Radar Transcriptions from AN/FPS-95 to Madre OTH Radar

[Unclassified Title]

F. E. Boyd and C. M. Howe

Radar Techniques Branch
Radar Division

April 1974

20070918706
### Report Documentation Page

<table>
<thead>
<tr>
<th>1. REPORT NUMBER</th>
<th>2. GOVT ACCESSION NO.</th>
<th>3. RECIPIENT'S CATALOG NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRL Memorandum Report 2766</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. TITLE (and Subtitle)</th>
<th>5. TYPE OF REPORT &amp; PERIOD COVERED</th>
<th>6. PERFORMING ORG. REPORT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADAR TRANSCRIPTIONS FROM AN/FPS-95 TO MADRE OTH RADAR (U)</td>
<td>Final report</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. AUTHOR(s)</th>
<th>8. CONTRACT OR GRANT NUMBER(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frank E. Boyd and Charles M. Howe</td>
<td>USAF MIPR FY76207300001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. PERFORMING ORGANIZATION NAME AND ADDRESS</th>
<th>10. PROGRAM ELEMENT, PROJECT, TASK AREA &amp; WORK UNIT NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naval Research Laboratory Washington, D.C. 20375</td>
<td>NRL Prob. No. 53R02-42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. CONTROLLING OFFICE NAME AND ADDRESS</th>
<th>12. REPORT DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of the Air Force Electronic Systems Division Bedford, Massachusetts 01730</td>
<td>April 1974</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. NUMBER OF PAGES</th>
<th>14. MONITORING AGENCY NAME &amp; ADDRESS (IF different from Controlling Office)</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SECURITY CLASS. (OF THIS REPORT)</th>
<th>16. DISTRIBUTION STATEMENT (OF THIS REPORT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECRET</td>
<td>Security requirements which apply to this document and must be met, may be further distributed by any holder ONLY, with specific prior approval of the Director, Naval Research Laboratory, Washington, D.C. 20375.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17. DISTRIBUTION STATEMENT (OF THE ABSTRACT ENTERED IN BLOCK 20, IF DIFFERENT FROM REPORT)</th>
<th>18. SUPPLEMENTARY NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>This document may be further distributed by any holder ONLY, with specific prior approval of the Director, Naval Research Laboratory, Washington, D.C. 20375.</td>
<td>Prompt from distribution to Defense Documentation Center in accordance with MOD Instruction 5110.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19. KEY WORDS (CONTINUE ON REVERSE SIDE IF NECESSARY AND IDENTIFY BY BLOCK NUMBER)</th>
<th>20. ABSTRACT (CONTINUE ON REVERSE SIDE IF NECESSARY AND IDENTIFY BY BLOCK NUMBER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radar performance OTH Radar Radar recording Computer programming Signal Processing</td>
<td>(U) Magnetic tape recordings of the AN/FPS-95 OTH radar receiver output have been converted on a general purpose computer to a form suitable for playback on the MADRE radar signal processor. These playbacks demonstrate the excellent detection capability of the AN/FPS-95 when used in conjunction with the MADRE processor and displays. The usefulness of clutter filtering, doppler shifting, and data word bit selection are demonstrated.</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. TAPE CONVERSION PROGRAM</td>
<td>1</td>
</tr>
<tr>
<td>III. DATA PROCESSING DURING CONVERSION</td>
<td>2</td>
</tr>
<tr>
<td>IV. TEST PROGRAM</td>
<td>2</td>
</tr>
<tr>
<td>V. PROBLEMS ENCOUNTERED DURING PLAYBACK</td>
<td>3</td>
</tr>
<tr>
<td>VI. RESULTS</td>
<td>4</td>
</tr>
<tr>
<td>VII. CONCLUSIONS</td>
<td>4</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>7</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
</tr>
<tr>
<td>I. Tape Conversion Program Listing</td>
<td>A-1</td>
</tr>
<tr>
<td>II. Test Program Listing</td>
<td>A-24</td>
</tr>
</tbody>
</table>
RADAR TRANSCRIPTIONS FROM AN/FPS-95
TO MADRE OTH RADAR (U)

I. INTRODUCTION (U)

(U) The AN/FPS-95 was designed to become an operational radar for
OTH detection and tracking of aircraft, while the MADRE radar was
designed to perform research. Considerable data and background inform-
ation have been accumulated with the MADRE radar. Data processors
and displays of the two radars are radically different. It therefore
became desirable to process the raw signals from the FPS-95 on the
MADRE processor in order to determine the relative performance of the
two radars as well as compare the two signal processors and display
systems.

(U) In effect, a third processor was utilized by programming a
Xerox Sigma 5 computer; this work has been reported elsewhere (Ref. 1).

II. TAPE CONVERSIONS (U)

(U) The FPS-95 and MADRE radars both have the capability to record
the receiver outputs on magnetic tape. However, to be able to play
back an FPS-95 recording on the MADRE processor it is necessary to
adjust for the following differences:

1. Nine vs seven track recording
2. Number of range bins
3. Tape header length and composition
4. Number of data words per record
5. Number of data channels
6. Number of bits per data word

(U) These adjustments are accomplished on a CDC-3800 general pur-
pose computer using the program listed in Appendix I. A very brief
description of this program follows.

(U) Data cards containing the range bins desired and other pro-
cessing parameters are read. The first record from FPS-95 tape is read
(Subroutine RECORDIN) and the next record is started to conserve com-
puter time. Meanwhile the first header is interpreted (Subroutines
HEADER1 and HEADER2). Data from the header is used to form a MADRE
header (Subroutine FORMHDS) and set additional parameters (Subroutine
SELECTER) such as PRF code, number of bins, and record size. The

Manuscript submitted March 4, 1974
program is then ready to transfer data words. This is done in three nested loops arranged to handle PRF intervals, range bins, and channels with channels being the inner loop. On completion of each PRF interval, if the input data from the last tape record have been exhausted, the next record (Subroutine NEXTIN) is read and processing continues. When the proper output record size for MADRE is reached (as determined by loop limits), an output record is made (Subroutine TAPE) and the process repeats. Throughout this process, an accurate account of time is kept by counting the PRF intervals and dividing by the PRF. This is updated from input tape headers to insure synchronism.

III. DATA PROCESSING DURING CONVERSION (U)

(U) During the tape conversion already described it is not too difficult to do some operations on the data to supplement the MADRE signal processor. Experiments were made with two processes - clutter filtering and doppler shifting.

(U) Clutter filtering was a logical experiment because the FPS-95 signal processor incorporates this feature while the MADRE clutter filter is essentially inoperative. Thus by doing the clutter filtering during preparation of tapes, one obtains a more direct comparison of the two signal processors. The program used provides a Butterworth filter (Subroutine BUTTR) in which the number of poles, notch width, and gain can be varied. Selection of the gain was best determined by a short preliminary computer run to observe the signal level generated. The gain was automatically adjusted downward from a high level until an acceptable criterion was reached.

(U) The MADRE signal processor eliminates the very low doppler frequencies. Doppler shifting by an amount equal to the PRF divided by four is easy to do during transcription and can be useful in examining the backscatter return and slow moving targets.

IV. TEST PROGRAM (U)

(U) In the process of correcting the program it was observed that certain errors cause a skewing of the data which produced a smearing of the normal radar displays. Depending on the degree, this type of error could be imperceptible from the displays. For this reason it was imperative that a test program be developed (see Appendix II). This program generates an artificial record of data having an easily recognizable pattern. Contained in the data word are numbers for the channel, range bin and pulse interval. The data are transcribed and then printed for visual inspection of individual data words.
V. PROBLEMS ENCOUNTERED DURING PLAYBACK (U)

(U) The FPS-95 has only one data sample rate, namely, 4000 Hz. The basic sample rate for the MADRE processor is 3960 Hz; however, this effectively changes whenever it is instructed to process a non-standard PRF. Because of this difference it is not possible to have the range and doppler cursors both reading correctly at the same time. The range will be correct whenever the effective sample rates match and the doppler readings will be correct when the original PRF is used. Actually, rather than the sample rate changing with the actual PRF instruction, the MADRE processor changes scaling for the various strobes and digital readout. However, for the purpose of explanation this can be regarded as a change in the effective sample rate.

(U) Scaling is further compounded because the first range bin recorded on FPS-95 tape does not always match the first range bin expected on MADRE tape. One additional correction is required because the FPS-95 samples did not occur at the center of the pulse with the exception of the 0.25-ms pulse length. The following formula has been evolved to account for the above:

\[
\text{FPS-95 True Range} = \text{(RB offset in nmi)} + (\text{MADRE RB No. - 1}) \times (\text{FPS-95 RB width}) - \text{(Pulse length correction)}
\]

The FPS-95 RB width is 20.24 nmi and the pulse length correction is shown below.

<table>
<thead>
<tr>
<th>Pulse Length (ms)</th>
<th>Correction (nmi)</th>
<th>First RB Recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>0.50</td>
<td>-11</td>
<td>3</td>
</tr>
<tr>
<td>0.75</td>
<td>-21</td>
<td>4</td>
</tr>
<tr>
<td>1.0</td>
<td>-31</td>
<td>5</td>
</tr>
<tr>
<td>1.5</td>
<td>-71</td>
<td>5</td>
</tr>
<tr>
<td>2.0</td>
<td>-91</td>
<td>5</td>
</tr>
<tr>
<td>3.0</td>
<td>-131</td>
<td>5</td>
</tr>
</tbody>
</table>

(In the FPS-95 displays this correction was made automatically.)

(U) The MADRE strobe readout can be corrected according to the following formula:

\[
\text{Corrected MADRE Range Readout} = [(\text{Actual MADRE Readout}) \times (\text{MESR} \div \text{FSR})] + \text{(RB Offset in nmi)} - \text{(Pulse Length Correction)}
\]

where \( \text{MESR} = \text{MADRE Effective Sample Rate} \)
\( = 3960 \times \text{Actual MADRE PRF} \div \text{Original FPS-95 PRF} \)
\( \text{FSR} = \text{FPS-95 Sample Rate} = 4000 \)
(U) In measuring time on a MADRE doppler vs time display, the
time scale is corrected as follows:

\[
\text{Corrected MADRE Time Readout} = \text{Actual MADRE Readout} \times \text{Actual MADRE PRF} \div \text{Original FPS-95 PRF}
\]

As an example, a tape was transcribed and played back so that the
doppler readings would be correct. This then resulted in the range
relationships shown in Table I.

VI. RESULTS (U)

(S) An example of the results produced by this program has been
previously reported in Ref. 2. Two additional missile observations
have been made; one occurring on 14 Oct 1972 for Plesetsk at 0617 GMT. The observed signature is shown in Figs. 1 and 2. This is most likely
an ionospherically refracted return from the burning missile for the
following reasons:

1. The signal commenced 3½ minutes after reported launch time
and lasted 40 seconds. Thus the missile would reach altitudes under
refracted illumination but be below the ionosphere.

2. The measured slant range is 327 nmi beyond the launch point.
Ionospheric perturbations are usually observed at double the range of
ionospheric missile penetration.

3. The target changed range at an average rate of 8936 knots.

4. The signal is discrete in range for its entire duration.

(S) This detection would undoubtedly have continued beyond 40
seconds were it not for the fact that it disappeared into the trans-
mitter pulse at the end of the PRF interval. Also the beginning of
the interval was obscured by heavy clutter returns.

(S) Another example is shown in Figures 3, 4, and 5. This
missile was reported launched at 0736 GMT from the Northern Fleet
Missile Test Center (NFMTC). A signature at 1430 nmi (70 nmi beyond
launch slant range) commenced 4 min. 37 sec. after launch and lasted
1 min. 29 sec. (Figs 3 and 4) This was immediately followed by another
signature at 2357 nmi (1000 mi beyond launch) commencing 6 min. after
launch and lasting 1 min. 54 sec. (Fig. 5) It is entirely possible
that more detailed analysis would reveal the significance of these
signatures.

VII. CONCLUSIONS (U)
TABLE I - RANGE BIN CORRELATION TABLE
FOR THE FOLLOWING CONDITIONS:

FPS-95 PRF = 40 Pulse Length = 1 ms
tape transcribed to MADRE-type tape = 4th
PRF = 40.00
First RB on FPS-95
MADRE processor

<table>
<thead>
<tr>
<th>FPS-95</th>
<th>MADRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB No.</td>
<td>Computed Range</td>
</tr>
<tr>
<td>1*</td>
<td>0</td>
</tr>
<tr>
<td>2*</td>
<td>20.24</td>
</tr>
<tr>
<td>3*</td>
<td>40.5</td>
</tr>
<tr>
<td>4*</td>
<td>60.7</td>
</tr>
<tr>
<td>5</td>
<td>81.0</td>
</tr>
<tr>
<td>6</td>
<td>101.2</td>
</tr>
<tr>
<td>7</td>
<td>121.4</td>
</tr>
<tr>
<td>8+</td>
<td>141.7</td>
</tr>
<tr>
<td>9</td>
<td>161.9</td>
</tr>
<tr>
<td>10</td>
<td>182.2</td>
</tr>
<tr>
<td>11</td>
<td>202.4</td>
</tr>
<tr>
<td>12</td>
<td>222.6</td>
</tr>
<tr>
<td>93</td>
<td>1862.1</td>
</tr>
<tr>
<td>100</td>
<td>2024</td>
</tr>
</tbody>
</table>

True range = (MRB - 1) x (20.24) + 101.2 - 31
where MRB = MADRE range bin number

Corrected range = (MADRE readout x 0.88) + 101.2 - 31

* Not available
+ First range bin transcribed
(U) Tapes played back on the MADRE system have served to emphasize the weakness in the FPS-95 display system. Despite the fact that the MADRE processor has less dynamic range (12 bits vs 16), it has consistently been possible to make detections on an initial playback that were missed in either real time or playback on the FPS-95 system.

(S) Five periods of observation have been converted to date. Four of these cover missile launches and in each case evidence of the missile was detected. Every tape produced numerous aircraft tracks in areas of suitable radar coverage.

(U) This program has served as a useful medium for investigating the effectiveness of various signal processing procedures such as digital clutter filtering, doppler frequency shifting, and selection of data word bits (when the data word size exceeded the processor capability). A dynamic selection of data word bits on a range-bin basis promises to yield further improvement and may be attempted in the future.
REFERENCES


(S) Fig. 1 - Range vs doppler display for 10/14/72 at 06:20:36 GMT. Range strobe is centered on missile signature at 1798 nmi.
(S) Fig. 2 - Time vs doppler display for 10/14/72 showing 248 seconds ending at 06:22:43 GMT. The range bins selected cover 1690 to 1831 nmi and the time strobe is at 16:20:36 GMT.
(S) Fig. 3 - Time vs doppler display for 10/31/72 showing 16 minutes and 30 seconds ending at 07:47:44 GMT. The range bins selected cover 1285 to 1366 nmi and the missile signature can be seen about one-third of the distance from the right-hand side.
Fig. 4 - Same as Fig. 3 except for expanded time scale (4 min. shown). Missile signature occurs between 07:40:37 and 07:42:06 GMT.
(S) Fig. 5 - Time vs doppler display for 10/31/72 showing 240 seconds ending at 07:44:31 GMT. The range bins selected for the upper trace cover 2237 to 2318 nmi.
APPENDIX I - TAPE CONVERSION PROGRAM LISTING (U)

PROGRAM FPS95REC
C CONVERTS FPS-95 REC TAPE TO MADRE TAPE
C VERSION THREE, MODIFIED 3/10/73, 3/20/73
C FOR INPUT TAPE USE EQUIP,9=M9
C FOR OUTPUT TAPE USE EQUIP,20=*HY*DA
C FIRST DATA CARD, COL 1-59 SERIAL NUMBER OF ORIGINAL TAPE
C SECOND DATA CARD, COL 1-29 FIRST RANGE BIN TO BE PROCESSED
C COL 4-69 NUMBER OF RECORDS TO BE PRINTED
C COL 8-119 NUMBER OF RECORDS TO BE PROCESSED
C THIRD DATA CARD, COL 1-16 F10.3 NO. POLES
C COL 11-20 F10.3 NOTCH RATIO
C COL 21-30 F10.3 CFGAIN
C ARITHMETIC INCLUDED FOR SELECTION OF LSB OF DATA
C CHANNEL 1 IS CLUTTER FILTERED, CHANNEL 3 IS FREQUENCY SHIFTED
C
C COMMON /FILTER/ NPOLES, RATIO, CFGAIN, NBIN
C COMMON /DATA/ ICDC(7000)
C COMMON /IND REC/ LHEADER(15), LDATA(2216)
C COMMON /HEADERL/ BLANK, IPRF, CODE, ISRATE, IAR, INCHAN, INFILTER
C COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK
C COMMON /SWITCHES/ IEOTSW, ILOT9T
C COMMON /1 I0VER (100), IUNDER (100)
C DATA(K4=1)

C
C START EXECUTION
C FIRST RECORD
22 CALL RECORD IN
10 ITIME6 = INITIME + INTCOUNT/ PRF
C LOOP ON PRF INTERVAL TO COMPLETE ONE OUTPUT RECORD
DO 16 INT NO = 1, IPERREC
  INTCOUNT = INTCOUNT + 1
C   LOOP ON BINS TO COMPLETE ONE INTERVAL
DO 14 IBINNO = 1, IBINMAX
C   LOOP ON CHANNELS
   IBINWRD = 1
C
'L' IS WORD NUMBER WITHIN CURRENT DATA RECORD
  L = IBINWRD + NCPB * IBINNO - NCPB + INTNO * IBINMAX
  * NCPB = IBINMAX * NCPB
  LDATA(L) = IFILTER(ICDC(M + LENHEADS), IBINNO)
IF (LDATA(L) .GT. 403 777B) GO TO 34
IF (LDATA(L) .LT. 374 000B) LDATA(L) = 374 000B
GO TO 36
34
   LDATA(L) = 403 777B
36
   LDATA(L) = LDATA(L) - 374 000B
C   CHANNEL TWO
C
FREQ SHIFT PRF/4, NEXT CHAN.
 DC BIAS UNCORRECTED
GO TO (1, 2, 3, 4) K4
1
   LDATA(L+1) = ICDC(M+1+LENHEADS)
GO TO 20
2
   LDATA(L+1) = ICDC(M+LENHEADS)
GO TO 20
3
   LDATA(L+1) = ICDC(M+1+LENHEADS) + 1 000 000B
GO TO 20
4
   LDATA(L+1) = ICDC(M+LENHEADS) + 1 000 000B
20
   M = M + 3
IF (LDATA(L+1) .GT. 403 777B) GO TO 24
IF (LDATA(L+1) .LT. 374 000B) LDATA(L+1) = 374 000B
GO TO 26
24
   LDATA(L+1) = 403 777B
IUNDER(IBINNO) = IUNDER(IBINNO) + 1
26
   LDATA(L+1) = LDATA(L+1) - 374 000B
C
END OF CHANNEL LOOP
14  _CONTINUE
C END OF BIN LOOP, ONE INTERVAL COMPLETED
K4 = K4 + 1
IF(K4 \* GT \* 4) K4=1
M = M + MDROP \* 3
C CHECK FOR EXHAUSTION OF INPUT DATA
16 IF (M \* GE \* MSIZE) CALL NEXT IN
C END LOOP ON NUMBER OF INTERVALS PER RECORD, RECORD COMPLETED
18 CALL TAPE
IF (IEOTSW \* EQ \* 1) CALL FINIS(3)
GO TO 10
END
C SUBROUTINE RECORD IN
C PREPARES FOR INITIAL LOOP
COMMON /KOPFER/ LIST (400)
DIMENSION IHEADER(200), JHEADER(200)
EQUIVALENCE (IHEADER (1), LIST (1)), (JHEADER (1), LIST (201))
EQUIVALENCE (JHEADER (10), JPRF)
EQUIVALENCE (JHEADER (37), JTIME DAY)
EQUIVALENCE (JHEADER (52), JFHDRF)
EQUIVALENCE (JHEADER (53), JNEWTAPE)
EQUIVALENCE (JHEADER (57), NRECST)
COMMON /DATA/ ICDC(7000)
COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 M, MSIZE, INITIME, MDROP, PRF, MKCVRWRED, LENHEADS, MSTART,
2 NPRINT, NREC
COMMON /SWITCHES/ IEOTSW, ILOT9T
COMMON /FILTER/ NPOLES, RATIO, CFAGAIN, NBIN
C C START EXECUTION
C FIRST DATA CARD
READ 50, M
50 FORMAT (15)
PRINT 51, M
51 FORMAT (* ORIGINAL TAPE SERIAL NUMBER IS --, 15)
C SECOND DATA CARD
READ 53, MSTART, NPRINT, NREC
53 FORMAT (I2,X,13,X,14)
54 FORMAT (/,* TAPE REFORMATTED STARTING WITH RANGE BIN*,13)
55 FORMAT (3F10.3)
56 FORMAT (5X,POLES = F10.3, 5X *NOTCH RATIO I = F10.3, 5X *CFGA = F10.3)
C PRINT PAGE HEADING
C PRINT 8980
C8980 FORMAT (118X,*RECORD NUMBERS*/ 118X, *FROM START OF*/ /101X, *VOICE
C 1E NO. DATA -------------- */ /102X, *CUE WORDS INTEGR TAP
C 2E*)
C READ FIRST RECORD
CALL NINEGO
C PROCESS FIRST RECORD
CALL READNINE
CALL HEADER1
C JFDHF IS TRUE WHEN FULL HEADER FOLLOWS OR JNEWTAPE
IF (NOT JFDHF AND NOT JNEWTAPE) GO TO 20
LENHEADS = 74
CALL HEADER2
CALL SELECTER
NBIN = IBINMAX
C SET INITIAL VALUE OF INPUT WORD COUNTER, M. USE IN PHASE SUM DATA
10 M = 1 + (MSTART-1) * 3
C MSIZE = NO. RECEIVER WORDS
MSIZE = MRCVRWRD
RETURN
C END OF RECORD
C 01% ENTRY NEXT IN
C READS ONE INPUT RECORD, CHECKS E OF F, REPACKS, PRINTS HEADER, SETS M

FILTER
IF (NRECST.GT.NREC) CALL FINIS (1)
LPRF = JPRF
CALL READNINE
IF (IEOT9T .NE. 0) CALL FINIS (6)
CALL HEADER1
C JFHDRF IS TRUE WHEN FULL HEADER FOLLOWS OR JNEWTAPE
IF (.NOT. JFHDRF .AND. .NOT. JNEWTAPE) GO TO 30
LENHEADS = 74
CALL HEADER2
C RESET TIME TO AGREE WITH HEADER
INTIME = JTIMEDAY
INTCOUNT = 0
C CRITICAL PARAMETER TESTS FOLLOW
IF (JPRF .NE. LPRF) CALL SELECTER
40 M = 1 + (MSTART-1) * 3
C MSIZE = NO. RECEIVER WORDS
MSIZE = MRCVWRD
RETURN
30 LENHEADS = 4
GO TO 40
END
SUBROUTINE HEADER1
COMMON /KOPFER/ LIST (400)
DIMENSION IHEADER(200), JHEADER(200)
EQUIVALENCE (IHEADER (1), LIST (1)), (JHEADER (1), LIST (201))
C FULL EQUIVALENCE STATEMENTS OMITTED TO ACHIEVE BREVITY
EQUIVALENCE (JHEADER (51), JEOC)
LOGICAL JET
EQUIVALENCE (JHEADER (52), JFHDRF)
LOGICAL JFHDRF
EQUIVALENCE (JHEADER (53), JNEWTAPE)
LOGICAL JNEWTAPE
EQUIVALENCE (JHEADER (54), JRNSTII)
C VOICE CUE SWITCH--SET IF ACTIVE. JVOICEQ LOGICAL
EQUIVALENCE (JHEADER (55), JVOICEQ)
LOGICAL JVOICEQ
C NUMBER OF RECEIVER WORDS IN THIS RECORD
EQUIVALENCE (JHEADER (56), NRCVRWRD)
C RECORD NUMBER OF CURRENT RECORD RELATIVE TO START OF TAPE
EQUIVALENCE (JHEADER (57), NRECST)
COMMON /DATA/ ICDC(7000)
COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 M, MSIZE, INITIME, MDROP, PRF, MRCVRWRD, LENHEADS, MSTART,
2 NPRINT, NREC
C DISSECT WORD ONE AND SET LOGICALS
CALL DYSSECT
C JEOT = END OF RECORDS
JEOT = .FALSE.
IF (LIST(51)) *NE. 0) JEOT = .TRUE.
C JNEWTAPE = TAPE CONTINUATION AT BREAK IN INTEGRATION INTERVAL
JFHDRF = .FALSE.
IF (LIST(52)) *NE. 0) JFHDRF = .TRUE.
JNEWTAPE = .FALSE.
IF (LIST(53)) *NE. 0) JNEWTAPE = .TRUE.
C JRNSTII = RECORD NO. REL. TO START OF INTEGRATION INTERVAL
JRNSTII = LIST(54)
C END WORD ONE DISSECTION
IF (JEOT) CALL FINIS(4)
C 980 IF (JNEWTAPE) PRINT 2
C 2 FORMAT(* THIS IS A CONTINUED TAPE WITH BREAK DURING INTEGRATION IN
C INTERVAL*)
980 CONTINUE
C EQUATE REMAINING WORDS OF HEADER (PART 1)
JVOICE = ICDC(2)
NRCVRWRD = ICDC(3)
NRECST = ICDC(4)
IRCHECK = NRECST
MVOICEQ = 4HOFF
IF (JVOICEQ) MVOICEQ = 4HON
C COMPUTE ONE'S COMPLEMENT OF NRCVRWRD
C NECESSARY CORRECTIONS FOR COMPLEMENTARY ARITHMETIC IS \(-2+1\)
MRCVWRD =777776B - NRCVWRD
C HEADER 1 OUTPUT IF NEEDED
C PRINT 8980, (MVOCWQ, MRCVWRD, JKNSTII, NRECST)
C 8980 FORMAT (102X, A4, 4X, I4, 2X, 16, 2X, 16)
C FOR SAKE OF UNIFORMITY 2ND HALF OF LIST SHOULD HAVE BEEN USED -
C APPLIES TO DYSPECT ALSO
RETURN
END
SUBROUTINE HEADER2
COMMON /KOPFER/ LIST (400)
DIMENSION IHEADER(200), JHEADER(200)
EQUIVALENCE (IHEADER (1), LIST (1)), (JHEADER (1), LIST (201))
C PRF/IPRF 1-160, 2-80, 3-53, 4-40, 5-10, ALSO PRF IS REAL
EQUIVALENCE (JHEADER (10), JPRF)
EQUIVALENCE (JHEADER (11), PRFHDRRC)
C TIME OF DAY, DAY OF YEAR
EQUIVALENCE (JHEADER (37), JTIMEDAY)
EQUIVALENCE (JHEADER (38), JDAYYEAR)
COMMON /DATA/ ICDC(7000)
COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 M, MSIZE, INITIME, MDROP, PRF, MRCVWRD, LENHEADS, MSTART,
2 NPRINT, NREC
C PRF LEGEND
DIMENSION MPRF(5)
DATA(MPRF =4H 160, 4H 80, 4H53.3, 4H 40, 4H 10)
DIMENSION MTIME (3), MDAY (2)
C TIME OF DAY, DAY OF YEAR PRINTOUT LIST
C LIST TO TRANSLATE FROM DAY OF YEAR TO MONTH OF YEAR, DAY OF MONTH
C LEAP YEAR ALTERNATIVE AVAILABLE
DIMENSION LMDO (13), LMD (12), LMDOLY (13), LMDLY (12)
EQUIVALENCE (LMDO (2), LMD (1)), (LMDOLY (2), LMDLY (1))
DATA(LMDO =0, 31, 59, 90, 120, 151, 181, 212, 243, 273, 304, 334,
1 365)
DATA(LMDOLY = 0, 31, 60, 91, 121, 152, 182, 213, 244, 274, 305, 670
1 335, 366)

C**********************************************************
CALL DSSCT2
1000 MTIME (1) = JTIMEDAY / 3600
MTIME (2) = (JTIMEDAY - MTIME (1) * 3600) / 60
MTIME (3) = JTIMEDAY - MTIME (1) * 3600 - MTIME (2) * 60
DO 1020 I = 1, 12
C
IF (JDAYYEAR .LE. LMD (I)) GO TO 1040
IF (JDAYYEAR .LE. LMDLY(I)) GO TO 1040
1020 CONTINUE
PRINT 1021
1021 FORMAT (* ERROR - DAY TOO LARGE*)
1040 MDAY (1) = I
C
MDAY (2) = JDAYYEAR - LMD0 (I)
MDAY (2) = JDAYYEAR - LMDOLY(I)
PRINT 9120, (MTIME (1), I = 1, 3), (MDAY (1), J = 1, 2); 1
MPRF(JPRF), MSIZE
9120 FORMAT (8X,*TIME*,13,*9*,12,*9*,12,* DAY *,12,**,I2,
A * PRF *, A4, * MSIZE *, I5)
END
SUBROUTINE SELECTER
COMMON /KOPFERS/ LIST (400)
DIMENSION IHEADER(200), JHEADER(200)
EQUIVALENCE (IHEADER (1), LIST (1)), (JHEADER (1), LIST (201))
EQUIVALENCE (JHEADER (10), JPRF)
COMMON /HEADER/BLANK1, IPRFcode, ISRATE, IAR, INCHAN, INFILTER,
1 IAB, IAPRF, NUMBER6, ITIME6, FREQ, IRCOUNT, IDC, IAPRFF
COMMON /USE /ISIZE, IPERKEC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 MSIZE ,INITIME,MCTOR,PRF,MRCVRWRD, LENHEADS, MSTART, NPRINT, NREC
DIMENSION SIZE (21), JBINMAX(7), MDROPT(4)
DATA (SIZE = 1750, 1740, 2150, 1920, 2100, 2170, 2200, 1
2 2100, 2088, 2064, 2112, 2142, 2139, 2160,
2 2100, 2088, 2064, 1920, 2016, 2046, 2160)
DATA (JBINMAX = 350, 174, 86, 64, 42, 31, 20)
DATA (MDROPT = 4, 6, 8, 10)
INTEGER SIZE
NO. OF RANGE BINS DROPPED FROM INPUT DATA
MDROP = MDROPT(JPRF)
IF(MSTART .LE. MDROP) GO TO 9
PRINT 3, MSTART
3 FORMAT (* ERROR EXIT BECAUSE MSTART = * 12)
CALL EXIT
9 CONTINUE
C SELECT PRF CODE
IF (JPRF .EQ. 1) GO TO 10
IF (JPRF .EQ. 2) GO TO 20
IF (JPRF .EQ. 3) GO TO 30
IF (JPRF .EQ. 4) GO TO 40
PRINT 2, JPRF
2 FORMAT (* ERROR EXIT BECAUSE PRF CODE = *12)
CALL EXIT
IAPRF AND IAPRFF USED TO FORM AP FOR HEADER ONLY
10 PRF=160.0 $ IPRF CODE=7 $ IAPRF=1750B
20 PRF= 80.0 $ IPRF CODE=5 $ IAPRF= 764B
30 PRF= 53.33333 $ IPRF CODE=4 $ IAPRF= 515B $ IAPRFF=5
40 PRF= 40.0 $ IPRF CODE=3 $ IAPRF=372B
GO TO 60
60 CONTINUE
ISRATE = 4
ICHAN = 2
C SELECT NO. OF CHANNELS PER BIN(NCPB)
NCPB = 3
C SELECT NO. OF DATA WORDS PER RECORD(ISIZE)
N = IPRF CODE + 7
ISIZE = SIZE(N)
C SELECT NO. OF BINS(IBINMAX)
IBINMAX =JBINMAX(IPRF CODE)
IF (ISRATE .EQ. 8) IBINMAX = 2 * IBINMAX
C COMPUTE NO. OF PRF INTERVALS PER RECORD(IPERREC)
IPERREC = ISIZE / (IBINMAX * NCPB)
INITIME = JHEADER(37)
PRINT 1,IPRF CODE,NCPB,N,ISIZE,IBINMAX,IPERREC,MDROP

TEMP
TEMP
RETURN
END
SUBROUTINE BUTTR (NPOLE, RATIO, GAIN, NSTAG)
C COMPUTES SCALED DIFFERENCE EQUATION COEFFICIENTS FOR POLES OF
C BUTTERWORTH FILTER
COMM 0N /CO/ A(2,5), B(2,5)
DIMENSION F(3,2), P(2), S(100)
DATA (N = 100)
DATA (PI = 3.14159265358979)
C START EXECUTION
100 IF (NPOLE .GT. 10) NPOLE = 10
W = TANF (RATIO * PI)
D = W * W
NSTAG = NPOLE / 2
NODD = NPOLE - 2 * NSTAG
F = FLOAT (2 * NPOLE)
IF (NODD .EQ. 0) GO TO 200
A(1,1) = -1.0 $ A(2,1) = 0.0
B(1,1) = (W - 1.0) / (W + 1.0) $ B(2,1) = 0.0
200 IF (NSTAG .EQ. 0) GO TO 400
DO 300 K = 1, NSTAG
J = K + NODD
G = FLOAT (2 * K + NPOLE - 1)
C = 2.0 * W * COS (PI * G / F)
A (1, J) = -2.0 $ A (2, J) = 1.0
B (1, J) = -2.0 * (1.0 - D) / (1.0 + D - C)
B (2, J) = (1.0 + D + C) / (1.0 + D - C)
300 CONTINUE
400 IF (NODD .EQ. 1) NSTAG = NSTAG + 1
PRINT 9000, (A(1, I), A(2, I), B(1, I), B(2, I), I=1,NSTAG)
9000 FORMAT (* FILTER COEFFICIENTS*, /, 5 (2.5X, 2((2.10.5))/))
GAIN = 1.0
DO 500 K = 1, NSTAG
GAIN = GAIN * (1.0 - A(1, K) + A(2, K)) / (1.0 - B(1, K) + B(2, K))
500 CONTINUE
PRINT 9020, GAIN
9020 FORMAT (X,* PASSBAND GAIN = *F10.2)
RETURN
END
FUNCTION IFILTER (IDATA, IBIN)
COMMON /FILTER/ NPOLES, RATIO, CFGAIN, NBINS
DIMENSION DELAY(4,5,100)
COMMON /11 / IOVER (100), IUNDER (100)
COMMON /CO/ A(2,5), B(2,5)
DATA (IFIRST = 1)
C
C START EXECUTION
IF (IFIRST .NE. 1) GO TO 500
CALL BUTTR (NPOLES, RATIO, GAIN, NSTAGES)
DO 400 IB = 1, NBINS
IOVER (IB) = 0
IUNDER (IB) = 0
DO 300 ISTAGE = 1, NSTAGES
DO 200 K = 1, 4
DELAY (K, ISTAGE, IB) = 0.0
200 CONTINUE
300 CONTINUE
400 CONTINUE
IFIRST = 0
500 CONTINUE
ID = IDATA - 4000000B
X = FLOAT (ID)
DO 600 ISTAGE = 1, NSTAGES
Y = + X
1 + A (1, ISTAGE) * DELAY (1, ISTAGE, IBIN)
2 + A (2, ISTAGE) * DELAY (2, ISTAGE, IBIN)
3 - B (1, ISTAGE) * DELAY (3, ISTAGE, IBIN)
4  -  B (2, ISTAGE) * DELAY (4, ISTAGE, IBIN)
DELAY (4, ISTAGE, IBIN) = DELAY (3, ISTAGE, IBIN)
DELAY (3, ISTAGE, IBIN) = Y
DELAY (2, ISTAGE, IBIN) = DELAY (1, ISTAGE, IBIN)
DELAY (1, ISTAGE, IBIN) = X
X = Y
600 CONTINUE
Y = Y / GAIN * CFGAIN
IFILTER = Y + 4000000B
IF (IFILTER .LE. 777777B) GO TO 700
IFILTER = 777777B
IOVER (IBIN) = IOVER (IBIN) + 1
GO TO 800
700 IF (IFILTER .GE. 0) GO TO 800
IFILTER = 0
800 CONTINUE
RETURN
END
SUBROUTINE FINIS (ISTOPSW)
SUBROUTINE TO TERMINATE PROGRAM WITH ASSOCIATED OUTPUT
COMMON /USE /ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 MMSIZE, INITIME, MDROP, NIN, MRCVRWRD, LENHEADS, MSTART, NPRINT, NREC
COMMON /11 / IOVER (100), LUNDER (100)
C
PRINT 102, IRCHECK
102 FORMAT (* RECORD COUNT FROM START OF INPUT TAPE = * 18)
PRINT 103
103 FORMAT (* NO. TIMES SIG. EXCEEDS 18 BIT CAPACITY IN CHAN. 1 OR 12
1BIT CAPACITY IN CHAN. 3 * /
2                * BIN NUMBER  CHAN. 1  CHAN. 3 *)
DO 200 IBIN=1, IBINMAX
200 PRINT 104, IBIN, IOVER (IBIN), LUNDER (IBIN)
104 FORMAT (3I12)
C
GO TO (10, 20, 30, 40, 50, 60) ISTOPSW
C
10 PRINT 105
105 FORMAT (* TERMINATE ON RECORD LIMIT*)
   ENDFILE 20
   CALL EXIT
C
20 PRINT 106
106 FORMAT (* TERMINATED ON CRITICAL PARAMETER CHANGE ON INPUT TAPE*)
   ENDFILE 20
   CALL EXIT
C
30 PRINT 101
101 FORMAT (* END OF OUTPUT TAPE REACHED*)
   CALL EXIT
C
40 PRINT 1
1 FORMAT (* END OF INPUT TAPE RECORD*)
   ENDFILE 20
   CALL EXIT
C
60 PRINT 110
110 FORMAT (* END OF INPUT TAPE REACHED*)
   ENDFILE 20
   CALL EXIT
C
C
50 RETURN
   END
   IDENT READNINE
   ENTRY NINEGO
   ENTRY READNINE
   DATA BLOCK
   COMMON WLISTOUT(7000)
   SWITCHES BLOCK
   COMMON SW1,EOT9TR
* SUBROUTINE TO ESTABLISH MODE AND START READING OF FIRST RECORD
   NINEGO OCT 0
* ESTABLISH TAPE INPUT AS LOGICAL UNIT 9
ESTABLU MODE 9
* START FIRST RECORD READIN
READIST READ 9
* THEN EXIT
SLJ NINEGO

* SUBROUTINE TO MOVE / TRANSFORM INPUT LIST AND START NEXT READ
READINE OCT 0
* STATUS CHECK
STATCHIN STATUS 9
QJP,MI STATCHIN
* CHECK FOR EOT ENCOUNTED
QLS 10
QJP,PL ESTLIN
RXT P1,Q
STQ EOT9TR
SLJ READINE

* ESTABLISH LENGTH OF INPUT RECORD
ESTLIN SUB INCNTRL
ARS 24
STA COUNTER
ROP, PZ,A,B1
RXT PZ,B2
RXT P1,B3
RXT PZ,B4
RXT P1,B5
XMIT,AUG INPLIST,WLSTIN

* THEN START TO READ NEXT RECORD
READ 9

* REFORMAT LIST
REFLIST RXT PZ,B1
RXT PZ,B2
ENI 36,3
ENI 24,4
ENI 12,5

A-14
ALoop

ENI 0,6
LDA WLISTIN,1
STA HOLD3
LDA WLISTIN+1,1
STA HOLD3+1
LDA WLISTIN+2,1
STA HOLD3+2
LBYT A12,E6,CL HOLD3+3
LBYT A6,E6 HOLD3+4
LBYT A0,E6 HOLD3+5
LBYT Q12,E6,CL HOLD3+6
LBYT Q6,E6 HOLD3+1,3
LBYT Q0,E6 HOLD3+1,4
DSTA WLISTOUT,2
LBYT A12,E6,CL HOLD3+1,5
LBYT A6,E6 HOLD3+1,6
LBYT A0,E6 HOLD3+2,3
LBYT Q12,E6,CL HOLD3+2,4
LBYT Q6,E6 HOLD3+2,5
LBYT Q0,E6 HOLD3+2,6
DSTA WLISTOUT+2,2
INI 3,1
INI 4,2
LDA COUNTER
INA 3
STA COUNTER
AJP MI ALOOP
SLJ READINE

COUNTER
HOLD3
INCNTRL
INPLIST
WLISTIN

BSS 1
BSS 3
IOTR INPLIST,5240
BSS 5240
BSS 5240
END
IDENT DSSCT2
TITLE GET PRF (CODE), TIME, DAY
ENTRY DSSCT2
KOPFER BLOCK 400 300
COMMON LIST(400) 400
DATA BLOCK COMMON ICDC(7000) 600
DSSCT2 OCT 0 700
* PRF
ENG 1600B 800
LDL ICDC+5 900
ARS 7 1100
STA LIST+209
* DAY
LDA ICDC+18 1500
STA LIST+237
* TIME
LDA ICDC+17 1400
STA LIST+236
SLJ DSSCT2 1700
END IDENT DYSSECT 1800
*SEPERATES INFO CONTAINED IN FIRST WORD OF HEADER (PART 1)
*ERROR IN DATA WORD COUNT WILL OCCUR IF BIT 1 IS SET
ENTRY DYSSECT
KOPFER BLOCK 400
COMMON LIST
DATA BLOCK COMMON ICDC(7000)
ZERO OCT 0
ONE OCT 1
DYSSCET OCT 0
LDA ICDC
NBJP CL A,17,JUMP1 IF BIT 17 IS 1, GO TO JUMP1, CLEAR BIT
XMIT ZERO, LIST+50 EQUIATE TO ZERO
SLJ  JUMP2
JUMP1  XMIT  ONE;LIST+50
JUMP2  NBJP;CL  A15;JUMP3
XMIT  ZERO;LIST+51
SLJ  JUMP4
JUMP3  XMIT  ONE;LIST+51
JUMP4  NBJP;CL  A14;JUMP5
XMIT  ZERO;LIST+52
SLJ  JUMP6
JUMP5  XMIT  ONE;LIST+52
JUMP6  STA  LIST+53
SLJ  DYSECT
END
IDENT  TAPE SUBROUTINE
*CHANGES  FROM  TEST  TAPE  ARE  CARD  NOS.  181, 191
ENTRY  TAPE
EXT  FORMHDR
IND  REC  BLOCK
COMON  IHEADER(15), IDATA(2216)
USE  BLOCK
COMON  NWREC*, IPERREC*, INTCOUNT*, MAXNBI*, NCHANPB
SWITCHES  BLOCK
COMON  EOTSW
TAPE  OCT  0
BRTJ  FORMHDR
ENI  1
ENI  36,2
ENI  3
HDRLOOP  LDA  IHEADER;3
SBYT*AOE12*RI  LIST;1,2
INI  1,1
ENI  36,2
ISK  15,3
SLJ  HDRLOOP
ENI  3,1
ENI  2
ENI 3
LDA NWREC
SAU DATALOOP+3
LDA 1DATA+3
SBYT, AO, EL2, RI LIST, 1, 2
IN1 1, 1
EN1 36, 2
ISK **, 3
SLJ DATALOOP
LDA NWREC
INA 18
ARS 2
SAU CWREC
STATUS 20
QJP, MI **, 2
QLS 1
QJP, MI **, 3
QLS 9
QJP, MI HALTEOT
LIU CWREC+1
ENI , 2
ENI 1, 3
ENI , 4
ENI 1, 5
XMIT, AUG LIST, WLIST
WRITE 20, CWREC, *
SLJ TAPE
CWREC IOTW WLIST, **
WLIST BSS 558
LIST BSS 558
HALTEOT WRITE 61, HALTMC, *
RXT P1, A
STA EOTSW
SLJ TAPE
HALTMC IOTR HALTM, 4
HALTM BCD 4, END OF TAPE MARK ENCOUNTERED
<p>| END | FORMHDR SUBROUTINE | 340 |
| IDENT | FORMHDR ENTRY | 10 |
| HEADER BLOCK | COMMON | DRMSW, PRFCODE, SRSW |
| COMMON | ARSRSW, ICSW, IFBSW |
| COMMON | ARSTBSW, ACTPRF, TESTNBR |
| COMMON | TIMEBIN, FREQFXPT, RECCNT |
| COMMON | DCSW, APRFF |
| IND REC BLOCK | COMMON | IHEADER(15), IDATA(2216) |
| FORMHDR | OCT | 0 |
| * DATA RECORDING MODE | LDA | DRMSW |
| ALS | 6 |
| * PRF | ADD | PRFCODE |
| STA | IHEADER |
| * SAMPLE RATE | LDA | SRSW |
| ALS | 6 |
| * APPROACH-RECEDE SAMPLE RATE | ADD | ARSRSW |
| STA | IHEADER+1 |
| * INPUT CHANNELS | LDA | ICSW |
| ALS | 6 |
| * INPUT FILTER BANDWIDTH CODE | ADD | IFBSW |
| STA | IHEADER+2 |
| * APPROACH-RECEDE STARTING BIN | LDA | ARSTBSW |
| STA | IHEADER+3 |
| * ACTUAL PRF (TENS OF CYCLES) | LDA | ACTPRF |
| STA | IHEADER+4 |</p>
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>RXT</td>
<td>PZ,A</td>
<td>350</td>
</tr>
<tr>
<td>STA</td>
<td>IHEADER+5</td>
<td>330</td>
</tr>
<tr>
<td>STA</td>
<td>IHEADER+6</td>
<td>360</td>
</tr>
<tr>
<td>STA</td>
<td>IHEADER+7</td>
<td>370</td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>EJECT</td>
<td>390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>410</td>
</tr>
<tr>
<td></td>
<td></td>
<td>420</td>
</tr>
<tr>
<td></td>
<td></td>
<td>430</td>
</tr>
<tr>
<td>LDA</td>
<td>TIMEBIN</td>
<td>440</td>
</tr>
<tr>
<td>STA</td>
<td>US</td>
<td>450</td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td>460</td>
</tr>
<tr>
<td>STA</td>
<td>LOOK</td>
<td>470</td>
</tr>
<tr>
<td>DVI</td>
<td>TEN</td>
<td>480</td>
</tr>
<tr>
<td>STA</td>
<td>TS</td>
<td>490</td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td>500</td>
</tr>
<tr>
<td>STA</td>
<td>LOOK+1</td>
<td>510</td>
</tr>
<tr>
<td>DVI</td>
<td>SIX</td>
<td>520</td>
</tr>
<tr>
<td>STA</td>
<td>TM</td>
<td>530</td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td>540</td>
</tr>
<tr>
<td>STA</td>
<td>LOOK+3</td>
<td>550</td>
</tr>
<tr>
<td>DVI</td>
<td>SIX</td>
<td>560</td>
</tr>
<tr>
<td>STA</td>
<td>UH</td>
<td>570</td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td></td>
</tr>
<tr>
<td>STA</td>
<td>LOOK+4</td>
<td></td>
</tr>
<tr>
<td>DVI</td>
<td>TEN</td>
<td></td>
</tr>
<tr>
<td>STA</td>
<td>TH</td>
<td></td>
</tr>
<tr>
<td>RXT</td>
<td>PZ,Q</td>
<td></td>
</tr>
<tr>
<td>STA</td>
<td>LOOK+5</td>
<td></td>
</tr>
<tr>
<td>LDA</td>
<td>TS</td>
<td></td>
</tr>
<tr>
<td>MUI</td>
<td>TEN</td>
<td></td>
</tr>
<tr>
<td>SUB</td>
<td>US</td>
<td></td>
</tr>
<tr>
<td>ROP,-</td>
<td>PZ,A,A</td>
<td></td>
</tr>
</tbody>
</table>
* FORM AND STORE FREQUENCY

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RXT</td>
<td>PZ, Q</td>
</tr>
<tr>
<td>LDA</td>
<td>FREQXPT</td>
</tr>
<tr>
<td>STA</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>DVI</td>
<td>TENM</td>
</tr>
<tr>
<td>STA</td>
<td>TENSM</td>
</tr>
<tr>
<td>MUI</td>
<td>TENM</td>
</tr>
<tr>
<td>ROP,-</td>
<td>PZ, A,A</td>
</tr>
<tr>
<td>ADD</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>DVI</td>
<td>ONEM</td>
</tr>
<tr>
<td>STA</td>
<td>ONESM</td>
</tr>
<tr>
<td>MUI</td>
<td>ONEM</td>
</tr>
<tr>
<td>ROP,-</td>
<td>PZ, A,A</td>
</tr>
<tr>
<td>ADD</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>STA</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>DVI</td>
<td>HUNK</td>
</tr>
<tr>
<td>STA</td>
<td>HUNK</td>
</tr>
<tr>
<td>MUI</td>
<td>HUNK</td>
</tr>
<tr>
<td>ROP,-</td>
<td>PZ, A,A</td>
</tr>
<tr>
<td>ADD</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>STA</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>DVI</td>
<td>TENK</td>
</tr>
<tr>
<td>STA</td>
<td>TENSK</td>
</tr>
<tr>
<td>MUI</td>
<td>TENK</td>
</tr>
<tr>
<td>ROP,-</td>
<td>PZ, A,A</td>
</tr>
<tr>
<td>ADD</td>
<td>FRTTEMP</td>
</tr>
<tr>
<td>DVI</td>
<td>FIVEK</td>
</tr>
<tr>
<td>STA</td>
<td>FIVESK</td>
</tr>
<tr>
<td>LDA</td>
<td>TENSM</td>
</tr>
<tr>
<td>ALS</td>
<td>4</td>
</tr>
<tr>
<td>ADD</td>
<td>ONESM</td>
</tr>
<tr>
<td>STA</td>
<td>IHEDGER+10</td>
</tr>
<tr>
<td>LDA</td>
<td>HUNK</td>
</tr>
<tr>
<td>ALS</td>
<td>4</td>
</tr>
<tr>
<td>ADD</td>
<td>TENSK</td>
</tr>
<tr>
<td>ALS</td>
<td>1</td>
</tr>
</tbody>
</table>
APPENDIX II - TEST PROGRAM LISTING (U)

PROGRAM TEST 95
COMMON /DATA/ ICDC(7000)
COMMON /IND REC/ LHEADER(15), LDATA(2216)
COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 M, MSIZE, INITIME, MDROP, PRF, MRCVRWRD, LENHEADS, MSTART,
2 NPRINT, NREC
CALL TEST DATA
DO 18 J=1,96
DO 16 INT NO = 1, IPERREC
   DO 14 IBINNO = 1, IBINMAX
      DO 12 IBINWRD=1,NCPB
         L = IBINWRD + NCPB * IBINNO - NCPB + INTNO * IBINMAX
         * NCPB = IBINMAX * NCPB
         LDATA(L) = ICDC(M+LENHEADS)
      M=M+1
   12 CONTINUE
   14 CONTINUE
   M = M + MDROP * 3
   IF (M .GE. MSIZE ) M=1
16 CONTINUE
C PRINT FIRST 6 BINS OF EACH OUTPUT RECORD
   PRINT 101, (LDATA(I), I=1,18)
101 FORMAT (18(1X, I6))
18 CONTINUE
   PRINT 102
102 FORMAT (* START DUMP LAST RECORD*)
   PRINT 101, (LDATA(K), K=1,2150)
END
SUBROUTINE TEST DATA
COMMON /DATA/ IHD(4), ICDC(3,48,48)
COMMON /USE/ ISIZE, IPERREC, INTCOUNT, IBINMAX, NCPB, IRCHECK,
1 M, MSIZE, INITIME, MDROP, PRF, MRCVRWRD, LENHEADS, MSTART,
A-25
(Following page blank)