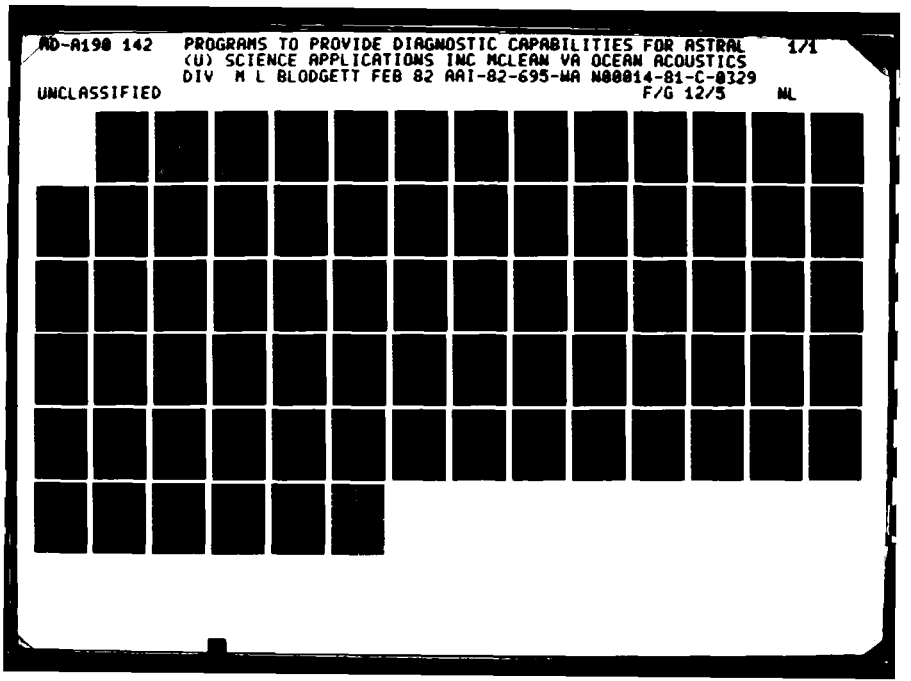
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PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES FOR ASTRAL
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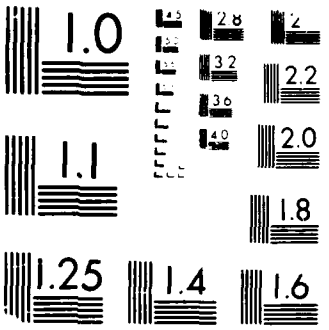

MICROCOPY RESOLUTION TEST CHART

PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES FOR ASTRAL

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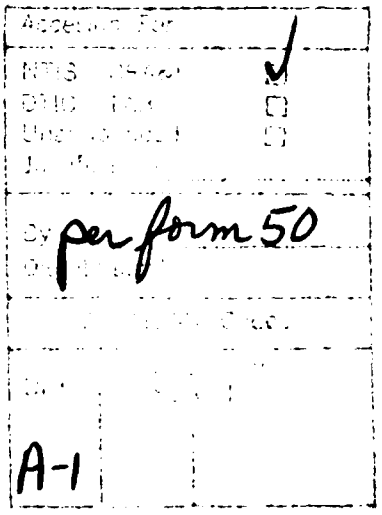
PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES FOR ASTRAL

SAI-82-695-WA



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PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES FOR ASTRAL

SAI-82-695-WA

February 1982

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Section 1
INTRODUCTION

This report documents three computer programs developed to provide ASTRAL users with more diagnostic capabilities. Basically the programs read data files generated by the ASTRAL propagation loss model and display the input. The programs were written for use on the Digital Equipment Corporation VAX 11/780 in FORTRAN utilizing standard CALCOMP plotting software. For each program this report will provide:

A. Brief description of program

B. Modifications made to ASTRAL

C. Table of all input parameters

D. Sample run

E. Source language listing

Section 2
PROGRAM PLTSMDS

2.1 DESCRIPTION OF PROGRAM

The purpose of PROGRAM PLTSMDS is to provide the ASTRAL user with a plot of the modal transmission loss (dB) for each frequency/source depth combination and also the final transmission loss results calculated by ASTRAL.

It is a complete program. The total length is 16896 bytes. It does not require any temporary storage. The execution time obviously will vary with the number of f/ZS combinations. For the sample computer run, the total central processor (CP) time was 4.9 s.

The required input data are listed in table form (Section 2.3). The data fall into two groups: transmission loss as generated by ASTRAL and plot information.

Briefly, PROGRAM PLTSMDS reads the scaling factors for the x-y axes. If this information is omitted, the values last specified are used or, if never specified, default values are supplied. Next the title, minimum and maximum range (nm), and number of nm/inch are read. The axes are drawn and labeled. Finally the parameters specifying the exact frequency/source depth combination to be plotted are read in. The program is now ready to process the data file.

First, the header record is read. It contains the run date, receiver depth, and source and frequency values. This information is used to further entitle the plot. The program reads the data one record at a time. It singles out the modal transmission loss for the correct frequency/source

depth combination and stores the data in core. The final transmission loss results are also read and stored.

The modal transmission loss is plotted for all propagating modes. The points are connected with a solid line and labeled with mode number. The standard transmission loss output is plotted with a dotted line. All the actual plotting instructions are contained in subroutine DLINE3.

When the plot is complete, PROGRAM PLTSMDS cycles back to the beginning of the program to allow the user to plot another frequency/source depth combination for the same or a different track. There is no limit to the number of plots which may be generated.

2.2 MODIFICATIONS TO ASTRAL

PROGRAM PLTSMDS requires a binary unformatted data file containing the modal transmission loss and standard ASTRAL transmission loss results. The data are written on FILE 1. Changes have been made in DRIVER and subroutine INTSUM.

2.2.1 Program DRIVER

Several minor changes have been made to this main driver. It writes the header record for FILE 1. The statement has the form:

```
WRITE(1)(TITLE(L),L=1,8),WHEN,ZR,NZS,(ZS(L),L=1,
NZS),NF,(F(L),L=1,NF)
```

TITLE is obviously the title array and WHEN a variable containing the run date. The receiver depth is ZR. Array ZS

contains NZS source depth values and array F the NF frequency values. Most of this information is available in DRIVER through labeled common /RECVER/ and /SRCFRQ/. The title is defined in a data statement and WHEN is obtained through a call to subroutine DATE.

An end-of-file is written on FILE 1 signaling the end of the modal transmission loss data for one track. The statement is

```
      END FILE 1
```

After subroutine TLOUT has been called to output the transmission loss results, the same results are written out to FILE 1 and terminated with an end-of-file. The set of statements are:

```
      DO 105 LPLOT = 2, IR
      WRITE(1)RANGE(LPLOT),((AMPM(LPLOT,KPLOT,MPLOT),
      KPLOT=1,NZS),MPLOT=1,NF)
105   CONTINUE
      END FILE 1
```

Array AMPM contains the transmission loss values at range (RANGE). There are IR range steps. This information is contained in labeled commons /RANGE/ and /TLINT/.

All of these changes have been incorporated into the track loop which means they will be repeated for each track. Two files are written for each track processed by the ASTRAL model.

2.2.2 Subroutine INTSUM

Subroutine INTSUM attenuates the amplitude of each mode and sums the product of this attenuated amplitude and the source eigenfunction value. The result is divided by the range. Several changes have been made to store the product for each mode at each range step.

The first change was to define a new array SMTL to store the modal transmission loss. It is dimensioned SMTL (3,6,25) since there is a maximum of three source depths, six frequencies, and twenty-five modes.

The entire array is initialized to value 999. Subroutine INTSUM will only generate values for modes M1 through M2, the first and last propagating modes. The 999 value will signal PROGRAM PLTSMDS that all the real data have been processed. The coding used to initialize array SMTL is

```
      DO 700 J=1,NZS
      DO 700 N=1,NF
      DO 700 M=1,25
700   SMTL(J,N,M)=999.
```

where NZS is the number of the source depths, NF the number of frequencies and 25 is the maximum number of modes.

The statements incorporated to calculate the modal transmission loss with a maximum value TLMAX and store the results in array SMTL are:

```
      SMINT=PHIRC(N,M)*PHIM(J,N,M)*R1
      IF(SMINT.LE.AMPMIN)GO TO 41
      SMTL(J,N,M)=-10.*ALOG10(SMINT)+DBCONV
```

```
          GO TO 40
   41     SMTL(J,N,M)=TLMAX
```

Array PHIRC contains the attenuated mode amplitude values and PHIM the source eigenfunction values. The minimum amplitude is defined by AMPMIN, the conversion factor to dB re 1 yd by DBCONV and the maximum transmission loss by TLMAX. All of these variables are in labeled common /MODEMS/ and /CONV/.

Finally the results are written out to FILE 1. The coding is:

```
          DO 701 N=1,NF
          WRITE(1)RANGE(IR),N,((SMTL(J,N,M),M=1,25),
            J=1,NZS)
   701    CONTINUE
```

The array RANGE containing the range at each range step is found in labeled common /RANGES/.

2.3 INPUT TO PROGRAM PLTSMDS

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1	FORMAT (5F10.2)
TLMIND	Minimum transmission loss (dB) - default is 60.0.
TLMAXD	Maximum transmission loss (dB) - default is 130.0.
TLINC	Transmission loss increment (dB/inch) - default is 10.0.

RECORD 1 (continued) FORMAT (5F10.2)

FX	Scale factor for x-axis - default is 1.0. If FX=0.5, tick marks drawn every 0.5 inches and x-axis compressed by 50%. If FX=3.0, tick marks drawn every 3.0 inches and x-axis length is tripled.
FY	Scale factor for y-axis - default is 1.0. Scales y-axis same as FX scales x-axis.

RECORD 1 MAY BE OMITTED. If omitted the program will default to last specified value or to default values if never specified.

RECORD 2 FORMAT (3F10.2,10A4)

RMIN	Minimum range (nm).
RMAX	Maximum range (nm).
RSC	Scale factor - number of nm/inch.
TITLE(10)	Title of plot (40 characters).

RECORD 3 FORMAT (2A4,2X,3I5)

MODEL	Set to SMODES. NO CHOICE. MUST BE SPECIFIED.
ITRK	Number of track to be read on FILE 1 as processed by ASTRAL.
INDEX	Index of frequency array in ASTRAL (not actual frequency value).
NOSRC	Index of source depth array in ASTRAL (not actual source depth value).

RECORD 4 FORMAT (2A4,2X,3I5)

MODEL	Set to TL. NO CHOICE. MUST BE SPECIFIED.
ITRK	Number of track.
INDEX	Index of frequency array in ASTRAL.
NOSRC	Index of source depth array in ASTRAL.

Entire sequence of cards may be repeated for as many plots as desired.

FILE ACCESS NAME FOR001 (FILE 1)
(Unformatted, binary data file written by ASTRAL)

RECORD 1

TITLE(8)	Set to ASTRAL TRANSMISSION LOSS DATA FILE.
RDATE	Date of ASTRAL run (character*9 format).
R	Receiver depth (ft).
NZS	Number of source depths (≤ 3).
ZS(3)	Source depth values (ft).
NDF	Number of frequencies (≤ 6).
DF(6)	Frequency values.

RECORD 2

RANGE	Range (nm).
N	Index of frequency value.
SMTL(J,N,M)	Modal transmission loss (dB) for all J source depths and M modes at frequency DF(N).

RECORD 2 is repeated for each of the NDF frequencies at each range step. Each record contains the modal transmission loss for all source depths at the specified frequency.

EOF	End-of-file signaling end of modal transmission loss for this track.

Record 1

RANGE(J)	Range (nm) at range step J.
AMPM(J,K,M)	Transmission loss (dB) for each frequency/source depth combination at each range step J.

RECORD 1 will be repeated for each range step.

EOF	End-of-file to signal end of transmission loss data for this track.

NOTE: There are two files written onto the binary, data file for each track processed by the ASTRAL transmission loss model. The entire sequence of records is repeated for each track.

2.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

```
100            80.       150.        10.       1.0       1.0
200             0.      1250.       100.SAMPLE RUN FOR PGM PLTSNDS
300   SNDDFS              1     1     1
400   TL                  1     1     1
```

INPUT DATA FOR001 (FILE 1)

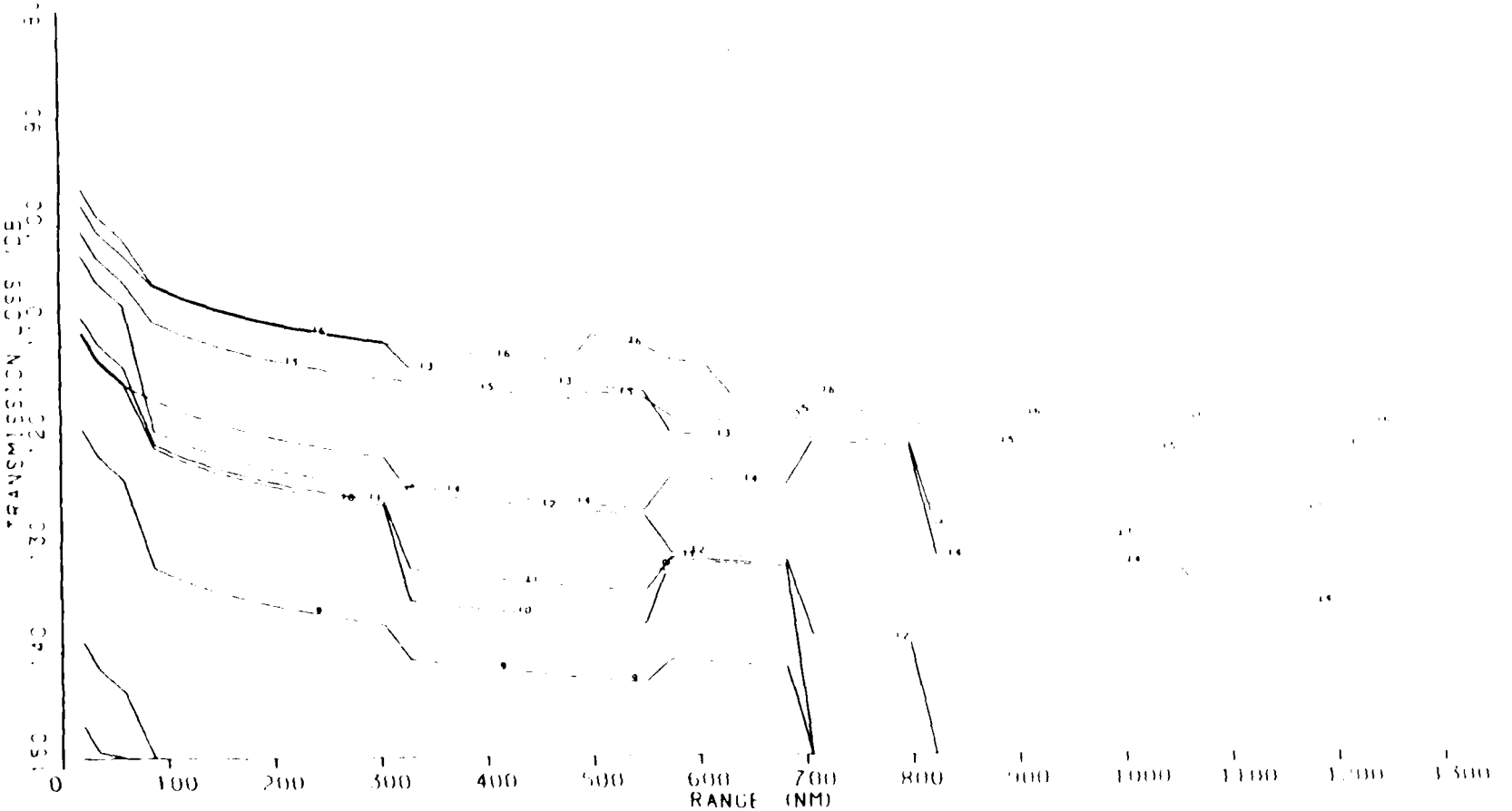
FILE 1 was generated by the ASTRAL propagation loss model using the following input.

100	12 14 14	14 14	15 15 15	14 13	14			
200	0.00	4956.04	98.43	4957.02	246.06	4937.99	656.17	4914.37
300	1640.42	4866.14	1968.50	4857.61	2624.67	4851.71	3280.84	4854.00
400	6561.68	4892.06	9842.52	4942.59	16404.20	5058.40	32808.40	5364.17
500	0.00							
600	0.00	4993.44	65.62	4992.13	246.06	4950.46	492.13	4926.18
700	984.25	4897.64	1312.34	4870.73	1640.42	4852.69	1968.50	4847.44
800	3280.84	4853.02	4921.26	4873.69	6561.68	4893.37	9842.52	4942.91
900	16404.20	5057.74	32808.40	5364.17				
1000	0.00							
1100	0.00	4995.08	98.43	4996.39	246.06	4967.52	656.17	4919.29
1200	984.25	4890.42	1312.34	4867.45	1640.42	4856.30	2296.59	4849.41
1300	3280.84	4852.69	4921.26	4870.41	6561.68	4891.40	9842.52	4942.91
1400	16404.20	5057.74	32808.40	5364.17				
1500	0.00							
1600	0.00	4995.08	164.04	4998.36	328.08	4942.26	492.13	4922.57
1700	820.21	4896.33	1312.34	4852.03	1640.42	4844.49	1968.50	4841.86
1800	2952.76	4849.08	3937.01	4856.30	6561.68	4893.37	9842.52	4942.59
1900	16404.20	5058.40	32808.40	5364.17				
2000	0.00							
2100	0.00	4986.55	246.06	4989.83	410.10	4978.02	820.21	4957.02
2200	1968.50	4870.41	2296.59	4859.58	2624.67	4856.30	3280.84	4856.96
2300	4265.09	4863.85	4921.26	4870.41	6561.68	4893.37	9842.52	4942.59
2400	16404.20	5058.40	32808.40	5364.17				
2500	0.00							
2600	0.00	5020.34	246.06	5026.90	410.10	4999.67	656.17	4981.96
2700	984.25	4972.11	1640.42	4933.40	1968.50	4902.56	2296.59	4879.92
2800	2952.76	4862.86	3937.01	4863.52	4921.26	4871.39	6561.68	4891.73
2900	9842.52	4942.91	16404.20	5058.40	32808.40	5364.17		
3000	0.00							
3100	0.00	5010.17	246.06	5011.81	410.10	4994.75	656.17	4985.89
3200	984.25	4980.97	1312.34	4964.90	2296.59	4882.22	2624.67	4867.45
3300	3280.84	4862.20	3937.01	4863.85	4921.26	4871.06	6561.68	4893.04
3400	9842.52	4943.24	16404.20	5058.07	32808.40	5364.17		
3500	0.00							
3600	0.00	5021.33	65.62	5021.65	164.04	5020.34	328.08	5009.51
3700	492.13	4989.17	984.25	4975.39	1312.34	4961.94	2296.59	4879.59

```
3800      2624.67   4860.24   3280.84   4860.56   4921.26   4872.38   6561.68   4893.37
3900      9842.52   4942.91  16404.20   5057.74  32808.40   5364.17
4000         0.00
4100         0.00   5018.37    410.10   5019.36    656.17   4994.42    984.25   4983.92
4200      1968.50   4920.28   2296.59   4889.44   2624.67   4874.02   3280.84   4863.52
4300      3937.01   4864.83   4921.26   4870.08   6561.68   4891.08   9842.52   4942.91
4400     16404.20   5057.74  32808.40   5364.17
4500         0.00
4600         0.00   5020.34     98.43   5021.00    246.06   5010.83    656.17   4960.63
4700      1312.34   4894.36   1640.42   4874.34   1968.50   4861.22   2952.76   4853.67
4800      3608.92   4859.25   6561.68   4893.37   9842.52   4942.91  16404.20   5057.74
4900     32808.40   5364.17
5000         0.00
5100         0.00   5028.87    246.06   5033.14    492.13   4999.67    656.17   4992.45
5200      1312.34   4982.28   1640.42   4966.21   2624.67   4885.50   2952.76   4877.62
5300      3937.01   4867.78   4921.26   4873.03   6561.68   4893.04   9842.52   4943.24
5400     16404.20   5060.04  32808.40   5364.17
5500         0.00
5600      400      30.00
5700        2    5
5800          60.00     800.00
5900          35.00      50.00     100.00     200.00     400.00
6000       25
6100     FFFFF     0
6200         2     0     2     0     1
6300         1   2964.00     0     0.0000     0.0000     0.0000     0.0000
6400       2964.00
6500       -.18535
6600         18.54
6700         1
6800         31
6900         1250.00    -.00846    -1
7000         0      18.54
7100         8
```

7200		0.00	2964.00	0	.70	3000.00	0	.90	3600.00	0	
7300		1.10	4200.00	0	2.30	6000.00	0	5.30	9000.00	0	
7350		10.43	13654.86	3	18.54	15967.85	3				
7400	1	4	0.00	2388.45							
7500	1	4	2.32	4593.18							
7600	1	3	10.43	13654.86							
7700	1	3	18.54	15967.85							
7800	1	3	34.77	17083.33							
7900	2	3	59.10	17385.17							
8000	2	3	172.73	18287.40							
8100	3	3	302.85	18963.25							
8200	3	3	376.22	17992.13							
8300	3	3	408.89	16955.38							
8400	3	3	441.59	15846.46							
8500	3	1	449.77	15305.12							
8600	3	1	466.14	14412.73							
8700	3	1	482.52	13674.54							
8800	3	3	498.92	13441.60							
8900	3	3	539.95	14274.93							
9000	4	3	548.17	14537.40							
9100	4	1	597.53	14852.36							
9200	4	1	605.89	16043.31							
9300	5	1	681.07	16820.87							
9400	5	1	729.81	17818.24							
9500	6	1	796.34	18510.50							
9600	6	3	846.42	19143.70							
9700	6	4	997.77	19757.22							
9800	6	4	1006.23	16781.50							
9900	6	4	1014.70	18664.70							
10000	6	3	1025.36	19133.86							
10100	7	4	1048.62	19570.21							
10200	7	4	1185.29	16679.79							
10300	7	4	1193.88	18448.16							
10400	7	3	1202.49	18454.72							

TITLE	FREQUENCY	SOURCE	RECEIVER	RUN DATE
MODES	35.0 HZ	60.0 FT	2964.0 FT	19 JAN 82
TL	35.0 HZ	60.0 FT	2964.0 FT	19 JAN 82



2.5 SOURCE LANGUAGE LISTING

```
      PROGRAM PLTSMDS
C
C
C     ******************************************************************
C
C  TAPE1 --  INPUT FILE FOR PROGRAM
C  PROGRAM ASSUMES QUANTITIES ARE IN NMI AND TL RE L YARD.
C
      COMMON/SYMFPN/M,II
      CHARACTER*9 RDATE
      DIMENSION TLPLOT(400,26),RANGE(400),SMTL(3,25)
      DIMENSION ZS(3)
      LOGICAL METRIK
      REAL NUM,NMTOKM
      INTEGER CHH,YCH,TITLE(20),TITLE1(20),TITLE2(40)
      DIMENSION ICAP(7),YA(6),DF(6),TTLE(3),TTLEKM(3)
      DIMENSION MODEL(2)
      DIMENSION NLINE(10),NSPACE(10),NSHORT(10),NLONG(10)
      EQUIVALENCE (YI,TLMAX),(YF,TLMIN),(XI,RMIN),(XF,RMAX)
C
      DATA NLINE /100000,2,5,10,20,20,20,20,20,20/,
     X     NSPACE /0,4,5,10,10,10,10,10,10,10/,
     *     NSHORT /0,0,0,0,0,1,2,1,1,3/,
     *    NLONG /0,0,0,0,0,1,1,2,3,1/
      DATA TLMIN,TLMAX,TLSC /60.,130.,-10./
      DATA METRIK/.FALSE./
      DATA TWOCM /1./, NMTOKM /1./, DBCON /0./
      DATA FACTX,FACTY/1.,1./
      DATA TTLE/4HRANG,4HE (N,4HM)  /
      DATA TAHEAD /0./, ICURVE /0/, IREP /0/
      DATA CTL/54,64/
C
```

```
 4300    C
 4400    C
 4500    C
 4600    C     ************************************************************************
 4700    C     ************************************************************************
 5350          OPEN(UNIT=50,TYPE='NEW',NAME='TTA2:X,Y')
 5375          OPEN(UNIT=1,TYPE='UNKNOWN',FORM='UNFORMATTED')
 5393          CALL PLOTS(0,0,50)
 5396          LC=5
 5398          LP=6
 5399          IFILE=1
 5900          CALL PLOT(1.5,1.0,-3)
 6000    C     (END INITIALIZATION.)
 6100    C     ************************************************************************
 6200    C     ************************************************************************
 6300    C
 6400    C
 6500    C     BEGIN MAJOR LOOP ON STACKED CASES (MULTIPLE PLOTS<
 6600     50   CONTINUE
 6700          ICURVE=0
 6900    C
 7000    C     ************************************************************************
10600    C
10700    C
10800    C     CARD (?<-- IF ACCEPTABLE TO @READ@, TL AXIS PARAMETERS AND X/Y
10900    C     SCALING FACTORS WERE SPECIFIED.
11000    C          TLMIN--Y-AXIS VALUE AT TOP OF PAGE (MIN DB<
11100    C          TLMAX--Y-AXIS VALUE AT BOTTOM OF PAGE (DB MAX<
11200    C          TLINC--DB PER TICK MARK (***POSITIVE***<
11300    C          FACTX,FACTY--AXIS AND DATA SCALING, E.G., IF FACTX # 0.75,
11400    C               X-AXIS TICKS ARE DRAWN EVERY 0.75 INCHES--PLOT IS
11500    C               REDUCED IN X-DIRECTION BY 25 PER CENT.  IF FACTX # 2.0,
11600    C               PLOT LENGTH IS DOUBLED.
11700    C     *** THIS CARD IS OPTIONAL ***  DEFAULTS ARE THE VALUES LAST SPECI-
11800    C     FIED ON SOME PREVIOUS GRAPH, OR IF NEVER SPECIFIED,  ARE--
11900    C          60.,130.,10.,1.,1.
12000    C     IF TLMIN, -MAX, -INC LEFT BLANK, DEFAULTS TO PRIOR VALUE.
```

```
12100    C      IF FACTX, FACTY LEFT BLANK, DEFAULTS TO PRIOR VALUE.
12200    C
12300     31    READ(LC,32,END=1000,ERR=33)TLMIND,TLMAXD,TLINC,FX,FY
12400     32    FORMAT(8F10.2)
12500           GO TO 35
12600     33    BACKSPACE 5
12700           GO TO 37
12900    C
13000     35    CONTINUE
13100           IF(FX.EQ.0.) FX=FACTX
13200           IF(FY.EQ.0.) FY=FACTY
13300           FACTX=FX
13400           FACTY=FY
13500           IF(TLMIND.EQ.0. .AND. TLMAXD.EQ.0.) GO TO 37
13600           TLMIN=TLMIND
13700           TLMAX=TLMAXD
13800           TLSC=-TLINC
13900    C
14000    C      CHANGE AXIS SCALING IF AXIS TOO LONG.
14100           IF( (.NOT. METRIK) .AND. (TLMAX.GT.(TLMIN-8.*TLSC/FACTY)))
14200          *  TLMAX=TLMIN+TLINC*8.
14300           IF( (METRIK) .AND. (TLMAX.GT.(TLMIN-10.*TLSC/FACTY)))
14400          *   TLMAX=TLMIN+TLINC*10.
14500    C      ************************************************************
14600    C
14700    C      CARD (3<--RANGE-AXIS CARD ***NECESSARY FOR EACH SET OF AXES.***
14800    C      IF CARD UNACCEPTABLE TO READ, INPUTS ARE IN ERROR--STOP.
14900     37    CONTINUE
15000           READ(5,60,END=1000,ERR=63)  RMIN,RMAX,RSC,(TITLE(I),I=1,10)
15200        60 FORMAT (3F10.2,10A4)
15300    C
15400           GO TO 65
15500    C
15600    C      IF READ ERROR, PRINT MESSAGE AND STOP
15700    C
15800        63 PRINT 64
```

```
15900       64 FORMAT(' ++++++++++++ READ ERROR WAS FATAL -- CHECK THE INDICATED
16000         + CARD +++++++++++++++')
16100           GO TO 1000
16200     C
16300      65     CONTINUE
17700     C       SIZEB IS HEIGHT OF NUMBERS, SIZEW IS WIDTH (IN INCHES<
17750           XSC=RSC/FACTX
17775           YSC=TLSC/FACTY
17800           SIZEB=.14
17900           SIZEW=.12
18000           MAG=-1
18200     C
18300     C       ***************************************************************************
18400     C
18500     C       PLOT X AXIS
18600           NLEN=(RMAX-RMIN)/RSC+.5
18700           XLEN=NLEN*TWOCM
18900           CALL PLOT(0.,-.1,2)
19000           NUM=RMIN
19100           CALL NUMBER(-.12,-.3,SIZEB,NUM,0.,MAG)
19200           CALL PLOT(0.,0.,3)
19300           NLEN=(RMAX-RMIN)/RSC +.5
19400           DO 150 I=1,NLEN
19500           NUM=NUM+RSC
19600           X=FLOAT(I)*TWOCM*FACTX
19700           CALL PLOT(X,0.,2)
19800           CALL PLOT(X,-.1,2)
19900           CALL NUMBER(X -.12,-.3,SIZEB,NUM,0.,MAG)
20000           CALL PLOT(X,0.,3)
20100       150 CONTINUE
20200           XLEN=X
20300           NCH=10
20400           ASTART=(X-NCH*SIZEW)*.5
20600           CALL SYMBOL(ASTART,-.5,SIZEB,TTLE,0.,NCH)
20900         2 CALL PLOT(0.,0.,3)
21000     C       (END X-AXIS)
```

```
C
C     ******************************************************************
C
C      PLOT Y AXIS
      MAG = -1
C
      CALL PLOT(-.1,0.,2)
      NUM=TLMAX
      CALLNUMBER(-.16,-.12,SIZEB,NUM,90.,MAG)
      CALL PLOT(0.,0.,3)
      NLEN=(YF-YI)/TLSC+.5

      DO 200 I=1,NLEN
      NUM=NUM+TLSC
      Y=FLOAT(I)*TWOCM*FACTY
      CALL PLOT(0.,Y,2)
      CALL PLOT(-.1,Y,2)
      CALL NUMBER(-.16,Y-.12,SIZEB,NUM,90.,MAG)
      CALL PLOT(0.,Y,3)
  200 CONTINUE
      YLEN=Y
      NCH=22
      ASTART=(Y-NCH*SIZEW)*.5
      CALLSYMBOL(-.36,ASTART,SIZEB,22HTRANSMISSION LOSS (DB) ,90.,NCH)
C     (END Y AXIS)
C
C     ******************************************************************
C
C     WRITE TITLE AND LABEL HEADINGS
      CALL SYMBOL(.5,9.1,.21,TITLE,0.,40)
      ENCODE(63,225,TCAP)
  225 FORMAT(7X,5HTITLE,6X,9HFREQUENCY,6X,6HSOURCE,5X,8HRECEIVER,3X,
     *   8HRUN DATE )
      CALL SYMBOL(0.5,8.8,SIZEB,TCAP,0.,63    )
      CAPH=8.6
      CAPH1=CAPH
      TSYM=2
```

```
24800    C      ***************************************************************
24900    C
25000      250 IER=0
32800    C      ***************************************************************
32900    C
33100    C
33800          READ(5,255,END=1000)MODEL,IFILE,INDEX,NOSRC
33900     255  FORMAT(2A4,2X,3I5)
33950    C   IFILE--# OF TRACK TO BE PROCESSED.
33975    C   INDEX--INDEX OF FREQ ARRAY
33987    C   NOSRC--INDEX OF SOURCE ARRAY
34000    C
35400          IOUT=3
35500     260  GO TO 270
35600
36600    C
36650     265  AHEAD=XLEN+6.0
36675          CALL PLOT(AHEAD,0,-3)
36687          GO TO 50
36700    C      ***************************************************************
36800    C      GET THE FILE HEADER RECORD AND WRITE SUBTITLE FOR THIS CURVE
36900     270  INSK=(IFILE*2)-2
37000          ICURVE=ICURVE + 1
37100          IF(KCURVE.NE.0) ICURVE=KCURVE
37200          IF(ICURVE.GT.10) ICURVE=1
37300          NLI=NLINE(ICURVE)
37400          NSP=NSPACE(ICURVE)
37500          NSH=NSHORT(ICURVE)
37600          NLO=NLONG(ICURVE)
37650          IF(MODEL(1).EQ.4HTL  )GO TO 290
37700    C
37800    C     CHECK WHICH MODEL THIS IS AND GO TO THE APPROPRIATE PLACE
37900    C
38100          REWIND 1
38102          IF(INSK.EQ.0)GO TO 700
38104          DO 10 I=1,INSK
38106       5  CONTINUE
38108
```

```
38110          READ(1,END=10)
38112          GO TO 5
38114    10    CONTINUE
39100    C
39600    C
39650     700  READ(1)(TITLE(I),I=1,8),RDATE,R,NZS,(ZS(L),L=1,NZS),
39675         1NDF,(DF(L),L=1,NDF)
39687          FREQ=DF(INDEX)
39690          II=0
39693          S=ZS(NOSRC)
40700     290  LBL=3H FT
41400     305  ENCODE(65,310,ICAP) MODEL,FREQ,S,LBL,R,LBL,RDATE
41500     310  FORMAT(7X,2A4,1X,F8.1,3H HZ,F9.1,A3,F10.1,A3,3X,A)
41900          CALL DLINE3(-0.1,CAPH1+0.07,NLI,NSP,NLO,NSH)
42000          CALL DLINE2(1.00,CAPH1+0.07,NLI,NSP,NLO,NSH)
42100          CALL SYMBOL(0.5,CAPH1,SIZEB,ICAP,0.,65)
42200          CAPH1=CAPH1-.2
42300    C     (END OF HEADER READING AND WRITING)
42350          IF(MODEL(1).EQ.4HTL  )GO TO 265
42400    C     **********************************************************************
42475     907  II=II+1
42487     908  READ(1,END=949)RANGE(II),IFREQ,((SMTL(J,M),M=1,25),
42493         1J=1,NZS)
42496          IF(IFREQ.NE.INDEX)GO TO 908
42498          DO 902 M=1,25
42499     902  TLPLOT(II,M)=SMTL(NOSRC,M)
42500          GO TO 907
42525     949  NR=II-1
42600    C     NOW PLOT THE CURVE.   LOOP ON ALL POINTS ON TAPE 1
42625          DO 400 IT=1,NR
42637          READ(1)XRNG,((SMTL(N,J),N=1,NZS),J=1,NDF)
42643          TLPLOT(IT,26)=SMTL(NOSRC,INDEX)
42646     400  CONTINUE
42650          M=0
42700     998  IOUT=3
42750          M=M+1
42775          IF(M.GT.26)GO TO 250
42781          IF(M.NE.26)GO TO 401
42784          NLI=NLINE(2)
```

```
42785           NSP=NSPACE(2)
42787     401   II=1
42790           FPN=M
42793           IEND=10000
42800           OLDX=0
42900           OLDY=0
43000           INCH=0
43100           XTOP=(XF-XI)/XSC
43200           YTOP=(YF-YI)/YSC
43300     C     INITIAL POINT
43400           XA=RANGE(II)
43450           TL=TLPLOT(II,M)
43475           IF(TL.GT.900.)GO TO 998
44100           X=(XA-RMIN)/XSC
44200           Y =(TL-YI)/YSC
44300     C     SECOND POINT
44400           II=II+1
44450           IF(II.GT.NR)GO TO 998
44475           XA=RANGE(II)
44487           TL=TLPLOT(II,M)
44493           IF(TL.GT.900.)GO TO 998
45100           X1=(XA-RMIN)/XSC
45200           Y1=(TL-YI)/YSC
45300           XYINCH=0
45400           DELX=X
45500           DELY=Y
45600           IF(X) 1050,1070,1060
45700     1050  XCH=-1
45800           XNEW=0
45900           GO TO 1075
46000     1060  IF(X-XTOP) 1070,1070,1065
46100     1065  XCH=1
46200           XNEW=XTOP
46300           GO TO 1075
46400     1070  XCH=0
46500           XNEW=X
46600     1075  IF(Y) 1080,1095,1085
46700     1080  YCH=-1
46800           YNEW=0
46900           GO TO 1100
47000     1085  IF(Y-YTOP) 1095,1095,1090
```

```
47100     1090 YCH=1
47200          YNEW=YTOP
47300          GO TO 1100
47400     1095 YCH=0
47500          YNEW=Y
47600     1100 CONTINUE
47700          OXCH=XCH
47800          OYCH=YCH
47900          IF(DELX)1130,1110,1130

48000     1110 IF(DELY)1130,1120,1130
48100     1120 INCH=1
48200     1130 CONTINUE
48300          IEND=10000
48400          GO TO 1150
48500     1140 IEND=1
48600     C
48700     C      BEGIN LOOP ON DATA POINTS FOR THIS CURVE--UP TO 10,000 OF THEM
48800     C
48900     1150 DO 1600 I=1,IEND
49000          IF(INCH)1300,1175,1300
49100     1175 IF(XCH)1190,1180,1190
49200     1180 IF(YCH)1230,1185,1230
49300     C
49400     C    IF POINT IN RANGE, PLOT IT, SET FLAG FOR SKIPPING THE INTERPOLATION
49500     C       OF WHERE THE NEXT LINE  WILL COME IN BOUNDS, AND SKIP THE LOOP
49600     C       FOR INTERPOLATING WHERE THIS LINE GOES OUT OF BOUNDS  (SINCE IT WON@T)
49700     C
49800     1185 CONTINUE
49900          IF(IOUT.EQ.2) CALL DLINE2(X   ,Y   ,NLI,NSP,NLO,NSH)
50000          IF(IOUT.EQ.3) CALL DLINE3(X   ,Y   ,NLI,NSP,NLO,NSH)
50100          XYINCH=1
50200          GO TO 1300
50300     1190 CONTINUE
50400     C
50500     C     DRAW AN INTERPOLATED LINE TO THE GRAPH EDGE IF THIS POINT IS OUT OF RANGE
50600     C
50700     1200 IF(DELX) 1205,1220,1205
50800     1205 YPL=DELY/DELX*(XNEW-OLDX)+OLDY
```

```
50900           IF(YPL) 1215,1270,1210
51000     1210  IF(YPL-YTOP) 1270,1270,1215
51100     1215  IF(DELY) 1220,1300,1220
51200     1220  XPL=DELX/DELY*(YNEW-OLDY)+OLDX
51300           IF(XPL) 1300,1275,1225
51400     1225  IF(XPL-XTOP) 1275,1275,1300
51500     1230  CONTINUE
51600           IF(XCH-OXCH) 1235,1232,1235
51700     1232  IF(XCH)1300,1235,1300
51800     1235  IF(YCH-OYCH) 1240,1236,1240
51900     1236  IF(YCH)1300,1240,1300
52000     1240  IF(DELY) 1245,1260,1245
52100     1245  XPL=DELX/DELY*(YNEW-OLDY)+OLDX
52200           IF(XPL) 1255,1275,1250
52300     1250  IF(XPL-XTOP) 1275,1275,1255
52400     1255  IF(DELX) 1260,1300,1260
52500     1260  YPL=DELY/DELX*(XNEW-OLDX)+OLDY
52600           IF(YPL) 1300,1270,1265
52700     1265  IF(YPL-YTOP) 1270,1270,1300
52800     1270  XPL=XNEW
52900           GO TO 1280
53000     1275  YPL=YNEW
53100     1280    CONTINUE
53200           IF(IOUT.EQ.3) CALL DLINE3(XPL,YPL,NLI,NSP,NLO,NSH)
53300           IF(IOUT.EQ.2) CALL DLINE2(XPL,YPL,NLI,NSP,NLO,NSH)
53400     1300  CONTINUE
53500           OXCH=XCH
53600           OYCH=YCH
53700           DELX=X1-X
53800           DELY=Y1-Y
53900           IF(DELX)1310,1305,1310
54000     1305  IF(DELY)1310,1306,1310
54100     1306  INCH=1
54200           X1NEW=XNEW
54300           Y1NEW=YNEW
54400           GO TO 1500
54500     C
```

```
C   DETERMINE WHETHER X (OR Y) IS TO LEFT OF (ABOVE), TO RIGHT OF (BELOW),
C    OR IN BOUNDS OF GRAPH, AND SET FLAGS AND INTERPOLATING VALUES ACCORDINGLY
C
 1310 IF(X1)1312,1320,1314
 1312 XCH=-1
      X1NEW=0
      GO TO 1321
 1314 IF(X1-XTOP)1320,1320,1316
 1316 XCH=1
      X1NEW=XTOP
      GO TO 1321
 1320 XCH=0
      X1NEW=X1
 1321 IF(Y1)1322,1326,1324
 1322 YCH=-1
      Y1NEW=0
      GO TO 1328
 1324 IF(Y1-YTOP)1326,1326,1325
 1325 YCH=1
      Y1NEW=YTOP
      GO TO 1328
 1326 YCH=0
      Y1NEW=Y1
 1328 CONTINUE
      INCH=0
C
C  INCH IS A FLAG FOR 2 IDENTICAL POINTS OR 2 POINTS OUT ON THE SAME SIDE
C
      IF(DXCH)1332,1330,1332
 1330 XNEW=X1NEW
 1332 IF(DYCH)1336,1334,1336
 1334 YNEW=Y1NEW
 1336 IF(XCH-DXCH)1340,1338,1340
 1338 IF(XCH)1344,1340,1344
 1340 IF(YCH-DYCH)1346,1342,1346
 1342 IF(YCH)1344,1346,1344
 1344 INCH=1
      GO TO 1500
```

```
C
 1346 CONTINUE
C     IF THIS POINT OUT OF RANGE AND NEXT POINT IN RANGE, FIND WHERE LINE
C       WOULD COME IN RANGE AND MOVE TO THERE WITH PEN UP
C
       IF(XYINCH)1500,1351,1500
 1351 IF(DYCH)1352,1354,1352
 1352 IF(DXCH)1354,1365,1354
 1354 IF(DELX)1355,1365,1355
C
C     INTERPOLATE FROM X OUT OF RANGE, FIND Y WHERE X WOULD COME IN RANGE
C
 1355 YPL=DELY/DELX*(XNEW-X)+Y
       IF(YPL) 1365,1385,1360
 1360 IF(YPL-YTOP) 1385,1385,1365
 1365 IF(DELY) 1370,1500,1370
C
C     INTERPOLATE FROM Y OUT OF RANGE, FIND X WHERE Y WOULD COME IN RANGE
C
 1370 XPL=DELX/DELY*(YNEW-Y)+X
       IF(XPL) 1500,1380,1375
 1375 IF(XPL-XTOP) 1380,1380,1500
 1380 YPL=YNEW
       GO TO 1400
 1385 XPL=XNEW
 1400  CONTINUE
       CALL DLINE3(XPL,YPL,NLI,NSP,NLO,NSH)
 1500 CONTINUE
       XYINCH=0
       OLDX=X
       OLDY=Y
C
C    SET FOR NEXT POINT
C
       XNEW=X1NEW
       YNEW=Y1NEW
       X=X1
       Y=Y1
```

```
62200           IOUT=2
62300           IF(IEND-1)1600,1600,1510
62400     C     GET NEXT POINT
62500      1510  II=II+1
62550           IF(II.GT.NR) GO TO 1140
62575           XA=RANGE(II)
62587           TL=TLPLOT(II,M)
62593           IF(TL.GT.900.) GO TO 1140
63200      1520 X1=(XA-RMIN)/XSC
63300           Y1=(TL-YI)/YSC
63400      1600 CONTINUE
63500     C     (END LOOP ON THIS CURVE)
63600     C
63700     C    GO BACK AND READ NEXT MODEL CARD
63800     C
63900           GO TO 998
64000     C     ************************************************************************
64100     C
64200        500 CONTINUE
64300     C
 3500     C     END OF JOB
 3600      1000 CALL PLOT(0.,0.,999)
 5400           STOP
 5500     C
 5600           END
10300           SUBROUTINE DLINE3(X,Y,NLINE,NSPACE,NMORSE,NMORSE1)
10400     C
10500     C     THIS SUBROUTINE DRAWS DASHED LINES.
10600     C
10650           COMMON/SYMFPN/M,II
10700           DIMENSION ALEN(2),DELX(2),DELY(2)
10800           ALEN(1)=0.01*NLINE
10900           ALEN(2)=0.01*NSPACE
11000           FACT=4.
11050           DTOR=.017453293
11075           NDEC=-1
11100            IMORSE=0
11200           CALL PLOT(X,Y,3)
```

```
11300           XP=X
11400           YP=Y
11500           XOLD=X
11600           YOLD=Y
11700           IFLAG=1
11800           PARTX=1.
11900           RETURN
12000           ENTRY DLINE2
12100           DISTAN=SQRT((X-XOLD)**2 + (Y-YOLD)**2)
12200           IF(DISTAN.LE.0.) RETURN
12300           SINX= (Y-YOLD)/DISTAN
12400           COSX=(X-XOLD)/DISTAN
12500           DELX(1)=ALEN(1)*COSX
12600           DELX(2)=ALEN(2)*COSX
12700           DELY(1)=ALEN(1)*SINX
12800           DELY(2)=ALEN(2)*SINX
12900           IF(FACT.GT.1.) GO TO 15
13000           DELX(1)=FACT*DELX(1)
13100           DELY(1)=FACT*DELY(1)
13200     15    CONTINUE
13300     20    CONTINUE
13400           DELXP=DELX(IFLAG)*PARTX
13500           DELYP=DELY(IFLAG)*PARTX
13600            IF(ABS(DELXP) .GE. ABS(X-XP) .AND. ABS(DELYP) .GE. ABS(Y-YP))
13700          *   GO TO 40
13800           XP=XP+DELXP
13900           YP=YP+DELYP
14000           PARTX=1.
14100           CALL PLOT(XP,YP,IFLAG+1)
14200           IFLAG=3-IFLAG
14300           IF(NMORSE.EQ.0) GO TO 20
14400            IF(IFLAG.EQ.1) GO TO 20
14500           IMORSE=IMORSE+1
14600           IF(IMORSE.NE. 0 .AND. IMORSE .NE. NMORSE) GO TO 20
14700           FACT=1./FACT
14800           DELX(1)=FACT*DELX(1)
14900           DELY(1)=DELY(1)*FACT
15000            IF(IMORSE.EQ.NMORSE  ) IMORSE=-NMORSE1
```

```
15100          GO TO 20
15200     40   CONTINUE
15300           IF(ABS(DELX(IFLAG)) .LT. 1.E-10) GO TO 45
15400          PARTX=PARTX-ABS((X-XP)/DELX(IFLAG))
15500          GO TO 46
15600     45   CONTINUE
15700          PARTX=PARTX-ABS((Y-YP)/DELY(IFLAG))
15800     46   CONTINUE
15850          IF(NLINE.LT.50)GO TO 48
15862          IF(IT.LT.1)GO TO 48
15868          IF(Y.EQ.0)GO TO 48
15875          MSUB=M
15881          III=II-1
15887          IF(M.GE.8.AND.M.LE.14)MSUB=M-7
15893          IF(M.GE.15.AND.M.LE.21)MSUB=M-14
15896          IF(M.GE.22.AND.M.LE.28)MSUB=M-21
15897          IF(III.LE.8)GO TO 48
15898          IF(MOD(III,8).NE.MSUB)GO TO 48
15899          XP=X-.15*COSX
15900          YP=Y-.15*SINX
15950          CALL PLOT(XP,YP,IFLAG+1)
15975          XP=X-.14*COSX
15987          YP=Y-.14*SINX
15993          FPN=M
15996          ANG=ASIN(SINX)/DTOR
15997          CALL PLOT(XP,YP,3)
15998          CALL NUMBER(XP,YP,.07,FPN,ANG,NDEC)
15999          XP=X
16000          XOLD=X
16025          YP=Y
16050          YOLD=Y
16075          CALL PLOT(XP,YP,3)
16087          GO TO 100
16093     48   XP=X
16096          YP=Y
16100          XOLD=X
16200           YOLD=Y
16300           CALL PLOT(XP,YP,IFLAG+1)
16400     100  CONTINUE
16500          RETURN
16600          END
```

Section 3
PROGRAM PLTMP

3.1 DESCRIPTION OF PROGRAM

PROGRAM PLTMP provides the ASTRAL user with the diagnostic capability of plotting the mode coupling indices determined by adiabatic mapping for each significant new water depth change.

It is a complete program and is 14336 bytes long. Execution time will vary. The total central processor (CP) time used for the sample run was 2.3 s.

The required input data are listed in table form (Section 3.3). The data fall naturally into two categories: the unformatted, binary data file written by ASTRAL on FILE 4 and the plot-specific information on FILE 5.

Basically PROGRAM PLTMP reads the title, maximum and minimum ranges of interest (nm), scaling factor (nm/inch), and specific track to be processed from FILE 4. It calls subroutine LAYOUT to draw and label the axes. Subroutine BTMPLT is invoked. It reads and stores all required data from FILE 4. The mode coupling indices are plotted by mode. The points are joined in a solid-line and labeled with mode number. After all the data have been processed, control returns to the beginning of the program. The user can plot as many plots as desired.

3.2 MODIFICATIONS TO ASTRAL

Changes have been made in ASTRAL to create the binary, unformatted data file used by PROGRAM PLTMP. File 4

contains the mode coupling indices for each significant new water depth change. Additions have been made to DRIVER, subroutine MARCH, and subroutine COMPDW.

3.2.1 Program DRIVER

A few minor changes have been made in this routine to write the header record and end-of-file on FILE 4. The statements are:

```
DIMENSION TITLE4(20)
DATA TITLE4/4HASTR,4HAL-C,4HOUPL,4HING ,4HINDE,
4HX F0,4HR EA,4HCH N,4HEW W,4HATER,4H DEP,4HTH   ,
8*4H    /
WRITE(4)TITLE4,WHEN
END FILE 4
```

where TITLE4 is obviously the title array and WHEN a variable containing the date of the ASTRAL run.

3.2.2 Subroutine MARCH

Subroutine MARCH controls the flow for the propagation of the field out in range. It calls subroutine COMPDW whenever a significant, new water depth change is introduced. A new parameter has been added to the list of arguments for subroutine COMPDW. The call is

```
CALL COMPDW (FIRST,DEPNEW,IXNEW,PHINF(1,IXNEW),
  RNG)
```

where RNG is the beginning range for the new water depth.

On the first call to subroutine COMPDW, it treats the receiver, so the beginning range is zero. This value of RNG is defined by the statement

```
RNG=0.0
```

After the loss at the end of the near-field bathymetry has been computed, the environmental index (KENV) is found for the first region. If the new water depth differs significantly from its previous value, COMPDW is called. Here the beginning range (RNG) is the range at the end of the near-field bathymetry. The statement is

```
IF(IR.EQ.2)RNG=RANGE(IR)
```

As subroutine MARCH continues to march out in range, the RNG value for each significant water depth change is set to the beginning range of the environmental index (KENV). The statement is

```
RNG=RENV(KENV)
```

3.2.3 Subroutine COMPDW

Subroutine COMPDW makes the parametric adjustments necessitated by a significant change in water depth. As noted earlier, RNG has been added to its list of arguments. The form of the subroutine is

```
SUBROUTINE COMPDW(FIRST,DEPTH,IX,XPHINF,RNG)
```

Before any calculations are performed, the array MP containing the mode coupling indices is initialized to 999. The array MP(M) will only contain real values between M1 and

M2, the first and last propagating modes. The 999 value will signal PROGRAM PLTMP that all the real data have been processed. Initialization of MP is accomplished by the following statements:

```
      DO 30 L=1,25
30    MP(L)=999
```

Each time subroutine COMPDW is called it writes the RNG value and MP array out onto FILE 4. The single statement is

```
WRITE(4)RNG,(MP(M),M=1,25)
```

One file is written on FILE 4 for each track processed by ASTRAL.

3.3 INPUT TO PROGRAM PLTMP

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1	FORMAT (20A4)
TITLE	Title of plot (80 characters).
RECORD 2	**FORMAT (3F10.2,I5)**
RMAX	Maximum range (nm).
RMIN	Minimum range (nm).
DELTAR	Scaling factor - number of nm/in.
ITRK	Number of track to be read on FILE 4 as processed by ASTRAL.

These two records may be repeated for as many plots as desired.

FILE ACCESS NAME FOR004 (FILE 4)

(Unformatted, binary data file generated by ASTRAL)

RECORD 1

TITLE	Set to ASTRAL COUPLING INDEX FOR EACH NEW WATER DEPTH.
WHEN	Date of ASTRAL run (character*9 format).

RECORD 2

RNG	Beginning range of each significant new water depth change.
MP(M)	Mode coupling indices for all 25 modes at range, RNG. (A dummy value of 999 is supplied for non-propagating modes.)

RECORD 2 is repeated for each significant new water depth change encountered in the environment.

EOF	End-of-file signaling end of data for this track.

Entire sequence of records is repeated for each track processed by ASTRAL. There is one file on FILE 4 for each track.

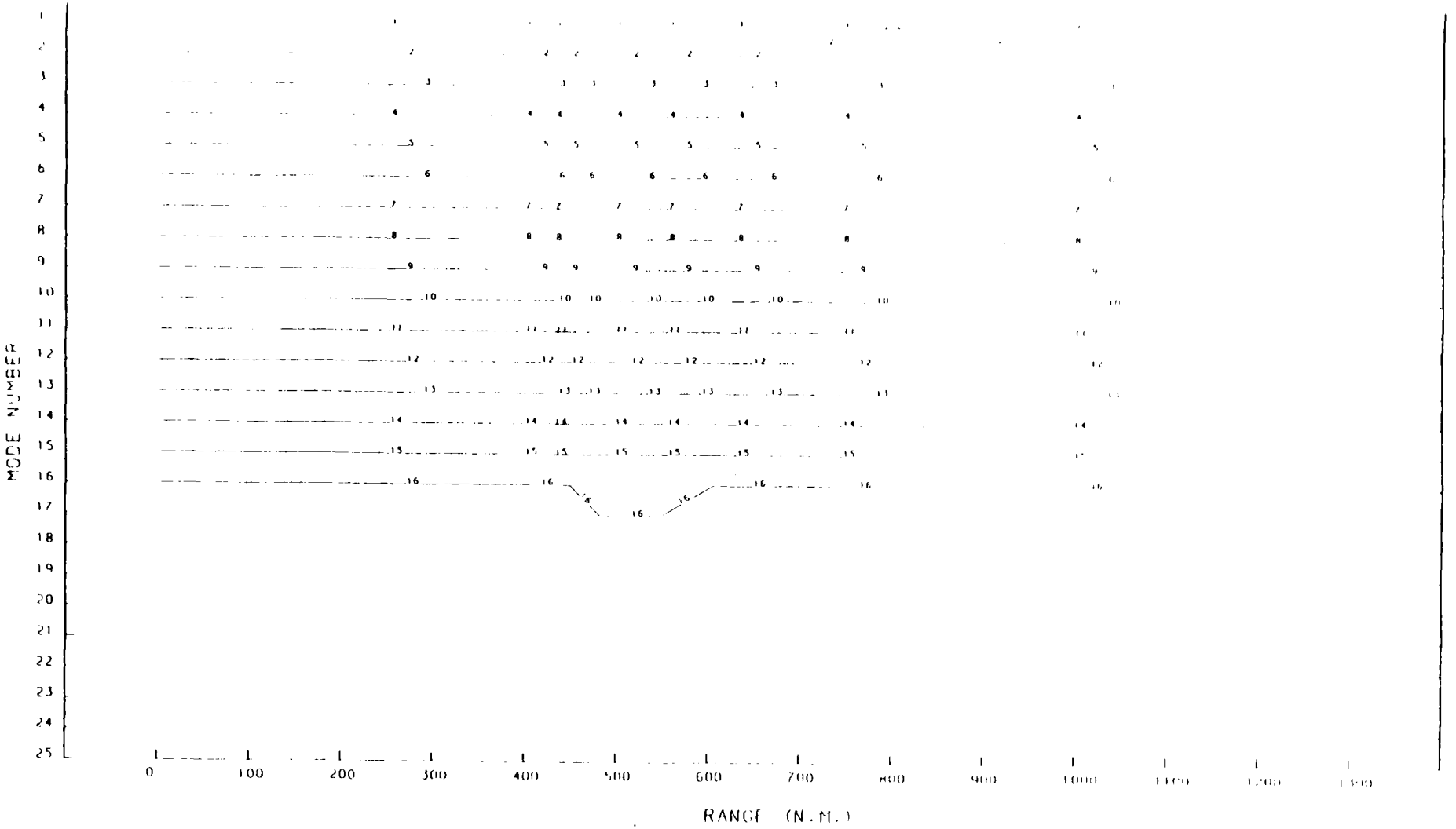
3.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

```
100   SAMPLE RUN FOR PGM PLTMP
200         1250.          0.       100.     1
```

INPUT DATA FOR004 (FILE 4)

FILE 4 was generated by the ASTRAL propagation loss model using the same input as was used for PROGRAM PLTSMDS (Section 2.4).



SAMPLE RUN FOR PGM PLTMP

3.5 SOURCE LANGUAGE LISTING

```
      PROGRAM PLTMP
C
C      PROGRAM READS AND PLOTS MODE COUPLING INDEX AS WRITTEN
C      BY ASTRAL ON FILE 4.
C
      INTEGER TITLE
      COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
     X                NIN   , NOUT  , NCFL , MEAS
      DIMENSION XNUM(200),TITLE(20),R(201),BD(201),DP(100),SPD(100)
C
C                    BASEX AND BASEY ARE THE MARGINS (IN INCHES) ON
C                    THE SIDES OF THE PLOTS.  YHT IS THE WIDTH OF THE
C                    PLOT.
C
C
C                    READ TITLE, MAXIMUM AND MINIMUM RANGES OF INTEREST
C                    (N.M.), SCALING FACTOR (N.M./IN.), MAXIMUM DEPTH
C                    (FT.).
C
C
      NIN = 5
      NOUT = 6
      ITRK=1
      NCFL = 4
      BASEX = 1.5
      BASEY = 1.3
      YHT = 8.325
C
      OPEN(UNIT=50,TYPE='NEW',NAME='TTA2:X.Y')
      CALL PLOTS(0,0,50)
   20 READ(NIN,100,END=21)TITLE
      READ(NIN,110)RMAX,RMIN,DELTAR,ITRK
  100 FORMAT(20A4)
  110 FORMAT(3F10.2,I5)
C
C                    DETERMINE X AXIS AND Y AXIS SCALE FACTORS.
```

```
C                    CONVERT YMAX TO METERS AND ROUND UPWARDS.
C
      OPEN(UNIT=NCFL,TYPE='OLD',FORM='UNFORMATTED')
      INSK=ITRK-1
      REWIND=4
      IF(INSK.EQ.0)GO TO 15
      DO 10 I=1,INSK
    5 CONTINUE
      READ(4,END=10)
      GO TO 5
   10 CONTINUE
   15 XSCL=1./DELTAR
      YMAX=25
      YSCL=YHT/25.
      NY=25
C                    DIVIDE THE RANGE INTO INTERVALS.  COMPUTE THE
C                    NUMBER OF INTERVALS AND THE VALUE AT EACH ENDPOINT.
C
      NX = (RMAX - RMIN - 1.) / DELTAR + 2.
      RNG = RMIN - DELTAR
      DO 200  I = 1, NX
      RNG = RNG + DELTAR
      K = NX + 1 - I
      XNUM(K) = RNG
  200 CONTINUE
      RMAX = XNUM(1)
C                    DRAW THE AXES AND THE BORDER ON THE PLOT.
C
      CALL LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
C
C                    DRAW THE SPEED SCALE.
C
      SS = XMAX - RMAX * XSCL
C
  405 CALL BTMPLT
      AHEAD=XMAX+5.0
      CALL PLOT(AHEAD,0.,-3)
      GO TO 20
```

```
C
C                    CLOSE PLOT OUTPUT FILE.
C
 21    CALL PLOT(0,0,999)
       CLOSE (UNIT=NCFL)
       STOP
       END
       SUBROUTINE BTMPLT
C
C   SUBROUTINE BTMPLT READS THE MODE COUPLING INDEX
C   AND PLOTS THE DATA.
C
C
       COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
      X                NIN   , NOUT  , NCFL , MEAS
       DIMENSION SPCE(7)
       DIMENSION R(500),RD(500),TITLE(20),MP(500,25)
       DATA SPCF/.49,.31,.13,.49,.31,.13,.49/
       CHARACTER*9 WHEN
C                    XLOC AND YLOC ARE INLINE FUNCTIONS THAT SCALE THE
C                    VARIABLES TO BE PLOTTED.  NOTE THAT YLOC(0) =
C                    BASEY + YHT, THAT YLOC(YMAX) = BASEY, AND THAT
C                    XLOC(R(1)) = BASEX + 1.
       XLOC(X)=(BASEX + SS + 1.) + X * XSCL
       YLOC(Y)=(BASEY + YHT) - Y * YSCL
C
       NDEC=-1


 205   I=0
       READ(NCFL)TITLE,WHEN
 301   I=I+1
       READ(NCFL,END=300)R(I),(MP(I,M),M=1,25)
       GO TO 301
 300   NBP=I-1
       M=0
 302   M=M+1
       IF(M.GT.25)GO TO 120
       DO 500 K=1,NBP
```

```
1160     500  BD(K)=MP(K,M)
1170          IF(BD(1).GT.900.) GO TO 302
1180     C                    PLOT THE MODE COUPLING INDEX
1200     200  BDT=AMIN1(BD(1),YMAX)
1210          CALL PLOT(XLOC(R(1)),YLOC(BDT),3)
1230          DO 110  I = 2, NBP
1240          IF(BD(I).GT.900.)GO TO 302
1250          BDT = AMIN1 (BD(I), YMAX)
1350          YPT=YLOC(BDT)
1360          XPT=XLOC(R(I))
1370          FPN=M
1380          DISTAN=SQRT((XPT-XOLD)**2+(YPT-YOLD)**2)
1390          SINX=(YPT-YOLD)/DISTAN
1391          COSX=(XPT-XOLD)/DISTAN
1392          IF(I.EQ.2)GO TO 400
1400          IF(SINX.EQ.0.0) GO TO 600
1410          XP=XOLD+((XPT-XOLD)/2.0)
1415          XP=XP-.07*COSX
1420          YP=YOLD+((YPT-YOLD)/2.0)
1425          YP=YP-.07*SINX
1430          CALL PLOT(XP,YP,2)
1440          GO TO 601
1450     600  IF(XPT.LT.5.0)GO TO 400
1460          XDIFF=XPT-XOLD
1470          IF(XDIFF.LT.0.25)GO TO 400
1490          MSUB=M
1500          IF(M.GE.8.AND.M.LE.14)MSUB=M-7
1510          IF(M.GE.15.AND.M.LE.21)MSUB=M-14
1520          IF(M.GE.22.AND.M.LE.28)MSUB=M-21
1530          SP=SPCF(MSUB)
1540          XP=XPT-SP*COSX
1550          YP=YPT-SP*SINX
1560          CALL PLOT(XP,YP,2)
1570          SP=SP-.01
1580          XP=XPT-SP*COSX
1590          YP=YPT-SP*SINX
1600     601  ANG=ASIN(SINX)/.017453293
```

```
      CALL NUMBER(XP,YP,.07,FPN,ANG,NDEC)
  400 XP=XPT
      YP=YPT
      XOLD=XPT
      YOLD=YPT
      CALL PLOT(XP,YP,2)
  110 CONTINUE
      GO TO 302
  120 CONTINUE
      RETURN
      END


      SUBROUTINE LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
C
C                     SUBROUTINE LAYOUT WRITES THE RUN TITLE ON THE
C                     PLOT.  IT THEN DRAWS AND LABELS THE AXES.
C
      COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
     X                NIN   , NOUT  , NCFL , MEAS
      INTEGER TITLE
      DIMENSION ICHARS(10),TITLE(20),XNUM(200)
      DIMENSION ICAP(40)
C
      FX(X) = AINT(X + 100000.)
C                     INITIALIZE LOCAL VARIABLES.
      NYPT = NY + 1
      YINC = YHT / FLOAT(NY)
C                     WRITE TITLE ON PLOT.
      ENCODE(80,101,ICAP)TITLE
  101 FORMAT(20A4)
      CALL SYMBOL(BASEX,BASEY-1.3,.3,ICAP,0.0,80)
C                     MOVE PLOTTER TO ORIGIN.
      CALL PLOT (BASEX, BASEY, 3)
      YNUM = NYPT
      Y = -YINC
C                     DRAW Y AXIS ON LEFT SIDE OF PLOT.  INCLUDE TIC
C                     MARKS, TITLE, AND DEPTHS.
      DO 200  I = 1, NYPT
      Y = Y + YINC
```

```
      YNUM = YNUM - 1.
      CALL PLOT (BASEX, BASEY + Y, 2)
      CALL PLOT (BASEX + .1, BASEY + Y, 2)
      IF(I.EQ.NYPT)GO TO 600


      CALL NUMBER (BASEX - .3, BASEY + Y, .1, YNUM, 0., -1)
  600 CALL PLOT (BASEX, BASEY + Y, 3)
  200 CONTINUE
      BYMAX = BASEY + Y
C                     LABEL Y AXIS.
      CALL SYMBOL (BASEX - .5, BASEY + 3., .14, 11HMODE NUMBER ,
     C              90., 11)
C                     ALLOW 1" MARGIN ON LEFT OF PLOT.
      BXMIN = BASEX + 1.
      CALL PLOT (BASEX, BYMAX, 3)
      CALL PLOT (BXMIN, BYMAX, 2)
      CALL PLOT (BXMIN, BYMAX - .1, 2)
      CALL PLOT (BXMIN, BYMAX, 3)
C        DRAW X AXIS ON UPPER EDGE OF PLOT. INCLUDE TIC MARKS ONLY
      X = 0.
      NXX = NX - 1
      DO 300  I = 1, NXX
      X = X + 1.
      CALL PLOT (BXMIN + X, BYMAX, 2)
      CALL PLOT (BXMIN + X, BYMAX - .1, 2)
      CALL PLOT (BXMIN + X, BYMAX, 3)
  300 CONTINUE
      XMAX = X
C                     ALLOW 1" MARGIN ON RIGHT OF PLOT.
      BXMAX=BXMIN+X+1.
      CALL PLOT (BXMAX, BYMAX, 2)
C                     DRAW Y AXIS ON RIGHT SIDE OF PLOT. INCLUDE TIC
C                     MARKS ONLY.
      DO 400 I = 1, NY
      Y = Y - YINC
      CALL PLOT (BXMAX, BASEY + Y, 2)
      CALL PLOT (BXMAX - .1, BASEY + Y, 2)
```

```
      CALL PLOT (BXMAX, BASEY + Y, 3)
  400 CONTINUE
C                     DRAW X AXIS ON LOWER EDGE OF PLOT.  INCLUDE TIC
C                     MARKS, TITLE, RANGE VALUES, AND MARGINS.
      CALL PLOT (BXMIN + X, BASEY, 2)
      DO 520  I = 1, NX
      CALL PLOT (BXMIN + X, BASEY, 2)
      CALL PLOT (BXMIN + X, BASEY + .1, 2)
C                     DO NOT NUMBER FRACTIONAL PARTS OF MILES.
      IF (I.EQ.NX .OR. XNUM(I).EQ.0.)  GO TO 500
      IF (FX(XNUM(I)).EQ.FX(XNUM(I + 1)))  GO TO 510
  500 CONTINUE
      CALL NUMBER (BXMIN + X - .1, BASEY - .2, .1, XNUM(I), 0., -1)
  510 CONTINUE
      CALL PLOT (BXMIN + X, BASEY, 3)
      X = X - 1.
  520 CONTINUE
      CALL PLOT (BASEX, BASEY, 2)
C                     COMPUTE LABEL OFFSET.  THEN LABEL X AXIS.
C
      IF(NX.LT.21) XOFF=((FLOAT(NX-1)+2)/2.0)-.5
      CALL SYMBOL (BASEX + XOFF, BASEY - .64, .14, 12HRANGE (N.M.),
     C                0., 12)
      RETURN
      END
```

Section 4
PROGRAM CFPLT

4.1 DESCRIPTION OF PROGRAM

PROGRAM CFPLT was written to provide the ASTRAL user with the capability of plotting the upper/lower turning point depths for each mode. The program is a modification of PROGRAM CFIELDPLOT which plots sound velocity profiles and, if desired, bathymetry for the given range of interest.

PROGRAM CFPLT is a complete program whose total length is 18944 bytes. Execution time will vary according to the specific input. The central processor time (CP) for the sample run was 3.0 s.

The input of the program varies according to usage. If a plot of the sound velocity profiles is desired, the data is contained on FILE 2 as generated by PEPREP or CFIELD. Bathymetry, if supplied, is read from FILE 5. If a plot of the upper and lower turning point depths for each new environment is requested, the data are obtained from FILE 3 as written by ASTRAL. The bathymetric data are also on FILE 3. The plotting parameters are always specified on FILE 5. A detailed description of the input data is contained in Section 4.3.

Briefly, PROGRAM CFPLT reads the title, maximum and minimum ranges of interest (nm), scaling factor (nm/inch), maximum depth of plot (ft), and the variable IPROF specifying the type of plot. Subroutine LAYOUT is called to draw and label the axes. At this point the program follows two separate paths.

If IPROF equals zero, a plot of sound velocity profiles is desired. The program calls subroutine SPDSCL to draw the sound speed scale. The actual depth/velocity pairs for each range are read by subroutine SVPRD and plotted by subroutine SVPPLT. These two programs are called sequentially until all the profiles in the given range of interest have been processed. Subroutine BTMRD accesses FILE 5 for the bathymetric data. If supplied, subroutine BTMPLT plots the data in the specified manner (point by point or as a step function). The program always returns to the beginning to enable the user to generate as many plots as desired.

If IPROF equals one, a plot of the upper/lower turning point depths overlaid on the bathymetry of the area is desired. The program calls subroutine BTMPLT. This subroutine fetches and stores all the pertinent ASTRAL information from FILE 3. A separate curve is drawn for each mode of both the upper and lower turning point depths. The points are connected with a solid line and labeled with mode number. The bathymetry is plotted as a step function which is the way it is actually treated in the ASTRAL model. Plot finished, PROGRAM CFPLT returns to the beginning to accept a new set of input data.

4.2 MODIFICATIONS TO ASTRAL

PROGRAM CFPLT requires a binary, unformatted data file containing bathymetry and upper/lower turning point depths. All of this information is readily available in the main program driver (DRIVER) and needs only to be written out onto FILE 3.

4.2.1 Program DRIVER

The changes made in DRIVER are as follows:

Dimension title array (TITLE3) and SRENV array used to store the beginning range for each new environment.

```
      DIMENSION TITLE3(20), SRENV(20)
```

Define actual title with data statement.

```
DATA/TITLE3/4HASTR,4HAL-U,4HPPER,4H/LOW,4HER T,4HURNI,
4HNG P,4HOINT, 4H DEP, 4HTHS , 10*4H    /
```

Locate the beginning range for each new environment and store in array SRENV. The variable JTOP is set to the number of environments. The arrays used in this exercise are found in labeled common /ENVDET/. The statements are

```
      J = 1
      IRTFE =1
      DO 51 L = 1, NENV
      IF (INDEX(L).NE.J) GO TO 51
      SRENV(J) = RENV(L)
      J = J+1
51    CONTINUE
      JTOP = J-1
```

Write the header record containing the title (TITLE3) and date of ASTRAL run (WHEN).

```
      WRITE(3) TITLE3, WHEN
```

Write all the bathymetric data onto FILE 3. The range/depth pairs for the detailed ray trace front end are contained in arrays BRANGE and DEPTH found in labeled common /BOTTOM/. The remainder of the range/depth pairs are found in arrays RENV and DEP.

```
      DO 300 J = 1, NBP
```

```
300       WRITE(3) BRANGE(J), DEPTH(J)
          DO 301 J = 2, NENV
          IF (RENV(J).LE.BRANGE(NBP)) GO TO 301
          WRITE(3) RENV(J), DEP(J)
301       CONTINUE
```

Write end-of-file to signal end of bathymetric data.

```
          END FILE 3
```

Write out the previously determined beginning ranges for each new environment.

```
          WRITE(3) JTOP, (SRENV(J), J= 1, JTOP)
```

Write out the receiver depth (ZR) and its immediate slope (THBRC), range at end of near-field bathymetry (RNFBDT) and variable (IRTFE) signaling ray trace front end version of ASTRAL. This information is all stored in labeled commons /RECVER/ and /DETRAY/.

```
          WRITE(3) ZR, THBRC, RNFBDT, IRTFE
```

Finally write out the upper/lower turning point depths for all twenty-five modes at JTOP environments. Terminate the file for this track with an end-of-file mark.

```
          DO 209 M = 1, 25
          WRITE(3) (ZUP(M,J), J = 1, JTOP)
          WRITE(3) (ZDN(M,J), J = 1, JTOP)
209       CONTINUE
          END FILE 3
```

All of these changes have been inserted inside the track loop of DRIVER. This means that two files of data will be written on FILE 3 for each track processed by ASTRAL.

4.3 INPUT TO PROGRAM CFPLT

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1 — FORMAT (20A4)

TITLE — Title - 20 words (80 characters).

RECORD 2 — FORMAT (4F10.2, 2I5)

RMAX — Maximum range (nm).

RMIN — Minimum range (nm).

DELTAR — Scaling factor - numbers of nm/inch.

YMAX — Maximum depth (ft) of plot.
(Maximum depth plotted on meter scale; therefore, maximum depth should be less than even hundred meters wanted.)

IPROF — Variable to determine type of plot.

=0 Plot SS profiles-data FILE 2
Read bathymetric data - FILE 5
Plot bathymetry - point by point or as step function

=1 Plot upper/lower turning point depths - data FILE 3
Read bathymetry - FILE 3
Plot bathymetry as step function

ITRK	Number of track as processed by ASTRAL to be read on FILE 3.

RECORD 3 FORMAT(2I5)

NBP	Number of (range, depth) pairs of bathymetry to be read in. if >0, input in (nm,ft) if <0, input in (nm, meters)
ISTEP	Type of bathymetric plot. = 0 Plot point by point = 1 Plot as step function

RECORD 3 IS OMITTED IF

1. No bathymetry to be plotted with sound velocity profiles.
2. IPROF = 1 (Bathymetry read FILE 3).

RECORD 4 FORMAT (8F10.2)

R	Range (nm).
BD	Depth (ft or meters) as specified on RECORD 3.

Four range/depth pairs contained on each record. RECORD 4 repeated as many times as required to read in NBP pairs of bathymetric points

RECORD 4 IS OMITTED IF RECORD 3 IS OMITTED.

Sequence of records may be repeated for as many plots as desired.

FILE ACCESS NAME FOR003 (FILE 3)
(Unformatted, binary data file written by ASTRAL)

RECORD 1

TITLE3	Set to ASTRAL UPPER/LOWER TURNING POINT DEPTHS.
WHEN	Date of ASTRAL run (character*9 format).

RECORD 2

RANGE	Range (nm).
DEPTH	Depth (ft).

One range/depth pair written on each record. RECORD 2 repeated till all bathymetric data is written out.

EOF	*End-of-file.*

RECORD 1

JTOP	Number of elements in SRENV array.
SRENV	Array containing beginning range of each new environment.

RECORD 2

ZR	Receiver depth (ft).
THBRC	Immediate slope of receiver (radians) - negative down.

RNFBDT — Range of near-field bathymetry (nm).

IRTFE — Variable signifies version of ASTRAL which generated FILE 3.

=0 Regular version
CFPLT plots ZR and THBRC.

=1 Ray trace front end version ZR and THBRC not plotted.

RECORD 3

(ZUP(M,J),J=1,JTOP) — Array containing upper turning point depths at JTOP environments for mode M.

(ZDN(M,J),J=1,JTOP) — Array containing lower turning point depths at JTOP environments for mode M.

RECORDS 3 and 4 repeated sequentially 25 times - once for each mode.

EOF — End-of-file.

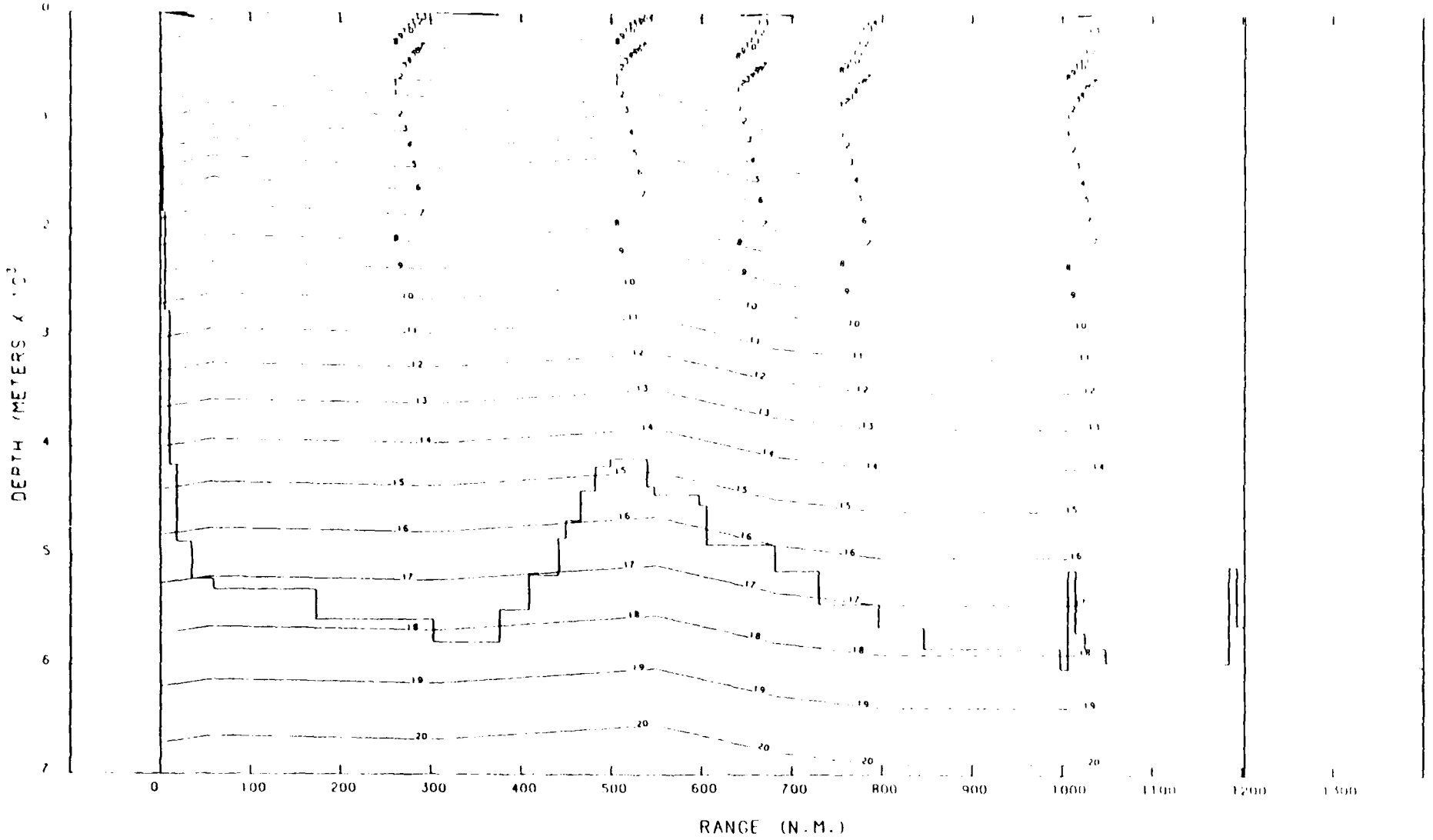
4.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

```
100   SAMPLE RUN FOR PGM CFPLT
200        1250.        0.      100.     20000.     1     1
```

INPUT DATA FOR003 (FILE 3)

FILE 3 was generated by the ASTRAL propagation loss model using the same input as was used for PROGRAM PLTSMDS (Section 2.4).



SAMPLE RUN FOR PCM CFPLT

```
      PROGRAM CFPLT
C
C        CFPLT GENERATES A PLOT OF THE SOUND SPEED PROFILES AND
C        BATHYMETRY FOR A GIVEN RANGE OF INTEREST. THE DESIRED RANGE,
C        PROFILES ARE INPUT FROM A TAPE2 GENERATED BY PEPREP AND CFIELD.
C
C        CFPLT AS MODIFIED WILL ALSO PLOT UPPER AND LOWER TURNING
C        POINTS AND BATHYMETRY FOR A GIVEN RANGE OF INTEREST.  THE
C        DATA IS ALL READ FROM A TAPE3 GENERATED BY ASTRAL.
C
      INTEGER TITLE
      COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
     X                NIN   , NOUT  , NCFL , MEAS
      DIMENSION XNUM(200),TITLE(40),R(500),BD(500),DP(100),SPD(100)
C
C                     BASEX AND BASEY ARE THE MARGINS (IN INCHES) ON
C                     THE SIDES OF THE PLOTS.  YHT IS THE WIDTH OF THE
C                     PLOT.
C
C
C                     READ TITLE, MAXIMUM AND MINIMUM RANGES OF INTEREST
C                     (N.M.), SCALING FACTOR (N.M./IN.), MAXIMUM DEPTH
C                     (FT.),TYPE OF PLOT (SS PROFILE OR ZUP/ZDN)
C
C                     IPROF=0  PLOT SS PROFILE, READ BATHY FROM CARDS,
C                              PLOT BATHY POINT-WISE OR STEP-WISE.
C
C                     IPROF=1  PLOT ZUP/ZDN, READ BATHY FROM SAME TAPE,
C                              PLOT BATHY STEP-WISE.
      NIN = 5
      NOUT = 6
      NCFL = 2
      ITRK=1
      BASEX = 1.5
      BASEY = 1.3
      YHT = 8.4
C
```

```
3700          OPEN(UNIT=50,TYPE='NEW',NAME='TTA2:X.Y')
3750          CALL PLOTS(0,0,50)
3800     20   READ(NIN,100,END=21)TITLE
3900          READ(NIN,110)RMAX,RMIN,DELTAR,YMAX,IPROF,ITRK
4000      100 FORMAT(40A2)
4100      110 FORMAT(4F10.2, 2I5)
4200     C
4300     C                    DETERMINE X AXIS AND Y AXIS SCALE FACTORS.
4400     C                    CONVERT YMAX TO METERS AND ROUND UPWARDS.
4500     C
4600          IF(IPROF.EQ.1)NCEL=3
4700          OPEN(UNIT=NCEL,TYPE='OLD',FORM='UNFORMATTED')
4750     C  TWO FILES WRITTEN FOR EVERY TRACK
4752          INSK=(ITRK*2)-2
4754          REWIND NCEL
4756          IF(INSK.EQ.0)GO TO 15
4758          DO 10 I=1,INSK
4760        5 CONTINUE
4762          READ(INSK,END=10)
4764          GO TO 5
4766     10   CONTINUE
4768
4800     15   XSCL = 1. / DELTAR
4900          YMAX = .3048 * YMAX
5000          NCOUNT = ALOG10(YMAX)
5100          COUNT = 10. ** NCOUNT
5200          NY = 1 + INT(YMAX / COUNT)
5300          YMAX = COUNT * FLOAT(NY)
5400          YSCL = YHT / YMAX
5500          YMFT = YMAX / .3048
5600     C
5800     C
6000     C
6100     C                    DIVIDE THE RANGE INTO INTERVALS.  COMPUTE THE
6200     C                    NUMBER OF INTERVALS AND THE VALUE AT EACH ENDPOINT.
6300     C
6400          NX = (RMAX - RMIN - 1.) / DELTAR + 2.
6500          RNG = RMIN - DELTAR
6600          DO 200  I = 1, NX
```

```
      RNG = RNG + DELTAR
      K = NX + 1 - I
      XNUM(K) = RNG
  200 CONTINUE
      RMAX = XNUM(1)
C
C                     PRINT OUT CARD INPUT, AS MODIFIED.
C
      WRITE(NOUT,210) TITLE,RMIN,RMAX,DELTAR,YMAX,YMET
  210 FORMAT(1H1,40A2,/,7HORANGE ,F7.2,8H N.M. TO ,F8.2,5H N.M. ,/,
     C               14H SCALE FACTOR- , F7.2, 9H N.M./IN. /
     C               15H MAXIMUM DEPTH-, F9.2, 4H M (, F9.2, 5H FT.))
C
C                     DRAW THE AXES AND THE BORDER ON THE PLOT.
C
      CALL LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
C
C                     DRAW THE SPEED SCALE.
C
      SS = XMAX - RMAX * XSCL
      IF(IPROF.EQ.1)GO TO 500
      CALL SPDSCL(NX)
C
C                     READ THE SOUND SPEED PROFILES.
C
       WRITE(NOUT,300)
  300 FORMAT(24HOSOUND SPEED PROFILES                    )
      REWIND NCEL
C
C                     IT MAY BE NECESSARY TO DELETE THE FOLLOWING CARD
C                     IF TAPE2 WAS GENERATED BY A PROGRAM OTHER THAN
C                     PEPREP.
C
      READ(NCEL)
  310 CONTINUE
      CALL SVPRD (RMAX,RMIN,RNG,N,DP,SPD)
C
C                     IF IN RANGE, PLOT THE PROFILES.
C
```

```
10600           IF (RNG.LT.RMIN)  GO TO 310
10700           IF (RNG.GT.RMAX)  GO TO 400
10800           CALL SVPPLT (RNG,N,DP,SPD)
10900           GO TO 310
11000     C
11100     C        READ AND PLOT THE BATHYMETRY FROM CARDS
11200     C
11300       400 CONTINUE
11400           CALL BTMRD(RMAX,RMIN,NBP,R,BD,ISTEP)
11500     C        IF NBP=0, ONLY PLOT SS PROFILES - NO BATHY GIVEN.
11600           IF(NBP.EQ.0)GO TO 410
11700        500  CALL BTMPLT (NBP, R, BD,ISTEP,IPROF)
11800         410 CONTINUE
11802           AHEAD=XMAX+9.0
11804           CALL PLOT(AHEAD,0,-3)
11806           GO TO 20
11900     C
12000     C                    CLOSE PLOT OUTPUT FILE.
12100     C
12200        21   CALL PLOT(0,0,999)
12300           CLOSE (UNIT=NCFL)
12400           STOP
12500           END
12600           SUBROUTINE BTMPLT (NNBP, RR, BBD,ISTEP,IPROF)
12700     C
12800     C                    SUBROUTINE BTMPLT DRAWS MARGINS ON THE PLOT AND
12900     C                    PLOTS THE BATHYMETRY, IF GIVEN.  THE BOTTOM PROFILE
13000     C                    POINTS ARE CONNECTED BY STRAIGHT LINES.  HOWEVER,
13100     C                    ONLY THAT PORTION OF THE BOTTOM PROFILE ABOVE
13200     C                    THE MAXIMUM DEPTH OF INTEREST IS SHOWN.
13300     C
13400           COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
13500          X                NIN   , NOUT  , NCFL , MEAS
13600           DIMENSION RR(500), BBD(500)
13700           DIMENSION SPCE(7)
13800           DIMENSION IFLAG(20)
13900           DIMENSION R(500),BD(500)
14000           DIMENSION SPENV(20),ZUP(50,20)
14100           DIMENSION TITLE3(20)
14400           DATA SPCE/.45,.40,.35,.30,.25,.20,.15/
```

```
      CHARACTER*9 WHEN
C                     XLOC AND YLOC ARE INLINE FUNCTIONS THAT SCALE THE
C                     VARIABLES TO BE PLOTTED.  NOTE THAT YLOC(0) =
C                     BASEY + YHT, THAT YLOC(YMAX) = BASEY, AND THAT
C                     XLOC(R(1)) = BASEX + 3.
      XLOC(X)=(BASEX + SS + 1.) + X * XSCL
      YLOC(Y)=(BASEY + YHT) - Y * YSCL
      NDEC=-1
      IF(IPROF.EQ.0)GO TO 205
      TSTEP=1
      READ(3)TITLE3,WHEN
C                      READ BATHY FROM TAPE3 AS WRITTEN BY ASTRAL.
      DO 701 J=1,500
      READ(3,END=700)RR(J),BBD(J)
  701 CONTINUE
C     READ ZUP/ZDN VALUES FROM TAPE3 GENERATED BY ASTRAL.
  700 NNRP=J-1
C    CONVERT FEET TO METERS
      DO 99 J=1,NNRP
   99 BBD(J)=BBD(J)*.3048
      READ(3) JTOP,(SRENV(J),J=1,JTOP)
      READ(3)ZR,THARC,RNFR,IRTFE
      ZR=ZR*.3048
C
      DO 300 M=1,25
      READ(3,END=205)(ZUP(M,J),J=1,JTOP)
      READ(3,END=205)(ZUP(M+25,J),J=1,JTOP)
  300 CONTINUE
C         INITIALIZE THE PLOT BY DRAWING THE MARGIN AT MINIMUM RANGE
  205 CALL PLOT (BASEX + 3., BASEY + YHT, 3)
      CALL PLOT (BASEX + 3., BASEY, 2)

      M=0
      IF(ISTEP.EQ.0)GO TO 600
C  CALCULATE EXTRA POINT TO PLOT BATHY STEP-WISE.
      R(1)=RR(1)
      BD(1)=BBD(1)
      J=0
      DO 500 L=2,NNRP
      J=J+2
```

```
18200          R(J)=RR(L)
18300          BD(J)=BBD(L-1)
18400          R(J+1)=RR(L)
18500          BD(J+1)=BBD(L)
18600     500  CONTINUE
18700          NBP=J+1
18800          GO TO 200
18900     600  DO 601 L=1,NNBP
19000          R(L)=RR(L)
19100     601  BD(L)=BBD(L)
19200          NBP=NNBP
19300     C                    THE BATHYMETRY HAS BEEN GIVEN.  MOVE THE PEN TO
19400     C                    THE STARTING POINT.
19500     200  BDT=AMIN1(BD(1),YMAX)
19600          CALL PLOT(BASEX+1.,YLOC(BDT),3)
19700     C                    LOOP OVER EACH BOTTOM PROFILE POINT.
19800          DO 110  I = 2, NBP
19900          BDT = AMIN1 (BD(I), YMAX)
20000     C                    DOES THE LINE TO THE NEXT POINT CROSS YMAX?
20100          IF (((BD(I - 1) - YMAX) * (BD(I) - YMAX)) .GE. 0.)  GO TO 100
20200     C                    THERE IS A CROSSING AT XMAX.  DRAW A LINE TO THERE.
20300          XMAX = R(I - 1) + (YMAX - BD(I - 1)) * (R(I) - R(I - 1)) /
20400         C                 (BD(I) - BD(I - 1))
20500     C                    DRAW A LINE TO THE NEXT PROFILE POINT (OR TO
20600     C                    YMAX IF THAT POINT IS DEEPER THAN YMAX).
20700          CALL PLOT (XLOC(XMAX), BASEY, 2)
20800       100 CONTINUE
20900          YPT=YLOC(BDT)
21000          XPT=XLOC(R(I))
21100          IF(YPT.LE.(BASEY+.005))GO TO 400
21200          IF(M.EQ.0)GO TO 400
21300          IF(BDT.EQ.0)GO TO 400
21400          IF(I.EQ.2)GO TO 400
21500          DISTAN=SQRT((XPT-XOLD)**2+(YPT-YOLD)**2)
21600          SINX=(YPT-YOLD)/DISTAN
21700          COSX=(XPT-XOLD)/DISTAN
21800          MM=M
21900          IF(MM.GT.25)MM=MM-25
```

```
22000          FPN=MM
22100          MSUB=MM
22200          IF(MM.GE.8.AND.MM.LE.14)MSUB=MM-7
22300          IF(MM.GE.15.AND.MM.LE.21)MSUB=MM-14
22400          IF(MM.GE.22.AND.MM.LE.28)MSUB=MM-21
22500          SP=SPCF(MSUB)
22600          XP=XPT-SP*COSX
22700          YP=YPT-SP*SINX
22800          CALL PLOT(XP,YP,2)
22900          SP=SP-.01
23000          XP=XPT-SP*COSX
23100          YP=YPT-SP*SINX
23200          ANG=ASIN(SINX)/.017453293
23300          CALL NUMBER(XP,YP,.07,FPN,ANG,NDEC)
23400      400 XP=XPT
23500          YP=YPT
23600          XOLD=XPT
23700          YOLD=YPT
23800          CALL PLOT(XP,YP,2)
23900      110 CONTINUE
24000          IF(IPROF.EQ.0)GO TO 121
24100          IF(M.NE.0)GO TO 120
24200          IF(IRTFE.EQ.1)GO TO 207
24250      C   PLOT RECEIVER DEPTH AND IMMEDIATE SLOPE IF REG. ASTRAL.
24300          CALL PLOT(XLOC(0),YLOC(ZR),3)
24400          CALL PLOT(XLOC(RNFR),YLOC(ZR),2)
24500          CALL PLOT(XLOC(0),YLOC(ZR),3)
24600          Y1=ZR-RNFR*6076.1*.3048*TAN(THRRC)
24700          CALL PLOT(XLOC(RNFR),YLOC(Y1),2)
24750      C   FINISH THE PLOT BY DRAWING A MARGIN.
24800       207 CALL PLOT(XLOC(R(NRP)),BASEY,3)
24900          CALL PLOT(XLOC(R(NRP)),BASEY+YHT,2)
25200       120 CONTINUE
25300          M=M+1
25400          IF(M.GT.50)RETURN
25500          DO 201 I=1,JTOP
25600          IFLAG(I)=0
25700          ZZ=ZUP(M,I)
25800          RD(I)=ZZ*.3048
25900          R(I)=SPENV(I)
```

```
26000     201  CONTINUE
26100          NBP=JTOP
26150          DO 705 I=1,JTOP
26175          IF(BD(I).GT.0.0.AND.BD(I).LT.YMAX)GO TO 200
26187     705  CONTINUE
26193          GO TO 120
26400     121  CALL PLOT(XLOC(R(NBP)),BASEY,3)
26500          CALL PLOT (XLOC(R(NBP)), BASEY + YHT, 2)
26600          RETURN
26800          END
26900          SUBROUTINE BTMRD (RMAX, RMIN, NBP, R, BD,ISTEP)
27000          COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
27100         X                NIN   , NOUT  , NCEL , MEAS
27200     C
27300     C                    SUBROUTINE BTMRD READS THE BATHYMETRY FROM
27400     C                    CARDS.  THE MINIMUM RANGE AT WHICH A BOTTOM IS
27500     C                    SPECIFIED CANNOT BE GREATER THAN RMIN.  IF
27600     C                    NECESSARY THE BOTTOM AT RMIN IS CALULATED BY
27700     C                    INTERPOLATION.  IF THE BOTTOM AT RMAX IS NOT
27800     C                    GIVEN, THEN IT IS CALCULATED BY INTERPOLATION OR
27900     C                    BY EXTENDING THE BOTTOM OF THE MAXIMUM RANGE
28000     C                    POINT KNOWN.  THE PROGRAM CONVERTS THE FINAL
28100     C                    PROFILE TO METERS IF NECESSARY AND OUTPUTS THE
28200     C                    RESULTS.
28300     C
28400          DIMENSION R(500), BD(500)
28500          NBP = 0
28600          MSW = 0
28700     C       READ THE NUMBER OF BOTTOM POINTS, RETURN IF NONE
28750     C       READ ISTEP  = 0  PLOT BATHY POINT-WISE
28775     C                     1  PLOT BATHY STEP-WISE
28787     C
28800          READ(NIN,100,END= 105) NBP,ISTEP
28900       100 FORMAT(2I5)
29000          GO TO 107
29100     105  NBP = 0
29200          RETURN
29300     C
29400     C                    IF THE GIVEN NUMBER IS NEGATIVE, THE DEPTHS ARE
29500     C                    GIVEN IN METERS, NOT FEET.
29600     107  IF (NBP.LT.0)  MSW = 1
29700          NBP = IABS(NBP)
29800     C                    READ THE POINTS.
```

```
29900           READ(NIN,110) (R(I),BD(I),I=1,NBP)
30000       110 FORMAT (BF10.2)
30100       C                   DOES THE BATHYMETRY INCLUDE THE RANGE OF INTEREST?
30200       150 CONTINUE
30300           IF (P(NBP).GE.RMIN)  GO TO 200
30400           R(1) = RMIN
30500           BD(1) = BD(NBP)
30600           R(2) = RMAX
30700           BD(2) = BD(NBP)
30800           NBP = 2
30900           RETURN
31000       C                   IS THE FIRST POINT AT RMIN?
31100       200 CONTINUE
31200           K = 0
31300           IF (R(1) - RMIN)  230, 300, 210
31400       210 CONTINUE
31500       C       THE BATHYMETRY IS NOT SPECIFIED FOR RMIN AND SO IS DELETED
31600           WRITE(NOUT,220)
31700       220 FORMAT (47H0BATHYMETRY DELETED. VALUE REQUIRED FOR MINIMUM,
31800          C                7H RANGE.)
31900           NBP = 0
32000           RETURN
32100       230 CONTINUE
32200       C                   THE K-TH POINT IN THE BATHYMETRY PRECEDES RMIN.
32300           K = K + 1
32400           IF (R(K + 1) - RMIN)  230, 250, 240
32500       240 CONTINUE
32600       C                   THE (K+1)ST POINT FOLLOWS RMIN.  INTERPOLATE
32700       C                   TO OBTAIN BOTTOM AT RMIN.
32800           BD(K) = BD(K) + (RMIN - R(K)) * (BD(K + 1) - BD(K)) /
32900          C                (R(K + 1) - R(K))
33000           R(K) = RMIN
33100           K = K - 1
33200           IF (K.EQ.0)  GO TO 300
33300       250 CONTINUE
33400           NBP = NBP - K
33500           DO 260  I = 1, NBP
33600           LLL=K+I
```

```
      R(I)=R(LLL)
      BD(I)=BD(LLL)
  260 CONTINUE
C                     THE FIRST POINT IS NOW AT RMIN.
  300 CONTINUE
C                     IS THE LAST POINT AT RMAX?
      IF (R(NBP) - RMAX)  310, 340, 320
  310 CONTINUE
C        THE LAST POINT PRECEDES RMAX. COMPLETE ASSUMING A FLAT BOTTOM
      NBP = NBP + 1
      R(NBP) = RMAX
      BD(NBP) = BD(NBP - 1)
      GO TO 340
  320 CONTINUE
C                     SEARCH TO FIND A RANGE INTERVAL CONTAINING RMAX.
      NBP = NBP - 1
      IF (R(NBP) - RMAX)  330, 340, 320
  330 CONTINUE
C        RMAX IS IN THIS INTERVAL. INTERPOLATE TO FIND BOTTOM THERE
      NBP = NBP + 1
      BD(NBP) = BD(NBP - 1) + (RMAX - R(NBP - 1)) * (BD(NBP) -
     C              BD(NBP - 1)) / (R(NBP) - R(NBP - 1))
      R(NBP) = RMAX
C                     THE LAST BOTTOM POINT IS NOW AT RMAX.
  340 CONTINUE
C                     ARE THE DEPTHS IN METERS?
      IF (MSW.EQ.0)  GO TO 410
C                     YES, WRITE THEM OUT.
      WRITE(NOUT,400) (R(I),BD(I),I=1,NBP)
  400 FORMAT (11HBATHYMETRY / 27H RANGE (N.M.)      DEPTH (M) /
     C              (F10.2, 9X, F7.2))
      RETURN
  410 CONTINUE
C                     NO, CONVERT THEM AND WRITE THEM OUT.
      WRITE(NOUT,420)
  420 FORMAT (11HBATHYMETRY / 13H RANGE (N.M.), 5X, 11HDEPTH (FT.),
     C              5X, 9HDEPTH (M))
      DO 440 I = 1, NBP
      D = BD(I)
      BD(I) = .3048 * D
```

```
37700           WRITE(NOUT,430) R(I),D,BD(I)
37800       430 FORMAT (F10.2, 8X, F9.2, 8X, F7.2)
37900       440 CONTINUE
38000           RETURN
38100           END


  100           SUBROUTINE LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
  200     C
  300     C                     SUBROUTINE LAYOUT WRITES THE RUN TITLE ON THE
  400     C                     PLOT.  IT THEN DRAWS AND LABELS THE AXES.
  500     C
  600           COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
  700          X                  NIN   , NOUT  , NCFL , MEAS
  800           INTEGER TITLE
  900           DIMENSION ICHARS(10),TITLE(40),XNUM(200)
 1000           DIMENSION ICAP(40)
 1100           DATA ICHARS/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9/
 1200     C
 1300           FX(X) = AINT(X + 100000.)
 1400     C                     INITIALIZE LOCAL VARIABLES.
 1500           NYPT = NY + 1
 1600           YINC = YHT / FLOAT(NY)
 1700     C                     WRITE TITLE ON PLOT.
 1800           ENCODE(80,101,ICAP)TITLE
 1900      101  FORMAT(40A2)
 2000           CALL SYMBOL(BASEX,BASEY-1.3,.3,ICAP,0.0,80)
 2100     C                     MOVE PLOTTER TO ORIGIN.
 2200           CALL PLOT (BASEX, BASEY, 3)
 2300           YNUM = NYPT
 2400           Y = -YINC
 2500     C                     DRAW Y AXIS ON LEFT SIDE OF PLOT.  INCLUDE TIC
 2600     C                     MARKS, TITLE, AND DEPTHS.
 2700           DO 200  I = 1, NYPT
 2800           Y = Y + YINC
 2900           YNUM = YNUM - 1.
 3000           CALL PLOT (BASEX, BASEY + Y, 2)
 3100           CALL PLOT (BASEX + .1, BASEY + Y, 2)
 3200           CALL NUMBER (BASEX - .3, BASEY + Y, .1, YNUM, 0., -1)
 3300           CALL PLOT (BASEX, BASEY + Y, 3)
 3400       200 CONTINUE
```

```
      BYMAX = BASEY + Y
C                     LABEL Y AXIS.
      CALL SYMBOL (BASEX - .5, BASEY + 3., .14, 20HDEPTH (METERS X 10 ),
     C             90., 20)
      NCOUNT = ICHARS(NCOUNT+1)
      CALL SYMBOL (BASEX - .6, BASEY + 5.5, .1, NCOUNT, 90., 1)
C                     ALLOW 1" MARGIN ON LEFT OF PLOT.
      BXMIN = BASEX + 1.
      CALL PLOT (BASEX, BYMAX, 3)
      CALL PLOT (BXMIN, BYMAX, 2)
      CALL PLOT (BXMIN, BYMAX - .1, 2)
      CALL PLOT (BXMIN, BYMAX, 3)
C        DRAW X AXIS ON UPPER EDGE OF PLOT. INCLUDE TIC MARKS ONLY
      X = 0.
      NXX = NX - 1
      DO 300  I = 1, NXX
      X = X + 1.
      CALL PLOT (BXMIN + X, BYMAX, 2)
      CALL PLOT (BXMIN + X, BYMAX - .1, 2)
      CALL PLOT (BXMIN + X, BYMAX, 3)
  300 CONTINUE
      XMAX = X
C                     ALLOW 1" MARGIN ON RIGHT OF PLOT.
      BXMAX=BXMIN+X+1.
      CALL PLOT (BXMAX, BYMAX, 2)
C                     DRAW Y AXIS ON RIGHT SIDE OF PLOT. INCLUDE TIC
C                     MARKS ONLY.
      DO 400 I = 1, NY
      Y = Y - YINC
      CALL PLOT (BXMAX, BASEY + Y, 2)
      CALL PLOT (BXMAX - .1, BASEY + Y, 2)
      CALL PLOT (BXMAX, BASEY + Y, 3)
  400 CONTINUE
C                     DRAW X AXIS ON LOWER EDGE OF PLOT.  INCLUDE TIC
C                     MARKS. TITLE, RANGE VALUES, AND MARGINS.
      CALL PLOT (BXMIN + X, BASEY, 2)
      DO 520  I = 1, NX
      CALL PLOT (BXMIN + X, BASEY, 2)
      CALL PLOT (BXMIN + X, BASEY + .1, 2)
C                     DO NOT NUMBER FRACTIONAL PARTS OF MILES.
```

```
7500          IF (I.EQ.NX .OR. XNUM(I).EQ.0.)  GO TO 500
7600          IF (FX(XNUM(I)).EQ.FX(XNUM(I + 1)))  GO TO 510
7700      500 CONTINUE
7800          CALL NUMBER (BXMIN + X - .1, BASEY - .2, .1, XNUM(I), 0., -1)
7900      510 CONTINUE
8000          CALL PLOT (BXMIN + X, BASEY, 3)
8100          X = X - 1.
8200      520 CONTINUE
8300          CALL PLOT (BASEX, BASEY, 2)
8400      C                   COMPUTE LABEL OFFSET.  THEN LABEL X AXIS.
8500      C
8600          IF (NX.LT.21)  XOFF = ((FLOAT(NX-1)+2)/2.0)-.5
8700          CALL SYMBOL (BASEX + XOFF, BASEY - .64, .14, 12HRANGE (N.M.),
8800         C                0., 12)
8900          RETURN
9000          END
```

```
 100          SUBROUTINE SPDSCL(NX)
 200          COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
 300         X                NIN   , NOUT  , NCEL , MEAS
 400      C       SPDSCL DRAWS THE SOUND SPEED SCALE ON THE PLOT
 500          DIMENSION SNUM(6)
 600          DATA SNUM/1460.,1480.,1500.,1520.,1540.,1560./
 700      C       MOVE PLOTTER TO THE STARTING POINT OF SCALE
 800          XD = BASEX + 17.
 900          IF (NX.LT.21)  XD = BASEX + FLOAT(2 * NX) / 3. + 3.
1000          YD = BASEY - .93
1100          CALL PLOT (XD, YD, 3)
1200      C                   DRAW SCALE.
1300          X = 0.
1400          DO 100  I = 1, 6
1500          CALL PLOT (XD + X, YD, 2)
1600          CALL NUMBER (XD + X - .2, YD - .25, .1, SNUM(I), 0., -1)
1700          CALL PLOT (XD + X, YD + .1, 3)
1800          CALL PLOT (XD + X, YD, 2)
1900          X = X + 1.
2000      100 CONTINUE
2100      C                   TITLE SCALE.
```

```
2200          CALL SYMBOL (XD + 1., YD + .15, .14, 24H SOUND SPEED SCALE (M/S),
2300         C                0., 24)
2400          RETURN
2500          END



 100          SUBROUTINE SVPRD(RMAX,RMIN,R,I,DP,SPD)
 200    C
 300    C                    SUBROUTINE SVPRD READS SOUND VELOCITY PROFILES
 400    C                    FROM TAPE2.  IT DETERMINES IF THE SVP IS IN
 500    C                    RANGE OF INTEREST.  IF SO, IT COMPUTES THE
 600    C                    GRADIENTS FOR EACH INTERVAL IN THE PROFILE AND,
 700    C                    IF REQUIRED, COMPUTES THE SOUND SPEED AT YMAX.
 800    C
 900          DIMENSION DP(100), SPD(100)
1000          COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
1100         X                NIN   , NOUT  , NCFL , MEAS
1200    C
1300       100 CONTINUE
1400          READ(NCFL) R
1500          IF (R.GE.1.0E12)  RETURN
1600          MEAS=0
1700          IF(R.LE.0)MEAS=1
1800          R=ABS(R)
1900          R = R / 6076.1
2000    C                    READ THE PROFILE.
2100          READ(NCFL) N,(DP(I),SPD(I),I=1,N)
2200          IF (R.LT.RMIN)  GO TO 100
2300          IF (R.GT.RMAX)  RETURN
2400          METRIC = 1
2500          IF (SPD(1).LT.3000.)  GO TO 105
2600          METRIC = 0
2700          DP(1) = .3048 * DP(1)
2800          SPD(1) = .3048 * SPD(1)
2900       105 CONTINUE
3000          WRITE(NOUT,110) R,DP(1),SPD(1)
3100       110 FORMAT (RHORANGE =, F8.2, 5H N.M. / 10X, 1H1, 5X, F7.1, 3X, F7.2)
3200          DO 130  I = 2, N
```

```
      IF (METRIC.EQ.1)  GO TO 115
      SPD(I) = .3048 * SPD(I)
      DP(I) = .3048 * DP(I)
  115 CONTINUE
C                     CALCULATE THE GRADIENT.
      G = (SPD(I) - SPD(I - 1)) / (DP(I) - DP(I - 1))
C                     IF THE DEPTH IS GREATER THAN YMAX, EXIT THE LOOP.
C                     IF NOT, PRINT THE PROFILE POINT AND THE GRADIENT.
      IF (DP(I).GT.YMAX)  GO TO 140
      WRITE(NOUT,120) I,DP(I),SPD(I),G
  120 FORMAT (I11, 5X, F7.1, 3X, F7.2, 3X, 1PE11.4)
C                     THE SPEED AT YMAX HAS BEEN CALCULATED.  RETURN.
      IF (DP(I).EQ.YMAX)  RETURN
  130 CONTINUE
C                     COMPUTE THE SPEED AT YMAX, THEN RETURN.
      I = N + 1
  140 CONTINUE
      DP(I) = YMAX
      SPD(I) = SPD(I - 1) + G * (DP(I) - DP(I - 1))
      WRITE(NOUT,120) I,DP(I),SPD(I),G
      RETURN
      END


      SUBROUTINE SVPPLT(RNG,N,DP,SPD)
C                     SUBROUTINE SVPPLT PLOTS THE SOUND VELOCITY PROFILE
C                     FOR A GIVEN RANGE POINT.  IT PRINTS OUT THE SURFACE
C                     SOUND SPEED.
C
      COMMON / PLTR / BASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
     X                NIN   , NOUT  , NCFL , MEAS
      DIMENSION DP(100), SPD(100)
      DATA SPDSCL /.05/, SLAST /-999./, SOFF/.14/, SN /0./
C                     COMPUTE BASE POINTS FOR PLOTTING.
      BXSPD = (BASEX + SS + 3.) + RNG * XSCL
      BYSPD = BASEY + YHT
C                     DETERMINE OFFSET FOR WRITING SURFACE SOUND
C                     SPEED, THEN WRITE IT.
      SOFF = SOFF + .14
      IF ((BXSPD - SLAST) .LT. 0.65)  GO TO 100
```

```
1700          SLAST = BXSPD
1800          SOFF = .14
1900      100 CONTINUE
2000          CALL NUMBER (BXSPD - .2, BYSPD + SOFF, .1, SPD(1), 0., 1)
2100    C                     PLOT SOUND SPEED CURVE.
2200          CALL PLOT (BXSPD, BYSPD + .1, 3)
2300          DO 110  I = 1, N
2400          CALL PLOT (BXSPD + SPDSCL * (SPD(I) - SPD(1)), BYSPD - DP(I)
2500         C               * YSCL, 2)
2600          IF(MEAS.NE.0)  CALL SYMBOL(BXSPD+SPDSCL*(SPD(I)-SPD(1)),
2700         X  BYSPD-DP(I)*YSCL , 0.07 , 2 , 0.0 , -1)
2800      110 CONTINUE
2900          IF(MEAS.EQ.0) RETURN
3000    C
3100    C         INDICATE A MEASURED (REAL) PROFILE BY NUMBERING IT
3200    C
3300          SN = SN + 1.0
3400          CALL NUMBER(BXSPD+SPDSCL*(SPD(N)-SPD(1)), BYSPD-DP(N)*YSCL+0.05,
3500         X  0.14,SN,0.0,-1)
3600          RETURN
3700          END
```

END

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