.6700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      11.2000
 STATION HQRN
 STATION SET #          1
 START-TIME=      16.6700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      11.2000
 STATION HQRE
 STATION SET #          1
 START-TIME=      16.6700
 STATION SET #          2
 START-TIME=      32.5000
 STATION SET #          3
 START-TIME=      11.2000
 END OF RUN

 STOP
 R
```

```
TYPE OTHER
JALZ
JALN
JALE
BSRZ
BSRN
BSRE
HQRZ
HQRN
HQRE
R
```

ECLIPSE ASCII WAVEFORM DATA
(SPRINT FORMAT)

Seismic data including event ID, Earthquake location, station information, P and S phase information and wave-form data are available in a printable form.

The data within a SPRINT file are organized into variable-length logical records. Each logical record corresponds to a seismic trace.

LOGICAL RECORD FORMAT:

1)	Event	'bID:b',4A2,A1,3X	9 digit event ID
	Date	3I2,2X	yr, mo, day
	Hour	I2	
	Minute	I2,2X	
	Second	F8.3,2X	time of first data point
	DT	F5.3	sampling interval
2)	Name	'bSTATION:b', 2A2,2X	
	Trace No.	'TRACEb#b', I3, IX	relative to .TR file
	NPTS	I8,'bSAMPLES'	number of samples in waveform data
3)	Summary Card	(40A2)*	
4)	Station Card	(40A2)*	
5)	P-Phase Card	(40A2)*	optional+
6)	S-Phase Card	(40A2)*	optional+
7)	SPRINT processing time	'-bSPRINTb-',1X, 3I2, 1X, 2I2, 58X	
		yr, mo, day, hr, min,	
8)	Header terminator	'--', 78X	
9)	WAVEFORM DATA	(5X, 15I5)	varible length
10)	Trace Terminator	'END-OF-TRACE', 68X	

* Formats of the summary, station, and Phase cards depend on the Hypocenter program which produced them.

+ P and S phase cards are included only if present in the -.EQ file when the SPRINT file was generated.

HYPO 79 SUMMARY, STATION AND PHASE FORMATS

The summary card format is:

item	columns	format	description
1	1-6	3i2	year, month, day
2	7	1x	blank
3	8-11	2i2	hour, minute
4	12-17	f6.2	origin time, seconds
5	18-20	i3	latitude, degrees
6	21	a1	+ or N or - or s, if blank assume +
7	22-26	f5.2	latitude, minutes
8	27-30	i4	longitude, degrees
9	31	a1	+ or E or - or W, if blank assume +
10	32-36	f5.2	longitude, minutes
11	37	1x	blank
12	38-43	f6.2	depth, kilometers
13	44	1x	blank
14	45-50	f6.2	magnitude
15	51-53	i3	number of P phases
16	54-57	i4	gaps
17	58-60	i3	minimum distance, kilometers
18	61-62	i2	number of S phases
19	63-67	f5.2	RMS
20	68-72	f5.1	ERH
21	73-77	f5.1	ERZ
22	78	a1	"q" if an explosion or quarry
23	79	a1	quality
24	80	a1	rank of the inverse matrix for the hypo-center program (usually 4)

The station card format is:

item	columns	format	description
1	1-4	a4	name
2	5	a1	station weight
3	6	1x	blank
4	7-8	i2	latitude, degrees
5	9	a1	+ or N, - of S
6	10-14	f5.2	latitude, minutes
7	15	1x	blank
8	16-18	i3	longitude, degrees
9	19	a1	+ or E, - or W
10	20-24	f5.2	longitude, minutes
11	25-29	i5	elevation, meters
12	30-31	i2	instrument class
13	32-34	i3	attenuation (db)
14	35-37	i3	velocity model number
15	38-42	f5.2	pdelay, seconds
16	43	1x	blank
17	44-45	a2	x phase (S or PN)
18	46-48	i3	x model number
19	49-53	f5.2	x delays, seconds
20	54-59	6x	blanks
21	60-65	f6.2	dt, clock correction, seconds
22	66	a1	"R" if first motion reversed
23	67-70	a4	analog tape name, track, and vco
24	71-74	a4	remark
25	75-80	i6	yr, mo, day of the entry in the instrument history file

The phase card format is:

item	columns	formats	description
1	1-4	a4	station name
2	5	1x	blank
3	6	a1	first motion descriptor E or I
4	7-8	a2	name of the phase (e.g. P phase)
5	9	a1	first motion
6	10	i1	arrival reading weight
7	11-12	2x	blanks
8	13-14	i2	year
9	15-16	i2	month
10	17-18	i2	day
11	19	1x	blank
12	20-21	i2	hour
13	22-23	i2	minute
14	24	1x	blank
15	25-29	f5.2	second
16	30	1x	blank
17	31-35	f5.2	travel-time residual, seconds
18	36-40	f5.0	Maximum Amplitude (peak-peak)
19	41	1x	blank
20	42-45	f4.2	Period of Maximum amplitude
21	46	1x	blank
22	47-53	f6.2	epicentral distance, kilometers
23	53	1x	blank
24	54-56	13	azimuth to station, clockwise from north in degrees
25	57	1x	blank
26	58-60	i3	angle of incidence, degrees
27	61-65	f5.0	coda length in seconds
28	66	1x	blank
29	67-70	f4.1	coda magnitude
30	71-73	i3	amplitude of first half cycle in digital counts
31	74-76	i3	pulse time in digital counts (usually hundredths of seconds)
32	77-80	2a2	remark

SPEKLIST FORMAT

1) Spectra set number	'-b-bSPEKTRAbSETb#',I4
Year, month, day	'-b-bRUNTIME:b',3I2
Hour, minute	'b:b', 2I2
2) Event ID	'EVENTbID=',4A2,A1
3) Station	'STATION-',2A2
4) frequency range	'FRQ1=',F7.2,'bFRQ2=',F7.2
frequency increment	'bDF=',F8.5
5) number of ratio points	'SPECTRALbRATIO',I5,'bPOINTS'
6) individual ratio values	5(E12.5,2X)
7) Band number*	'BANDb#b',I2,2X
band ratio	'R=',F8.3
lower band limit (hz)	'bLO=',F5.2
upper band limit (hz)	'bHI=',F5.2
8) end of data	'#/#/#bENDbOFbDATAbFILEb#/#/#'

(only if end of SPRINT file is encountered)

* there are seven bands

EXAMPLE of SPEKLIST file

```
- - SPEKTRA SET #   1- - RUNTIME: 81 424 : 1146
EVENT ID=790810010
STATION-JALZ
FRQ1=     .10 FRQ2= 100.00 DF=   .39062
SPECTRAL RATIO  128 POINTS
   .79196E 00     .15215E 01     .16605E 01     .13155E 01     .13508E 01
   .19352E 01     .18344E 01     .29488E 01     .48548E 01     .95506E 01
   .14577E 02     .25650E 02     .26352E 02     .18173E 02     .13788E 02
   .10505E 02     .10295E 02     .16391E 02     .19901E 02     .16911E 02
   .20000E 02     .22239E 02     .22346E 02     .22556E 02     .24280E 02
   .19893E 02     .18549E 02     .16576E 02     .14500E 02     .12515E 02
   .13860E 02     .72128E 01     .60177E 01     .75273E 01     .98502E 01
   .11759E 02     .13574E 02     .96596E 01     .71059E 01     .76378E 01
   .63032E 01     .70501E 01     .83416E 01     .94967E 01     .82220E 01
   .81195E 01     .85153E 01     .69905E 01     .81672E 01     .58137E 01
   .50056E 01     .45293E 01     .51551E 01     .44978E 01     .43309E 01
   .52120E 01     .66667E 01     .41121E 01     .20484E 01     .15839E 01
   .13883E 01     .10604E 01     .97720E 00     .70854E 00     .55599E 00
   .43511E 00     .53033E 00     .58713E 00     .10619E 01     .82579E 00
   .95241E 00     .80575E 00     .77327E 00     .52944E 00     .64715E 00
   .81550E 00     .10889E 01     .11981E 01     .14024E 01     .11167E 01
   .72300E 00     .50983E 00     .54978E 00     .99289E 00     .12628E 01
   .14318E 01     .16808E 01     .10819E 01     .89863E 00     .90936E 00
   .99292E 00     .10524E 01     .95453E 00     .82568E 00     .10996E 01
   .11579E 01     .11473E 01     .11695E 01     .13086E 01     .11478E 01
   .13850E 01     .16135E 01     .16579E 01     .15284E 01     .13963E 01
   .91226E 00     .12232E 01     .14333E 01     .12531E 01     .12499E 01
   .14443E 01     .11327E 01     .85891E 00     .98830E 00     .13514E 01
   .19160E 01     .18135E 01     .17741E 01     .20478E 01     .21099E 01
   .15371E 01     .16633E 01     .16377E 01     .13933E 01     .86364E 00
   .13014E 01     .16278E 01     .14263E 01
BAND #  1  R=   1.639 LO=   .35 HI=   .71
BAND #  2  R=   1.685 LO=   .71 HI= 1.41
BAND #  3  R=   3.158 LO= 1.41 HI= 2.83
BAND #  4  R=  18.120 LO= 2.83 HI= 5.66
BAND #  5  R=  50.888 LO= 5.66 HI=11.31
BAND #  6  R=   4.834 LO=11.31 HI=22.63
BAND #  7  R=    .877 LO=22.63 HI=45.25
- - SPEKTRA SET #   2- - RUNTIME: 81 424 : 1146
EVENT ID=790810010
STATION-JALN
FRQ1=     .10 FRQ2= 100.00 DF=   .39062
SPECTRAL RATIO  128 POINTS
   .11901E 01     .19861E 01     .32471E 01     .22800E 01     .33551E 01
   .38781E 01     .62052E 01     .82402E 01     .81072E 01     .80567E 01
   .91797E 01     .99464E 01     .12779E 02     .18154E 02     .12716E 02
   .11792E 02     .18388E 02     .21147E 02     .24120E 02     .21391E 02
   .21211E 02     .11422E 02     .89697E 01     .10301E 02     .16756E 02
   .13638E 02     .12194E 02     .14232E 02     .15230E 02     .11806E 02
   .10715E 02     .70813E 01     .71713E 01     .61418E 01     .69557E 01
   .10643E 02     .17551E 02     .11800E 02     .86383E 01     .75102E 01
   .84136E 01     .10110E 02     .10173E 02     .12254E 02     .13332E 02
   .12198E 02     .89072E 01     .10207E 02     .68596E 01     .65795E 01
   .64844E 01     .86956E 01     .84139E 01     .62435E 01     .39332E 01
   .35155E 01     .28864E 01     .21669E 01     .13839E 01     .18907E 01
   .13612E 01     .12875E 01     .87907E 00     .94731E 00     .83877E 00
   .12277E 01     .98789E 00     .12861E 01     .16673E 01     .15478E 01
   .13519E 01     .15257E 01     .17367E 01     .14259E 01     .13182E 01
   .18610E 01     .16304E 01     .10510E 01     .83274E 00     .63502E 00
   .55082E 00     .73116E 00     .76689E 00     .95093E 00     .11539E 01
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- FRIDAY, APRIL 17, 1981  12:43:13 PM

                              SPEKTRA.FR

  1:    C  PROGRAM TO SPLOT SPECTRA OF EARTHQUAKES
  2:    C  PROGRAM READS TEXT FILES GENERATED BY
  3:    C  THE (...) OPTION OF SISDS
  4:    C  MODIFIED 2-13-81 TO ACCOMODATE NEW SPRINT FORMAT
  5:    C  MODIFIED 2-24-81 TO INCLUDE SPECTRAL RATIO AND NOISE SPEKTRA
  6:    C  MODIFIED 4-17-81 TO CALCULATE SPECTRAL RATIO MORE PRECISELY
  7:    C
  8:          INTEGER TS
  9:          DIMENSION TS(3100),SA(512),SB(512),C(512),SNOIS(128)
 10:          DIMENSION R(128)
 11:          EQUIVALENCE (R(1),SNOIS(1))
 12:          COMPLEX C
 13:          DIMENSION LB1(4),LB2(5),LB3(4),ID(5),T(3),OR(7),PT(3),ST(3)
 14:          DIMENSION LBS(3),LBC(2),LBR(7)
 15:          DATA LB2/'AM','PL','IT','UD','E '/
 16:          DATA LB3/'FR','EQ','(N','Z)'/
 17:          DATA LB1/'S ','% ','CO','DA'/
 18:          DATA LBS/'S-','VA','VE'/
 19:          DATA LBC/'CO','DA'/
 20:          DATA LBR/'SP','EC','TR','AL',' R','AT','IO'/
 21:          REAL MAG
 22:          INTEGER DO,AIN,AZ
 23:          NCNT = 0
 24:    C    NMAX AND IMAX SET UPPER LIMITS ON DIMENSIONS
 25:    C    OF THE TIME SERIES AND COMPLEX AMPLITUDE ARRAYS
 26:          NMAX = 3100
 27:          IMAX = 512
 28:          OPEN 10,'$TT01'
 29:          ACCEPT 'DO YOU WANT THE 5-PT SMOOTHING(Y=1)?',JSM
 30:    C
 31:          ACCEPT 'DO YOU WANT TO PLOT A SPECTRAL RATIO(Y=1)?',JRAT
 32:    C  10% TAPER
 33:          P=.05
 34:    C  OPEN TEXT FILE
 35:          LU = 0
 36:          OPEN LU,'SPRINT'
 37:    44    CLOSE 10
 38:          OPEN 10,'SPEKLIST',ATT='A'
 39:    C
 40:    C  STAMP OUTPUT WITH TIME OF RUN
 41:          CALL FGDAY(JMO,JDA,JYR)
 42:          CALL FGTIME(JHR,JMIN,JSEC)
 43:          NCNT = NCNT + 1
 44:          WRITE(10,200)NCNT,JYR,JMO,JDA,JHR,JMIN
 45:    200   FORMAT('- - SPEKTRA SET #',I4,'- - RUNTIME) ',3I2,' ) ',2I2)
 46:          N1 = NMAX
 47:    C    ASSUME 1ST SPRINT RECORD IS S-PHASE DATA
 48:          CALL FSEIS(TS,N1,ID,SNAM,T,DT,DO,OR,MAG,
 49:         X IFM,JFM,EPD,AZ,AIN,PT,ST,LU,0)
 50:          WRITE(10,201)ID
 51:    201   FORMAT('EVENT ID=',4A2,A1)
 52:          T1 = T(3)
 53:          IF(N1.GT.IMAX)N1 = IMAX
 54:          CALL SPEK(TS,SA,C,N1,NN1,P)
 55:          IF(JSM.EQ.1)CALL SMOOTH(SA,NN1)
 56:          N2 = NMAX
```

```
C   ASSUME 2ND SPRINT RECORD IS CODA DATA
      CALL FSEIS(TS,N2,ID,SNAM,T,DT,DB,OR,MAG,
     X IFM,JFM,EPD,AZ,AIN,PT,ST,LU,0)
      T2 = T(3)
      IF(N2.GT.IMAX)N2 = IMAX
      CALL SPEK(TS,SB,C,N2,NN2,P)
      IF(JSM.EQ.1)CALL SMOOTH(SB,NN2)
      NN = NMAX
C   ASSUME 3RD SPECTRAL RECORD ENCONPASSES
C   THE 1ST 2 RECORDS FOR DISPLAY PURPOSES
C
      CALL FSEIS(TS,NN,ID,SNAM,T,DT,DB,OR,MAG,
     X IFM,JFM,EPD,AZ,AIN,PT,ST,LU,0)
      T0 = T(3)
C   ALSO. . . . .
C    ASSUME 1ST 128 SAMPLES OF 3RD SPRINT
C    RECORD CONTAIN ONLY SEISMIC NOISE
      NOIS = 128
      CALL SPEK(TS,SNOIS,C,NOIS,NOIS2,P)
      IF(JSM.EQ.1)CALL SMOOTH(SNOIS,NOIS2)
C
      SPS = 1./DT
C
      T1 = T1 - T0
      T2 = T2 - T0
      TL1 = T1 + (N1-1)/SPS
      TL2 = T2 + (N2-1)/SPS
C
C  SET AMPLITUDE AND FREQUENCY RANGE
      A1 = .1
      A2 = 100000.
      F1 = .1
      F2 = 100.
      CALL DSPEK(SA,NN1,TS,NN,SNOIS,NOIS2,SPS,A1,A2,
     *F1,F2,T1,TL1,LBS,LB2,LB3,6,9,8,SNAM,ID)
C
      ACCEPT IDUM
      CALL ERASE
      CALL DSPEK(SB,NN2,TS,NN,SNOIS,NOIS2,SPS,A1,A2,
     *F1,F2,T2,TL2,LBC,LB2,LB3,4,9,8,SNAM,ID)
      ACCEPT IDUM
      IF(JRAT.NE.1)GOTO 11
C  COMPUTE SPECTRAL RATIO
      DFA = SPS/(NN1*2)
      DFB = SPS/(NN2*2)
C
C
      WRITE(10,1000)SNAM
1000  FORMAT('STATION-',A4)
      NR = 128
      DF = SPS/(NR*2)
      WRITE(10,1001)F1,F2,DF
1001  FORMAT('FRQ1=',F7.2,' FRQ2=',F7.2,' DF=',F8.5)
C
      CALL CRAT(SA,SB,NN1,NN2,R,NR)
      CALL PRAT(SA,SB,NN1,NN2,DFA,DFB,R)
C
C
11    CONTINUE
      CLOSE 10
```

```
117:          ACCEPT 'MORE DATA(Y=1)?',IY
118:          IF(IY.EQ.1)CALL ERASE
119:          IF(IY.EQ.1)GOTO 44
120:          TYPE 'END OF PROGRAM'
121:          STOP
122:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 14, 1981  3:00:08 PM

                                FSEIS.FR

  1:          SUBROUTINE FSEIS(X,NPTS,ID,SNAM,T,DT,DB,OR,MAG,IFM,JFM,
  2:         *EPD,AZ,AIN,PT,ST,LU,ISW)
  3:     C    SUBROUTINE TO READ TEXT FILES GENERATED
  4:     C    BY ( . . . ) OPTION OF SISDS
  5:     C
  6:     C    P.R.STEVENSON 11-28-80
  7:     C    MODIFIED 2-13-81 TO ACCOMODATE NEW SPRINT FORMAT P.R.S.
  8:     C
  9:     C    X    = DATA ARRAY
 10:     C    NPTS = NUMBER OF POINTS TO BE OUTPUT
 11:     C           (ON INPUT IT IS THE MAXIMUM
 12:     C           PERMISSIBLE NUMBER TO STORE IN X)
 13:     C    ID   = EVENT IDENTIFICATION
 14:     C    SNAM = STATION NAME
 15:     C    T    = TIME OF START OF DATA(HR,MIN,SEC)
 16:     C    DT   = SAMPLING INTERVAL
 17:     C    DB   = STATION ATTENUATION SETTING(DECIBELS)
 18:     C    OR   = ORIGIN TIME(HR,MIN SEC) AND PLACE(LAT,LAT-MIN,LONG,LONG MIN)
 19:     C    MAG  = ESTIMATED MAGNITUDE
 20:     C    IFM  = P-WAVE FIRST MOTION DIRECTION
 21:     C    JFM  = S-WAVE FIRST MOTION DIRECTION
 22:     C    EPD  = EPICENTRAL DISTANCE
 23:     C    AZ   = AZIMUTH
 24:     C    AIN  = ANGLE OF INCIDENCE
 25:     C    PT   = P-ARRIVAL TIME (HR,MIN,SEC)
 26:     C    ST   = S-ARRIVAL TIME (HR,MIN,SEC)
 27:     C    LU   = LOGICAL UNIT OF INPUT FILE
 28:     C    ISW  = MESSAGE SWITCH, ISW=0 FOR NO MESSAGE, ISW=1
 29:     C           FOR PRINT OUT INPUT DATA TO MESSAGE FILE.
 30:          INTEGER X
 31:          DIMENSION X(1),I9(5),T(3),OR(7),ICARD(40),PT(3),ST(3)
 32:          INTEGER DUM,DB,AIN,AZ
 33:          REAL MAG
 34:          MMAX = NPTS
 35:          NREM = 0
 36:     C
 37:          ISKIP = 2H-
 38:          IP = 2HP
 39:          IS = 2HS
 40:          ILIN = 2H--
 41:          READ(LU,100,END=500)ID,T,DT
 42:     100  FORMAT(5X,5A2,10X,2F2.0,2X,F8.3,2X,F5.3)
 43:          READ(LU,101,END=500)SNAM,NPTS
 44:     101  FORMAT(10X,A4,14X,I8)
 45:     C
 46:     C  MODS OF 2-13-81 TO ACCOMODATE NEW SPRINT FORMAT
 47:          READ(LU,103,END=300)OR,MAG
 48:     103  FORMAT(7X,2F2.0,F6.2,F3.0,1X,F5.2,F4.0,1X,F5.2,8X,F6.2)
 49:          READ(LU,104,END=500)DB
 50:     104  FORMAT(31X,I3)
 51:          DO 5 J=1,2
 52:          READ(LU,105)ICARD
 53:     105  FORMAT(40A2)
 54:          IF(ICARD(1).EQ.ISKIP)GOTO 10
 55:          IF(ICARD(4).EQ.IP)DECODE(ICARD,106)IFM,PT,EPD,AZ,AIN
 56:          IF(ICARD(4).EQ.IS)DECODE(ICARD,106)JFM,ST,EPD,AZ,AIN
```

```
106   FORMAT(8X,A1,10X,2F2.0,1X,F5.2,17X,F6.2,1X,I3,1X,I3)
5     CONTINUE
      READ(LU,105)ICARD
10    READ(LU,105)ICARD
      IF(ICARD(1).NE.ILIM)WRITE(10,105)ICARD
C
C  - END OF MODS -
C
      IF(NPTS.GT.NMAX)NREM = NPTS - NMAX
      IF(NPTS.GT.NMAX)TYPE '--- ',NPTS,' POINTS READ. ---'
      IF(NPTS.GT.NMAX)TYPE '*** TOO MANY POINTS,',NREM,' POINTS SKIPPED! ***'
      IF(NPTS.GT.NMAX)NPTS = NMAX
      READ(LU,102,END=500)(X(J),J=1,NPTS)
102   FORMAT(5X,15I5)
C
      IF(ISW.EQ.0)GOTO 90
      WRITE(10,1000)ID,SNAM
1000  FORMAT('ID=',5A2,' SNAM=',A4)
      TYPE 'NPTS=',NPTS
      WRITE(10,1001)(X(J),J=1,NPTS)
1001  FORMAT('X=',/,(5X,15I5))
90    IF(NREM.NE.0)GOTO 92
C  READ END OF TRACE DELIMITER
      READ(LU,105)ICARD
      RETURN
92    CONTINUE
C  DUMMY READ OF EXCESS DATA
      IEND = 2HEN
91    CONTINUE
      READ(LU,105,END=500)ICARD(1)
      IF(IEND.NE.ICARD(1))GOTO 91
      TYPE 'END OF DUMMY READ!'
      RETURN
500   TYPE '@/@/@ END OF DATA FILE @/@/@'
      STOP
      END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 14, 1981 1:36:51 PM

SPEK.FR

```
   1:          SUBROUTINE SPEK(A,B,C,N,N2,P)
   2:    C
   3:    C - - SUBROUTINE TO TAPER TIME DATA,
   4:    C - - FILL DATA OUT WITH ZEROS, DO FFT,
   5:    C - - AND CALCULATE SPECTRAL AMPLITUDES
   6:    C - - WRITTEN BY P.R.STEVENSON 11/5/80
   7:          INTEGER A(N)
   8:          COMPLEX C(N)
   9:          REAL B(N)
  10:          DO 1 I=1,N
  11:    1     C(I)=(0.,0.)
  12:          DO 2 I=1,N
  13:          R=A(I)
  14:          C(I)=CMPLX(R,0.)
  15:    2     CONTINUE
  16:          IF(P.GT.0.)CALL TAPER(C,N,P)
  17:    C  COMPUTE THE BASE 2 EXPONENT OF N
  18:          M=NEXP(N,2)
  19:          NN=2**M
  20:    C  FILL OUT REST OF TIME WITH ZERO'S
  21:          IF(N.EQ.NN)GOTO 5
  22:          DO 4 J=N+1,NN
  23:          C(J) = CMPLX(0.,0.)
  24:    4     CONTINUE
  25:    5     CONTINUE
  26:          CALL FFT(C,M,NN)
  27:          N2=NN/2
  28:          DO 3 I=1,N2
  29:    3     B(I)=CABS(C(I))
  30:          RETURN
  31:          END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, DECEMBER 3, 1980 8:51:41 PM

TAPER.FR

```
  1:          SUBROUTINE TAPER(B,N,P)
  2:    C    THIS ROUTINE PUTS A 'COSINE BELL'
  3:    C    TAPER ON THE DATA IN ARRAY B
  4:    C    P IS THE FACTOR WHICH DETERMINES
  5:    C    THE % OF TAPERING ON EACH END
  6:          COMPLEX B(N)
  7:          PI=3.1415926
  8:    CC
  9:          NXPTS=N
 10:          M=P*N
 11:          L=N/2-M
 12:          DO 7 J=1,M
 13:          ARG=PI*(J-M)/M
 14:    7     B(J)=B(J)*(.5+.5*COS(ARG))
 15:          NX=NXPTS-M
 16:          DO 8 J=NX,NXPTS
 17:          ARG=PI*(J-2*L-M)/M
 18:    8     B(J)=B(J)*(.5+.5*COS(ARG))
 19:          RETURN
 20:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, NOVEMBER 5, 1980  11:45:51 AM

                                FFT.FR

  1:          SUBROUTINE FFT(A,M,N)
  2:    C   FORTRAN CODE FOR A DECIMATION-IN-TIME,RADIX 2,IN-PLACE FFT
  3:    C   AFTER COOLEY,LEWIS,AND WELCH
  4:    C   COPIED FROM RABINER AND GOLD(1975),PAGE 367
  5:    C   AND INSTALLED ON THE DATA GENERAL ECLIPSE BY
  6:    C   PETE STEVENSON (6-22-78)
  7:    C
  8:          COMPLEX A(N),U,W,T
  9:          N = 2**M
 10:          NV2 = N/2
 11:          NM1 = N - 1
 12:          J = 1
 13:          DO 7 I = 1,NM1
 14:          IF(I .GE. J) GO TO 5
 15:          T = A(J)
 16:          A(J) = A(I)
 17:          A(I) = T
 18:    5     K = NV2
 19:    6     IF(K .GE. J)GO TO 7
 20:          J = J - K
 21:          K = K/2
 22:          GO TO 6
 23:    7     J = J + K
 24:          PI = 3.141592653589793
 25:          DO 20 L = 1,M
 26:          LE = 2**L
 27:          LE1 = LE/2
 28:          U = (1.0,0.)
 29:          W= CMPLX(COS(PI/LE1),-SIN(PI/LE1))
 30:          DO 20 J = 1,LE1
 31:          DO 10 I = J,N,LE
 32:          IP = I + LE1
 33:          T = A(IP) * U
 34:          A(IP) = A(I) - T
 35:    10    A(I) = A(I) + T
 36:    20    U = U * W
 37:          RETURN
 38:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, DECEMBER 3, 1980  8:52:20 PM

                                NEXP.FR

  1:          FUNCTION NEXP(N,NBASE)
  2:    C  FUNCTION CALCULATES THE LARGEST POWER
  3:    C  OF TWO SUCH THAT 2**NEXP <= N
  4:    C  WRITTEN BY P.R.STEVENSON
  5:    C
  6:          XN=NBASE
  7:          XPTS=N
  8:          X=ALOG(XPTS)/ALOG(XN)
  9:          LX=X
 10:          RX=LX
 11:          IF(X.NE.RX)LX=LX+1
 12:          NEXP=LX
 13:          RETURN
 14:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 14, 1981  3:01:05 PM

                              DSPEK.FR

    1:          SUBROUTINE DSPEK(A,N,B,M,G,L,SPS,A1,A2,FQ1,FQ2,T1,T2,LABEL1,LABEL2,
    2:         *LABEL3,L1,L2,L3,SNAM,ID)
    3:          INTEGER B
    4:          DIMENSION A(N),B(M),G(L),ID(5),LABEL1(1),LABEL2(5),LABEL3(1),LLL(21)
    5:          DIMENSION ICHAR(1)
    6:    C
    7:    C - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
    8:    C
    9:    C - - ROUTINE TO DISPLAY SEISMIC AMPLITUDE SPECTRA AND THE ASSOCIATED
   10:    C - - TIME SERIES ON A TEKTRONIX 4014 USING THE PLOT10 PACKAGE.
   11:    C
   12:    C          PETER R. STEVENSON 11-19-80
   13:    C    MODIFIED 2-24-81 TO INCLUDE NOISE SPECTRA
   14:    C
   15:    C - - PARAMETERS:
   16:    C       A = INPUT SPECTRA
   17:    C       N = NUMBER OF SPECTRAL VALUES
   18:    C       B = INPUT SEISMIC TIME SERIES
   19:    C       M = NUMBER OF TIME SERIES VALUES
   20:    C       A1 = MINIMUM AMPLITUDE VALUE
   21:    C       A2 = MAXIMUM AMPLITUDE VALUE
   22:    C       FQ1 = MINIMUM SPECTRAL FREQUENCY TO BE DISPLAYED
   23:    C       FQ2 = MAXIMUM     "          "     "  "     "
   24:    C       T1 = FIRST POINT OF TIME SERIES USED IN SPECTRA
   25:    C       T2 = LAST    "   "    "   "      "    "     "
   26:    C
   27:    C       SNAM = SEISMIC STATION NAME
   28:    C       ID = EVENT ID(9 CHAR.)
   29:          DATA IZIT/0/
   30:          INTEGER HX,HY,HXL,HYL,TX,TY,TXL,TYL,SX,SY,SXL,SYL
   31:    C  DESCRIPTION OF HEADER POSITION
   32:          DATA HX,HY,HXL,HYL/404,2954,3498,48/
   33:    C  DESCRIPTION OF TIME SERIES WINDOW POSITION
   34:          DATA TX,TY,TXL,TYL/404,2348,3498,566/
   35:    C  DESCRIPTION OF SPECTRA WINDOW POSITION
   36:          DATA SX,SY,SXL,SYL/404,303,3498,2020/
   37:    C
   38:    C  IF FIRST TIME THROUGH, INITIALIZE PLOT ROUTINES
   39:          IF(IZIT.NE.0)GOTO 1
   40:          CLOSE 10
   41:          OPEN 10,'SPEKLIST',ATT='A'
   42:          OPEN 4,'$TTO1'
   43:          OPEN 5,'$TTI1'
   44:          CALL INITT(0)
   45:          CALL TERM(3,4096)
   46:          CALL SETBUF(3)
   47:          CALL CHRSIZE(4)
   48:          CALL TSEND
   49:          CALL HITEK(1,0)
   50:          IZIT = 1
   51:    1     CONTINUE
   52:    C
   53:          YM = -512.
   54:          YR = 1024
   55:          IC = 2
   56:          TIC = 10.
```

```
      TL=M
      DX = 1./SPS
C  COMPUTE FREQ SAMPLE INTERVAL
      DF = SPS/(2*(N-1))
C  COMPUTE FREQ INTERVAL FOR NOISE
      DN = SPS/(2*(L-1))
C  SELECT DASHED LINE CODE (SEE TEKTRONIX PLOT10 USER MANUAL)
      LDSH = 2
C
      XM = 0.
      XR = M*DX
C  SETUP TIME SERIES WINDOW
      CALL VPORT(XM,XR,YM,YR,TX,TXL,TY,TYL,TIC,IC)
C   PLOT SEISMIC TRACE
      CALL ITRACE(B,M,XM,DX)
C   DASHED LINES INDICATE WHERE SPECTRA WAS SAMPLED
      CALL MOVEA(T1,YM)
      CALL DASHR(0.,YR,3)
      CALL MOVEA(T2,YM)
      CALL DASHR(0.,YR,3)
C  SETUP SPECTRA WINDOW(LOG-LOG)
      CALL LPORT(FQ1,FQ2,A1,A2,SX,SXL,SY,SYL)
      CALL TRACE(A,N,DF,DF)
C  PLOT NOISE SPEKTRA AS DASHED LINE
      CALL TDASH(G,L,DN,DN,LDSH)
C
C
C   RESTORE LINER MAPPING AND FULL SCREEN
      CALL LINTRN
      CALL SWINDO(0,4095,0,3120)
      CALL VWINDO(0.,4095.,0.,3120.)
C  LABEL PLOT
C - - - - - - - - - - - - - - - - - -
C  LABEL HEADER
      HXX=HX
      HYY=HY
      CALL MOVEA(HXX,HYY)
      ENCODE(LLL,100)SNAM
100   FORMAT(A4)
      CALL AOUTST(4,LLL)
      RX = HX + HXL/2 - LINWDT(L1/2)
      CALL MOVEA(RX,HYY)
      KL=L1/2+1
      ENCODE(LLL,101)(LABEL1(KK),KK=1,KL)
101   FORMAT(20A2)
      CALL AOUTST(L1,LLL)
      RX = HX + HXL - LINWDT(16)
      CALL MOVEA(RX,HYY)
      ENCODE(LLL,102)ID
102   FORMAT('EVENT: ',4A2,A1)
      CALL AOUTST(16,LLL)
C - - - - - - - - - - - - - - - - - -
C    LABEL VERTICAL AXIS OF SPECTRA WINDOW
      XLH = -LINHGT(1)
      XOFF = SX - LINWDT(5)
      YOFF = SY + SYL/2 + LINWDT(L2/2)
      CALL MOVEA(XOFF,YOFF)
      DECODE(LABEL2,103)(LLL(KK),KK=1,L2)
103   FORMAT(20A1)
      DO 10 J=1,L2
```

```
      ICHAR(1) = LLL(J)
      CALL AOUTST(1,ICHAR)
      YOFF =YOFF + XLH
      CALL MOVEA(XOFF,YOFF)
10    CONTINUE
C - - - - - - - - - - - - - - - - - - - - -
C  LABEL HORIZONTAL AXIS
      RX = SX + SXL/2. - LINWDT(L3/2)
      RY = SY - LINWDT(5)
      CALL MOVEA(RX,RY)
      KL=L3/2+1
      ENCODE(LLL,101)(LABEL3(KK),KK=1,KL)
      CALL AOUTST(L3,LLL)
C   - - - - - - - - - - - - - - - - - -
      CALL TSEND
      RETURN
      END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- MONDAY, NOVEMBER 24, 1980  10:06:07 AM

                                VPORT.FR

  1:          SUBROUTINE VPORT(R1,RL,S1,SL,IX,LX,IY,LY,TIC,IC)
  2:          DIMENSION SXB(2),SXL(2),SBB(2)
  3:    CC
  4:    CC  IF IC=0, DRAW BOX ONLY
  5:    CC  IF IC=1, PUT ON TIC MARKS AT TIC INTERVALS
  6:    CC  STARTING AT FIRST UNIT INTERVAL
  7:    CC  IF IC=2, ALSO PUT ON FINE TICS AT TIC/10
  8:    CC  INTERVALS
  9:    CC
 10:          S2=S1+SL
 11:          R2=R1+RL
 12:          S=SL/LY
 13:    CC
 14:          CALL VWINDO(R1,RL,S1,SL)
 15:          CALL BOX(IX,LX,IY,LY)
 16:          IF(IC.EQ.0)GO TO 99
 17:          TT=TIC/10
 18:          Y=R1/TIC+1
 19:          Z=INT(Y)*TIC
 20:          NTIC=RL/TIC+1
 21:    CC
 22:          SXB(1)=-60*S
 23:          SXB(2)=60*S
 24:          SXL(1)=-40*S
 25:          SXL(2)=40*S
 26:          SBB(1)=S2
 27:          SBB(2)=S1
 28:    CC
 29:          DO 20 L=1,2
 30:    CC
 31:          SB=SBB(L)
 32:          SIT=SXB(L)
 33:          SLT=SXL(L)
 34:          IF(IC.EQ.1)GO TO 6
 35:          DO 5 K=1,9
 36:          XTT=Z-K*TT
 37:          IF(XTT.LE.R1)GO TO 6
 38:          SLT=SXL(L)
 39:          CALL MOVEA(XTT,SB)
 40:          CALL DRAWR(0.,SLT)
 41:    5     CONTINUE
 42:    CC
 43:    6     CONTINUE
 44:    CC
 45:          DO 1 J=1,NTIC
 46:          XT=Z+(J-1)*TIC
 47:          CALL MOVEA(XT,SB)
 48:    CC  LARGE TIC DRAWN DOUBLE
 49:          CALL DRAWR(0.,SIT)
 50:          CALL DRAWR(0.,-SIT)
 51:          IF(IC.EQ.1)GO TO 1
 52:    CC
 53:    CC  DRAW SMALL TICS
 54:          DO 2 K=1,9
 55:          XTT=XT+TT*K
 56:          IF(XTT.GE.R2)GO TO 1
```

```
57:           CALL MOVEA(XTT,S0)
58:           CALL DRAUR(0.,SLT)
59:    2      CONTINUE
60:    CC
61:    1      CONTINUE
62:    20     CONTINUE
63:    CC
64:    99     RETURN
65:           END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, NOVEMBER 19, 1980  5:28:56 PM

                                BOX.FR

  1:          SUBROUTINE BOX(IX,LX,IY,LY)
  2:    C  P.R.STEVENSON
  3:          CALL SWINDO(IX,LX,IY,LY)
  4:    CC  DRAW BOX
  5:    CC
  6:          CALL MOVABS(IX,IY)
  7:          CALL DRWREL(LX,0)
  8:          CALL DRWREL(0,LY)
  9:          CALL DRWREL(-LX,0)
 10:          CALL DRWREL(0,-LY)
 11:          RETURN
 12:          END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- THURSDAY, APRIL 16, 1981 5:28:38 PM

CRAT.FR

```
  1:          SUBROUTINE CRAT(SA,SB,NA,NB,R,NR)
  2:          DIMENSION SA(NA),SB(NB),R(1)
  3:    C  CALCULATE SPECTRAL RATIO SA/SB
  4:    C  RETURN RATIO IN ARRAY  R
  5:    C  P.R.STEVENSON 4-16-81
  6:    C
  7:          NR = NB/NA
  8:          IF(NR.GT.1)GOTO 10
  9:          IF(NR.EQ.1)GOTO 30
 10:    C  NA > NB
 11:          NR = NA/NB
 12:          CALL COMPR(SA,NA,NB)
 13:          NP = NB
 14:          GOTO 30
 15:    C  NB > NA
 16:    10    CALL COMPR(SB,NB,NA)
 17:          NP = NA
 18:    C  CALCULATE RATIO
 19:    30    CONTINUE
 20:          DO 31 J=1,NP
 21:    31    R(J) = SA(J)/SB(J)
 22:          WRITE(10,101)NP
 23:    101   FORMAT('SPECTRAL RATIO',I5,' POINTS')
 24:          WRITE(10,100)(R(J),J=1,NP)
 25:    100   FORMAT(5(E12.5,2X))
 26:          RETURN
 27:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 14, 1981  3:02:09 PM

                                COMPR.FR

  1:          SUBROUTINE COMPR(SA,NA,NB)
  2:          DIMENSION SA(NA)
  3:    C  THIS ROUTINE COMPRESSES SA FROM NA TO NB POINTS
  4:    C
  5:          NR = NA/NB
  6:          JJ = 1
  7:          DO 10 J=1,NA,NR
  8:          SUM = 0.
  9:          DO 11 K=1,NR
 10:          KK = J+K-1
 11:          SUM = SA(KK) + SUM
 12:    11    SUM = SUM/NR
 13:          SA(JJ) = SUM
 14:    10    JJ = JJ + 1
 15:          RETURN
 16:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- THURSDAY, MARCH 12, 1981  9:48:20 AM

                                ITRACE.FR

  1:          SUBROUTINE ITRACE(A,NL,S,DX)
  2:          INTEGER A(NL)
  3:    C  ROUTINE TO PLOT ONE TRACE USING TEKTRONIX PACKAGE
  4:    C  P.R.STEVENSON  11-25-80
  5:    C    A  = AMPLITUDE
  6:    C    NL = NUMBER OF POINTS
  7:    C    S  = STARTING X COORDINATE
  8:    C    DX = VALUE OF EACH X INCREMENT
  9:    C
 10:          R = A(1)
 11:          CALL MOVEA(S,R)
 12:          DO 1 J=2,NL
 13:          X = J*DX
 14:          R = A(J)
 15:          CALL DRAWA(X,R)
 16:    1     CONTINUE
 17:          CALL TSEND
 18:          RETURN
 19:          END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- FRIDAY, DECEMBER 5, 1980 10:14:15 AM

LPORT.FR

```
  1:          SUBROUTINE LPORT(X1,X2,Y1,Y2,SX,SXL,SY,SYL)
  2:    C
  3:    C   SUBROUTINE TO PLOT LOG-LOG AXIS AND TO CALL
  4:    C   LOGTRAN(TEKTRONIX) TO SET UP TRANSFORMATION
  5:    C   P.R.STEVENSON   11-19-80
  6:    C
  7:          REAL INTX,INTY
  8:          INTEGER SS,TT,UU,VV
  9:          INTEGER SX,SXL,SY,SYL
 10:    C   X1 = MINIMUM X-VALUE
 11:    C   X2 = MAXIMUM X-VALUE
 12:    C   Y1 = MINIMUM Y-VALUE
 13:    C   Y2 = MAXIMUM Y-VALUE
 14:    C
 15:          YRNG = ALOG10(Y2/Y1)
 16:          XRNG = ALOG10(X2/X1)
 17:          ARNG = IFIX(YRNG)
 18:          FRNG = IFIX(XRNG)
 19:          IF(YRNG-ARNG.GT.0.)ARNG = ARNG + 1.
 20:          IF(XRNG-FRNG.GT.0.)FRNG = FRNG + 1.
 21:    C
 22:          CALL SWINDO(SX,SXL,SY,SYL)
 23:          XLE = 10.**FRNG
 24:          YLE = 10.**ARNG
 25:          XM = X2/XLE
 26:          YM = Y2/YLE
 27:          XL = X2 - XM
 28:          YL = Y2 - YM
 29:          CALL VWINDO(XM,XL,YM,YL)
 30:          CALL BOX(SX,SXL,SY,SYL)
 31:    C
 32:          JL = FRNG
 33:          KL = ARNG
 34:          INTX = XL/FRNG
 35:          INTY = YL/ARNG
 36:          SS = 60
 37:          TT = 60
 38:          UU = 30
 39:          VV = 30
 40:          XX2 = XM + XL
 41:          YY2 = YM + YL
 42:    C  DRAW HORIZONTAL TICS
 43:          DO 20 J=1,JL
 44:    C PUT IN LOG TICS
 45:          DO 21 L=2,8,2
 46:          DD = (J-1)*INTX + XM + ALOG10(FLOAT(L))*INTX
 47:          CALL MOVEA(DD,YM)
 48:          CALL DRWREL(0.,UU)
 49:          CALL MOVEA(DD,YY2)
 50:          CALL DRWREL(0.,-UU)
 51:    21    CONTINUE
 52:    C
 53:          D = J*INTX + XM
 54:          DO 22 JR=1,2
 55:          CALL MOVEA(D,YM)
 56:          CALL DRWREL(0,SS)
```

```
57:           CALL MOVEA(D,YY2)
58:    22     CALL DRWREL(0,-SS)
59:    20     CONTINUE
60:    C   DRAW VERTICAL TICS
61:    C
62:           DO 30 K=1,KL
63:    C PUT IN LOG TICS
64:           DO 31 L=2,8,2
65:           DD = (K-1)*INTY + YM + ALOG10(FLOAT(L))*INTY
66:           CALL MOVEA(XM,DD)
67:           CALL DRWREL(VV,0.)
68:           CALL MOVEA(XX2,DD)
69:           CALL DRWREL(-VV,0.)
70:    31     CONTINUE
71:           D = K*INTY
72:           DO 32 JR=1,2
73:           CALL MOVEA(XM,D)
74:           CALL DRWREL(TT,0)
75:           CALL MOVEA(XX2,D)
76:    32     CALL DRWREL(-TT,0)
77:    30     CONTINUE
78:    C   INVOKE LOG-LOG TRANSFORMATION
79:           CALL LOGTRN(3)
80:           RETURN
81:           END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, DECEMBER 3, 1980  8:52:55 PM

                                TRACE.FR

  1:          SUBROUTINE TRACE(A,NL,S,DX)
  2:          DIMENSION A(NL)
  3:    C  ROUTINE TO PLOT ONE TRACE USING TEKTRONIX PACKAGE
  4:    C  P.R.STEVENSON  11-25-80
  5:    C   A  = AMPLITUDE
  6:    C   NL = NUMBER OF POINTS
  7:    C   S  = STARTING X COORDINATE
  8:    C   DX = VALUE OF EACH X INCREMENT
  9:    C
 10:          CALL MOVEA(S,A(1))
 11:          DO 1 J=2,NL
 12:          X = J*DX
 13:          CALL DRAWA(X,A(J))
 14:    1     CONTINUE
 15:          CALL TSEND
 16:          RETURN
 17:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, FEBRUARY 24, 1981  4:01:25 PM

                                TDASH.FR

  1:          SUBROUTINE TDASH(A,NL,S,DX,LDSH)
  2:          DIMENSION A(NL)
  3:    C  ROUTINE TO PLOT ONE DASHED TRACE USING TEKTRONIX PACKAGE
  4:    C  P.R.STEVENSON  2-24-81
  5:    C    A  = AMPLITUDE
  6:    C    NL = NUMBER OF POINTS
  7:    C    S  = STARTING X COORDINATE
  8:    C    DX = VALUE OF EACH X INCREMENT
  9:    C    LDSH = TEKTRONIX DASH CODE
 10:    C
 11:          CALL MOVEA(S,A(1))
 12:          DO 1 J=2,NL
 13:          X = J*DX
 14:          CALL DASHA(X,A(J),LDSH)
 15:    1     CONTINUE
 16:          CALL TSEND
 17:          RETURN
 18:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- THURSDAY, FEBRUARY 19, 1981  4:49:27 PM

                              SMOOTH.FR

  1:          SUBROUTINE SMOOTH(A,N)
  2:    C    P.R.STEVENSON  2-19-81
  3:    C    SUBROUTINE TO PERFORM 5-POINT SMOOTHING
  4:    C
  5:    C    DATA IS STORED INTO ARRAY A
  6:    C
  7:          DIMENSION A(N),R(5)
  8:          NA = 5
  9:          L = 2
 10:    C
 11:    C    LOAD SLIDING REGISTER
 12:          DO 1 J=1,NA
 13:    1     R(J) = A(J)
 14:    C
 15:    C   1ST TWO POINTS ARE THREE AND FOUR POINT AVERAGES
 16:          S1 = A(1) + A(2) + A(3)
 17:          S2 = S1 + A(4)
 18:          A(1) = S1/3
 19:          A(2) = S2/4
 20:    C
 21:    C
 22:    C   MAIN AVERAGING LOOP
 23:          DO 2 J=1+L,N-L
 24:          SS=0.
 25:          DO 3 JJ=1,NA
 26:    3     SS = SS + R(JJ)
 27:          A(J) = SS/NA
 28:          IF(J.EQ.N-L)GOTO 2
 29:    C   SHIFT REGISTER BY ONE SAMPLE
 30:          DO 4 K=1,NA-1
 31:    4     R(K) = R(K+1)
 32:          R(NA) = A(J+L+1)
 33:    C
 34:    2     CONTINUE
 35:    C
 36:    C   COMPUTE TRAILING AVERAGES
 37:          SN = R(3) + R(4) + R(5)
 38:          SN = SN + R(2)
 39:          A(N) = SN/3
 40:          A(N-1) = SN/4
 41:          RETURN
 42:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- THURSDAY, APRIL 16, 1981  4:40:36 PM

                              PRAT.FR

  1:          SUBROUTINE PRAT(A,B,NA,NB,DFA,DFB,R)
  2:          DIMENSION A(NA),B(NB),R(1),BV1(7),BV2(7)
  3:          DIMENSION BL1(7),BL2(7),BH1(7),BH2(7)
  4:    C    THIS ROUTINE COMPUTES THE SPECTRAL RATION OF
  5:    C    A AND B AT EACH OF THE SPECTAL BANDS
  6:    C
  7:          CALL BAVG(A,NA,DFA,BV1,BL1,BH1)
  8:          CALL BAVG(B,NB,DFB,BV2,BL2,BH2)
  9:    C  COMPUTE RATIOS OF VARIOUS BAND AVERAGES
 10:          DO 1 J=1,7
 11:          R(J) = BV1(J)/BV2(J)
 12:          WRITE(10,100)J,R(J),BL1(J),BH1(J)
 13:    100   FORMAT('BAND # ',I2,2X,'R=',F8.3,' LO=',F5.2,' HI=',F5.2)
 14:    1     CONTINUE
 15:          RETURN
 16:          END
```

```
ECLIPSE FORTRAN 5. VERSION 5.21 -- TUESDAY, MARCH 3, 1981  4:24:17 PM

                                BAVG.FR

  1:          SUBROUTINE BAVG(A,N,DF,BV,BL,BH)
  2:          DIMENSION A(N),R(7),BL(7),BH(7),CF(7),BV(7)
  3:          DATA CF/.5,1.,2.,4.,8.,16.,32./
  4:          EDGE = .5*ALOG(2.)
  5:          BL(1) = EXP(ALOG(CF(1)) - EDGE)
  6:          DO 1 J=1,6
  7:          BH(J) = EXP(ALOG(CF(J)) + EDGE)
  8:    1     BL(J+1) = BH(J)
  9:    C
 10:          BH(7) = EXP(ALOG(CF(7)) + EDGE)
 11:    C
 12:          DO 2 K=1,7
 13:          J1 = BL(K)/DF + 1.5
 14:          J2 = BH(K)/DF + 1.5
 15:          BV(K) = 0.
 16:          DO 3 J=J1,J2
 17:    3     BV(K) = BV(K) + A(J)
 18:          BV(K) = BV(K)/(J2-J1+1)
 19:    C
 20:    2     CONTINUE
 21:          RETURN
 22:          END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 21, 1981 11:11:26 AM

RPLOT.FR

```
   1:    C  PROGRAM RPLOT
   2:    C  THIS PROGRAM IS DESIGNED TO MAKE A PLOT
   3:    C  OF THE SPECTRAL RATIOS AS WRITTEN IN FILE SPEKLIST
   4:    C   P.R.STEVENSON   4-20-81
   5:    C
   6:          DIMENSION HORZN(128),HORZE(128),VERT(128),R(128)
   7:          INTEGER FZ,FE,FN,ID(5),STA(2),OLD(2),COMP
   8:          INTEGER CZ,CN,CE,CV
   9:          OLD(1) = 2H
  10:          OLD(2) = 1H
  11:          IZIT = 0
  12:          CZ = 2HZ
  13:          CV = 2HV
  14:          CN = 2HN
  15:          CE = 2HE
  16:          FZ = 0
  17:          FE = 0
  18:          FN = 0
  19:    C
  20:          OPEN 15,'SPEKLIST'
  21:          OPEN 14,'RLIST'
  22:    10    READ(15,100,END=500)IDUM
  23:    100   FORMAT(A2)
  24:          READ(15,101)ID
  25:    101   FORMAT(9X,4A2,A1)
  26:          READ(15,102,END=500)STA,COMP
  27:    102   FORMAT(8X,A2,A1,A1)
  28:          WRITE(14,102)STA,COMP
  29:    C
  30:          READ(15,104)F1,F2,DF
  31:    104   FORMAT(5X,F7.2,6X,F7.2,4X,F8.5)
  32:          WRITE(14,104)F1,F2,DF
  33:          READ(15,105)NP
  34:    105   FORMAT(14X,I5)
  35:          WRITE(14,105)NP
  36:          IF(IZIT.EQ.1)GOTO 8
  37:          IZIT = 1
  38:          GOTO 6
  39:    8     CONTINUE
  40:          IF(OLD(1).NE.STA(1))GOTO 5
  41:          IF(OLD(2).NE.STA(2))GOTO 5
  42:          GOTO 6
  43:    5     CALL OUTR(HORZN,HORZE,VERT,NP,FN,FE,FZ,R,IER)
  44:          IF(IER.NE.0)GOTO 6
  45:          WRITE(14,103)(R(J),J=1,NP)
  46:          CALL VRAT(R,NP,F1,F2,DF)
  47:          ACCEPT IDUM
  48:          FZ = 0
  49:          FE = 0
  50:          FN = 0
  51:    6     CONTINUE
  52:          IF(COMP.EQ.CZ)GOTO 1
  53:          IF(COMP.EQ.CV)GOTO 1
  54:          IF(COMP.EQ.CN)GOTO 2
  55:          IF(COMP.EQ.CE)GOTO 3
  56:          WRITE(10,300)COMP
```

```
      300   FORMAT('UNIDENTIFIED COMPONENT-',A1)
      C  DUMMY READ
            READ(15,103)(VERT(J),J=1,MP)
            GOTO 7
      1     READ(15,103)(VERT(J),J=1,MP)
      103   FORMAT(5(E12.5,2X))
            FZ = 1
            GOTO 7
      2     READ(15,103)(HORZN(J),J=1,MP)
            FN = 1
            GOTO 7
      3     READ(15,103)(HORZE(J),J=1,MP)
            FE = 1
      7     CONTINUE
            DO 11 J=1,7
      11    READ(15,100)IDUM
            OLD(1) = STA(1)
            OLD(2) = STA(2)
            GOTO 10
      500   CALL OUTR(HORZN,HORZE,VERT,MP,FN,FE,FZ,R,IER)
            IF(IER.NE.0)GOTO 99
            WRITE(14,103)(R(J),J=1,MP)
            CALL VRAT(R,MP,F1,F2,DF)
      99    CONTINUE
            STOP
            END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 21, 1981  11:12:25 AM

                                OUTR.FR

  1:          SUBROUTINE OUTR(HN,HE,V,N,FZ,FE,FM,R,IER)
  2:    C  COMPUTE STATION RATIO ACCORDING TO WHICH
  3:    C  OF THE COMPONENTS ARE AVAILABLE
  4:    C  P.R.STEVENSON  4-17-81
  5:          REAL HN(N),HE(N),V(N),R(N)
  6:          INTEGER FZ,FE,FM
  7:    C  ICODE DETERMINES WHICH COMPUTATION TO
  8:    C  PERFORM, ACCORDING TO WHICH COMPONENTS
  9:    C  ARE PRESENT
 10:    C
 11:          IER = 0
 12:          ICODE = 4*FE + 2*FM + FZ
 13:          WRITE(14,141)ICODE
 14:    141   FORMAT('OUTR-ICODE=',I5)
 15:          GOTO (1,2,3,4,5,6,7),ICODE
 16:    8     TYPE 'NO DATA FOR THIS STATION'
 17:          IER = 1
 18:          RETURN
 19:    1     CONTINUE
 20:          DO 10 J=1,N
 21:    10    R(J) = V(J)
 22:          GOTO 80
 23:    2     CONTINUE
 24:          DO 20 J=1,N
 25:    20    R(J) = HN(J)
 26:          GOTO 80
 27:    3     CONTINUE
 28:          DO 30 J=1,N
 29:    30    R(J) = (HN(J) + V(J))/2.
 30:          GOTO 80
 31:    4     CONTINUE
 32:          DO 40 J=1,N
 33:    40    R(J) =  HE(J)
 34:          GOTO 80
 35:    5     CONTINUE
 36:          DO 50 J=1,N
 37:    50    R(J) = (HE(J) + V(J))/2.
 38:          GOTO 80
 39:    6     CONTINUE
 40:          DO 60 J=1,N
 41:    60    R(J) = SQRT(HE(J)**2 + HN(J)**2)
 42:          GOTO 80
 43:    7     CONTINUE
 44:          DO 70 J=1,N
 45:          R(J) = (SQRT(HE(J)**2 + HN(J)**2) + V(J))/2.
 46:    70    CONTINUE
 47:    C
 48:    80    RETURN
 49:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- MONDAY, APRIL 20, 1981  3:41:28 PM

                                HPORT.FR

  1:          SUBROUTINE HPORT(X1,X2,Y1,Y2,SX,SXL,SY,SYL)
  2:    C
  3:    C    SUBROUTINE TO PLOT LINEAR-LOG AXIS AND TO CALL
  4:    C    LOGTRAN(TEKTRONIX) TO SET UP TRANSFORMATION
  5:    C    P.R.STEVENSON   4-20-81
  6:    C
  7:          REAL INTX,INTY
  8:          INTEGER SS,TT,UU,VV
  9:          INTEGER SX,SXL,SY,SYL
 10:    C    X1 = MINIMUM X-VALUE
 11:    C    X2 = MAXIMUM X-VALUE
 12:    C    Y1 = MINIMUM Y-VALUE
 13:    C    Y2 = MAXIMUM Y-VALUE
 14:    C
 15:          TIC = 10.
 16:          XRNG = ALOG10(X2/X1)
 17:          FRNG = IFIX(XRNG)
 18:          IF(XRNG-FRNG.GT.0.)FRNG = FRNG + 1.
 19:    C
 20:          CALL SWINDO(SX,SXL,SY,SYL)
 21:          XLE = 10.**FRNG
 22:          XM = X2/XLE
 23:          YM = Y1
 24:          XL = X2 - XM
 25:          YL = Y2 - YM
 26:          CALL VWINDO(XM,XL,YM,YL)
 27:          CALL BOX(SX,SXL,SY,SYL)
 28:    C
 29:          JL = FRNG
 30:          KL = YL/TIC + 1
 31:          INTX = XL/FRNG
 32:          INTY = TIC
 33:          SS = 60
 34:          TT = 60
 35:          UU = 30
 36:          VV = 30
 37:          XX2 = XM + XL
 38:          YY2 = YM + YL
 39:    C  DRAW HORIZONTAL TICS
 40:          DO 20 J=1,JL
 41:    C PUT IN LOG TICS
 42:          DO 21 L=2,9,2
 43:          DD = (J-1)*INTX + XM + ALOG10(FLOAT(L))*INTX
 44:          CALL MOVEA(DD,YM)
 45:          CALL DRWREL(0.,UU)
 46:          CALL MOVEA(DD,YY2)
 47:          CALL DRWREL(0.,-UU)
 48:    21    CONTINUE
 49:    C
 50:          D = J*INTX + XM
 51:          DO 22 JR=1,2
 52:          CALL MOVEA(D,YM)
 53:          CALL DRWREL(0,SS)
 54:          CALL MOVEA(D,YY2)
 55:    22    CALL DRWREL(0,-SS)
 56:    20    CONTINUE
```

```
57:   C  DRAW VERTICAL TICS
58:   C
59:         DO 30 K=1,KL
60:         D = K*INTY
61:         DO 32 JR=1,2
62:         CALL MOVEA(XN,D)
63:         CALL DRUREL(TT,0)
64:         CALL MOVEA(XX2,D)
65:   32    CALL DRUREL(-TT,0)
66:   30    CONTINUE
67:   C  INVOKE LINEAR-LOG TRANSFORMATION
68:         CALL LOGTRN(1)
69:         RETURN
70:         END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, NOVEMBER 19, 1980  5:28:56 PM

                                BOX.FR

  1:          SUBROUTINE BOX(IX,LX,IY,LY)
  2:    C  P.R.STEVENSON
  3:          CALL SWINDO(IX,LX,IY,LY)
  4:    CC  DRAW BOX
  5:    CC
  6:          CALL MOVABS(IX,IY)
  7:          CALL DRUREL(LX,0)
  8:          CALL DRUREL(0,LY)
  9:          CALL DRUREL(-LX,0)
 10:          CALL DRUREL(0,-LY)
 11:          RETURN
 12:          END
```

```
ECLIPSE FORTRAN 5, VERSION 5.21 -- WEDNESDAY, DECEMBER 3, 1980  8:52:55 PM

                                TRACE.FR

  1:          SUBROUTINE TRACE(A,NL,S,DX)
  2:          DIMENSION A(NL)
  3:    C   ROUTINE TO PLOT ONE TRACE USING TEKTRONIX PACKAGE
  4:    C   P.R.STEVENSON  11-25-80
  5:    C    A  = AMPLITUDE
  6:    C    NL = NUMBER OF POINTS
  7:    C    S  = STARTING X COORDINATE
  8:    C    DX = VALUE OF EACH X INCREMENT
  9:    C
 10:          CALL MOVEA(S,A(1))
 11:          DO 1 J=2,NL
 12:          X = J*DX
 13:          CALL DRAWA(X,A(J))
 14:    1     CONTINUE
 15:          CALL TSEND
 16:          RETURN
 17:          END
```

ECLIPSE FORTRAN 5, VERSION 5.21 -- TUESDAY, APRIL 21, 1981 10:35:10 AM

VRAT.FR

```
  1:          SUBROUTINE VRAT(R,N,FQ1,FQ2,DF)
  2:    C   P.R.STEVENSON   4-21-81
  3:    C   THIS ROUTINE PLOTS SPECTRAL RATIOS IN A SEMI-LOG FORMAT
  4:    C
  5:          REAL R(N)
  6:          DATA LL/'R','A','T','I','O'/
  7:          INTEGER HX,HY,LL(5),ICHAR(1)
  8:          INTEGER SX,SY,SXL,SYL
  9:          DATA SX,SY,SXL,SYL/404,303,3498,2020/
 10:          DATA IZIT/0/
 11:          IF(IZIT.NE.0)GOTO 1
 12:          OPEN 4,'$TT01'
 13:          OPEN 5,'$TTI1'
 14:          CALL INITT(0)
 15:          CALL TERM(3,4096)
 16:          CALL SETBUF(3)
 17:          CALL CHRSIZE(4)
 18:          CALL TSEND
 19:          CALL HITEK(1,0)
 20:          IZIT = 1
 21:    1     CONTINUE
 22:          CALL ERASE
 23:          A1 = 0.
 24:          A2 = 30.
 25:          CALL HPORT(FQ1,FQ2,A1,A2,SX,SXL,SY,SYL)
 26:          CALL TRACE(R,N,DF,DF)
 27:          CALL LINTRN
 28:          CALL SWINDO(0,4095,0,3120)
 29:          CALL VWINDO(0.,4095.,0.,3120.)
 30:          HX = 404
 31:          HY = 2954
 32:          CALL MOVEA(HX,HY)
 33:          XLH = -LINHGT(1)
 34:          XOFF = SX - LINWDT(5)
 35:          YOFF = SY + SYL/2 + LINWDT(3)
 36:          CALL MOVEA(XOFF,YOFF)
 37:          DO 10 J=1,5
 38:          ICHAR(1) = LL(J)
 39:          CALL AOUTST(1,ICHAR)
 40:          YOFF = YOFF + XLH
 41:          CALL MOVEA(XOFF,YOFF)
 42:    10    CONTINUE
 43:          CALL TSEND
 44:          RETURN
 45:          END
```