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Coal-seismic, desk-top computer programs in BASIC; part 4: transfer, edit, and display observed data

by

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ABSTRACT

Processing of data obtained with the U.S. Geological Survey's coal-seismic system begins with playback of the field-data magnetic tape through an RS-232 interface to a desk-top computer. The data are stored on a tape, edited to correct header information and to remove byte-shift errors, compressed from 4-byte to 3-byte hexadecimal, and then written on a master data tape. This tape in turn is edited to correct bias shifts, spikes, dropped or added bytes, and intra-trace level shifts (boxcar functions). Finally, results stored on the master data tape are plotted to produce a display of the observered data. Six initial-data-processing programs, written in an extended BASIC language accepted by the Tektronix 4051 Graphic System[1/] and augmented by use of special ROMs manufactured by the TransEra Corporation, are the subjects of this report.

INTRODUCTION

Field data obtained with the U.S. Geological Survey's coal-seismic system are initially stored within the digital memory of a geoMetrics model ES-1200 12-trace, signal-enhancement seismograph. When judged acceptable, the data are transferred to a field-data magnetic tape in a geoMetrics model G-724-S digital magnetic tape recorder. This same recorder, upon return to the field office, is used to playback the field data through an RS-232 interface to a temporary-storage magnetic tape in a Tektronix 4051 Graphic System. After

1/ Use of brand names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

editing and byte compression, the data are written on a master data tape. Data from these tapes are then edited to correct bias shifts, dropped or added bytes, spikes, and intra-trace level shifts (boxcar functions). The initial phase of data processing concludes with the plotting of a seismogram using values contained on the master data tape and identifiers added when the computer program is run.

All computer programs of the U.S. Geological Survey's coal-seismic system are written for use on a desk-top, stand-alone computer. The language is an extended BASIC specially augmented by Tektronix, Inc. for use on their 4051 Graphic System. In addition to the Tektronix 4051 Graphic System, a Tektronix 4662 Interactive Digital Plotter, and a Tektronix 4631 Hard Copy Unit are called for by the programs. Programs are designed to take full advantage of the interactive (self-prompting) capabilities of this computer. After the magnetic tape containing the program is inserted and the RUN command is executed, a series of statements, instructions, and questions are displayed telling the user what to enter from the keyboard and what to do next.

To speed computation, a set of routines contained within a plug-in ROM manufactured by the TransEra Corporation is employed. The following are its routine names and functions:

1. C4 TO 3--compresses a string of 4-character words to a string of 3-character words by truncating the first character of each word.
2. HEXDEC--extracts a series of hexadecimal numbers (1 to 4 characters per number) from a character string, inverts the numbers, and then converts the inverted numbers to a series of decimal numbers that are stored in an array.
3. DECHEX--extracts a series of non-negative decimal numbers from an array, and converts them to a series of hexadecimal numbers (1 to 4

characters per number) that are then inverted and stored in a character string.

Each seismic-record set (a 12-trace, 10-bit, 1024-samples-per-trace seismogram) is lead by an 8-digit number called the "header". In the construction of the G-724-S digital magnetic tape recorder, the last digit of the header is reserved for identification of the number of the record on the field-data tape and specification of the first seven digits is the user's choice. We have established the following header code:

1. Digits 1 through 3 designate the day of the year on which the recording were made; for example, 123 corresponds to May 3.
2. Digit 4 contains the code for one of six sample intervals (0.05, 0.1, 0.2, 0.5, 1.0 and 2.0 msec) available on the seismograph; thus, a 3 placed in the fourth digit means that a 0.2-msec sample was used.
3. Digits 5 and 6 indicate the delay in tens of msec used in the recording; thus, a 1 in the fifth and a 2 in the sixth position of the header shows that recording began after a 120-msec delay.
4. Digit 7 is the number of the tape of that day; thus, a 2 in seventh place indicates that this is the second tape of the day.

The six computer programs used to transfer, edit, and display observed coal-seismic data are listed below:

1. Format master data tape
2. Transfer field data to internal tape
3. Edit byte errors and transfer data from internal tape to master data tape
4. Edit master data tape
5. Plot master data-tape values: selectable-mode
6. Plot master data tape values: quick-plot routine

In separate sections which follow, program listings are given after a brief discussion of each of the above programs.

FORMAT MASTER DATA TAPE

The first computer program in the data-processing procedure is used to format the master data tapes (MDT). File 1 of each master data tape is established such that when a master data tape is set into the Tektronix 4051 and the AUTO LOAD key is struck, the headings of all data sets are found, read, and printed; the data tapes carry their own contents lists. Running time of this program is approximately 4 1/4 min.

Figure 1 shows a copy of the display on the CRT screen of the 4051 computer after the AUTO LOAD operation. Area and array information is entered by use of the LINE EDITOR and keyboard sections of the 4051. If a data file (for example, file number 7 in fig. 1) has not as yet been filled, then the term: "NO DATA", will be printed in the HEADER column.

Each master data tape can hold data from seven 12-trace, 10-bit, 1001-samples-per-trace seismic records. Data are stored as 3-character hexadecimal numbers.

YOU HAVE SELECTED MASTER DATA TAPE:W1-79

REC#	FILE#	HEADER	AREA	ARRAY
1	2	12330011	Watkins, line array	79-101A
2	14	12330512	Watkins, line array	79-102A
3	26	12330013	Watkins, line array	79-101B
4	38	12330014	Watkins, line array	79-102B
5	50	12330515	Watkins, line array	79-101C
6	62	12330021	Watkins, line array	79-102C
7	74	NO DATA	X- - - - - - - - - - -	X- - - - -

Figure 1. Sample of the CRT display produced when a master data tape is inserted into the 4051 computer and the AUTO LOAD key is struck.

Program to format master data tape

```
100 PRINT "LYOU HAVE SELECTED PROGRAM TO FORMAT MASTER DATA TAPE (MDT)"
110 INIT
120 DIM G$(1),H$(8)
130 PRI "GGG";"_INSERT CLEANED AND PRE-STRETCHED DATA TAPE WITHIN 4924_"
140 PRINT "_ARE YOU READY TO PROCEED? (Y OR N) ";
150 INPUT G$
160 IF G$="N" THEN 140
170 FIND @2:1
180 MARK @2:1,1536
190 FIND @2:1
200 SAVE @2:330,600
210 FOR K=2 TO 74 STEP 12
220    FIND @2:K
230    MARK @2:1,3072
240    FIND @2:K
250    WRITE @2:"HHH"
260    PRINT @2,2:
270    FIND @2:K+1
280    MARK @2:11,3072
290 NEXT K
300 FIND @2:1
310 PRINT "GGG";"_MDT FORMATTED"
320 END
330 PRINT "L         YOU HAVE SELECTED MASTER DATA TAPE:XX-XX_"
340 PRINT "_REC#  FILE#    HEADER              AREA                ARRAY_"
350 INIT
360 DIM H$(8)
370 N=0
380 FOR K=2 TO 74 STEP 12
390    N=N+1
400    FIND K
410    READ @33:H$
420    IF H$="HHH" THEN 440
430    GO TO 450
440    H$="NO  DATA"
450    GO TO N OF 470,490,510,530,550,570,590
460 NEXT K
470 PRINT "_ 1      2     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
480 GO TO 460
490 PRINT "_ 2     14     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
500 GO TO 460
510 PRINT "_ 3     26     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
520 GO TO 460
530 PRINT "_ 4     38     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
540 GO TO 460
550 PRINT "_ 5     50     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
560 GO TO 460
570 PRINT "_ 6     62     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
580 GO TO 460
590 PRINT "_ 7     74     ";H$;"  X- - - - - - - - - - - -   X- - - - - -"
600 END
```

TRANSFER FIELD DATA TO INTERNAL TAPE

The next step in the initial data-processing procedure is to transfer data from the field-data magnetic tape to a corrected master data tape that can be read directly and quickly by the computer. This is a three-step process, the first program of which commands the data on the field-data tape to be transferred to an intermediate-storage tape (called the internal tape) and then instructs the computing system to produce a plot of each record using a doubled-amplitude value of every tenth point of the transferred data. We call this plot a decimated monitor record.

Instructions on the use of this program are displayed on the screen of the 4051 after the user enters the number (5 alpha-numeric characters) of the internal tape to be inserted in the 4051. Once a Y answer is given to the question, "ARE YOU READY TO PROCEED? (Y OR N)", the program requires no other keyboard entries and it will proceed until all records on the field-data tape are transferred and all decimated monitor records made and copied.

Figure 2 shows an example of a decimated monitor record. The vertical line near the center of the display separates the two groups of data for each trace as recorded by the G-724-S system. Although 1024 data points are recorded, only the first 1001 are used in our procedures. Examination of the decimated monitor record can provide answers to three questions:

1. Have field data been transferred to the internal tape?
2. Have bytes been dropped or added?
3. Is the header information correct?

The decimated monitor also gives us a first look at the data so that we can decide which data-processing sequence should be followed. The time required to print and copy one decimated monitor record is about 2.5 min.

Standard procedure in the field calls for the making of a field monitor

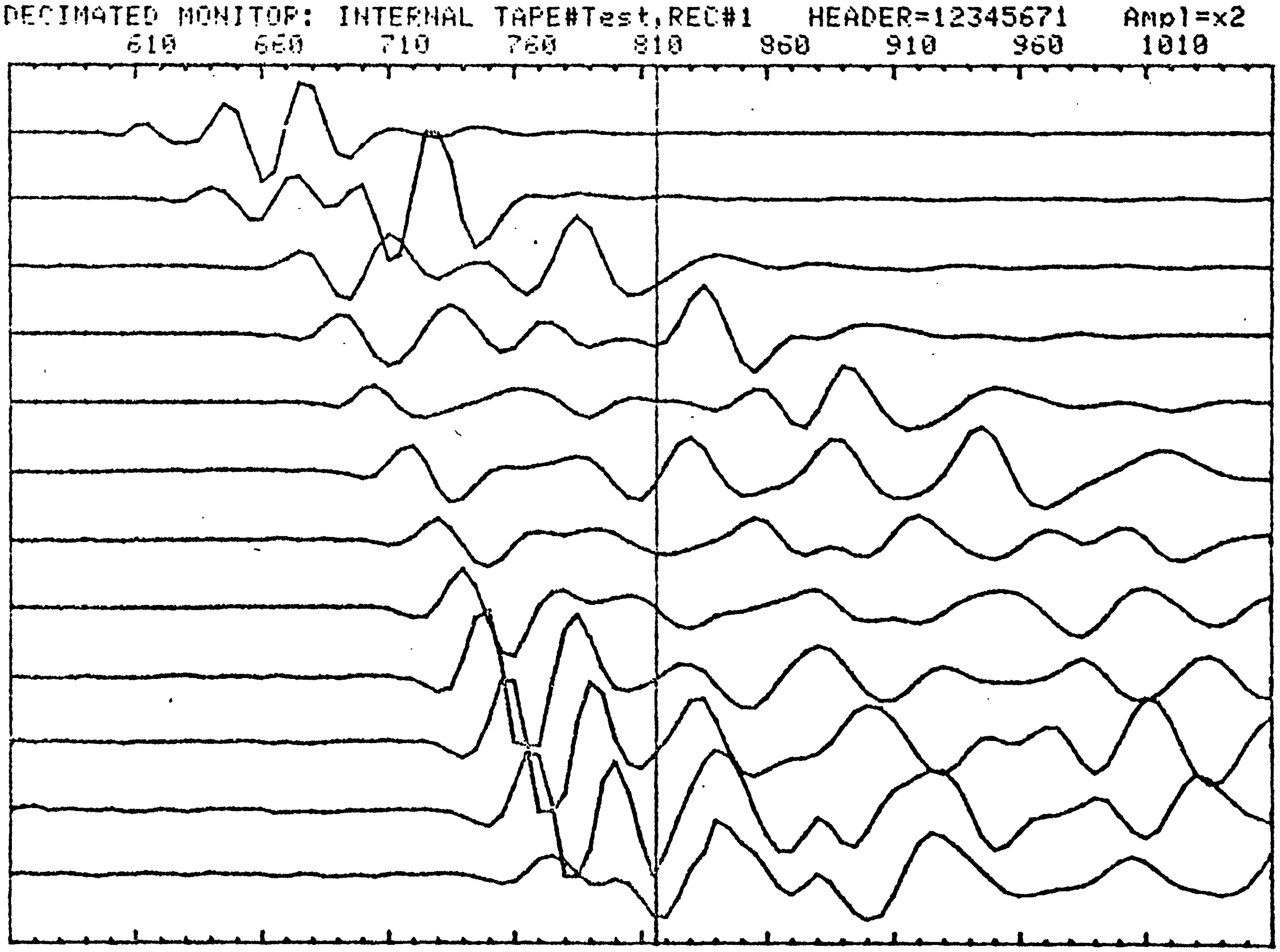

Figure 2. Decimated monitor record produced during the process of transferring field data to a temporary storage tape in the 4051 computer. Vertical line near the center divides the plot in accordance with the division of data as recorded by the G-724-S digital magnetic tape recorder.

record on photographic paper of each data set for which a field-data magnetic tape has been made. Looking at the field monitor paper record and checking field notes it would have been obvious that the header information was incorrectly entered on this particular field data tape. The correct header should have been 12330011, telling us that the data were taken on the 123rd day of the year with a sample interval of 0.2 msec and with a zero start time (that is, no delay). The computer, reading the header information on the tape, shows that a delay of 560 msec was introduced (56 in header positions 5 and 6) and that the sample interval was 0.5 msec (a 4 in the fourth digit of the header).

Program to transfer field data to internal tape

```
100 PRINT "L        YOU HAVE SELECTED THE PROGRAM THAT UPON ACCEPTING"
110 PRINT "       DATA PLAYED BACK FROM THE G-724-S RECORDER,PLACES"
120 PRINT "     THEM ON AN INTERNAL TAPE WITHIN THE 4051.  AND THEN"
130 PRINT "        MAKES HARD-COPIES OF A DECIMATED MONITOR RECORD"
150 INIT
160 DIM A$(4004),B$(4004),C$(720),D$(4),G$(1),H$(11)
170 DIM I$(1),L$(2),M$(5),S$(1),V(1,101),Z(202)
180 DATA 0.014423,130,96,7.3846
190 READ K1,C2,D2,D4
200 PRINT "_NUMBER OF INTERNAL TAPE BEING USED = ";
210 INPUT M$
220 PRINT "__                        INSTRUCTIONS_"
230 PRINT "   1. Remove program tape from the 4051."
240 PRINT "   2. Insert internal tape within the 4051."
250 PRINT "      Note: Internal tape must be marked as follows:"
260 PRINT "      FIND 1; MARK 1,1024"
270 PRINT "      FIND 2; MARK 1,250000"
280 PRINT "   3. Insert field-data tape into the G-724-S."
290 PRINT "   4. Set eighth dial of G-724-S to number of record at";
300 PRINT " which playback"
310 PRINT "      is to begin (0 for all records;5 for last record),";
320 PRINT " and then"
330 PRINT "      when ready to proceed, answer next question with Y."
340 R1:5
350 PRINT "_ARE YOU READY TO PROCEED? (Y OR N) ";
360 INPUT G$
370 IF G$="N" THEN 350
380 REM ** CONDITION 4051 TO ACCEPT DATA OVER THE RS-232-C BUSS
390 CALL "RATE",2400,4,0
400 CALL "MARGIN",1,2,1
410 CALL "RSTRIN","S","R","T"
420 CALL "BLKCHR",83,82,84
430 CALL "EOLCHR",0,"",1
440 REM ** TRANSFER DATA FROM G-724-S TO INTERNAL TAPE OF 4051
450 FIND 2
460 PRINT "GGG_PUSH PLAYBACK BUTTON ON G-724-S"
470 CALL "RCRLF",1,0,0
480 CALL "DELAYS",0,0,1
490 CALL "DTRECV"
500 CLOSE
510 REM ** INPUT DATA FROM INTERNAL TAPE
520 FIND 2
530 ON EOF (0) THEN 950
540 FOR M5=1 TO 5
550    INPUT @33:H$
560    H$=SEG(H$,2,8)
570    I$=SEG(H$,4,1)
580    L$=SEG(H$,5,2)
590    L=VAL(L$)*10
600    S1=VAL(I$)
610    IF S1>6 THEN 750
620    GO TO S1 OF 630,650,670,690,710,730
630    S1=0.05
640    GO TO 760
650    S1=0.1
660    GO TO 760
670    S1=0.2
680    GO TO 760
690    S1=0.5
700    GO TO 760
710    S1=1
720    GO TO 760
730    S1=2
740    GO TO 760
750    S1=10
760    T1=L
770    T2=L+1000*S1
780    T5=T2-T1
790    S2=S1
800    REM ** PLOT DECIMATED MONITOR RECORD
810    GOSUB 970
820    D5=D2-D4
830    FOR P=1 TO 12
840       GOSUB 1140
850       GOSUB 1530
860       V=0
870       CALL "HEXDEC",C$,V,LEN(C$),4
880       V=V-511
890       V=K1*V
900       V=V+D5
910       GOSUB 1210
920    NEXT P
930    COPY
940 NEXT M5
950 PRINT "GGG";"_PROGRAM COMPLETED"
960 END
970 REM ** SUB:PLOT TITLE, LABELS, AND BORDERS
980 PAGE
990 WINDOW 0,130,0,100
1000 VIEWPORT 0,130,0,100
1010 MOVE 0,100
1020 PRINT "DECIMATED MONITOR: INTERNAL TAPE#";M$;",REC#";M5;
1030 PRINT "   HEADER=";H$;"   Ampl=x2"
1040 MOVE 0,96
1050 GOSUB 1600
1060 MOVE 10.66,D2+1
1070 T6=T5/10
1080 PRINT T1+T6
1090 FOR K=2 TO 9
1100    RMOVE C2/10,0
1110    PRINT T1+K*T6
1120 NEXT K
1130 RETURN
1140 REM ** SUB:RETRIEVE, TEST, AND CONCATENATE DATA FOR PLOTTING
1150 INPUT @33:A$,B$
1160 GOSUB 1350
1170 A$=SEG(A$,1,LEN(A$)-2)
1180 B$=SEG(B$,1,LEN(B$)-94)
1190 A$=A$&B$
1200 RETURN
```

```
1210 REM ** SUB: PLOT TRACES
1220 MOVE 0,D5
1230 Z(1)=0
1240 Z(2)=V(1,1)
1250 K7=0
1260 FOR J=3 TO 201 STEP 2
1270    K7=K7+1.3
1280    Z(J)=K7
1290    Z(J+1)=V(1,0.5*(J+1))
1300 NEXT J
1310 PRINT @32,20:Z
1320 DRAW 130,D5
1330 D5=D5-D4
1340 RETURN
1350 REM ** SUB:TEST AND FILL
1360 IF LEN(A$)=2050 THEN 1410
1370 L1=2051-LEN(A$)
1380 GOSUB 1470
1390 A$=SEG(A$,1,LEN(A$)-2)
1400 A$=A$&C$
1410 IF LEN(B$)=2050 THEN 1460
1420 L1=2051-LEN(B$)
1430 GOSUB 1470
1440 B$=SEG(B$,1,LEN(B$)-2)
1450 B$=B$&C$
1460 RETURN
1470 REM ** SUB:BUILD APPENDING WORD
1480 C$="F"
1490 FOR I=1 TO L1
1500    C$="F"&C$
1510 NEXT I
1520 RETURN
1530 REM ** SUB:DECIMATE DATA STRING FOR MONITOR PLOT
1540 C$=SEG(A$,1,4)
1550 FOR K=41 TO 4004 STEP 40
1560    D$=SEG(A$,K,4)
1570    C$=C$&D$
1580 NEXT K
1590 RETURN
1600 REM ** SUB: PRINT BORDER AND TICKMARKS
1610 C3=C2/50
1620 DIM B(300)
1630 B=D2
1640 M1=0.4
1650 M2=1.2
1660 M3=D2-M1
1670 M4=D2-M2
1680 B(1)=0
1690 C4=0
1700 FOR K=3 TO 291 STEP 6
1710    C4=C4+C3
1720    B(K)=C4
1730    B(K+2)=C4
1740    B(K+3)=M3
1750    B(K+4)=C4
1760 NEXT K
1770 B(297)=130
1780 B(299)=130
1790 B(300)=0
1800 FOR K=30 TO 270 STEP 30
1810    B(K)=M4
1820 NEXT K
1830 MOVE 0,D2
1840 PRINT @32,20:B
1850 DELETE B
1860 DIM B(304)
1870 B=0
1880 B(1)=130
1890 C4=130
1900 FOR K=3 TO 291 STEP 6
1910    C4=C4-C3
1920    B(K)=C4
1930    B(K+2)=C4
1940    B(K+3)=M1
1950    B(K+4)=C4
1960 NEXT K
1970 FOR K=30 TO 270 STEP 30
1980    B(K)=M2
1990 NEXT K
2000 B(300)=D2
2010 B(301)=66.62
2020 B(302)=D2
2030 B(303)=66.62
2040 PRINT @32,20:B
2050 DELETE B
2060 RETURN
```

EDIT BYTE ERRORS AND TRANSFER DATA FROM INTERNAL TO MASTER DATA TAPE

The next data-processing step is to correct header and byte-shift errors, compress 4-character to 3-character words by truncating the first character of the 4-character words and transfer the corrected and compressed data to a master data tape.

Byte-shift errors occur when bytes are added or dropped. The resulting effect on the data can be disastrous because when bytes are dropped or added, the least significant numbers can be shifted into the position of the most significant numbers. Consider, for example, the string of 4-place numbers:

..., 0705, 0711, 0708, 0705, 0699, 0695,...

and let us drop the leading 07 from the third group. Now the string reads:

..., 0705, 0711, 0807, 0506, 9906, 95--,...

Whereas in the first set, the maximum difference between adjacent values is 6, in the dropped byte-pair set, the maximum difference is 9400. Note also that once the byte shift occurs, the subsequent numbers in the series vary widely. After word compression takes place, the above series of numbers becomes:

..., 705, 711, 807, 506, 906, 5--,...

and, as far as I can see, uncorrectable back to the series:

..., 705, 711, 708, 705, 699, 695,...

Evidently, byte correction must be made before word compression.

To correct byte errors within a data set, three things must be done:

1. locate where the error first appeared,
2. determine what bytes are missing, and
3. put these back into the data string.

This is what the byte-error segment of the program does. But it doesn't do it automatically. Interaction between the person and the computer is required, and this takes both time and effort.

Let us trace through the byte-error correction procedure using as an example the byte-shift error revealed on the left side of trace 4 as displayed on the decimated monitor of internal tape #III, figure 3. The header is incorrect, but this is no problem to fix. When the program asks if the header is correct, the reply would be entry of an N. The program will then request you to enter the correct header.

Two questions next are posed by the program:

1. TRACE ON WHICH BYTE SHIFTS OCCUR = ? The answer here would be a 4, and
2. Do byte shifts begin to the left of the near-center line? Here the answer would be a Y.

Upon receiving this information, the program then directs the display shown on figure 4 to be written on the CRT screen of the 4051. Near the lower right-hand side of this matrix of 4-character hexadecimal numbers is a statement of the number of missing bytes. Note that even though no bytes are shown as missing, there are nevertheless two that are. What has happened here is that the tape recorder has inserted the check-sum pair of numbers into the data string, and the computer has not recognized these as not being real data.

In the data transmission logic built into the G-724-S digital magnetic recorder, four 4-character words are required to handle the 10-bit data stored in the memory of the seismograph. The six unused leading-space bits are filled with binary ones by the recorder's logic circuits. Since no negative quantities are allowed, a constant is added to force negative values to become positive. Also, the data are inverted. What all this manipulation does is cause the leading character in the 4-character word to be an F, if no errors are present.

Scanning columns 1 through 69 in increments of 4, note that the leading

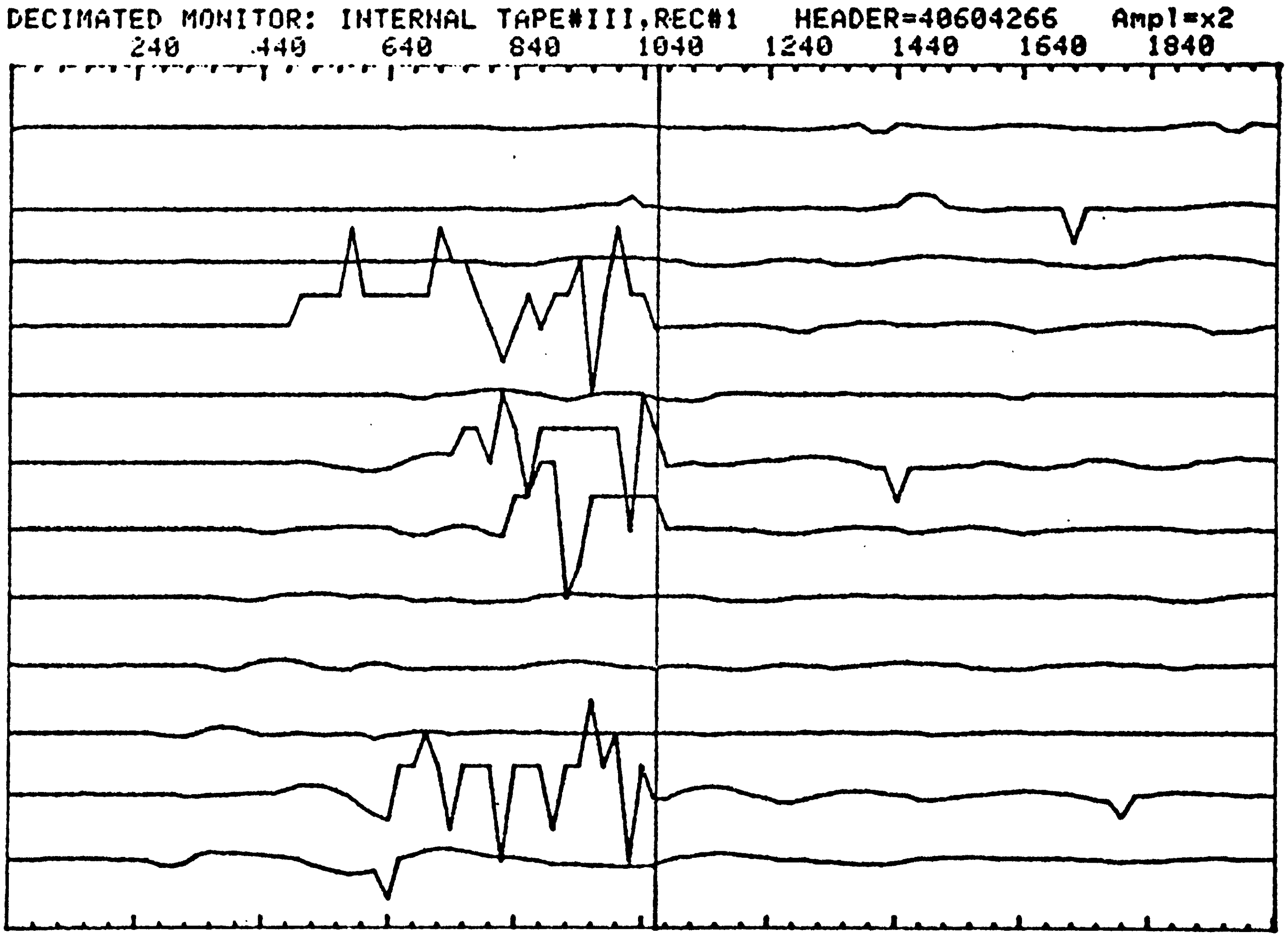

Figure 3. Decimated monitor record showing four traces (4, 6, 7 and 11 to the left side of dividing line) on which dropped-byte errors occurred.

```
        9       17      25      33      41      49      57      65
FDF1FDF5FDEDFDEBFDE7FDE6FDE8FDEDFDEAFDE7FDE7FDE9FDEBFDF0FDECFDEAFDE9FDEA
FDE9FDEAFDECFDE9FDE7FDEBFDE9FDE9FDEAFDEBFDEBFDEAFDE9FDE9FDEAFDE7FDE9FDE7
FDEBFDEBFDE7FDE7FDE9FDEBFDEAFDEAFDEAFDE9FDEBFDE9FDE9FDE9FDE9FDE9FDEBFDEB
FDE9FDEBFDE5FDE9FDEBFDE9FDE9FDEAFDEBFDEDFDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9
FDE9FDE9FDE7FDEAFDEAFDE9FDE7FDEAFDEAFDE9FDE8FDE9FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEBFDEBFDE9FDEBFDEAFDEAFDE9FDEAFDEAFDE8FDE9FDE9FDEAFDEAFDEAFDEAFDEA
FDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9FDEBFDEAFDE9FDEBFDEAFDEAFDEAFDEAFDE7FDE8
FDEBFDEAFDEBFDE9FDE9FDE9FDECFDE9FDEDFDE9FDEBFDE9FDE9FDEAFDE9FDE9FDE7FDE9
FDEBFDE8FDE9FDEAFDE8FDEDFDE9FDE8FDE9FDE9FDE7FDE8FDEAFDE8FDE9FDE7FDE8FDE5
FDE9FDE9FDE9FDE9FDE6FDE6FDE9FDE9FDE8FDE9FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9
FDE9FDE9FDE9FDE9FDE9FDEAFDEAFDE9FDEAFDE9FDE9FDE8FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEAFDE8FDE9FDEAFDE7FDEAFDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEB
FDEAFDE7FDEAFDE9FDE9FDE7FDE9FDE9FDE9FDE9FDE9FDE8E7FDE9FDE9FDE9FDE9FDE9FD
E9FDEAFDE9FDE7FDE9FDE9FDE9FDE8FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE9FD
EAFDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE7FDEAFDE9FDE9FDE9FDE9FDEAFDE9FDE9FDEAFD
EAFDEAFDEAFDECFDEAFDE9FDEAFDEAFDEBFDE9FDE9FDE8FDEAFDEBFDE9FDE9FDEBFDEAFD
EAFDE9FDE9FDEAFDE9FDE9FDE8FDEAFDEAFDE9FDE9FDE9FDE9FDE9FDE7FDE7FDE9FDE9FD
EAFDEEFDEBFDE9FDECFDEAFDE9FDE9FDE6FDE7FDE9FDE9FDE9FDE9FDE7FDE9FDE9FDE7FD
E9FDE6FDE6FDE9FDE9FDE9FDE7FDE7FDE9FDE7FDE7FDE9FDE9FDE9FDE6FDE6FDEAFDE9FD
ECFDE7FDE9FDEAFDE7FDEAFDECFDE8FDEBFDE9FDEEFDE9FDE9FDEAFDEBFDEBFDEBFDEDFD
EBFDEDFDEDFDEDFDECFDF3FDF3FDF9FDF7FDF5FDF7FDF7FDFAFDFBFDFDFDFDFDFDFDFDFD
FBFDFDFDFDFDFDFE02FE02FDFDFDFFFE0AFE06FE09FE0FFE0EFE0FFDFEFE03FE03FE02FE
02FE02FE02FDFFFDFDFDFFFDFFFDFBFDFDFDFBFDF9FDF3FDF3FDF4FDF1FDEFFDEDFDEAFD
EAFDE6FDE5FDE5FDE5FDE3FDDDFDDDFDDFFDDAFDD7FDD4FDD6FDD6FDD4FDD6FDD2FDCFFD
CFFDCEFDCBFDC9FDCDFDCBFDC9FDC9FDC9FDC9FDC9FDC9FDCBFDC7FDC9FDC9FDC9FDC8FD
CBFDCAFDC9FDC9FDC9FDCBFDCBFDCDFDCEFDCBFDCFFDD1FDD1FDD0FDD8FDD4FDD4FDD7FD
D7FDD9FDD9FDDBFDDFFDDFFDE1FDE1FDE2FDE4FDE5FDE7FDEAFDE9FDE9FDE9FDE9FDECFD
EFFDEFFDEFFDEEFDF3FDF1FDF1FDF3FDF5FDEFFDE7FDF8FDF9FDF9FDE9FDF9FDF9FDF9FD
F9FDF9FDEBFDF7FDFBFDFBFDEDFDF93434       NO. OF MISSING BYTES = 0
DO YOU WANT TO SEE THESE VALUES IN DECIMAL? (Y OR N) Y
```

Figure 4. Matrix display showing 4-character hexadecimal number representing values for trace 4 to left of vertical line on the decimated monitor of figure 3. Note that the orderly sequence of numbers appears to break at row 13, column 49.

F is first not present at a position located at the intersection of column 49 and row 13. Absence of a leading F, however, cannot be used as a reliable computer "flag" to automatically locate the beginning of the byte-shift region--for example look at row 29, column 1.

Because it is sometimes difficult to locate the position of the byte skip in the matrix of hexadecimal numbers, the program asks (bottom line of fig. 4): "DO YOU WANT TO SEE THESE VALUES IN DECIMAL?(Y OR N)". In this example we replied with a Y, and the display shown in figure 5 was produced.

From a glance at figure 5 it is relatively easy to see that the normal succession of numerical values ends at the value preceding the value located in row 13, column 49. The decimal conversion has put the numbers back from their hexadecimal representation and has re-inverted and re-shifted them in amplitude. The answer to the query on the bottom line, "ARE ADDITIONAL SKIP-BYTE CORRECTIONS REQUIRED? (Y OR N)", is clearly Y, whereupon the program produces the hexadecimal matrix (fig. 6). After asking if you want to see the decimal conversion again (the answer is N--we've already been there), the program next asks you to enter the row and column at which the incorrect string begins. Here one would enter a 13 followed by a 49. Finally at the bottom of figure 6 the program requests you enter the correct value, in this case, FDE7FD. How do you know to enter a leading FD? You know from having looked at the string of 4-character hexadecimal numbers that precede the spot at which trouble began and by assuming that the number will take the same form.

After being given the corrected values, the program than inserts these values into the data string and prints the corrected hexadecimal matrix as shown in figure 7. Compare this display to the one on figure 6, and note how the leading F's of the 4-place hexadecimal display are now all vertically

		9		17		25		33		41		49		57		65	
15	11	19	21	25	26	24	19	22	25	25	23	21	16	20	22	23	22
23	22	20	23	25	21	23	23	22	21	21	22	23	23	22	25	23	25
21	21	25	25	23	21	22	22	22	23	21	23	23	23	23	23	21	21
23	21	27	23	21	23	23	22	21	19	23	22	22	22	24	23	23	23
23	23	25	22	22	23	25	22	22	23	24	23	25	23	23	22	22	22
22	21	21	23	21	22	22	23	22	22	24	23	23	21	22	22	22	22
23	22	22	22	24	23	23	23	21	22	23	21	22	22	22	22	25	24
21	22	21	23	23	23	20	23	19	23	21	23	23	21	23	23	25	23
21	24	23	22	24	19	23	24	23	23	25	24	22	24	23	25	24	27
23	23	23	23	26	26	23	23	24	23	23	23	22	25	23	23	23	23
23	23	23	23	23	22	22	23	22	23	23	24	25	23	23	22	22	22
22	22	24	23	22	25	22	22	22	23	22	22	23	22	22	23	22	21
22	25	22	23	23	25	23	23	23	23	23	24	259	259	259	259	259	259
259	771	259	259	259	259	259	259	259	259	771	259	259	259	259	259	259	259
771	771	259	259	259	259	259	259	259	771	259	259	259	259	771	259	259	771
771	771	771	259	771	259	771	771	515	259	259	259	771	515	259	259	515	771
771	259	259	771	259	259	259	771	771	259	259	259	259	259	259	259	259	259
771	-253	515	259	259	771	259	259	259	259	259	259	259	259	259	259	259	259
259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	259	771	259
259	259	259	771	259	771	259	259	515	259	-253	259	259	771	515	515	515	3
515	3	3	3	259	259	259	259	259	259	259	259	771	515	3	3	3	3
515	3	3	2	258	259	3	-510	770	258	258	-510	-254	-509	-254	258	258	258
258	258	259	-509	3	-509	-509	515	3	515	259	259	259	259	259	-509	3	771
771	259	259	259	259	259	3	3	-509	771	259	259	259	259	259	259	259	-509
-509	-253	515	259	3	515	259	259	259	259	259	259	515	259	259	259	259	515
515	771	259	259	259	515	515	3	-253	515	-509	259	259	259	259	259	259	259
259	259	259	515	-509	-509	259	259	259	259	259	259	771	259	259	259	259	259
-509	-509	-509	-253	259	259	259	259	259	-509	259	259	259	259	259	259	259	259
259	259	515	259	515	515	3	460	0	0	0	0	0	0	0	0	0	0

ARE ADDITIONAL SKIP-BYTE CORRECTIONS REQUIRED? <Y OR N> Y

Figure 5. Matrix display showing decimal equivalents of hexadecimal numbers on figure 4.

```
        9       17      25      33      41      49      57      65
FDF1FDF5FDEDFDEBFDE7FDE6FDE8FDEDFDEAFDE7FDE7FDE9FDEBFDF0FDECFDEAFDE9FDEA
FDE9FDEAFDECFDE9FDE7FDEBFDE9FDE9FDEAFDEBFDEBFDEAFDE9FDE9FDEAFDE7FDE9FDE7
FDEBFDEBFDE7FDE7FDE9FDEBFDEAFDEAFDEAFDE9FDEBFDE9FDE9FDE9FDE9FDE9FDEBFDEB
FDE9FDEBFDE5FDE9FDEBFDE9FDE9FDEAFDEBFDEDFDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9
FDE9FDE9FDE7FDEAFDEAFDE9FDE7FDEAFDEAFDE9FDE8FDE9FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEBFDEBFDE9FDEBFDEAFDEAFDE9FDEAFDEAFDE8FDE9FDE9FDEBFDEAFDEAFDEAFDEA
FDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9FDEBFDEAFDE9FDEBFDEAFDEAFDEAFDEAFDE7FDE8
FDEBFDEAFDEBFDE9FDE9FDE9FDECFDE9FDEDFDE9FDEBFDE9FDE9FDEBFDE9FDE9FDE7FDE9
FDEBFDE8FDE9FDEAFDE8FDEDFDE9FDE8FDE9FDE9FDE7FDE8FDEAFDE8FDE9FDE7FDE8FDE5
FDE9FDE9FDE9FDE9FDE6FDE6FDE9FDE9FDE8FDE9FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE3
FDE9FDE9FDE9FDE9FDE9FDEAFDEAFDE9FDEAFDE9FDE9FDE8FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEAFDE8FDE9FDEAFDE7FDEAFDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEB
FDEAFDE7FDEAFDE9FDE9FDE7FDE9FDE9FDE9FDE9FDE9FDE8E7FDE9FDE9FDE9FDE9FDE9FD
E9FDEAFDE9FDE7FDE9FDE9FDE9FDE8FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE9FD
EAFDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE7FDEAFDE9FDE9FDE9FDE9FDEAFDE9FDE9FDEAFD
EAFDEAFDEAFDECFDEAFDE9FDEAFDEAFDEBFDE9FDE9FDE8FDEAFDE8FDE9FDE9FDEBFDEAFD
EAFDE9FDE9FDEAFDE9FDE9FDE8FDEAFDEAFDE9FDE9FDE9FDE9FDE9FDE7FDE7FDE9FDE9FD
EAFDEEFDEBFDE9FDECFDEAFDE9FDE9FDE6FDE7FDE9FDE9FDE9FDE9FDE7FDE9FDE9FDE7FD
E9FDE6FDE6FDE9FDE9FDE9FDE7FDE7FDE9FDE7FDE7FDE9FDE9FDE9FDE6FDE6FDEAFDE9FD
ECFDE7FDE9FDEAFDE7FDEAFDECFDE8FDEBFDE9FDEEFDE9FDE9FDEAFDEBFDEBFDEBFDEDFD
EBFDEDFDEDFDEDFDECFDF3FDF3FDF9FDF7FDF5FDF7FDF7FDFAFDFBFDFDFDFDFDFDFDFDFD
FBFDFDFDFDFDFDFE02FE02FDFDFDFFFE0AFE06FE09FE0FFE0EFE0FFDFEFE03FE03FE02FE
02FE02FE02FDFFFDFDFDFFFDFFFDFBFDFDFDFBFDF9FDF3FDF3FDF4FDF1FDEFFDEDFDEAFD
EAFDE6FDE5FDE5FDE5FDE3FDDDFDDDFDDFFDDAFDD7FDD4FDD6FDD6FDD4FDD6FDD2FDCFFD
CFFDCEFDC8FDC9FDCDFDCBFDC9FDC9FDC9FDC9FDC9FDC9FDCBFDC7FDC9FDC9FDC9FDCBFD
CBFDCAFDC9FDC9FDC9FDCBFDCBFDCDFDCEFDCBFDCFFDD1FDD1FDD0FDD0FDD4FDD4FDD7FD
D7FDD9FDD9FDDBFDDFFDDFFDE1FDE1FDE2FDE4FDE5FDE7FDEAFDE9FDE9FDE9FDE9FDECFD
EFFDEFFDEFFDEEFDF3FDF1FDF1FDF3FDF5FDEFFDE7FDF8FDF9FDF9FDF9FDF9FDF9FDF9FD
F9FDF9FDF8FDF7FDFBFDFBFDFDFDF93434      NO. OF MISSING BYTES = 0
DO YOU WANT TO SEE THESE VALUES IN DECIMAL? (Y OR N) N

INCORRECT STRING BEGINS AT ROW: 13 ,COL: 49
ERROR STRING: E7FD TO BE CHANGED TO: FDE7FD
```

Figure 6. Matrix display of hexadecimal numbers produced after decimal display were viewed. At the bottom of this display you are asked to enter where the incorrect string begins (row 13, column 49), and then asked to enter correct values (FDE7FD to replace E7FD).

```
                9               17              25              33              41              49              57              65
FDF1FDF5FDEDFDEBFDE7FDE6FDE8FDECFDEAFDE7FDE7FDE9FDEBFDFCFDECFDEAFDE9FDEA
FDE9FDEAFDECFDE9FDE7FDEBFDE9FDE9FDEAFDEBFDEBFDEAFDE9FDE9FDEAFDE7FDE9FDE7
FDEBFDEBFDE7FDE7FDE9FDEBFDEAFDEAFDEAFDE9FDEBFDE9FDE9FDE9FDE9FDE9FDEBFDEB
FDE9FDEBFDE5FDE9FDEBFDE9FDE9FDEAFDEBFDEDFDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9
FDE9FDE9FDE7FDEAFDEAFDE9FDE7FDEAFDEAFDE9FDE8FDE9FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEBFDEBFDE9FDEBFDEAFDEAFDE9FDEAFDEAFDE8FDE9FDE9FDEEFDEAFDEAFDEAFDEA
FDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9FDEBFDEAFDE9FDEBFDEAFDEAFDEAFDEAFDE7FDE8
FDEBFDEAFDEBFDE9FDE9FDE9FDECFDE9FDEDFDE9FDEBFDE9FDE9FDEEFDE9FDE9FDE7FDE9
FDEBFDE8FDE9FDEAFDE8FDECFDE9FDE8FDE9FDE9FDE7FDE8FDEAFDE9FDE9FDE7FDE8FDE5
FDE9FDE9FDE9FDE9FDE6FDE6FDE9FDE9FDE8FDE9FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9
FDE9FDE9FDE9FDE9FDE9FDEAFDEAFDE9FDEAFDE9FDE9FDE8FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEAFDE8FDE9FDEAFDE7FDEAFDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEB
FDEAFDE7FDEAFDE9FDE9FDE7FDE9FDE9FDE9FDE9FDE9FDE8FDE7FDE9FDE9FDE9FDE9FDE9
FDE9FDEAFDE9FDE7FDE9FDE9FDE9FDE8FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE9
FDEAFDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE7FDEAFDE9FDE9FDE9FDE9FDEAFDE9FDE9FDEA
FDEAFDEAFDEAFDECFDEAFDE9FDEAFDEAFDEBFDE9FDE9FDE8FDEAFDEBFDE9FDE9FDEBFDEA
FDEAFDE9FDE9FDEAFDE9FDE9FDE8FDEAFDEAFDE9FDE9FDE9FDE9FDE9FDE7FDE7FDE9FDE9
FDEAFDEEFDEBFDE9FDECFDEAFDE9FDE9FDE6FDE7FDE9FDE9FDE9FDE9FDE7FDE9FDE9FDE7
FDE9FDE6FDE6FDE9FDE9FDE9FDE7FDE7FDE9FDE7FDE7FDE9FDE9FDE9FDE6FDE6FDEAFDE9
FDECFDE7FDE9FDEAFDE7FDEAFDECFDE8FDEBFDE9FDEEFDE9FDE9FDEAFDEBFDEEFDEBFDED
FDE8FDEDFDEDFDEDFDECFDF3FDF3FDF9FDF7FDF5FDF7FDF7FDFAFDFBFDFDFDFDFDFDFDFD
FDFBFDFDFDFDFDFDFE02FE02FDFDFDFFFE0AFE06FE09FE0FFE0EFE0FFDFEFE03FE03FE02
FE02FE02FE02FDFFFDFDFDFFFDFFFDFBFDFDFDFBFDF9FDF3FDF3FDF4FDF1FDEFFDEDFDEA
FDEAFDE6FDE5FDE5FDE5FDE3FDDDFDDDFDDFFDDAFDD7FDD4FDD6FDD6FDD4FDD6FDD2FDCF
FDCFFDCEFDCBFDC9FDCDFDCCFDC9FDC9FDC9FDC9FDC9FDC9FDCBFDC7FDC9FDC9FDC9FDCB
FDCBFDCAFDC9FDC9FDC9FDCEFDCBFDCDFDCEFDCBFDCFFDD1FDD1FDD0FDD0FDD4FDD4FDD7
FDD7FDD9FDD9FDDBFDDFFDDFFDE1FDE1FDE2FDE4FDE5FDE7FDEAFDE9FDE9FDE9FDE9FDEC
FDEFFDEFFDFEFDFEFDF3FDF1FDF1FDF3FDF5FDEFFDF7FDF8FDF9FDF9FDF9FDF9FDF9FDF9
FDF9FDF9FDFBFDF7FDFBFDFBFDFDFDF934      NO. OF MISSING BYTES = 0
DO YOU WANT TO SEE THESE VALUES IN DECIMAL? (Y OR N) Y
```

Figure 7. Matrix display of hexadecimal numbers after correct values were entered.

aligned. If you want to be more sure of the correction, you can ask again for a decimal display by entering a Y in response to the question printed along the bottom line. Having done so, the display shown in figure 8 would have been produced. These values look reasonable for a set of seismic traces (although they are definitely biased); thus, the answer entered to the bottom question on figure 8 is an N. Upon receipt of an N entry, a display as shown on figure 7 is produced. Here the answer to the bottom-line question is again an N, and finally a display such as shown in figure 9 is produced on the screen.

You are next asked if there are any more byte shifts on this trace segment and if there are any more byte-shifted traces on this record. In this example, the response to the last question was a Y. This answer causes the statement: TRACE ON WHICH BYTE SHIFTS OCCUR=, to be printed. The reply given was entry of a 6, the next trace to be corrected.

Admittedly, the procedure to correct byte errors is a long one. But it is a task that must be done, for if not done, the data are useless--all because of two bytes having been dropped in the example given.

After all byte corrections have been made, the data are compressed from 4-character to 3-character words, and then transferred to a master data tape (MDT). Because a master data tape can hold data from 7 seismic records and the field-data tape can contain a maximum of 5 records, the program will ask you to specify to which file on the MDT one wants the data to be transferred.

		9		17		25		33		41		49		57		65	
15	11	19	21	25	26	24	19	22	25	25	23	21	16	20	22	23	22
23	22	20	23	25	21	23	23	22	21	21	22	23	23	22	25	23	25
21	21	25	25	23	21	22	22	22	23	21	23	23	23	23	23	21	21
23	21	27	23	21	23	23	22	21	19	23	22	22	23	24	23	23	23
23	23	25	22	22	23	25	22	22	23	24	23	25	23	23	22	22	22
22	21	21	23	21	22	22	23	22	22	24	23	23	21	22	23	22	22
23	22	22	22	24	23	23	23	21	22	23	21	22	23	22	23	25	24
21	22	21	23	23	23	20	23	19	23	21	23	23	21	23	23	25	23
21	24	23	22	24	19	23	24	23	23	25	24	22	24	23	25	24	27
23	23	23	23	25	26	23	23	24	23	23	23	22	25	23	23	23	23
23	23	23	23	23	22	22	23	22	23	23	24	25	23	23	22	22	22
22	22	24	23	22	25	22	22	22	23	22	22	23	22	22	23	22	21
22	25	22	23	23	25	23	23	23	23	23	24	25	23	23	23	23	23
23	22	23	25	23	23	23	24	23	23	22	25	23	23	23	23	23	23
22	22	25	23	23	23	23	23	25	22	23	23	23	23	22	23	23	22
22	22	22	20	22	23	22	22	21	23	23	24	22	21	23	23	21	22
22	23	23	22	23	23	24	22	22	23	23	23	23	23	25	25	23	23
22	18	21	23	20	22	23	23	26	25	23	23	23	23	25	23	23	25
23	26	26	23	23	23	25	25	23	25	25	23	23	23	26	26	22	23
20	25	23	22	25	22	20	24	21	23	18	23	23	22	21	21	21	19
21	19	19	19	20	13	13	7	9	11	9	9	6	5	3	3	3	3
5	3	3	3	-2	-2	3	1	-10	-6	-9	-15	-14	-15	2	-3	-3	-2
-2	-2	-2	1	3	1	1	5	3	5	7	13	13	12	15	17	19	22
22	26	27	27	27	29	35	35	33	38	41	44	42	42	44	42	46	49
49	50	53	55	51	53	55	55	55	55	55	55	53	57	55	55	55	53
53	54	55	55	55	53	53	51	58	53	49	47	47	48	48	44	44	41
41	39	39	37	33	33	31	31	30	28	27	25	22	23	23	23	23	20
17	17	17	18	13	15	15	13	11	17	9	8	7	7	7	7	7	7
7	7	5	9	5	5	3	7	0	0	0	0	0	0	0	0	0	0

ARE ADDITIONAL SKIP-BYTE CORRECTIONS REQUIRED? (Y OR N) N

Figure 8. Matrix display of decimal numbers equivalent to hexadecimal numbers of figure 7.

```
                9       17      25      33      41      49      57      65
FDF1FDF5FDEDFDEBFDE7FDE6FDE8FDEDFDEAFDE7FDE7FDE9FDEBFDF0FDECFDEAFDE9FDEA
FDE9FDEAFDECFDE9FDE7FDEBFDE9FDE9FDEAFDE8FDEBFDEAFDE9FDE9FDEAFDE7FDE9FDE7
FDE8FDEBFDE7FDE7FDE9FDEBFDEAFDEAFDEAFDE9FDEBFDE9FDE9FDE9FDE9FDE9FDEBFDEB
FDE9FDEBFDE5FDE9FDEBFDE9FDE9FDEAFDEBFDEDFDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9
FDE9FDE9FDE7FDEAFDEAFDE9FDE7FDEAFDEAFDE9FDE8FDE9FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEBFDEBFDE9FDEBFDEAFDEAFDE9FDEAFDEAFDE8FDE9FDE9FDEBFDEAFDEAFDEAFDEA
FDE9FDEAFDEAFDEAFDE8FDE9FDE9FDE9FDEBFDEAFDE9FDEBFDEAFDEAFDEAFDEAFDE7FDE8
FDEBFDEAFDEBFDE9FDE9FDE9FDECFDE9FDEDFDE9FDE8FDE9FDE9FDEBFDE9FDE9FDE7FDE9
FDEBFDE8FDE9FDEAFDE9FDEDFDE9FDE8FDE9FDE9FDE7FDE8FDEAFDE9FDE9FDE7FDE8FDE5
FDE9FDE9FDE9FDE9FDE6FDE6FDE9FDE9FDE8FDE9FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9
FDE9FDE9FDE9FDE9FDE9FDEAFDEAFDE9FDEAFDE9FDE9FDE8FDE7FDE9FDE9FDEAFDEAFDEA
FDEAFDEAFDE9FDE9FDEAFDE7FDEAFDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEAFDE9FDEAFDEB
FDEAFDE7FDEAFDE9FDE9FDE7FDE9FDE9FDE9FDE9FDE9FDE9FDE7FDE9FDE9FDE9FDE9FDE9
FDE9FDEAFDE9FDE7FDE9FDE9FDE9FDE8FDE9FDE9FDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE9
FDEAFDEAFDE7FDE9FDE9FDE9FDE9FDE9FDE7FDEAFDE9FDE9FDE9FDE9FDEAFDE9FDE9FDEA
FDEAFDEAFDEAFDECFDEAFDE9FDEAFDEAFDEBFDE9FDE9FDE8FDEAFDEBFDE9FDE9FDEBFDEA
FDEAFDE9FDE9FDEAFDE9FDE9FDE8FDEAFDEAFDE9FDE9FDE9FDE9FDE9FDE7FDE7FDE9FDE9
FDEAFDEEFDEBFDE9FDECFDEAFDE9FDE9FDE6FDE7FDE9FDE9FDE9FDE9FDE7FDE9FDE9FDE7
FDE9FDE6FDE6FDE9FDE9FDE9FDE7FDE7FDE9FDE7FDE7FDE9FDE9FDE9FDE6FDE6FDEAFDE9
FDECFDE7FDE9FDEAFDE7FDEAFDECFDE8FDEBFDE9FDEEFDE9FDE9FDEAFDEBFDEBFDEBFDED
FDEBFDEDFDEDFDEDFDECFDF3FDF3FDF5FDF7FDF5FDF7FDF7FDFAFDFCFDFDFDFDFDFDFDFD
FDFBFDFCFDFDFDFDFE02FE02FDFDFDFFFE0AFE06FE09FE0FFE0EFE0FFDFEFE03FE03FE02
FE02FE02FE02FDFFFDFDFDFFFDFFFDFCFDFDFDFBFDF9FDF3FDF3FDF4FDF1FDEFFDEDFDEA
FDEAFDE6FDE5FDE5FDE5FDE3FDDDFDDDFDDFFDDAFDD7FDD4FDD6FDD6FDD4FDD6FDD2FDCF
FDCFFDCEFDCBFDC9FDCDFDCEFDC9FDC9FDC9FDC5FDC9FDC9FDCBFDC7FDC9FDC9FDC9FDCB
FDCBFDCAFDC9FDC9FDC9FDCEFDCBFDCDFDCEFDCBFDCFFDD1FDD1FDD0FDD0FDD4FDD4FDD7
FDD7FDD9FDD9FDDBFDDFFDDFFDE1FDE1FDE2FDE4FDE5FDE7FDEAFDE9FDE9FDE9FDE9FDEC
FDEFFDEFFDEFFDEFFDF3FDF1FDF1FDF3FDF5FDEFFDF7FDF8FDF9FDF9FDF9FDF9FDF9FDF9
FDF9FDF9FDFBFDF7FDFBFDFBFDFDFDF934.     NO. OF MISSING BYTES = 0
DO YOU WANT TO SEE THESE VALUES IN DECIMAL? (Y OR N) N
               FIRST HALF OF TRACE 4 AFTER CORRECTION
Any more byte shifts on this trace segment? (Y OR N) N
Any more byte-shifted traces on this record? (Y OR N) Y

TRACE ON WHICH BYTE SHIFTS OCCUR = 6
```

Figure 9. Final matrix display of hexadecimal numbers after correction was made.

Program to edit byte errors and transfer data from internal tape to master data tape

```
100 PRINT "L  YOU HAVE SELECTED THE PROGRAM TO EDIT BYTE-SHIFT ERRORS"
110 PRINT "AND/OR TRANSFER DATA FROM AN INTERNAL TO A MASTER DATA TAPE"
120 INIT
130 DIM A$(4004),B$(4004),C$(4004),D$(4),G$(1),H$(11)
140 DIM M$(10),N$(10),P$(6),S$(1),V(1,522)
150 K1:1
160 PRINT "_DO YOU WANT TO SEE COMMENTS? (Y OR N) ";
170 INPUT G$
180 IF G$:"N" THEN 300
190 PRINT "_                              COMMENTS"
200 PRINT "   1. Field tape can contain up to five 12-trace records;"
210 PRI "      master data tape (MDT) can hold seven 12-trace records."
220 PRINT "   2. Program requires that instructions be given from"
230 PRINT "      the keyboard each time as to which field record is"
240 PRINT "      to be stored on which record of the master data tape."
250 PRINT "   3. Scratch tape should be formatted as follows;"
260 PRINT "         a. FIND 1 then MARK 1,1024"
270 PRINT "         b. FIND 2 then MARK 1,256;"
280 PRINT "         c. FIND 3 then MARK 24,2304."
290 GOSUB 1410
300 PRINT "GGG";"_REMOVE PROGRAM TAPE FROM 4051"
310 PRINT "_NO. OF RECORD ON INTERNAL TAPE TO BE EDITED OR";
320 PRINT " TRANSFERRED = ";
330 INPUT R1
340 Q1:1
350 PRINT "_CODE NO. OF MDT = ";
360 INPUT M$
370 PRINT "_ARE BYTE-SHIFT ERRORS PRESENT? (Y OR N) ";
380 INPUT G$
390 IF G$:"N" THEN 860
400 Q1:2
410 REM ** TRANSFER DATA FROM INTERNAL TAPE TO SCRATCH TAPE
420 PRINT "GGG";"INSERT INTERNAL TAPE WITHIN 4924, AND"
430 PRINT "FORMATTED SCRATCH TAPE WITHIN 4051."
440 GOSUB 1410
450 P:2
460 GOSUB 1080
470 H$:A$
480 H$:SEG(H$,2,8)
490 REM ** MAKE HEADER CORRECTIONS
500 GOSUB 2770
510 FIND 2
520 PRINT @33:H$
530 REM ** FILL SCRATCH TAPE WITH DATA FROM INTERNAL TAPE
540 FOR I:1 TO 24
550    INPUT @2:A$
560    FIND 2+I
570    PRINT @33:A$
580 NEXT I
590 CLOSE
600 REM ** MAKE BYTE-SHIFT CORRECTIONS
610 G:1
620 GOSUB 1480
630 FIND M4
640 PRINT @33:A$
650 CLOSE
660 GOSUB 1690
670 REM ** TRANSFER DATA FROM SCRATCH TAPE TO MASTER DATA TAPE
680 PRINT "GGG";"REMOVE INTERNAL TAPE FROM 4924, AND ";
690 PRINT "REPLACE WITH MASTER DATA TAPE."
700 GOSUB 1410
710 GOSUB 1200
720 K2:0
730 FIND 2
740 INPUT @33:H$
750 K:3
760 GOSUB 1140
770 FIND @2:F2
780 WRITE @2:H$,C$
790 FOR K:5 TO 25 STEP 2
800    GOSUB 1140
810    FIND @2:(K-1)/2+F2-1
820    WRITE @2:C$
830 NEXT K
840 PRINT @2,2:
850 GO TO 1340
860 REM ** TRANSFER DATA FROM INTERNAL TAPE TO MASTER DATA TAPE
870 PRINT "GGG";"_INSERT INTERNAL TAPE WITHIN 4051, AND"
880 PRINT "MASTER DATA TAPE WITHIN 4924."
890 GOSUB 1410
900 GOSUB 1200
910 P:33
920 GOSUB 1080
930 H$:A$
940 H$:SEG(H$,2,8)
950 REM ** MAKE HEADER CORRECTIONS
960 GOSUB 2770
970 K2:0
980 GOSUB 1140
990 FIND @2:F2
1000 WRITE @2:H$,C$
1010 FOR K:1 TO 11
1020    GOSUB 1140
1030    FIND @2:F2+K
1040    WRITE @2:C$
1050 NEXT K
1060 PRINT @2,2:
1070 GO TO 1340
1080 REM ** SUB:ADVANCE INTERNAL TAPE TO REQUIRED DATA SEGMENT
1090 FIND @P:2
1100 FOR I:1 TO R1*25-24
1110    INPUT @P:A$
1120 NEXT I
1130 RETURN
1140 REM ** SUB:INPUT TRACE SEGMENTS, CONCATENATE, AND COMPRESS
1150 K2=K2+1
1160 IF Q1:1 THEN 1180
1170 FIND K
1180 INPUT @33:A$
1190 A$=SEG(A$,1,2048)
```

```
1200 IF Q1=1 THEN 1220
1210 FIND K+1
1220 INPUT @33:B$
1230 B$=SEG(B$,1,1956)
1240 A$=A$&B$
1250 CALL "C4TO3",A$
1260 C$=A$
1270 RETURN
1280 REM ** SUB:IDENTIFY MASTER-DATA-TAPE RECORD TO RECEIVE DATA
1290 PRINT "To which record on MDT:";M$;" are";
1300 PRINT " field data to be transferred? ";
1310 INPUT F1
1320 F2=F1*12-10
1330 RETURN
1340 PRINT "GGG";"_FIELD RECORD ";H$;" STORED AS RECORD ";F1;" ON";
1350 PRINT " MDT ";M$;"."
1360 PRINT "_ARE ANY MORE RECORDS TO BE EDITED OR TRANSFERRED? ";
1370 PRINT "(Y OR N) ";
1380 INPUT G$
1390 IF G$="N" THEN 1460
1400 GO TO 310
1410 REM ** SUB:READY TO PROCEED?
1420 PRINT "GGG";"_ARE YOU READY TO PROCEED? (Y OR N) ";
1430 INPUT G$
1440 IF G$="N" THEN 1410
1450 RETURN
1460 PRINT "GGG";"_PROGRAM COMPLETED"
1470 END
1480 REM ** SUB:CORRECT BYTE-SHIFT ERRORS
1490 PRINT "_TRACE ON WHICH BYTE SHIFTS OCCUR = ";
1500 INPUT E1
1510 M5=3
1520 P$="FIRST"
1530 PRINT "   Do byte shifts begin to left of near-center line?";
1540 PRINT " (Y OR N) ";
1550 INPUT G$
1560 IF G$="Y" THEN 1590
1570 M5=4
1580 P$="SECOND"
1590 M4=(E1-1)*2+M5
1600 PRINT "_YOU HAVE ELECTED TO EDIT THE ";P$;" PART ";
1610 PRINT "OF TRACE ";E1;" OF RECORD ";R1;","
1620 FIND M4
1630 INPUT @33:A$
1640 GOSUB 1780
1650 GOSUB 2150
1660 GOSUB 2530
1670 GOSUB 2710
1680 GOSUB 2620
1690 REM ** SUB:ANY MORE BYTE SHIFTS?
1700 PRINT "Any more byte shifts on this trace segment? (Y OR N) ";
1710 INPUT G$
1720 IF G$="N" THEN 1740
1730 GO TO 1620
1740 PRINT "Any more byte-shifted traces on this record? (Y OR N) ";
1750 INPUT G$
1760 IF G$="Y" THEN 600
1770 RETURN
1780 REM ** SUB:DRAW EYE-GUIDING GRID
1790 K5=1.792
1800 K6=2.816
1810 K7=72*K5
1820 K8=29*K6
1830 PAGE
1840 IF Q=1 THEN 1870
1850 MOVE K7,100-K6
1860 GO TO 1880
1870 MOVE K7,100
1880 FOR K=1 TO 3
1890    RDRAW -K7,0
1900    RDRAW 0,-4*K6
1910    RDRAW K7,0
1920    RDRAW 0,-4*K6
1930 NEXT K
1940 RDRAW -K7,0
1950 IF Q=1 THEN 1980
1960 MOVE -0.3,100-K6
1970 GO TO 1990
1980 MOVE -0.3,100
1990 FOR K=1 TO 4
2000    IF K=3 THEN 2020
2010    GO TO 2030
2020    K8=K8-K6
2030    RMOVE K7/9,0
2040    RDRAW 0,-K8
2050    RDRAW K7/9,0
2060    RDRAW 0,K8
2070 NEXT K
2080 MOVE -1.792,100
2090 FOR K=1 TO 8
2100    RMOVE K7/9,0
2110    K9=K*8+1
2120    PRINT K9
2130 NEXT K
2140 RETURN
2150 REM ** PRINT 'HALF TRACE' DATA STRING
2160 MOVE 0,97.35
2170 PRINT A$;"      NO. OF MISSING BYTES = ";2050-LEN(A$)
2180 PRINT "DO YOU WANT TO SEE THESE VALUES IN DECIMAL? (Y OR N) ";
2190 INPUT G$
2200 IF G$="N" THEN 2620
2210 S1=1
2220 S2=S1
2230 N=1
2240 D=2
2250 D$=A$
2260 V=0
2270 CALL "HEXDEC",D$,V,LEN(D$),4
2280 V=V-511
2290 GOSUB 1780
```

```
2300 READ @2:A$
2310 GO TO 2330
2320 READ @2:H$,A$
2330 B$=SEG(A$,J1,J3)
2340 V=0
2350 CALL "HEXDEC",B$,V,LEN(B$),3
2360 V=V-511
2370 C$=SEG(A$,1,J1-1)
2380 RETURN
2390 REM ** SUB:MORE CHANGES?
2400 PRINT "_ARE MORE CHANGES WITHIN THIS WINDOW? (Y OR N) ";
2410 INPUT G$
2420 IF G$="Y" THEN 950
2430 RETURN
2440 REM ** SUB:TRANSFER TO MDT
2450 PRINT "_DO YOU WANT TO TRANSFER VALUES TO MDT? (Y OR N) ";
2460 INPUT G$
2470 IF G$="N" THEN 2720
2480 IF S7<3 THEN 2520
2490 FOR J=1 TO N3
2500    V(1,J)=INT((J-1)*K3+V2+V(1,J)+0.5)
2510 NEXT J
2520 FOR J=1 TO N3
2530    IF V(1,J)=>-511 THEN 2550
2540    V(1,J)=-511
2550    IF V(1,J)<9999 THEN 2570
2560    V(1,J)=1537
2570 NEXT J
2580 V=V+511
2590 IF G<9999 THEN 2620
2600 CALL "DECHEX",A$,V,1001,3
2610 GO TO 2660
2620 CALL "DECHEX",B$,V,N3,3
2630 B$=C$&B$
2640 C$=SEG(A$,J2+3,3003-J2-2)
2650 A$=B$&C$
2660 FIND @2:F2
2670 IF F2=F3 THEN 2700
2680 WRITE @2:A$
2690 GO TO 2710
2700 WRITE @2:H$,A$
2710 PRINT @2,2:
2720 RETURN
2730 REM ** SUB:DISPLAY VALUES
2740 PRINT "_DO YOU WANT TO SEE CORR.-WINDOW VALUES? (Y OR N) ";
2750 INPUT G$
2760 IF G$="N" THEN 2850
2770 PRINT "LVALUES WITHIN CORR. WINDOW: TRACE ";N7;", REC ";R+1;",";
2780 PRINT " MDT ";M$
2790 PRINT "INDEX","TIME","VALUE"
2800 K6=T3-S1
2810 FOR J=1 TO N3
2820    K6=K6+S1
2830    PRINT J,K6,V(1,J)
2840 NEXT J
2850 RETURN
2860 REM ** SUB:CORR. WINDOW
2870 S7=1
2880 PRINT "Beginning time of corr. window = ";
2890 INPUT T3
2900 PRINT "      End time of corr. window = ";
2910 INPUT T4
2920 T5=T4-T3
2930 W2=T5/S1
2940 J1=3*T3/S1+1
2950 J2=3*T4/S1+1
2960 J3=J2-J1+3
2970 N3=J3/3
2980 GOSUB 2270
2990 RETURN
3000 REM ** SUB:DATA JUMP
3010 DELETE T6,T7,T8,T9
3020 DIM T6(60),T7(15),T8(30),T9(30)
3030 PRINT "_Estimated minimum value of data jump = ";
3040 INPUT P7
3050 PRINT "LDATA JUMPS > ";P7;" ON TRACE ";N7;" OF REC: ";H$
3060 PRINT "_JUMP TIME  JUMP AM'T   V(T-2SI)  V(T-SI)   V(T)";
3070 PRINT "   V(T+SI)   JUMP TYPE_"
3080 IMAGE 5D.2D,4X,6D,6X,4(5D,4X),2X,10A
3090 M7=0
3100 M8=0
3110 M9=0
3120 K=3
3130 FOR J=3 TO N3
3140    IF V(1,J)=9999 THEN 3160
3150    IF ABS(V(1,J)-V(1,J-1))<P7 THEN 3180
3160    T6(K-2)=(J-1)*S1
3170    K=K+1
3180 NEXT J
3190 IF K=3 THEN 3210
3200 GO TO 3230
3210 PRINT "_NO DATA JUMPS > ";P7;" WITHIN CORR. WINDOW: ";T3;" TO ";T4
3220 GO TO 1180
3230 FOR J=1 TO K-3
3240    M=T6(J)/S1+1
3250    IF V(1,M)=9999 THEN 3380
3260    IF ABS(V(1,M+1)-V(1,M))>P7 THEN 3310
3270    K$="BOXCAR"
3280    M8=M8+1
3290    T8(M8)=T6(J)+T3
3300    GO TO 3410
3310    IF V(1,M+1)<>9999 THEN 3340
3320    K$="LAST POINT"
3330    GO TO 3410
3340    K$="SPIKE"
3350    M9=M9+1
3360    T9(M9)=T6(J)+T3
3370    GO TO 3410
3380    K$="MISSING PT"
3390    M7=M7+1
```

```
3400    T7(M7)=T6(J)+T3
3410    V1=V(1,M)-V(1,M-1)
3420    PRINT USING 3080:T6(J)+T3,V1,V(1,M-2),V(1,M-1),V(1,M),V(1,M+1),K$
3430    IF K$="SPIKE" OR V(1,M-1)=9999 THEN 3450
3440    GO TO 3460
3450    J=J+1
3460 NEXT J
3470 PRINT "_FOR THE TIME INTERVAL FROM T = ";T3;" TO ";T4;" msec:"
3480 PRINT "    No. of data spikes = ";M9
3490 PRINT "    No. of boxcar sides = ";M8
3500 PRINT "    No. of missing points = ";M7
3510 RETURN
3520 REM ** SUB:LEAST SQUARE
3530 FOR J=1 TO 4
3540    A1(J)=V(1,N2)
3550    A2(J)=J*V(1,N2)
3560    N2=N2+1
3570 NEXT J
3580 A3=SUM(A1)
3590 A4=SUM(A2)
3600 M1=(4*A4-10*A3)/20
3610 M2=(30*A3-10*A4)/20
3620 RETURN
3630 REM ** SUB:COMMON PROCEDURE
3640 GOSUB 2730
3650 GOSUB 2390
3660 GOSUB 2440
3670 RETURN
3680 REM ** SUB:HIGH-SLOPE
3690 PRINT "_ARE HIGH-SLOPE DATA PRESENT? (Y OR N) ";
3700 INPUT G$
3710 IF G$="N" THEN 3790
3720 S7=3
3730 K3=(V(1,N3)-V(1,1))/(N3-1)
3740 V2=V(1,1)
3750 FOR J=1 TO N3
3760    V(1,J)=INT(V(1,J)-(J-1)*K3-V2+0.5)
3770 NEXT J
3780 GOSUB 2730
3790 RETURN
3800 REM ** SUB:CONSTANT CORRECTION
3810 PRINT "Time at beginning of set = ";
3820 INPUT T1
3830 IF T1<T3 THEN 4170
3840 PRINT "       Time at end of set = ";
3850 INPUT T2
3860 IF T2>T4 THEN 4170
3870 K8=(T1-T3)/S1+1
3880 K9=(T2-T3)/S1+1
3890 PRINT "Constant to be applied to set = ";
3900 INPUT C3
3910 GO TO 2230
3920 REM ** SUB:MORE CHANGES?
3930 PRINT "_ARE ANY MORE CHANGES REQUIRED ON THIS RECORD? (Y OR N) ";
3940 INPUT G$
3950 IF G$="N" THEN 1280
3960 RETURN
3970 REM ** SUB:BIAS CORRECTION
3980 Q=9999
3990 PRINT "Earliest first break time = ";
4000 INPUT T4
4010 T3=0
4020 GOSUB 2920
4030 V1=0
4040 FOR J=1 TO N3
4050    V1=V1+V(1,J)
4060 NEXT J
4070 V1=-INT(V1/N3+0.5)
4080 PRINT "Bias correction = ";V1
4090 J1=1
4100 J2=3001
4110 J3=3003
4120 GOSUB 2270
4130 V=V+V1
4140 N3=1001
4150 GOSUB 2440
4160 RETURN
4170 PRINT "GGG_CONSTANT CORRECTION WINDOW OUT OF RANGE"
4180 GO TO 1280
```

EDIT MASTER DATA TAPE

Data contained on the master data tapes constitute what is commonly called the observed data. These are the data upon which, after subsequent data processing, all interpretation will be based. They must, therefore, be as error free as possible. The master data tape edit program interactively can perform seven tasks:

1. Edit header information,
2. Correct byte errors,
3. Add a constant to a value set,
4. Remove spikes,
5. Correct boxcar (step function) errors,
6. Substitute a value for a missing value, and
7. Compute and correct bias shifts.

Usually not all of the above corrections will need be applied--if we're lucky, none of them will have to be made.

Heading corrections are made as previously discussed; byte corrections follow essentially the same scheme as in the previous program.

Let us consider now the removal of spikes and the correction of intra-trace level shifts (boxcar functions). Figure 10 shows a segment on a trace on which spikes and boxcars are present. Figure 11 is a copy of the display produced on the screen when the edit program is used. After entering the record and trace number, you are requested to establish the limits of the correction window--in this case, from 100 to 120 msec.

In this example, top half of fig. 11, an N response was entered to the next four questions indicating that we did not want to see a listing of data values within the data window, no byte errors were present, we did not want to add a constant to a value set, and no high-slope data were present. You

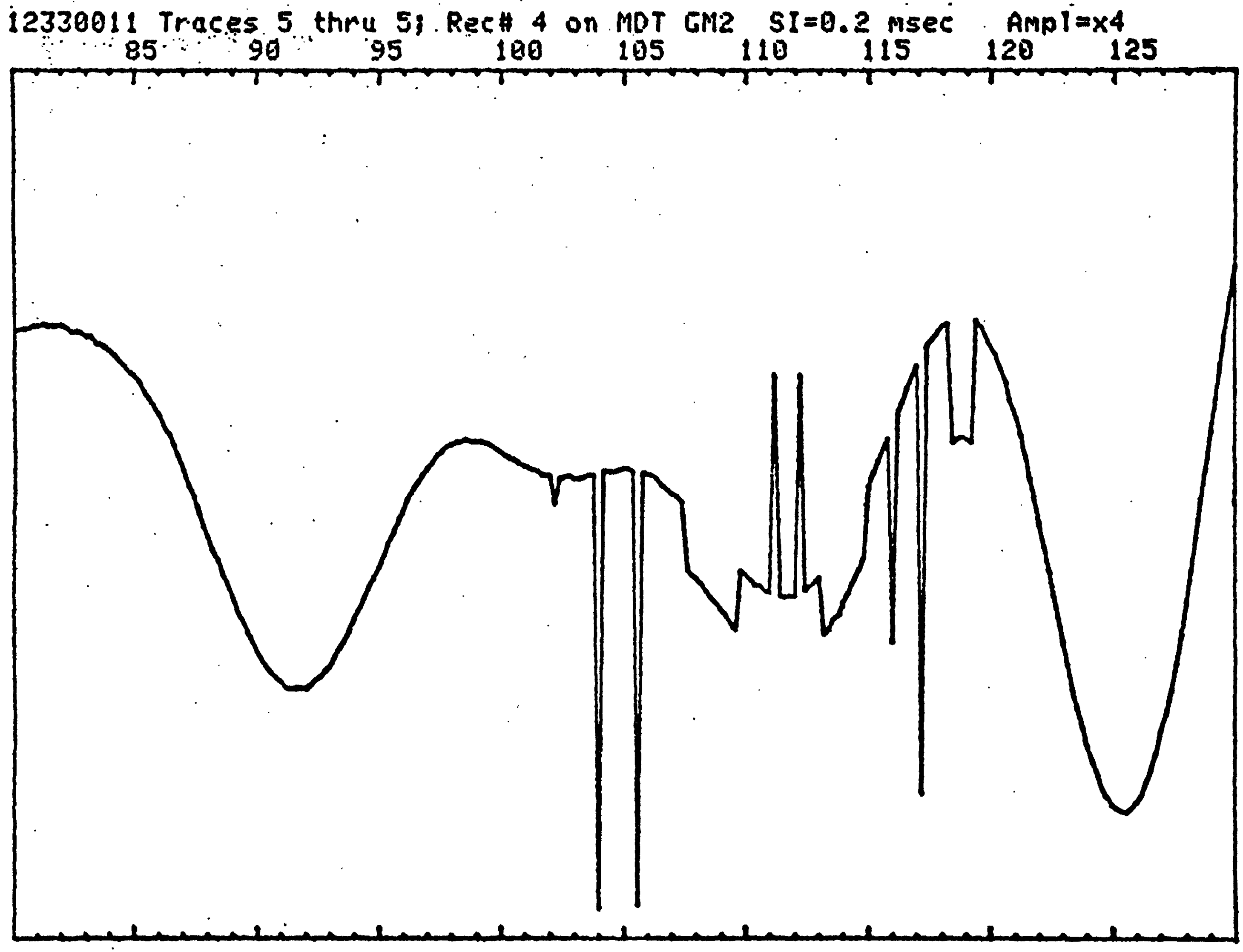

Figure 10. Sample trace segment exhibiting both spike and boxcar errors.

```
YOU HAVE SELECTED PROGRAM TO EDIT MASTER DATA TAPE (MDT)

INSERT MDT WITHIN 4924

CODE NO. OF MDT = GM1
RECORD NO. ON MDT = 4

DO YOU WANT TO CHANGE HEADER? (Y OR N) N

TRACE NO. TO BE EDITED = 5
Beginning time of corr. window = 100
      End time of corr. window = 120

DO YOU WANT TO SEE CORR.-WINDOW VALUES? (Y OR N) N

ARE BYTE ERRORS PRESENT? (Y OR N) N

DO YOU WANT TO ADD A CONSTANT TO A VALUE SET? (Y OR N) N

ARE HIGH-SLOPE DATA PRESENT? (Y OR N) N

Estimated minimum value of data jump = 14


DATA JUMPS > 14 ON TRACE 5 OF REC: 12330011
```

JUMP TIME	JUMP AM'T	V(T-2SI)	V(T-SI)	V(T)	V(T+SI)	JUMP TYPE
102.20	-16	17	17	1	16	SPIKE
104.00	-255	17	17	-238	19	SPIKE
105.60	-255	21	19	-236	18	SPIKE
107.60	-40	5	2	-38	-41	BOXCAR
109.80	33	-69	-72	-39	-41	BOXCAR
111.20	127	-50	-51	76	-53	SPIKE
112.20	129	-53	-53	76	-50	SPIKE
113.20	-32	-46	-43	-75	-72	BOXCAR
115.00	42	-38	-31	11	19	BOXCAR
116.00	-119	33	39	-80	54	SPIKE
117.20	-251	76	82	-169	93	SPIKE
118.40	-70	105	107	37	39	BOXCAR
119.40	71	39	37	108	105	BOXCAR

```
FOR THE TIME INTERVAL FROM T = 100 TO 120 msec:
   No. of data spikes = 7
   No. of boxcar sides = 6
   No. of missing points = 0
SPIKE CORR. COMPLETED
BOXCAR CORR. COMPLETED

DO YOU WANT TO SEE CORR.-WINDOW VALUES? (Y OR N) N

ARE MORE CHANGES WITHIN THIS WINDOW? (Y OR N) N

DO YOU WANT TO TRANSFER VALUES TO MDT? (Y OR N) Y

IS THE TRACE BIASED? (Y OR N) N

ARE MORE CHANGES REQUIRED ON THIS TRACE? (Y OR N) N
```

Figure 11. CRT displays produced when MDT edit program was used to edit trace segment shown in figure 10.

are next asked to supply the estimated value of the data jump that forms the side of the boxcar function. This selection takes some care. If too large an estimate is made, then smaller errors--the first spike on the record at a time of 102.2, for example--would not be automatically corrected; if too small an estimate is made, then normal changes in value that are part of the function would be interpreted as unwanted jumps. In this case, a choice of 14 appears satisfactory.

The bottom part of figure 11 shows the tabulation produced after the estimated data value was entered. For this particular example, all the required corrections were made automatically. This is not always the care. In the automatic spike-removal algorithm, two spike-free points are required on either side of the spike; for the automatic boxcar-corrections algorithm, four points are required on either side and within the boxcar. If these conditions are not met, then you would be directed to use and supplied with a manual-entry procedure.

The result after making these correction is shown in figure 12. For this report, the spikes and boxcars shown in figure 10 were intentionally added to a test trace in order to illustrate the operation of the program. The automatic spike-removal procedure corrected the data to within 1 digit; the automatic boxcar-correction procedure gave data that were not more than 5 digits off. Because the spike-removal algorithm uses an interpolation scheme (one that applies to polynomials up to the fifth degree) and because the boxcar-correction algorithm operates with an extrapolation method (based on linear least-square fits), it is reasonable to expect the spike correction to be of better quality.

The high-slope procedure is applied when the jump of the boxcar function is equal or greater than the magnitude of the difference between adjacent

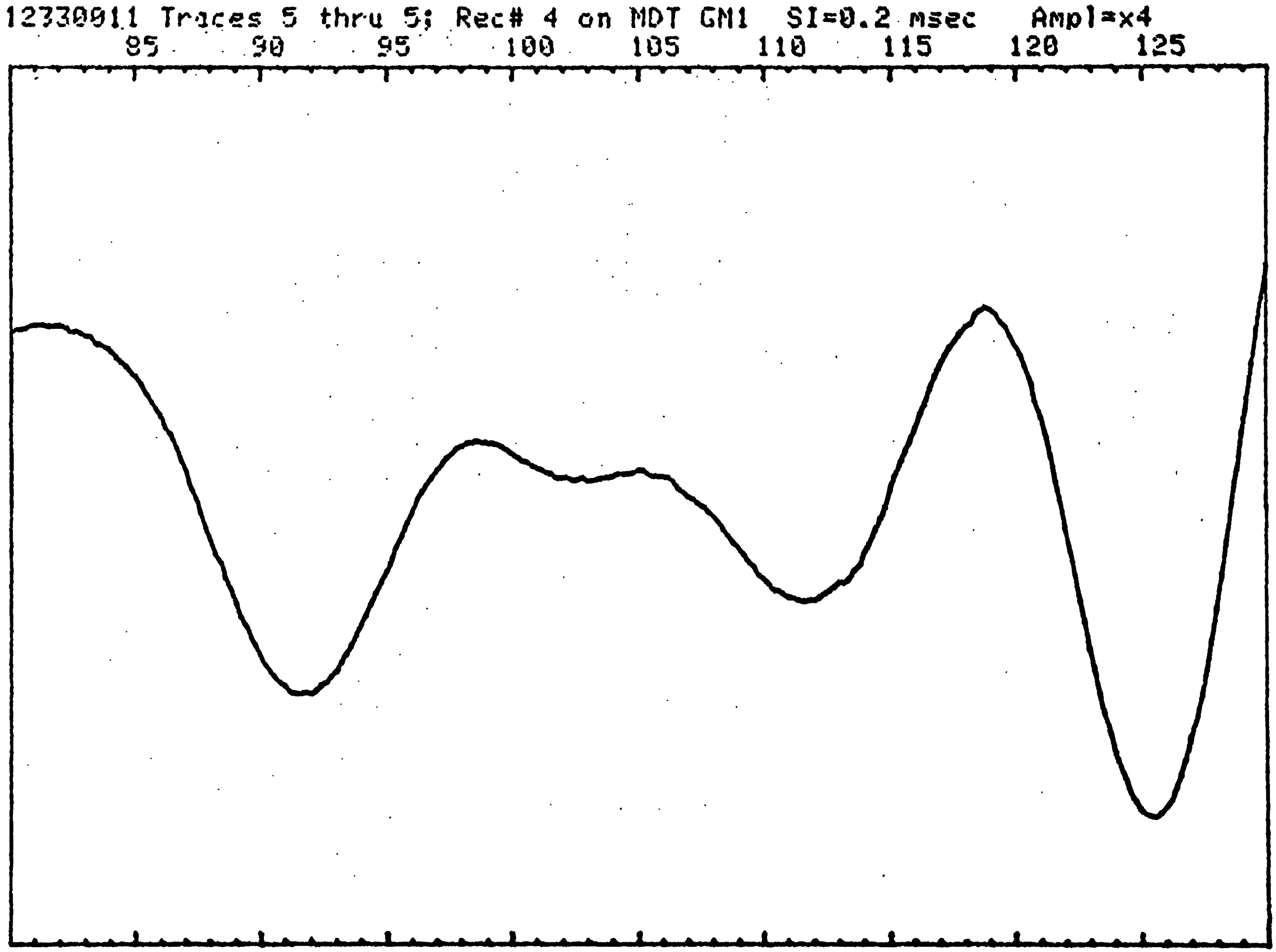

Figure 12. Sample trace segment after correction of spike and boxcar errors.

values of the function. Use of this procedure is straightforward: you select a data-window such that the straight line connecting values at the start and end times of the window passes through the functional values with little residual. The program temporarily removes this first-degree polynomial from the data, makes the boxcar correction, and then restores the first-degree polynomial values.

If data points are missing from the series, the program will find the locations of the missing points, and then will substitute a value of 2048 for the missing point. Thus, when the data are plotted, there is little doubt that a missing point was encountered, for the plot will show a value twice as much as can be obtained with a 10-bit data.

Adding a constant value to a set of values is readily done. The program will first ask if you want to add a constant (fig. 11) and then it will ask for the time frame in the series over which the constant is to be applied and for the value of the additive constant.

Bias-level shifts are produced by a d-c offset in the seismograph's electronics. An example of this effect can be seen on figure 8. In the example on figure 8, the first 20 rows show values whose mean value is approximately 23. If a Y answer is entered in response to the question: "IS THE TRACE BIASED? (Y OR N)", (fig. 12), then the next query is: "Earliest first break time = ". After this time is entered, the computer reads and averages the data on the master data tape from the beginning time to the selected first-break time. It then converts the average value to an integer, changes its sign, and prints the computed value of the bias correction. Finally, all trace values are read from the MDT, bias correction is applied, and the bias-corrected set of trace values written on the master data tape. It is recommended that bias correction be made late in the edit process.

Program to edit master data tape

```
100 PRINT "LYOU HAVE SELECTED PROGRAM TO EDIT MASTER DATA TAPE (MDT)"
110 PRINT "GGG_INSERT MDT WITHIN 4924"
120 INIT
130 DIM A$(3003),B$(3003),C$(3003),G$(1),H$(8),I$(1),M$(10)
140 DIM A1(4),A2(4),V(1,1001)
150 Q:1
160 V:9999
170 PRINT "_CODE NO. OF MDT = ";
180 INPUT M$
190 PRINT "RECORD NO. ON MDT = ";
200 INPUT R
210 R:R-1
220 F3:R*12+2
230 PRINT "_DO YOU WANT TO CHANGE HEADER? (Y OR N) ";
240 INPUT G$
250 IF G$:"N" THEN 280
260 GOSUB 1300
270 GOSUB 3920
280 PRINT "_TRACE NO. TO BE EDITED = ";
290 INPUT N7
300 IF Q:2 THEN 470
310 FIND @2:F3
320 READ @2:H$
330 I$:SEG(H$,4,1)
340 S1:VAL(I$)
350 GO TO S1 OF 360,380,400,420,440,460
360 S1:0.05
370 GO TO 470
380 S1:0.1
390 GO TO 470
400 S1:0.2
410 GO TO 470
420 S1:0.5
430 GO TO 470
440 S1:1
450 GO TO 470
460 S1:2
470 F2:F3-1+N7
480 S2:S1
490 N:1
500 GOSUB 2060
510 GOSUB 2730
520 PRINT "_ARE BYTE ERRORS PRESENT? (Y OR N) ";
530 INPUT G$
540 IF G$:"N" THEN 950
550 DIM D$(3),E$(200),F$(200),N$(10)
560 K5:1.792
570 K6:2.816
580 K7:72*K5
590 PAGE
600 K8:K6*INT(LEN(B$)/72)
610 MOVE -K5,100
620 FOR K:1 TO 11
630    RMOVE K7/12,0
640    K9:K*6+1
650    PRINT K9
660 NEXT K
670 MOVE -0.3,100
680 FOR K:1 TO 6
690    RDRAW 6*K5,0
700    RDRAW 0,-K8
710    RDRAW 6*K5,0
720    RDRAW 0,K8
730 NEXT K
740 MOVE 0,100-K6
750 PRINT B$;"_       NO. OF MISSING BYTES = ";3003-LEN(A$)
760 PRINT "_INCORRECT DATA STRING BEGINS AT ROW: ";
770 INPUT Y1
780 PRINT "KK"
790 PRINT "                                          ,COL: ";
800 INPUT X
810 J:72*(Y1-1)+X
820 E$:SEG(B$,1,J-1)
830 D$:SEG(B$,J,3)
840 F$:SEG(B$,J+3,LEN(B$)-LEN(E$)-3)
850 PRINT "_ERROR STRING: ";D$;" TO BE CHANGED TO: ";
860 INPUT N$
870 E$:E$&N$
880 B$:E$&F$
890 PRINT "_ARE ANY MORE BYTE CORRECTIONS NEEDED? (Y OR N) ";
900 INPUT G$
910 IF G$:"Y" THEN 590
920 GOSUB 2630
930 DELETE D$,E$,F$,N$
940 GO TO 1220
950 IF S7:3 THEN 1140
960 PRINT "_DO YOU WANT TO ADD A CONSTANT TO A VALUE SET? (Y OR N) ";
970 INPUT G$
980 IF G$:"N" THEN 1090
990 S7:2
1000 GOSUB 3000
1010 PRINT "ANY OTHER SETS TO BE CHANGED BY A CONSTANT? (Y OR N) ";
1020 INPUT G$
1030 IF G$:"N" THEN 1060
1040 GOSUB 3000
1050 GO TO 1010
1060 GOSUB 3630
1070 GO TO 1220
1080 GOSUB 3920
1090 GOSUB 3600
1100 GOSUB 3000
1110 IF M9:0 THEN 1140
1120 GOSUB 1460
1130 PRINT "SPIKE CORR. COMPLETED"
1140 IF M8:0 THEN 1170
1150 GOSUB 1640
1160 PRINT "BOXCAR CORR. COMPLETED"
1170 GOSUB 3630
1180 PRINT "_IS THE TRACE BIASED? (Y OR N) ";
1190 INPUT G$
```

```
1200 IF G$="N" THEN 1220
1210 GOSUB 3970
1220 PRINT "_ARE MORE CHANGES REQUIRED ON THIS TRACE? (Y OR N) ";
1230 INPUT G$
1240 IF G$="Y" THEN 500
1250 GOSUB 3920
1260 Q:2
1270 GO TO 280
1280 PRINT "GGG";"_PROGRAM COMPLETED"
1290 END
1300 REM ** SUB:CHANGE HEADER
1310 FIND @2:F3
1320 READ @2:H$,A$
1330 PRINT "Header now reads:  ";H$
1340 PRINT "Header is to read: ";
1350 INPUT H$
1360 FIND @2:F3
1370 WRITE @2:H$,A$
1380 PRINT @2,2:
1390 RETURN
1400 REM ** SUB:MANUAL SPIKE CORR.
1410 FOR M:1 TO M9
1420    PRINT " For spike at ";T9(M);" msec, correct value should be ";
1430    INPUT V(1,(T9(M)-T3)/S1+1)
1440 NEXT M
1450 RETURN
1460 REM ** SUB:AUTO SPIKE
1470 FOR M:1 TO M9
1480    K:(T9(M)-T3)/S1+1
1490    IF K<3 THEN 1570
1500    IF K>J3/3-2 THEN 1570
1510    IF V(1,K-2):9999 THEN 1570
1520    IF V(1,K-1):9999 THEN 1570
1530    IF V(1,K+1):9999 THEN 1570
1540    IF V(1,K+2):9999 THEN 1570
1550    IF ABS(V(1,K+2)-V(1,K+1))>P7 THEN 1570
1560    GO TO 1610
1570    PRINT "GGG";"_CONDITIONS ON AUTO SPIKE NOT MET;")
1580    PRINT " ENTER CORRECTIONS FROM KEYBOARD"
1590    GOSUB 1400
1600    GO TO 1620
1610    V(1,K):INT((-V(1,K-2)+4*(V(1,K-1)+V(1,K+1))-V(1,K+2))/6+0.5)
1620 NEXT M
1630 RETURN
1640 REM ** SUB:AUTO BOXCAR
1650 REM ** TESTS FOR AUTO BOXCAR
1660 FOR M:1 TO M8 STEP 2
1670    Q:1
1680    FOR K:M TO M+1
1690       IF K>M8 THEN 1850
1700       N2:(T8(K)-T3)/S1-3
1710       IF N2<0.9 THEN 1820
1720       IF N2>W2-5.9 THEN 1740
1730       GO TO 1760
1740       T8(K+1):T4+S1
1750       GO TO 1820
1760       IF V(1,N2):9999 OR V(1,N2+7):9999 THEN 1820
1770       FOR J:1 TO 3
1780          IF ABS(V(1,N2+J)-V(1,N2+J-1))>P7 THEN 1820
1790          IF ABS(V(1,N2+J+4)-V(1,N2+J+3))>P7 THEN 1820
1800       NEXT J
1810       GO TO 1840
1820       PRI "GGG";"CONDITIONS ON AUTO BOXCAR NOT MET FOR STEP AT T:";T8(K)
1830       Q:Q+1
1840    NEXT K
1850    IF Q<2 THEN 1890
1860    GOSUB 2170
1870 NEXT M
1880 RETURN
1890 L1:(T8(M)-T3)/S1+1
1900 GOSUB 3520
1910 P0:5*M1+M2-V(1,N2)
1920 GOSUB 3520
1930 P1:V(1,N2-5)+M1-M2
1940 P2:(P0+P1)/2
1950 IF M:M8 THEN 2050
1960 N2:(T8(M+1)-T3)/S1-3
1970 L2:N2+3
1980 GOSUB 3520
1990 P3:V(1,N2)-5*M1-M2
2000 GOSUB 3520
2010 P4:-M1+M2-V(1,N2-5)
2020 P5:(P3+P4)/2
2030 P6:INT((P5-P2)/2+0.5)
2040 IF ABS(P5)>P7 THEN 2120
2050 IF T3<>0 THEN 2100
2060 P2:-P2
2070 L2:L1-1
2080 L1:1
2090 GO TO 2110
2100 L2:N3
2110 P6:INT(P2+0.5)
2120 FOR J:L1 TO L2
2130    V(1,J):V(1,J)+P6
2140 NEXT J
2150 NEXT M
2160 RETURN
2170 REM ** SUB:MANUAL BOXCAR
2180 PRINT "For boxcar from T:";T8(K-2);" to T:";T8(K-1);",";
2190 PRINT " step corr. : ";
2200 INPUT C3
2210 K8:(T8(M)-T3)/S1+1
2220 K9:(T8(M+1)-T3)/S1
2230 FOR K:K8 TO K9
2240    V(1,K):V(1,K)+C3
2250 NEXT K
2260 RETURN
2270 REM ** SUB:FILL V ARRAY
2280 FIND @2:F2
2290 IF F2:F3 THEN 2320
```

```
2300 IMAGE 6(4D)
2310 IMAGE 24X,5(4D)
2320 IMAGE 44X,5(4D)
2330 IMAGE 64X,2(4D)
2340 FOR J:=LEN(A$)/4 TO 522
2350    V(1,J)=0
2360 NEXT J
2370 PRINT
2380 FOR K:=1 TO 522 STEP 18
2390    PRI USI 2300:V(1,K),V(1,K+1),V(1,K+2),V(1,K+3),V(1,K+4),V(1,K+5)
2400    PRINT "KK"
2410    PRINT USING 2310:V(1,K+6),V(1,K+7),V(1,K+8),V(1,K+9),V(1,K+10)
2420    PRINT "KK"
2430    PRINT USING 2320:V(1,K+11),V(1,K+12),V(1,K+13),V(1,K+14),V(1,K+15)
2440    PRINT "KK"
2450    PRINT USING 2330:V(1,K+16),V(1,K+17)
2460 NEXT K
2470 Q=1
2480 PRINT "_ARE ADDITIONAL SKIP-BYTE CORRECTIONS REQUIRED? (Y OR N) ";
2490 INPUT G$
2500 IF G$="N" THEN 2660
2510 GO TO 1640
2520 RETURN
2530 REM ** SUB:LOCATE ERROR SEGMENT
2540 PRINT "_INCORRECT STRING BEGINS AT ROW: ";
2550 INPUT Y1
2560 PRINT "KK"
2570 PRINT "                                   ,COL: ";
2580 INPUT X
2590 RETURN
2600 REM ** SEG:PRINT ERROR WINDOW CONTENTS AND CORRECTED CHARACTERS
2610 PRINT "ERROR STRING: ";D$;" TO BE CHANGED TO: ";
2620 INPUT N$
2630 C$=C$&N$
2640 A$=C$&D$
2650 A$=SEG(A$,1,2050)
2660 GOSUB 1030
2670 GOSUB 2150
2680 PRINT "                ";P$;" HALF OF TRACE ";E1;" AFTER";
2690 PRINT " CORRECTION"
2700 GO TO 630
2710 REM ** SUB:LOCATE AND EXTRACT CHARACTERS WITHIN DATA STRING
2720 J=72*(Y1-1)+X
2730 C$=SEG(A$,1,J-1)
2740 D$=SEG(A$,J,4)
2750 B$=SEG(A$,J+4,LEN(A$)-LEN(C$)-4)
2760 RETURN
2770 REM ** SUB:CORRECT HEADER
2780 PRINT "_DO YOU WANT TO CORRECT HEADER? (Y OR N) ";
2790 INPUT G$
2800 IF G$="N" THEN 2850
2810 PRINT "   Header now reads:  ";H$
2820 PRINT "   Header is to read: ";
2830 INPUT H$
2840 PAGE
2850 RETURN
```

PLOT MASTER DATA TAPE VALUES

Two plot-routine computer programs are presented in this report. With the first of these programs you have a choice as to whether plots are to be made on the digital plotter or on the CRT screen of the computer, and also you have the option to display seismic traces either with a wiggle-trace, full variable area, or top-half variable area presentation. We call this first plot program the selectable-mode plot program. With the second plot program, only a wiggle-trace CRT display can be made; however, plotting time is faster. This second plot program we've termed the quick-plot program. In general, the selectable-mode plot program is used to produce final displays and the quick-plot program is used to make work copies.

Both plot programs permit the following:

1. Choice of which trace or sequence of traces are to be plotted.
2. Selection of trace-amplitude multipliers. With the quick-plot program, the multiplicative factor is applied to all traces; with the selectable-mode plot program, the amplitude multiplier can be a different value for each trace.
3. Selection of beginning and end times of the trace-time interval to be plotted.
4. Choice of increased sample interval with the restriction that the new interval is an integral multiple of the one at which the data were taken. For example, if original data were sampled at 0.1 msec, then plots could be made using a sample interval of 0.1, 0.2, 0.3,...; but, a plot with a sample interval of 0.25 msec would not be allowed.

In using either plot program it is important that the header be correct since the programs read and use this information in order to set the origin time and to determine the original sample interval.

Figures 10 and 12 are examples of the graphic displays produced by the quick-plot program.

Variable area (VA) displays can be made with either a low or a high shading (filled-in vertical line) density. The number of fill-in-lines for shading the VA display is dependent on the sample interval chosen for plotting. When a high shading density is selected, a vertical line is drawn from each function value to the zero value; when low shading density is selected, lines for every fifth value are drawn.

The top half of figure 13 shows the 80 to 130 msec portion of trace 5 from record 4 on master data tape GM1 plotted with the upper-half variable area, high shading density mode. The lower half of figure 13 is a plot of the same trace segment using the full VA and low shading density option. In both displays the original amplitude was increased fourfold. The selected plot sample interval was 0.2 msec; therefore, on the low shading density VA display the vertical lines are at a time interval of 1 msec--a convenience when the time on the records are to be read.

The advantage of using low-density shading is shown on figure 14. Here the upper half of the figure uses high-density shading, the lower half low-density shading. Note that when the upper part of the traces are completely filled in, the copy is poor and that over-lapping traces are obscured.

Figure 14 also shows that trace bias can be readily detected whether either a low or high shading density VA display is made. For example, trace 10 on the bottom plot is biased, but trace 10 on the upper plot has been bias corrected.

The coal-seismic system does not contain a section plotter, record sections being made by cutting and taping individual plots. Rather than change plot parameters in the computer programs, we find it easier to use the

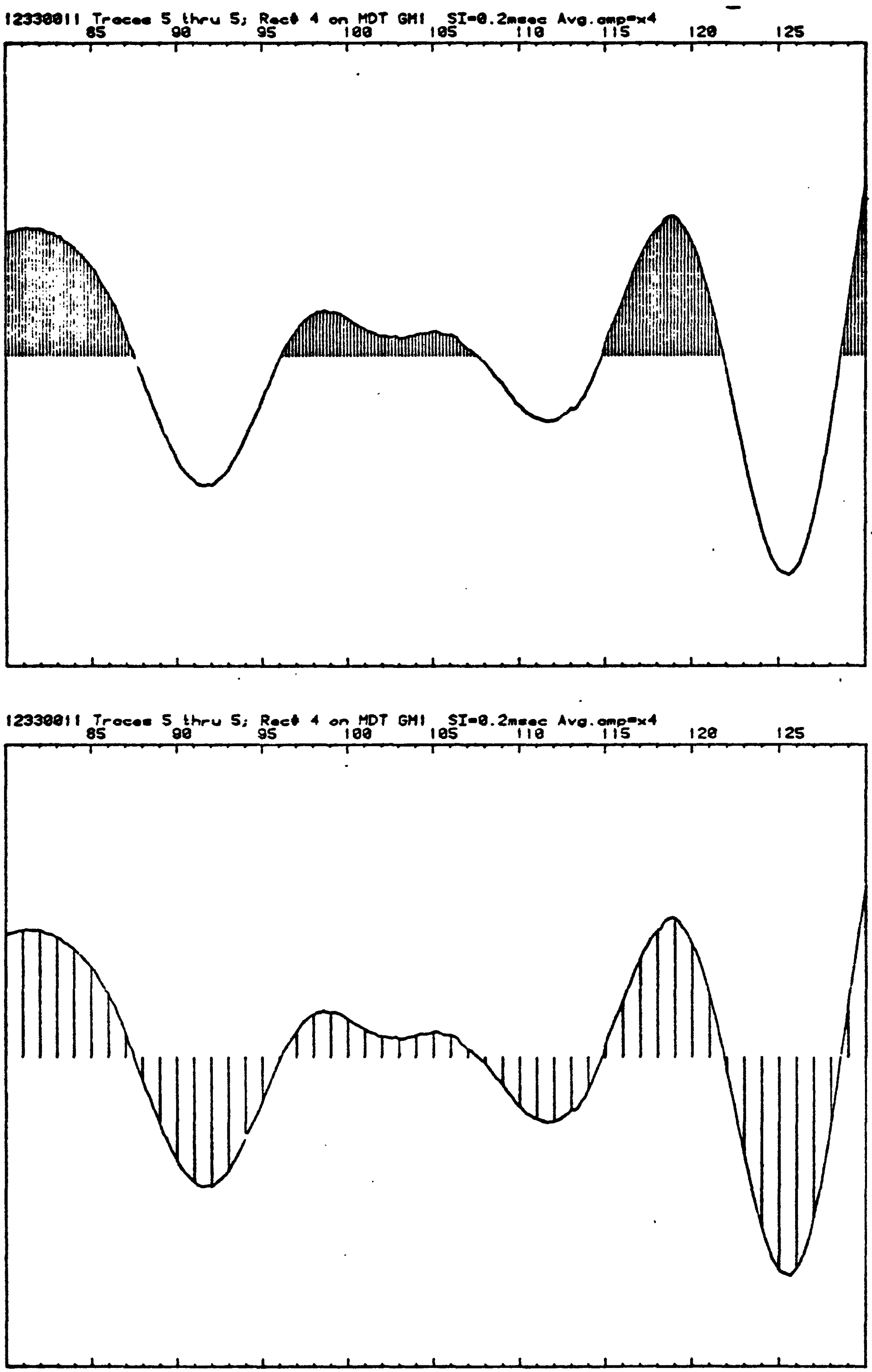

Figure 13. Trace segments plotted with high-density shading of upper-half variable area display (top) and low-density shading of full variable area display (bottom).

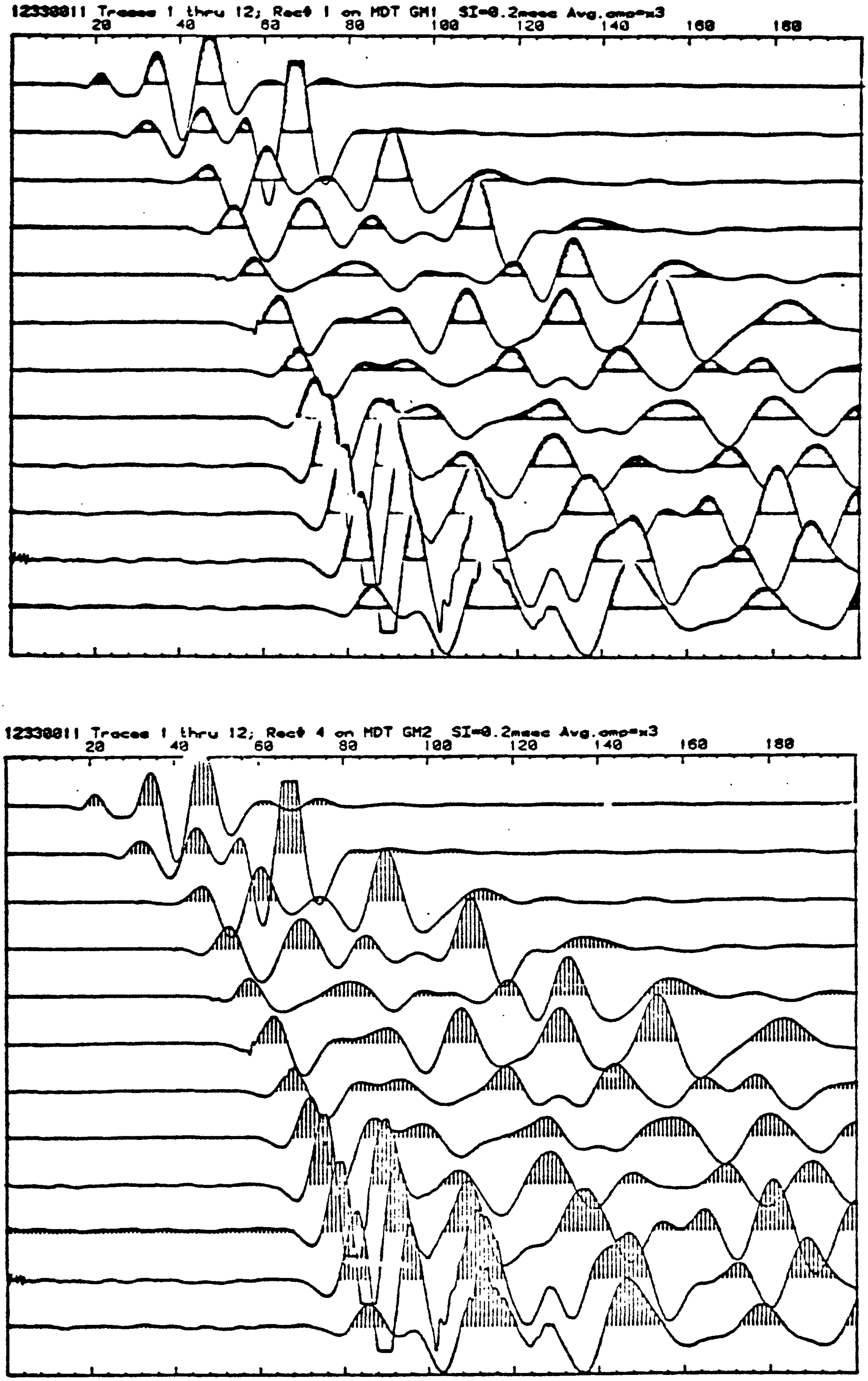

Figure 14. Variable area display of 12-channel record using high-density shading (top) and low-density shading (bottom).

border-set feature of the interactive digital plotter. Figure 15 shows a plot in which the digital plotter has been set to stretch the time axis relative to the distance axis. We've left the label on the display in order to illustrate this stretching action. Normally in making sections, however, the computer program is modified so as to omit printing the labels, and then the border-set controls of the plotter are used to permit plotting of 3 records all on one piece of paper. This procdure reduces the amount of cutting and taping required, but record-section construction is still a time-consuming task.

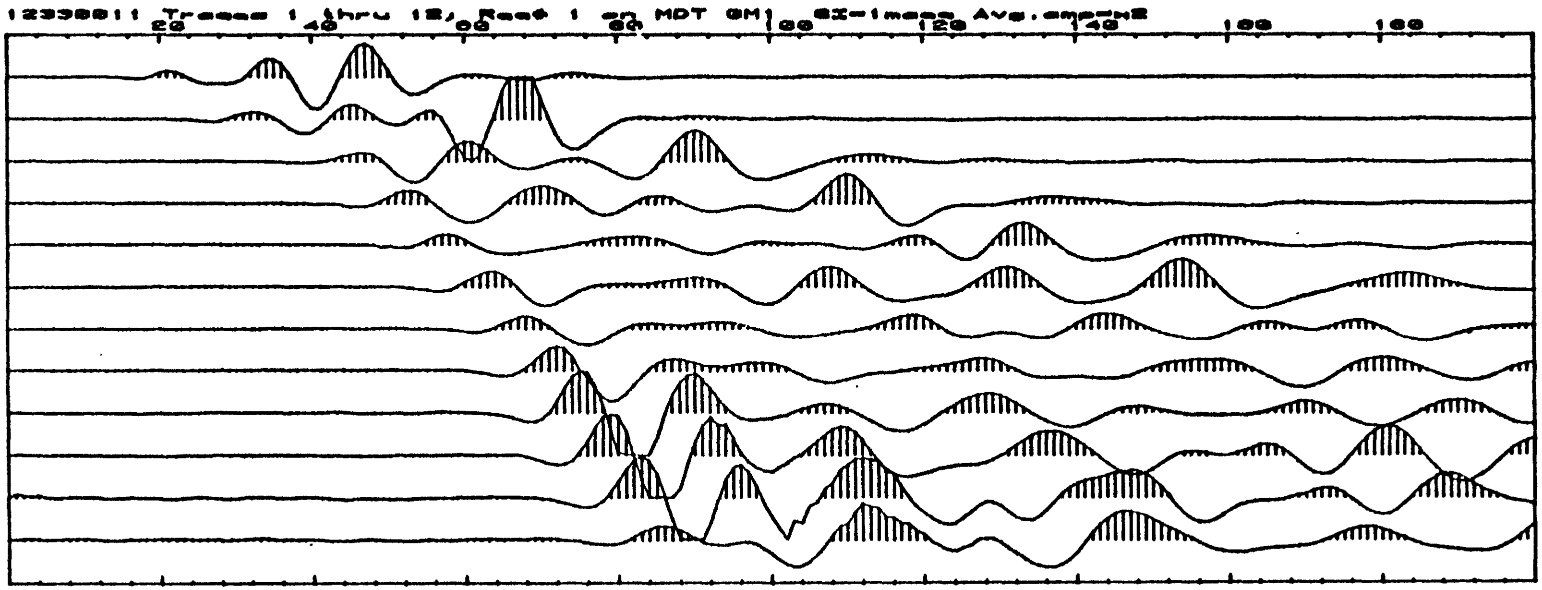

Figure 15. Variable area display with time axis stretched.

Program to plot master-data-tape values: selectable mode

```
100 PRINT "L          YOU HAVE SELECTED PROGRAM TO PLOT COMPLETE OR"
110 PRINT "            PARTIAL CONTENTS OF MASTER DATA TAPE (MDT)"
130 INIT
140 DIM A$(3003),B$(3003),D$(3),G$(1),H$(8),I$(1),L$(2),N$(5)
150 DIM S$(1),K1(12),V(1,1001)
160 PRINT "GGG_INSERT MDT WITHIN THE 4924"
170 PRINT "_CODE NO. OF MDT = ";
180 INPUT N$
190 PRINT "_RECORD NO. ON MDT TO BE PLOTTED = ";
200 INPUT R
210 A1=9999
220 K1=0
230 K6=1
240 K7=1
250 PRINT "_DO YOU WANT TO PLOT ALL TRACES? (Y OR N) ";
260 INPUT G$
270 IF G$="Y" THEN 330
280 PRINT "   At what trace is plot to begin? ";
290 INPUT N1
300 PRINT "      At what trace is plot to end? ";
310 INPUT N2
320 GO TO 350
330 N1=1
340 N2=12
350 N3=N2-N1+1
360 N4=512*(N3+1)
370 F1=R*12+N1-11
380 F2=P*12+N2-11
390 F3=R*12-10
400 PRINT "_DO YOU WANT TO MODIFY TRACE AMPLITUDE? (Y OR N) ";
410 INPUT G$
420 IF G$="N" THEN 610
430 IF N3=1 THEN 480
440 PRINT "   Do you want to apply the same trace-amplitude"
450 PRINT "   multiplier to all traces? (Y OR N) ";
460 INPUT G$
470 IF G$="N" THEN 550
480 PRINT "   Trace-amplitude multiplier for all traces = ";
490 INPUT A1
500 FOR J=N1 TO N2
510    K1(J)=A1
520 NEXT J
530 A2=A1
540 GO TO 630
550 FOR J=N1 TO N2
560    PRINT "   For trace ";J;", trace-amplitude multiplier = ";
570    INPUT K1(J)
580 NEXT J
590 A2=SUM(K1)/N3
600 GO TO 630
610 A1=1
620 A2=A1
630 REM ** FIND, RETRIEVE, AND DECODE HEADER FILE
640 FIND @2:F3
650 READ @2:H$
660 I$=SEG(H$,4,1)
670 L$=SEG(H$,5,2)
680 S1=VAL(I$)
690 L=VAL(L$)*10
700 GO TO S1 OF 710,730,750,770,790,810
710 S1=0.05
720 GO TO 820
730 S1=0.1
740 GO TO 820
750 S1=0.2
760 GO TO 820
770 S1=0.5
780 GO TO 820
790 S1=1
800 GO TO 820
810 S1=2
820 T3=1000*S1
830 PRINT "_DO YOU WANT TO PLOT COMPLETE TRACE-TIME INTERVAL?";
840 PRINT " (Y OR N) ";
850 INPUT G$
860 IF G$="Y" THEN 920
870 PRINT "      At what record time is plot to begin? ";
880 INPUT T1
890 PRINT "   and at what record time is plot to end? ";
900 INPUT T2
910 GO TO 940
920 T1=L
930 T2=L+T3
940 PRINT "_DO YOU WANT TO INCREASE SAMPLE INTERVAL? (Y OR N) ";
950 INPUT G$
960 IF G$="N" THEN 1030
970 PRINT "   Increased sample interval (msec/sample) = ";
980 INPUT S2
990 IF S2/S1-INT(S2/S1)=0 THEN 1040
1000 PRINT "ERROR! SELECTED INCREASED S.I. NOT INTEGRAL MULITPLE"
1010 PRINT " OF ORIGINAL S.I.--CHOOSE ANOTHER VALUE"
1020 GO TO 970
1030 S2=S1
1040 REM ** SELECT PLOT MODES AND THEIR PARAMETERS
1050 PRINT "_DO YOU WANT A VARIABLE-AREA DISPLAY? --If ";
1060 PRINT "variable area not selected,"
1070 PRINT "then standard ""wiggle-trace"" record";
1080 PRINT " is produced--(Y OR N) ";
1090 INPUT G$
1100 IF G$="N" THEN 1220
1110 PRINT "   Do you want a full variable-area display? (Y OR N) ";
1120 INPUT G$
1130 IF G$="Y" THEN 1160
1140 K6=2
1150 GO TO 1170
1160 K6=3
1170 PRINT "   Do you want high-density fill in? (Y OR N) ";
1180 INPUT G$
1190 IF G$="N" THEN 1210
1200 GO TO 1220
```

```
1210 K7=5
1220 C1=0
1230 D1=0
1240 PRINT "_DO YOU WANT TO PLOT ON THE CRT OF THE 4051? (Y OR N) ";
1250 INPUT G$
1260 IF G$="N" THEN 1370
1270 P=32
1280 C2=130
1290 D2=56
1300 K3=1.8
1310 PAGE
1320 MOVE 0,100
1330 GOSUB 1510
1340 PRINT "_DO YOU ALSO WANT A PLOT ON THE 4662? (Y OR N) ";
1350 INPUT G$
1360 IF G$="N" THEN 1450
1370 P=1
1380 C2=130
1390 D2=55
1400 K3=1.5
1410 K4=2.25
1420 GOSUB 1510
1430 WINDOW 0,130,0,100
1440 MOVE @1:150,100
1450 PRINT "_DO YOU WANT TO PLOT ANOTHER RECORD? (Y OR N) ";
1460 INPUT G$
1470 IF G$="N" THEN 1490
1480 GO TO 190
1490 PRINT "GGG";"PROGRAM COMPLETED"
1500 END
1510 REM ** SUB: PROCEDURE COMMON TO ALL PLOT MODES
1520 GOSUB 1710
1530 J1=3*T1/S1+1
1540 J2=3*T2/S1+1
1550 J3=J2-J1+3
1560 J4=(J2-J1)*S1/S2+3.0001
1570 N5=INT(J4/3)
1580 D4=D3/(N3+1)
1590 D5=D2-D4
1600 N6=N1
1610 FOR M=F1 TO F2
1620    GOSUB 2160
1630    GOSUB 2280
1640    N6=N6+1
1650 NEXT M
1660 WINDOW 0,130,0,100
1670 VIEWPORT 0,130,0,100
1680 MOVE 0,0
1690 PRINT "GGG"
1700 RETURN
1710 REM ** SUB: RECORD IDENTIFICATION, BORDER, AND TICKMARKS
1720 IF P=32 THEN 1770
1730 PRINT @1,17:K3,K4
1740 MOVE @1:0,D2+3
1750 REM ** PRINT RECORD INFORMATION ACROSS TOP OF PLOT
1760 A2=INT(10*A2)*0.1
1770 PRINT @P:H$;" Traces ";N1;" thru ";N2;"; Rec# ";R;" on MDT ";
1780 PRINT @P:N$;"  SI=";S2;"msec Avg.amp=x";A2
1790 REM ** PLOT BORDERS
1800 C3=C2-C1
1810 D3=D2-D1
1820 MOVE @P:C1,D2
1830 RDRAW @P:C3,0
1840 RDRAW @P:0,-D3
1850 RDRAW @P:-C3,0
1860 RDRAW @P:0,D3
1870 REM ** PLOT TIME TICKMARKS AND THEIR VALUES
1880 MOVE @P:C1,D2
1890 M1=0.4
1900 M2=1.2
1910 GOSUB 1970
1920 MOVE @P:C1,D1
1930 M1=-M1
1940 M2=-M2
1950 GOSUB 1970
1960 GO TO 2080
1970 FOR J=1 TO 10
1980    FOR K=1 TO 4
1990       RMOVE @P:C3/50,0
2000       RDRAW @P:0,-M1
2010       RDRAW @P:0,M1
2020    NEXT K
2030    RMOVE @P:C3/50,0
2040    RDRAW @P:0,-M2
2050    RDRAW @P:0,M2
2060 NEXT J
2070 RETURN
2080 MOVE @P:C3/10-1.3*K3,D2+1
2090 T4=(T2-T1)/10
2100 PRINT @P:T1+T4
2110 FOR K=2 TO 9
2120    RMOVE @P:C3/10,0
2130    PRINT @P:T1+K*T4
2140 NEXT K
2150 RETURN
2160 REM ** SUB: FIND, RETRIEVE, CONVERT AND SCALE DATA
2170 S3=S2/S1
2180 FIND @2:M
2190 IF M=F3 THEN 2220
2200 READ @2:A$
2210 GO TO 2230
2220 READ @2:H$,A$
2230 B$=SEG(A$,J1,J3)
2240 V=0
2250 CALL "HEXDEC",B$,V,LEN(B$),3
2260 V=V-511
2270 RETURN
2280 REM ** SUB: PLOT SELECTED TIMES AND TRACES
2290 IF A1=9999 THEN 2320
2300 V=A2*V
```

```
2310 GO TO 2330
2320 V=K1(N6)*V
2330 WINDOW 0,130,0,100
2340 VIEWPORT 0,130,0,100
2350 MOVE @P:0,D5
2360 WINDOW 0,N5-1,-N4,N4
2370 VIEWPORT C1,C2,D1,D2
2380 IF K6=1 THEN 2410
2390 GOSUB 2480
2400 GO TO 2460
2410 RMOVE @P:0,V(1,1)
2420 FOR J=2 TO N5
2430    K=S3*(J-1)+1
2440    RDRAW @P:1,V(1,K)-V(1,K-S3)
2450 NEXT J
2460 D5=D5-D4
2470 RETURN
2480 REM ** SUB: VARIABLE-AREA PRESENTATIONS
2490 RMOVE @P:0,V(1,1)
2500 IF V(1,1)<0 THEN 2530
2510 RDRAW @P:0,-V(1,1)
2520 RDRAW @P:0,V(1,1)
2530 FOR J=2 TO N5
2540    K=S3*(J-1)+1
2550    RDRAW @P:1,V(1,K)-V(1,K-S3)
2560    IF K6=3 THEN 2580
2570    IF V(1,K)<=0 THEN 2610
2580    IF (J-1)/K7-INT((J-1)/K7)>0.1 THEN 2610
2590    RDRAW @P:0,-V(1,K)
2600    RDRAW @P:0,V(1,K)
2610 NEXT J
2620 RETURN
```

Program to plot master-data-tape values: quick-plot routine

```
100 PRINT "L YOU HAVE SELECTED PROGRAM TO QUICK-PLOT SELECTED"
110 PRINT "CONTENTS OF MASTER DATA TAPE ON CRT SCREEN OF 4051"
120 INIT
130 DIM B$(3003),G$(1),H$(8),I$(1),L$(2),H$(5)
140 N=1
150 PRINT "GGG";"_INSERT MDT WITHIN THE 4924"
160 PRINT "_CODE NO. OF MDT = ";
170 INPUT N$
180 PRINT "_RECORD NO. ON MDT = ";
190 INPUT R
200 PRINT "_DO YOU WANT TO MULTIPLY TRACE AMPLITUDES BY A CONSTANT?";
210 PRINT " (Y OR N) ";
220 INPUT G$
230 K2=1
240 IF G$="N" THEN 270
250 PRINT "Trace-amplitude multiplier = ";
260 INPUT K2
270 PRINT "_DO YOU WANT TO PLOT ALL TRACES? (Y OR N) ";
280 INPUT G$
290 IF G$="Y" THEN 350
300 PRINT "At what trace is plot to begin? ";
310 INPUT N1
320 PRINT "  At what trace is plot to end? ";
330 INPUT N2
340 GO TO 370
350 N1=1
360 N2=12
370 N3=N2-N1+1
380 F1=R*12+N1-11
390 F2=R*12+N2-11
400 F3=R*12-10
410 REM ** FIND, RETRIEVE, AND DECODE HEADER FILE
420 FIND @2:F3
430 READ @2:H$
440 I$=SEG(H$,4,1)
450 L$=SEG(H$,5,2)
460 S1=VAL(I$)
470 L=VAL(L$)*10
480 GO TO S1 OF 490,510,530,550,570,590
490 S1=0.05
500 GO TO 600
510 S1=0.1
520 GO TO 600
530 S1=0.2
540 GO TO 600
550 S1=0.5
560 GO TO 600
570 S1=1
580 GO TO 600
590 S1=2
600 T3=1000*S1
610 PRINT "_DO YOU WANT TO PLOT COMPLETE TRACE? (Y OR N) ";
620 INPUT G$
630 IF G$="Y" THEN 690
640 PRINT "  At what record time is plot to begin? ";
650 INPUT T1
660 PRINT "and at what record time is plot to end? ";
670 INPUT T2
680 GO TO 710
690 T1=L
700 T2=L+T3
710 PRINT "_DO YOU WANT TO INCREASE SAMPLE INTERVAL? (Y OR N) ";
720 INPUT G$
730 IF G$="N" THEN 810
740 PRINT "Increased sample interval (msec/sample) = ";
750 INPUT S2
760 IF S2/S1-INT(S2/S1)=0 THEN 820
770 PRINT "ERROR! SELECTED INCREASED S.I. NOT INTEGRAL MULTIPLE"
780 PRINT " OF ORIGINAL S.I.--CHOOSE ANOTHER VALUE"
790 GO TO 740
800 GO TO 820
810 S2=S1
820 C2=130
830 D2=96
840 PAGE
```

```
850 MOVE 0,100
860 GOSUB 1030
870 J1:3*T1/S1+1
880 J2:3*T2/S1+1
890 J3:J2-J1+3
900 J4:(J2-J1)*S1/S2+3.0001
910 N4:INT(J4/3)
920 D4:D2/(N3+1)
930 D5:D2-D4
940 FOR M:F1 TO F2
950    DELETE Z
960    DIM B$(3003),V(1001)
970    GOSUB 1150
980    GOSUB 1290
990 NEXT M
1000 MOVE 0,0
1010 PRINT "GGG"
1020 END
1030 REM ** SUB: LABEL, PLOT BORDER AND TICKMARKS
1040 PRINT H$;" Traces ";N1;" thru ";N2;"; Rec# ";R;" on MDT ";
1050 PRINT N$;"  SI=";S2;" msec.  Ampl=x";K2
1060 GOSUB 1480
1070 MOVE C2/10-2.34,D2+1
1080 T4:(T2-T1)/10
1090 PRINT T1+T4
1100 FOR K:2 TO 9
1110    RMOVE C2/10,0
1120    PRINT T1+K*T4
1130 NEXT K
1140 RETURN
1150 REM ** SUB: FIND, RETRIEVE, CONVERT AND SCALE DATA
1160 FIND @2:M
1170 IF M:F3 THEN 1200
1180 READ @2:B$
1190 GO TO 1210
1200 READ @2:H$,B$
1210 B$:SEG(B$,J1,J3)
1220 V:0
1230 K1:K2*0.09375/(N3+1)
1240 CALL "HEXDEC",B$,V,LEN(B$),3
1250 V:V-511
1260 V:K1*V
1270 V:V+D5
1280 RETURN
1290 REM ** SUB: PLOT TRACES
1300 S3:S2/S1
1310 MOVE 0,D5
1320 K5:C2/(N4-1)
1330 DELETE B$,H$,N$,Z
1340 DIM Z(2*N4)
1350 Z(1):0
1360 Z(2):V(1)
1370 K7:0
1380 FOR J:3 TO 2*N4-1 STEP 2
1390    K7:K7+K5
1400    Z(J):K7
1410    K:S3*0.5*(J-1)+1
1420    Z(J+1):V(K)
1430 NEXT J
1440 PRINT @32,20:Z
1450 DRAW 130,D5
1460 D5:D5-D4
1470 RETURN
1480 REM ** SUB: PRINT BORDER AND TICKMARKS
1490 C3:C2/50
1500 DIM B(300)
1510 B:D2
1520 M1:0.4
1530 M2:1.2
1540 M3:D2-M1
1550 M4:D2-M2
1560 B(1):0
1570 C4:0
1580 FOR K:3 TO 291 STEP 6
1590    C4:C4+C3
1600    B(K):C4
1610    B(K+2):C4
1620    B(K+3):M3
1630    B(K+4):C4
1640 NEXT K
1650 B(297):130
1660 B(299):130
1670 B(300):0
1680 FOR K:30 TO 270 STEP 30
1690    B(K):M4
1700    MOVE 0,D2
1710 NEXT K
1720 PRINT @32,20:B
1730 DELETE B
1740 DIM B(300)
1750 B:0
1760 B(1):130
1770 C4:130
1780 FOR K:3 TO 291 STEP 6
1790    C4:C4-C3
1800    B(K):C4
1810    B(K+2):C4
1820    B(K+3):M1
1830    B(K+4):C4
1840 NEXT K
1850 FOR K:30 TO 270 STEP 30
1860    B(K):M2
1870 NEXT K
1880 B(300):D2
1890 PRINT @32,20:B
1900 DELETE B
1910 RETURN
```