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Project Report

PA-229-10
(RSP)

Data Reduction Program Documentation
ALCPOD

(Effective: May 1971)

C. R. Berndtson
R. H. French
D. E. Nessman

19686

24 May 1971

Prepared for the Advanced Research Projects Agency,
the Department of the Army, and the Department of the Air Force
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DATA REDUCTION PROGRAM DOCUMENTATION ALCPØD

(EFFECTIVE: MAY 1971)

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C. R. BERNDTSON

~~Group 92~~

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Editors

14 PA-229-10

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11 24 MAY 1971

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FOREWORD

This is the tenth report in the Data Reduction Program Documentation series. It is dated according to the date of completion of the documentation. No implication is made that this program will not subsequently be modified, amended, or superseded; on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been reached.

The preparation of reports in this series is under the Editorship of Charles R. Berndtson of Lincoln, and of D. Nessman and R. French of Philco-Ford Corporation. Inquiries, suggestions, corrections, criticisms, and requests for additional copies should be directed to C. R. Berndtson.

The principal contributor to this report was G. L. Shapiro (Philco-Ford). Due to the intricate, evolutionary manner in which the programs came into being, the editors regret that it is in general impossible to give due credit to all -- mathematicians or radar analysts or programmers -- who contributed to the definition and writing of the programs.

Alan A. Grometstein

Alan A. Grometstein

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COMMON SYMBOLS AND ABBREVIATIONS

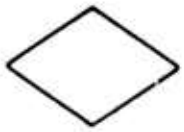
(The units given for certain quantities are the units commonly used for those quantities, unless otherwise noted.)

ADT	ALCOR Data Tape
ALCOR	ARPA-Lincoln C-band Observables Radar
ALTAIR	ARPA Long-Range Tracking and Instrumentation Radar
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
c	Speed of Light
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR frequency, 5664 MHz (NB) and 5667 MHz (WB)
DBLT	Wide Band Pulse Doublet
El	Elevation (deg)
EOF	End of File
GMT	Greenwich Mean Time
h	Hours
Hz	Hertz
IF	Intermediate Frequency
in	Inches
LC	Left Circular Polarization
lsb	Least Significant Bit
min	Minutes
NB	Narrow Band
NRTPOD	Non-real Time Precision Orbit Determination Program
POD	Project PRESS Operation and Data Summary Report
Phase	Presented in deg
PRF	Pulse Repetition Frequency (pps)
PRI	Pulse Repetition Interval (s)
pps	Pulses per second
pts	Points

R	Range (km)
$\dot{R}$	Range Rate (km/s)
rad	Radians
RC	Right Circular Polarization
RCS	Radar Cross Section (dbsm)
RF	Radio Frequency
s	Seconds
SD_w	Standard Deviation of Wake Velocity
SDBLT	Wide Band Slaved Pulse Doublet
S/N	Signal-to-noise Ratio
T	Time
TAL	Time After Launch (s)
UHF	ALTAIR Frequency; 415 MHz
V	Velocity
V_d	Doppler Velocity
V_w	Mean Wake Velocity
VHF	ALTAIR Frequency; 155.5 MHz
WB	Wide Band
WBS	Wide Band Slaved
WTR	Western Test Range
θ	Total Off-axis Angle (deg)
λ	Wavelength
*	Denotes Multiplication

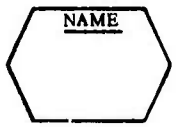
FLOW DIAGRAM SYMBOLS

PROCESS, ANNOTATION



DECISION

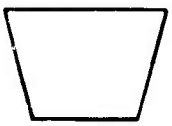
TERMINATOR



SUBROUTINE: where NAME is the entry call into the subroutine

CONNECTOR: where P specifies a page in the flow diagram, and L designates a statement number in the program listing or a reference point in the flow diagram

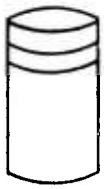
CONNECTOR: where X implies a continuation of the diagram to the next page



INPUT/OUTPUT OPERATION

MAGNETIC TAPE

PUNCHED CARD



DISK

ALCPOD

1. PURPOSE AND UTILIZATION

A. Source of Data

ALCOR[1]

B. Data Input

ALCOR Data Tape (ADT)

C. Description

ALCPOD is designed to produce punched card metric data on hard body radar targets in a format suitable for input to ~~NRTPOD~~. The data are ultimately used to obtain a ~~β~~ Beta profile. ALCPOD is normally run every 0.1 s without smoothing.

D. Output

1. A listing of all computed quantities.
2. Punched cards containing corrected R, Az, and El in a format suitable for input to NRTPOD. (Optional: smoothed $\dot{R}$.)

NRTPOD (non-real time precision orbit determination program).

from page 1

II. DESCRIPTION

ALCPOD produces punched metric data for input to NRTPOD. The program processes either ~~NB~~ narrowband or ~~WB~~ wideband tapes, and uses only primary pulses. The time between cards is determined by NSKIP, the number of primary pulses between output samples. Therefore, the sampling rate changes as the PRF changes.

GMT (h, min, s) is derived from one of three sources:

a. The transmitted pulse time (accurate to 10 μs) from tape.

b. Calculated time using the PRI and the received time of the initial pulse (accurate to 1 ms).

c. The received pulse time (accurate to 1 ms) from tape.

R, Az, and El are corrected as follows:

$$R = IRANGE + TRBIAS + TTCOR + RRCOR - RCORF$$

$$Az = IAZ + AZBIAS$$

$$El = IEL + ELBIAS - ECORF$$

where

IRANGE is uncorrected R

TRBIAS is range bias

TTCOR (transmit time correction) = $R\dot{R}/c$

RRCOR is range doppler coupling correction

RCORF is tropospheric refraction correction

IAZ is Az encoder angle

AZBIAS is Az bias (Calibration Record Word 602)

IEL is El encoder angle

ELBIAS is El bias (Calibration Record Word 603)

ECORF is tropospheric refraction correction

$\dot{R}$, if requested, is computed:

$$\dot{R}(t) = \frac{12 \sum_{n=1}^{N} [nR(t + n\Delta t) - nR(t - n\Delta t)]}{(\Delta t)(2N + 1)[(2N + 1)^2 - 1]}$$

where

$\dot{R}(t)$ = Range rate at time t

N = No. of points in a half interval

$R(t + n\Delta t)$ = Range at time $(t + n\Delta t)$

Δt = time between consecutive range samples; i.e. 1/(primary pulse PRF)

Before processing, the main program checks that ITBAND (tape) = IBAND (input). This determines that if WB data is requested, WB data exists on the tape requested.

III. OPERATION

A. Input

Waveform

Time of pulse option

$\dot{R}$ option

No. of pulses in smoothing half interval

Skip interval (pulses)

First and last pulse nos. of processing intervals

No. of processing intervals

A sample input is shown in Appendix A.

CARD 1 (5I5, 2X, A3)

(Col.)		
1- 5	NBAND	0 = NB; 1 = WB
6-10	ITLUSE#	0 = transmitted pulse time accurate to 10 μs (0) 1 = calculated pulse time accurate to 1 ms 2 = received pulse time accurate to 1 ms
11-15	NVALS	No. of processing intervals
16-20	NINT#	0 = $\dot{R}$ on cards (0) 1 = no $\dot{R}$ on cards
21-25	NSMTH#	No. of pulses in smoothing half interval (5)
28-30	TITL#	3 character title (ALC)

CARD 2 (6I10)

(Col.)		
1-10	NSTART(1)	First pulse no. of initial processing interval
11-20	NSTOP(1)	Last pulse no. of initial processing interval
21-30	NSKIP(1)	No. of pulses to skip between each output card
31-40	NSTART(2)	First pulse no. of second processing interval

---

#If left blank, program sets to indicated value.

(Col.)		
41-50	NSTOP(2)	Last pulse no. of second processing interval
51-60	NSKIP(2)	No. of pulses to skip between each output card

Repeat card 2 as necessary.

B. Output

LISTING

Selected input parameters

GMT h, min, s, and ms

R, $\dot{R}$, Az, El, and pulse no.

PUNCHED CARDS

Radar identification (A3)	
Year	(3X, I2)
Month	(I2)
Day	(I2)
h	(I2)
min	(I2)
s	(I2)
fraction of second (I3, 3X) or (I5, 1X)#	
Orbit no. (I1)	
Az	(F8.3)
El	(4X, F8.3)
R	(4X, F12.4)
$\dot{R}$ (if requested)	(5X, F8.5)

Sample outputs are given in Appendix B.

(I5, 1X) if ITLUSE = 0; (I3, 3X) if ITLUSE = 1 or 2

IV. PROGRAM LIMITATIONS

NVALS	$\leq$ 50 processing intervals
Length of run	If $\dot{R}$ is desired, no. of pulses $\leq$ 4000 If $\dot{R}$ is not desired, no limit

If $\dot{R}$ is requested (NINT = 0), a processing interval should not contain a PRF change. Program processes primary pulses only.

V. PROGRAMMING

A. ALCPOD (see Appendices C and D.)

ALCPOD is the control section of ALCPOD. ALCPOD reads the input cards, calls READJS and UNPACK, and punches the desired metric data.

B. HEDADT (see Appendix E.)

Subroutine HEDADT unpacks the ADT header record which contains bandwidth, reel no., WTR no., data of mission, and mission designator. The call statement is HEDADT [ISIG,# INBUF(1), IEQM(1)]

INPUT

INBUF(1)	First word in the ADT header record##

OUTPUT

IEQM(1)	IZBAND	(bandwidth: 1=WB, 0=NB)
IEQM(2)	ITREEL	(reel no.)
IEQM(3)	ITWTR	(WTR no.)
IEQM(4)	IMTH	
IEQM(5)	IDAY	(Date of test)
IEQM(6)	IYR	
IEQM(7-9)	ITDESG	(mission designator)

C. UNPACK (see Appendix F.)[2]

Subroutine UNPACK unpacks the raw data from the ADT, and translates it into a format usable by the IBM 360/67 computer.

#Not used.

##INBUF(2) to INBUF (1803) contain the remaining words in the record.

D. READJS[2]

The first call to subroutine READJS opens the file and reads the ADT header record. The second call to READJS reads the ADT calibration record and stores the values in a buffer area. ALCPOD extracts the individual calibration values it requires. Each subsequent call to READJS reads an ADT data record consisting of eight ALCOR pulses.

E. TIMDP (see Appendix G.)

TIMDP converts GMT total s to h, min, s, and μs.

The call statement is TIMDP (TIME, IHR, MIN, ISEC, IFRAC).

INPUT

TIME	Time of pulse transmission (GMT total seconds in double precision)

OUTPUT

IHR	Hours
MIN	Minutes
ISEC	Seconds
IFRAC	μs

F. SMOOTH (see Appendix H.)

Subroutine SMOOTH computes $\dot{R}$ using the original R and T.

The call statement is SMOOTH (N, L, X, NO, ZH).

INPUT

N	No. of points in smoothing half interval
L	No. of pulses within all processing intervals
X	Array of Ranges

NO Code specifying operation desired. Set to zero to obtain $\dot{R}$.

ZH Time (s) between range samples (1/primary pulse PRF)

STORED IN COMMON

RR Array of $\dot{R}$

G. DREFC (see Appendix J.)

The tropospheric refraction correction subroutine, DREFC, is based on tropospheric refraction tables in PPP-36.[3] A modified version of this subroutine is now in use. DREFC is the same as REFC except that the values or constants are defined as double precision words.

The call statement is DREFC (E, R, DEE, DRR).

E = Uncorrected El (must be between 0° and 90°)

R = Uncorrected R (km)

DEE = El tropospheric correction

DRR = R tropospheric correction (km)

The corrected values to be computed after exiting from the DREFC subroutine are:

El = E-DEE

R(km) = R-DRR

REFERENCES

1. "ALCOR Data Users Manual", LM-86, Lincoln Laboratory, M.I.T. (17 June 1970), UNCLASSIFIED.

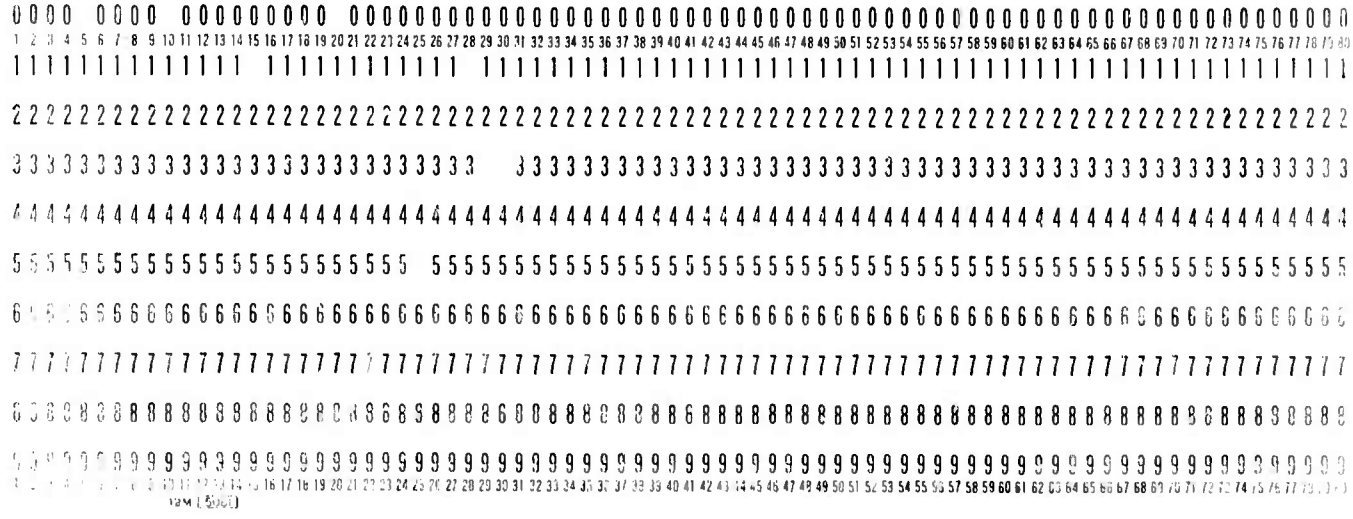
2. "Data Reduction Program Documentation, ALCOR Tape Read Package, (Effective: April 1971)", PA-229-7, Lincoln Laboratory, M.I.T. (26 April 1971), UNCLASSIFIED.

3. J. P. Penhune, "Refraction Corrections for the TRADEX Radar", PPP-36 Lincoln Laboratory, M.I.T. (21 April 1965), UNCLASSIFIED.

APPENDIX A
ALCPOD INPUT

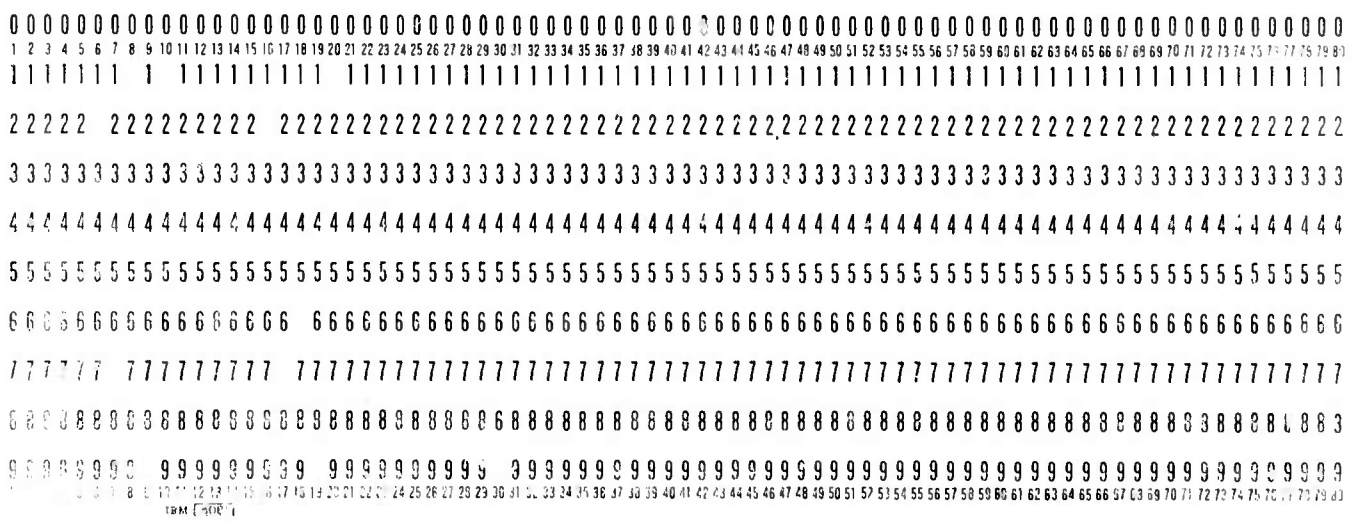
0 0 1 0 5 ALC

CARD 1



27191 27691 9

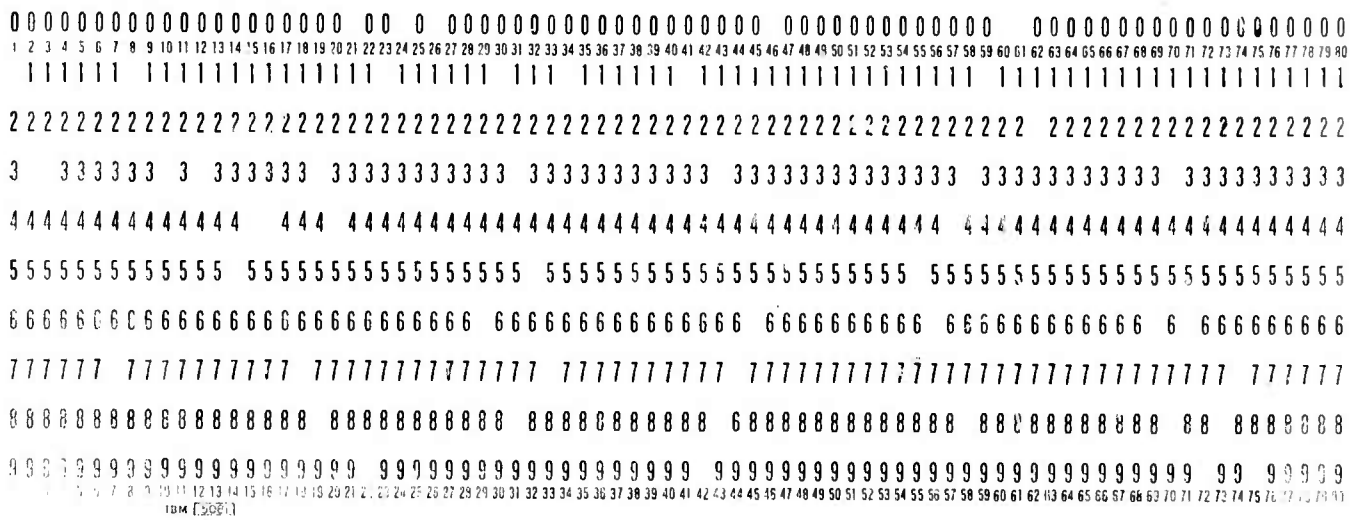
CARD 2



APPENDIX B
ALCPOD OUTPUTS

```
POD-ALCOR   POLAR = LC    BAND = NB    REEL NO. =     2   TITLE = ALC    DATE =  3/ 3/71
     ITLOSE =   0

 START   STOP   SKIP          START   STOP   SKIP          START   STOP   SKIP          START   STOP   SKIP
 27191  27691      9

ITLUSE = 0 : USE GMT AS COMPUTED BY DOUBLE PREC.WORDS ON TAPE ((TR-TT)/2)
ITLUSE = 1 : USE GMT AS COMPUTED BYPROGRAM AS A FUNCTION OF PRF (TIME OF RECEPTION)
ITLUSE = 2 : USE GMT AS COMPUTED BY REGULAR GMT WORDS (TIME OF RECEPTION)


NINT = 0 (SMOOTHING IS TO OCCUR)
NO. OF POINTS ON EACH SIDE OF INTERPOLATED POINT =     5

READY TO SMOOTH    501   POINTS WITH A DELTA TIME(SEC) =  0.010  THEN PUNCH EVERY     10

TITLE    DATE H M S  MS      AZI(DEG)     ELI(DEG)       RANGE(KM)   ROOT(KM/S)

ALC    71 3 3 544 7.30910 0  61.560       19.748        564.7701      0.00017     27191
ALC    71 3 3 544 7.40910 0  61.571       19.760        564.1002     -6.69879     27201
ALC    71 3 3 544 7.50910 0  61.576       19.762        563.4317     -6.68640     27211
ALC    71 3 3 544 7.60910 0  61.587       19.768        562.7504     -6.71191     27221
ALC    71 3 3 544 7.70909 0  61.595       19.768        562.0908     -6.69662     27231
ALC    71 3 3 544 7.80909 0  61.604       19.771        561.4219     -6.69025     27241
ALC    71 3 3 544 7.90909 0  61.606       19.773        560.7525     -6.69463     27251
ALC    71 3 3 544 8.  909 0  61.609       19.782        560.0829     -6.69636     27261
ALC    71 3 3 544 8.10908 0  61.612       19.784        559.4137     -6.69297     27271
ALC    71 3 3 544 8.20908 0  61.615       19.790        558.7438     -6.69912     27281
ALC    71 3 3 544 8.30908 0  61.620       19.793        558.0742     -6.69620     27291
ALC    71 3 3 544 8.40908 0  61.623       19.795        557.4044     -6.69765     27301
ALC    71 3 3 544 8.50907 0  61.626       19.801        556.7347     -6.69745     27311
ALC    71 3 3 544 8.60907 0  61.628       19.804        556.0646     -6.70117     27321
ALC    71 3 3 544 8.70907 0  61.631       19.806        555.3947     -6.69925     27331
ALC    71 3 3 544 8.80907 0  61.634       19.815        554.7248     -6.69947     27341
ALC    71 3 3 544 8.90907 0  61.637       19.817        554.0548     -6.69996     27351
ALC    71 3 3 544 9.  906 0  61.642       19.826        553.3846     -6.70181     27361
ALC    71 3 3 544 9.10906 0  61.648       19.828        552.7147     -6.69980     27371
ALC    71 3 3 544 9.20906 0  61.648       19.837        552.0448     -6.69852     27381
ALC    71 3 3 544 9.30906 0  61.650       19.839        551.3747     -6.70182     27391
ALC    71 3 3 544 9.40905 0  61.659       19.845        550.7046     -6.70105     27401
ALC    71 3 3 544 9.50905 0  61.661       19.848        550.0344     -6.70179     27411
ALC    71 3 3 544 9.60905 0  61.664       19.850        549.3641     -6.70333     27421
ALC    71 3 3 544 9.70905 0  61.670       19.856        548.6939     -6.70243     27431
ALC    71 3 3 544 9.80904 0  61.672       19.862        548.0236     -6.70257     27441
ALC    71 3 3 544 9.90904 0  61.678       19.867        547.3531     -6.70484     27451
ALC    71 3 3 54410.  904 0  61.683       19.873        546.6828     -6.70332     27461
ALC    71 3 3 54410.10904 0  61.692       19.881        546.0125     -6.70382     27471
ALC    71 3 3 54410.20904 0  61.694       19.884        545.3415     -6.70907     27481
ALC    71 3 3 54410.30903 0  61.697       19.889        544.5710     -6.70542     27491
ALC    71 3 3 54410.40903 0  61.703       19.892        544.0005     -6.70482     27501
ALC    71 3 3 54410.50903 0  61.708       19.897        543.3300     -6.70529     27511
ALC    71 3 3 54410.60903 0  61.714       19.903        542.6587     -6.71180     27521
ALC    71 3 3 54410.70902 0  61.716       19.906        541.9881     -6.70636     27531
ALC    71 3 3 54410.80902 0  61.719       19.911        541.3177     -6.70463     27541
ALC    71 3 3 54410.90902 0  61.725       19.914        540.6470     -6.70724     27551
ALC    71 3 3 54411.  902 0  61.730       19.922        539.9763     -6.70721     27561
ALC    71 3 3 54411.10901 0  61.735       19.925        539.3056     -6.70743     27571
ALC    71 3 3 54411.20901 0  61.738       19.930        538.6348     -6.70739     27581
ALC    71 3 3 54411.30901 0  61.741       19.936        537.9641     -6.70793     27591
ALC    71 3 3 54411.40901 0  61.746       19.939        537.2932     -6.70872     27601
ALC    71 3 3 54411.50900 0  61.752       19.944        536.6224     -6.70855     27611
```

ALC 71 3 3 544 7.40910 0 61.571 19.760 564.1002 -6.69879



APPENDIX C
ALCPOD PROGRAM LISTING

```
      DOUBLE PRECISION RDOT,DTRB,RANGE,TTCOR,DRRUSE,RRCOR,ZZ,XAZ,DAZB,
     1ZL,XEL,DELB,RNGF,ELVF,RADEL,ECORF,RCORF,XDPTIM
      REAL*8 RANG,RR
      DIMENSION IYEAR(4000),MONTH(4000) ,IDAY(4000),IHOUR(4000),
     1 MIN(4000),ISEC1(4000),ISEC2(4000),              AZ(4000),EL(4000),
     2 RANG(4000),RR(4000),ISPRI(4000)
      DIMENSION NSTART(50),NSTOP(50),NSKIP(50)
      DIMENSION XATBL(128),QBIAS(8),IPRS(8),IADD(8)
      DIMENSION XNBUF(1803),PIFA(16),OIFA(16),          XKPCS(5)
      DIMENSION IEQM(9),ITDESG(3)
C
      COMMON RR
      COMMON/ICOM/INPUF(1803),IAZ,IEL,INDEX,IPPRCS,IORS,IRANGE,IPKPWR,IR
     1DOT,IALT,INDAZ,JNDAZ,INDEL,IRB54,IRB85,IOPRCS,I240B1,I240B2,I240B3
     1,I241B1,I241B2,I241B3,XPPAGC,IBETA,NEWA,IBAND,NSW,RBIAS(8),ISVPRI,
     1IHRS,IMIN,ISEC,IMSEC,ISTAT(21),TRBIAS,ISTAT1,ISTAT2,ISTAT3,ISTAT4,
     1IALSW,ISTSW,NBWB,ISIGNC,I27B12,JCON,NBEG,NEND,ITST,NUMPRI,XOPAGC,
     1ITBAND,ITAPNC,IPRF,IPOLAR,ISSERR,PIFA,CIFA,PFSA,OFSA,PSSA,CSSA,
     1PSSL,OSSL,ICCDF,I273B5,I273B6,I273B7,I273B8,IMOVP,IMCVC,IOFFST,
     1XDPTIM,ICAT(682)
C
      EQUIVALENCE(XNBUF(1),INBUF(1))
      EQUIVALENCE (IEQM(1),IZBAND),(IEQM(2),ITREEL),(IEQM(3),ITWTR),
     2(IEQM(4) ,ITMNTH),(IEQM(5),ITDAY),(IEQM(6),ITYEAR),
     3(IEQM(7),ITDESG(1))
C
      DATA ZLC/'LC  '/,ZRC/'RC  '/,ZWB/'WB  '/,ZNB/'NB  '/ ,NTCT/0/
      DATA          IFRST3/0/,IFRST4/0/,INTAV/1/,IFRST2/0/
      DATA ALC/'ALC'/,ION/1/,IZERO/0/,IFRST1/0/,IMSAVE/0/,BLNKK/'    '/
      DATA IPRS/200,160,100,80,50,40,25,20/
      DATA IADD/10,13,10,13,20,25,40,50/
C
C        IPOLAR = 0 LEFT CIRCULAR DATA REQUESTED
C        IPOLAR = 1 RIGHT CIRCULAR DATA REQUESTED
C        NBAND = 0  NARROW BAND DATA REQUESTED
C        NBAND = 1  WIDE BAND DATA REQUESTED
C        ITLUSE = 0   USE GMT AS COMPUTED BY DOUB.PREC.TP.WD.((TR-TT)/2)
C        ITLUSE = 1   USE GMT AS COMPUTED BY PRF IN PROGRAM (TR)
C        ITLUSE = 2   USE GMT AS COMPUTED BY REGULAR GMT WCRDS  (TR)
C        NEWA = 0   MISSION FLOWN BEFORE 15 OCT 70 (OLD ATTN.)
C        NEWA = 1   MISSION FLOWN AFTER  15 OCT 70 (NEW ATTN.)
C        NINT = 0 SMOOTHING IS DONE
C        NINT = 1 NO SMOOTHING
C
      READ(5,1)NBAND,ITLUSE,NVALS,NINT,NSMOO1,TITL,
     2(NSTART(I),NSTOP(I),NSKIP(I),I=1,NVALS)
    1 FORMAT(5I5,       2X,A3/(6I10))
      IF(NSMOO1.LE.0)NSMOO1=5
```

```
      NSMOO=NSMOO1
      MSVE=NSKIP(1)
      IF(TITL.NE.BLNKK)ALC=TITL
      NSW=ITLUSE
C
      IEOF=0
      IERR=0
      CALL READJS(INPUF,IEOF,IERR)
      ISIG=1
      CALL HEDADT (ISIG,INBUF(1),IEOM(1))
      ITBAND=IZBAND
      NEWA=0
      IF(ITYEAR.GT.70)GO TO 282
      IF(ITYEAR.LT.70)GO TO 283
      IF(ITMNTH.GT.10)GO TO 282
      IF(ITMNTH.LT.10)GO TO 283
      IF(ITDAY.LT.15)GO TO 283
  282 NEWA=1
  283 CONTINUE
      IERR=0
      CALL READJS(INPUF,IEOF,IERR)
C
C        STORE THE DESIRED CALIBRATION VALUES
C
      N=0
      DO 20 K=256,383
      N=N+1
   20 XATBL(N)=XNBUF(K)
C
      N=0
      DO 22 K=512,527
      N=N+1
   22 PIFA(N)=XNBUF(K)
      N=0
      DO 23 K=528,543
      N=N+1
   23 OIFA(N)=XNBUF(K)
C
      PFSA=XNBUF(592)
      PSSA=XNBUF(593)
      OFSA=XNBUF(594)
      OSSA=XNBUF(595)
C
      ABIAS=XNBUF(602)
      EBIAS=XNBUF(603)
      DEGCON=(180.*.0479369)/3141.59
      AZBIAS=DEGCON*ABIAS
      ELBIAS=DEGCON*EBIAS
C
      N=0
      DO 25 K=604,611
      N=N+1
      QBIAS(N)=XNBUF(K)
   25 RBIAS(N)=QBIAS(N)
C
      PWRCN=XNBUF(620)
      PWRSN=XNBUF(621)
```

```
      PWRCW=XNBUF(627)
      PWRSW=XNBUF(628)
C
      N=0
      DO 27 K=624,628
      N=N+1
   27 XKRCS(N)=XNBUF(K)
C
      PSSL=XNBUF(629)
      OSSL=XNBUF(630)
C
      JCCN=-1
      INDEX=0
      ITST=1
      ITDEC=1
      IPOLAR=0
      ITCNT=0
      JJ=0
      IPULS=0
C
      DO 120 IJ=1,NVALS
      NBEG=NSTART(IJ)
C
      NNSET=NSKIP(IJ)+1
      IF(NINT.EQ.0)NNSET=1
C
    3 JCCN=JCCN+1
      IF(JCCN.EQ.9.OR.JCCN.EQ.0)GO TO 97
      INDEX=(JCCN-1)*900
      GO TO 99
   97 JCCN=1
      INDEX=0
   98 IEOF=0
      IERR=0
      CALL READJS(INBUF,IEOF,IERR)
      IF(IERR.EQ.1)GO TO 103
   99 CALL UNPACK
      IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 620
      IF(ITLUSE.NE.0)GO TO 100
      CALL TIMCP(XCPTIM,IHRS,IMIN,ISEC,IMSEC)
  100 CONTINUE
      IF(IFRST2.EQ.1)GO TO 92
      ZBAN=ZNB
      IF(ITBAND.EQ.1)ZBAN=ZWB
      ZPOL=ZLC
      IF(IPOLAR.EQ.1)ZPOL=ZRC
      RRUSE=-.00943
      IF(ITBAND.EQ.1)RRUSE=-.000115
C
      WRITE(6,200)ZPOL,ZBAN,ITREEL,TITL,(IEQM(I),I=4,6)
  200 FORMAT('1POD-ALCOR   POLAR = ',A2,4X,'BAND = ',A2,4X,'REEL NO. = '
     1,I5,'   TITLE = ',A4,'   DATE = ',I2,'/',I2,'/',I2)
      WRITE(6,208) ITLUSE
208   FORMAT('       ITLUSE = ',I3)
      WRITE(6,212)(NSTART(I),NSTOP(I),NSKIP(I),I=1,NVALS)
212   FORMAT('0 START   STOP   SKIP',10X,'START   STOP   SKIP',10X,
     1 'START   STOP   SKIP',10X,'START   STOP   SKIP'/
```

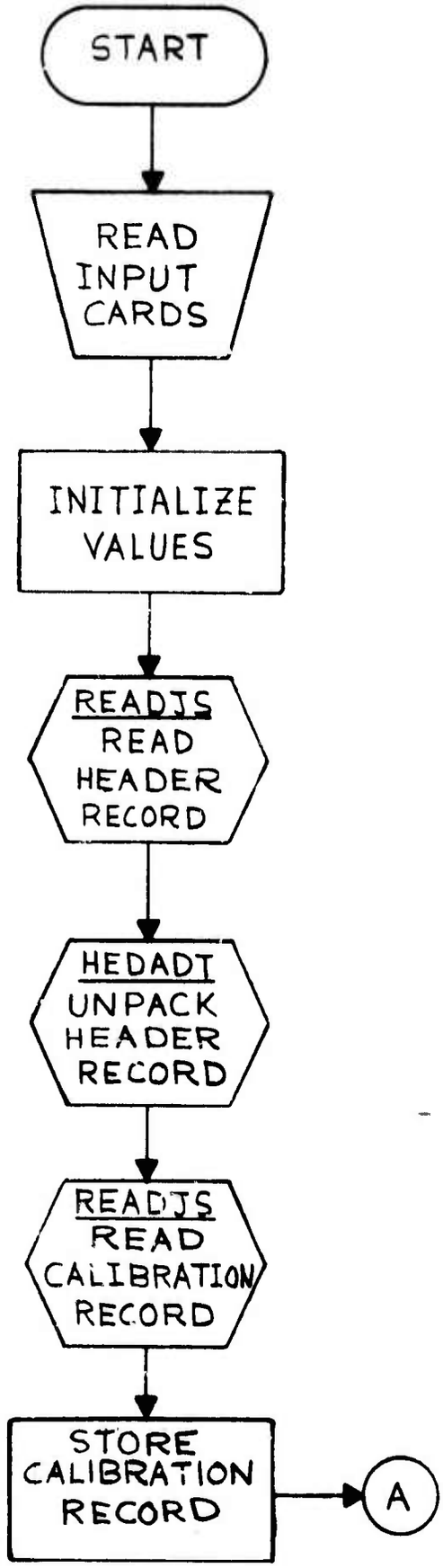
```
    2 (4(2X,I5,2X,I5,2X,I5,8X)))
      WRITE(6,201)
  201 FORMAT('0ITLUSE = 0 0 USE GMT AS COMPUTED BY DOUBLE PREC.WORDS ON
     1TAPE ((TR-TT)/2)            '/' ITLUSE = 1 0 USE GMT AS COMPUTED BY
     2PROGRAM AS A FUNCTION OF PRF (TIME OF RECEPTION)'/' ITLUSE = 2 0 U
     3SE GMT AS COMPUTED BY REGULAR GMT WORDS (TIME OF RECEPTION) '/)
      IF(NINT.NE.0)GO TO 218
      WRITE(6,214)      NSMOO
  214 FORMAT('0NINT = 0 (SMOOTHING IS TO OCCUR)'/ 1X,'NO. OF POINTS ON E
     1ACH SIDE OF INTERPOLATED POINT = ',I4)
  218 CONTINUE
C
      IF(NBAND.NE.ITBAND)GO TO 695
      IFRST2=1
   92 CONTINUE
      IF(ITLUSE.NE.1)GO TO 619
      IF(NUMPRI.LT.NSTART(IJ))GO TO 616
      IF(IFRST1.EQ.1)GO TO 617
      IADMS=0
      DO 612 K=1,8
  612 IF(IPRS(K).EQ.IPRF)IADMS=IADD(K)
      IF(IADMS.GT.0)GO TO 602
  599 WRITE(6,601)NUMPRI,IPRF
  601 FORMAT('0',12X,'UNKNOWN PRF',3X,'PRI. NO = ',I10,5X,'PRF = ',I5/)
      IF(NINT.EQ.0)GO TO 121
      GO TO 125
C
  602 IHNEXT=IHRS
      INNEXT=IMIN
      ISNEXT=ISEC
  584 IMNEXT=IMSEC +IADMS
C
      IF(IMNEXT.LT.1000)GO TO 585
      IMNEXT=IMNEXT-1000
      ISNEXT=ISNEXT+1
C
      IF(ISNEXT.LT.60)GO TO 585
      ISNEXT=ISNEXT-60
      INNEXT=INNEXT+1
C
      IF(INNEXT.LT.60)GO TO 585
      INNEXT=INNEXT-60
      IHNEXT=IHNEXT+1
C
  585 IFRST1=1
      GO TO 616
  617 IADMS=0
      DO 613 K=1,8
      IF(IPRS(K).EQ.IPRF)IADMS=IADD(K)
  613 CONTINUE
      IF(IADMS.LE.0)GO TO 599
  586 IHRS=IHNEXT
      IMIN=INNEXT
      ISEC=ISNEXT
      IMSEC=IMNEXT
      IMNEXT=IMSEC +IADMS
      IF(IMNEXT.LT.1000)GO TO 616
```

```
      IMNEXT=IMNEXT-1000
      ISNEXT=ISNEXT+1
C
      IF(ISNEXT.LT.60)GO TO 616
      ISNEXT=ISNEXT-60
      INNEXT=INNEXT+1
C
      IF(INNEXT.LT.60)GO TO 616
      INNEXT=INNEXT-60
      IHNEXT=IHNEXT+1
C
  616 CONTINUE
  619 CONTINUE
C
  620 IF(NUMPRI.LT.NSTART(IJ))GO TO 3
      IF(NUMPRI.GT.NSTART(IJ))GO TO 628
      IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 600
      GO TO 627
  600 NSTART(IJ)=NSTART(IJ)+1
      WRITE(6,6314)IJ,NSTART(IJ)
 6314 FORMAT('ONSTART(',I3,') HAS BEEN CHANGED TO ',I10)
      GO TO 3
  627 IPULS=0
      GO TO 10
  628 IF(ICODE.EQ.3.OR.ICODE.EQ.7.OR.ICODE.EQ.2)GO TO 118
      IPULS=IPULS+1
      IF(IPULS.NE.NNSET)GO TO 118
      IPULS=0
C
   10 CONTINUE
      IF(IFRST4.NE.0)GO TO 11
      DTIME=(1./FLOAT(IPRF))
      IFRST4=1
   11 RDOT=(DFLOAT(IPDOT)/(8192.0D+00))*14.989625D+00
      RZDT=RDOT/1000.
      DTRB=TRBIAS
      RANGE=(DFLOAT(IRANGE)/2048000.D+00)*14.989625D+00+DTRB*.1498962500
      IF(ITLUSE.NE.0)GO TO 663
      IDELTM=(RANGE/299776.D+00)*1.0D+06
      IMSEC=DFLOAT(IMSEC+IDELTM)/10.0D+00+.5D+00
      IF(IMSEC.LT.100000)GO TO 641
      IMSEC=IMSEC-100000
      ISEC=ISEC+1
      IF(ISEC.LT.60)GO TO 641
      ISEC=ISEC-60
      IMIN=IMIN+1
  641 CONTINUE
      GO TO 664
  663 TTCOR=(RANGE/299776.D+00)*(RDOT/1000.0D+00)
      RANGE=RANGE+TTCOR
  664 CONTINUE
      DRRUSE=RRUSE
      RRCOR=DRRUSE*RDOT
      RANGE=RANGE+RRCOR/1000.D+00
      ZZ=(DFLOAT(IAZ)*2.D+00*3141.5926535D+00)/(2.0D+00**17)
      XAZ=ZZ*.057295RD+00
      DAZB=AZBIAS
```

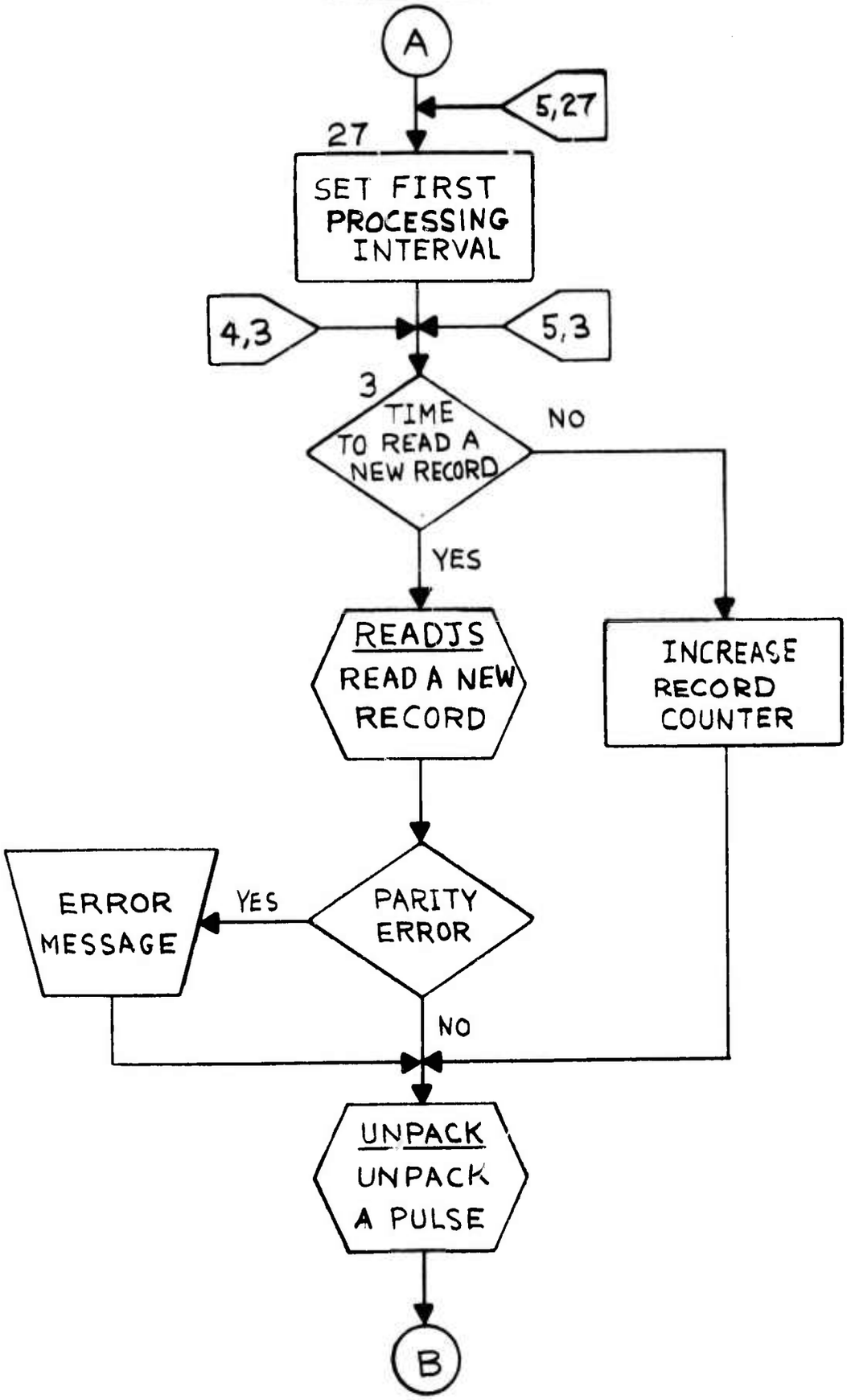
```
      XAZ=XAZ+DAZB
      ZL=(DFLOAT(IEL)*2.D+00*3141.5926535D+00)/(2.0D+00**17)
      XEL=ZL*.057295PD+00
      DELB=ELBIAS
      XEL=XEL+DELB
      CALL DREFC (XEL,RANGE,ECORF,RCORF)
      RNGF=RANGE-RCORF
      ELVF=XEL-ECORF
      RADEL=ELVF*.017453D+00
      RANGE=RNGF
C
      IF(NINT.EQ.0)ION=0
      IF(ION.EQ.1)WRITE(6,647)
  647 FORMAT('0TITLE   DATE H M S  MS      AZ(DEG)      EL(DEG)        RANG
     1E(KM)   RDOT(KM/S)'/)
      ION=0
      IF(NINT.NE.0)GO TO 681
      NTOT=NTOT+1
      IYEAR(NTOT)=ITYEAR
      MONTH(NTOT)=ITMNTH
      IDAY(NTOT)=ITDAY
      IHOUR(NTOT)=IHRS
      MIN(NTOT)=IMIN
      ISEC1(NTOT)=ISEC
      ISEC2(NTOT)=IMSEC
      AZ(NTOT)=XAZ
      EL(NTOT)=ELVF
      RANG(NTOT)=RNGF
      ISPRI(NTOT)=NUMPRI
      IF(NTOT.EQ.4000)GO TO 121
      GO TO 118
  681 IF(ITLOSE.NE.0)GO TO 117
      WRITE(6  ,645)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF,RZCT,NUMPRI
  645 FORMAT(1X,A3,3X,6I2,'.',I5,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
     1I10)
      WRITE(7  ,644)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF
  644 FORMAT(A3,3X,6I2,'.',I5,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5)
      GO TO 118
  117 WRITE(6  ,650)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF,RZCT,NUMPRI
  650 FORMAT(1X,A3,3X,6I2,'.',I3,1X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
     1 I10)
      WRITE(7  ,649)ALC,ITYEAR,ITMNTH,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
     1XAZ,ELVF,RNGF
  649 FORMAT(A3,3X,6I2,'.',I3,3X,I1,F8.3,4X,F8.3,4X,F12.4,5X,F8.5)
C
  118 IF(NUMPRI.LT.NSTOP(IJ))GO TO 3
      IPULS=0
      IFRST1=0
  119 IFRST3=0
  120 CONTINUE
C
  121 IF(NINT.NE.0)GO TO 125
      NUSE=MSVE+1
      WRITE(6,128)NTOT,DTIME,NUSE
```

```
  128 FORMAT('OREADY TO SMOOTH',I6,'   POINTS WITH A DELTA TIME(SEC) = '
     1,F6.3,'  THEN PUNCH EVERY ',I6)
      WRITE(6,647)
      NCARDS=NTOT
      CALL SMOOTH(NSMOO,NCARDS,RANG,0,DTIME)
      ITESS=-1
      DO 6 I=1,NCARDS
      ITESS=ITESS+1
      IF(ITLOSE.EQ.0)GO TO 704
      IF(MOD(ITESS,NUSE).NE.0)GO TO 6
      WRITE(6,650)ALC,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I),ISPRI(I)
      WRITE(7,649)ALC,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I)
      GO TO 6
  704 CONTINUE
      IF(MOD(ITESS,NUSE).NE.0)GO TO 6
      WRITE(6,645)ALC,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I),ISPRI(I)
      WRITE(7,644)ALC,IYEAR(I),MONTH(I),IDAY(I),IHOUR(I),MIN(I),ISEC1(I)
     1,ISEC2(I),IZERO,AZ(I),EL(I),RANG(I),RR(I)
    6 CONTINUE
C
      GO TO 125
  103 WRITE(6,107)NUMPRI
  107 FORMAT('OPARITY ERROR ON READ AFTER PRI = ',I10)
      GO TO 99
  680 WRITE(6,109)NUMPRI
  109 FORMAT(' END OF FILE REACHED LAST NUMPRI VALUE = ',I10)
      GO TO 125
  605 WRITE(6,114)NBAND,ITBAND
  114 FORMAT(' INPUT BAND= 'I10,'   BAND ON TAPE = 'I10)
  125 RETURN
      END
```

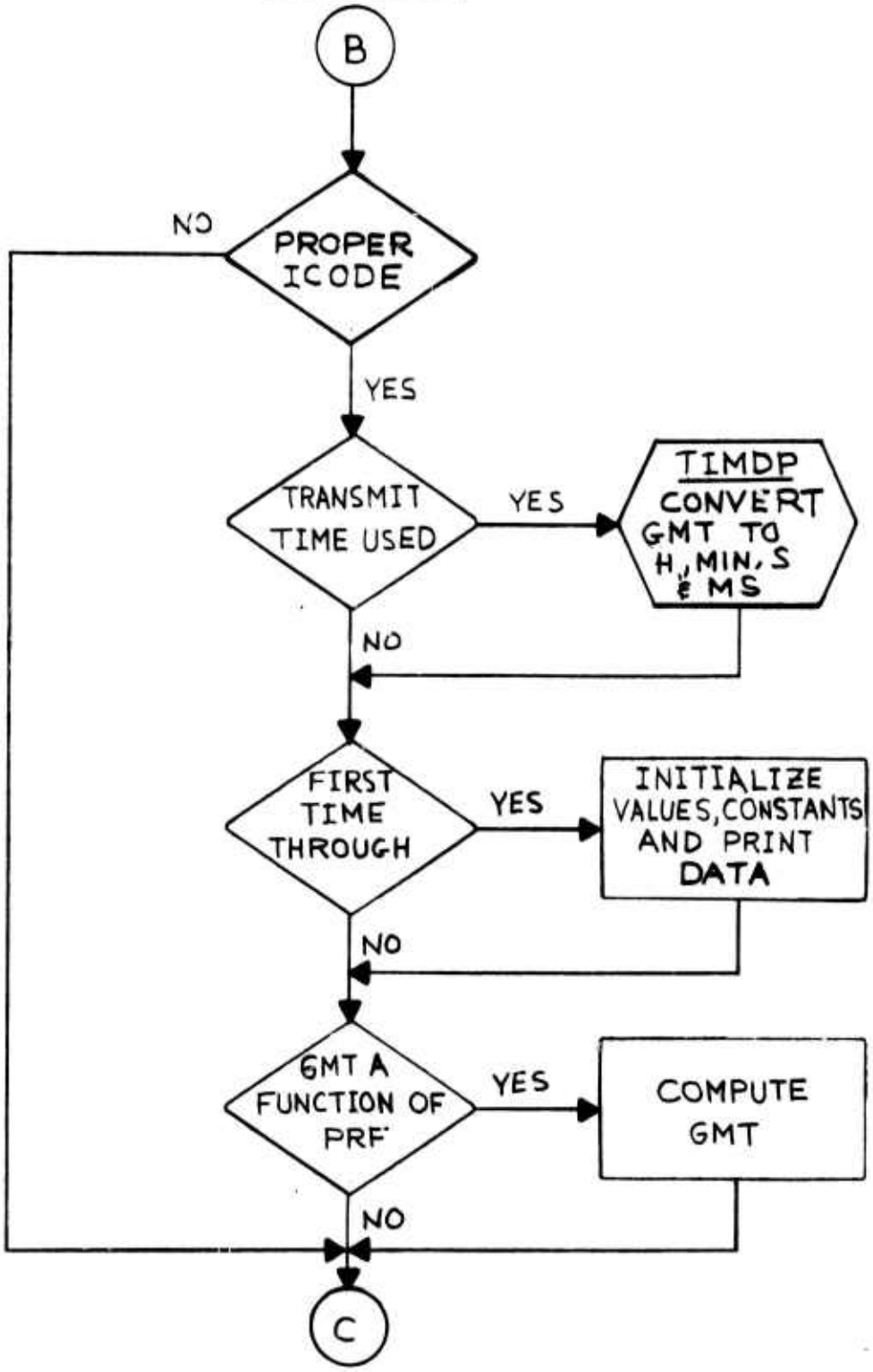
APPENDIX D
ALCPOD FLOW DIAGRAM



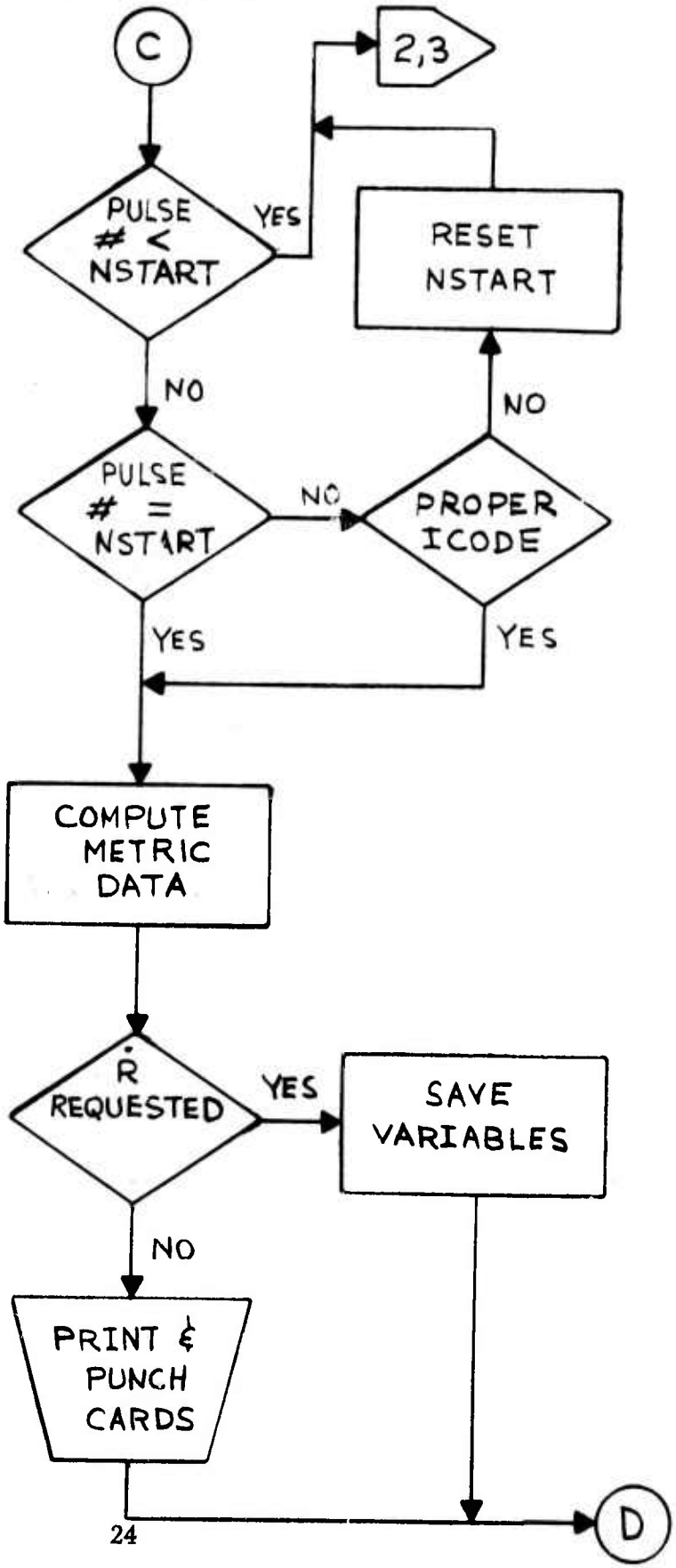
APPENDIX D-2


A
5,27
27
SET FIRST PROCESSING INTERVAL
4,3
5,3
3
TIME TO READ A NEW RECORD
NO
YES
READJS
READ A NEW RECORD
INCREASE RECORD COUNTER
ERROR MESSAGE
YES
PARITY ERROR
NO
UNPACK
UNPACK A PULSE
B

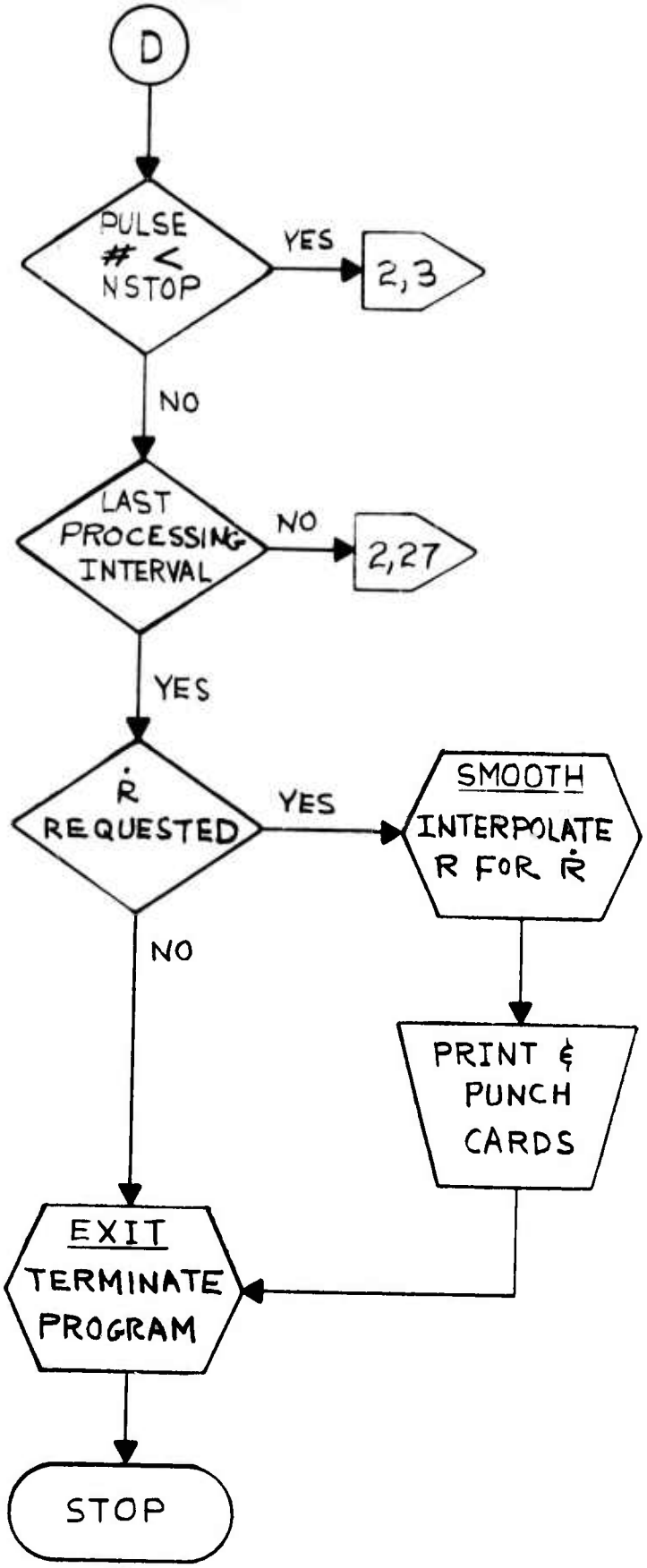
APPENDIX D-3


B
PROPER ICODE
NO
YES
TRANSMIT TIME USED
YES
TIMDP
CONVERT GMT TO H, MIN, S & MS
NO
FIRST TIME THROUGH
YES
INITIALIZE VALUES, CONSTANTS AND PRINT DATA
NO
GMT A FUNCTION OF PRF
YES
COMPUTE GMT
NO
C

APPENDIX D-4


C
2,3
PULSE # < NSTART
YES
RESET NSTART
NO
NO
PULSE # = NSTART
NO
PROPER ICODE
YES
YES
COMPUTE METRIC DATA
Ṙ REQUESTED
YES
SAVE VARIABLES
NO
PRINT & PUNCH CARDS
D

APPENDIX D-5


D
PULSE # < NSTOP
YES
2,3
NO
LAST PROCESSING INTERVAL
NO
2,27
YES
Ṙ REQUESTED
YES
SMOOTH
INTERPOLATE R FOR Ṙ
NO
PRINT & PUNCH CARDS
EXIT
TERMINATE PROGRAM
STOP

APPENDIX E
SUBROUTINE HEDADT PROGRAM LISTING

```
*                CALL HEDADT (ISIG,INBUF,IEQU)
*                ISIG = 1     UNPACK THE 20 WORD ADT HEADER
          START
          ENTRY HEDADT
          SPACE
XISIG     EQU   4
XICAL     EQU   5
XIEQU     EQU   6
BASE      EQU   12
          SPACE
HEDADT    SAVE  (14,12),T,*
          BALR  12,0
          USING *,BASE
          ST    13,SAVEA+4
          LA    7,SAVEA
          ST    7,8(0,13)
          LR    13,7
          SPACE
          LM    XISIG,XIEQU,0(1)
          SPACE
          L     8,0(XICAL)
          ST    8,TEMP1
          ST    8,TEMP2
          SRL   8,31
          ST    8,0(XIEQU)     MBAND
          L     8,TEMP1
          SLL   8,1
          SRL   8,25
          ST    8,4(XIEQU)     MREEL
          SPACE
          L     8,4(XICAL)
          ST    8,TEMP1
          ST    8,TEMP2
          SRL   8,16
          ST    8,8(XIEQU)     MWTR
          L     8,TEMP1
          SLL   8,16
          SRL   8,24
          ST    8,12(XIEQU)    MMNTH
          L     8,TEMP2
          SLL   8,24
          SRL   8,24
          ST    8,16(XIEQU)    MDAY
          SPACE
          SR    8,8
          IC    8,8(XICAL)
          ST    8,20(XIEQU)    MYEAR
          MVC   24(9,XIEQU),9(XICAL)     MISSION DES.
          SPACE
RETURN    L     13,SAVEA+4
          RETURN (14,12),T
          CNOP  0,4
TEMP1     DC    F'0'
TEMP2     DC    F'0'
SAVEA     DC    18A(*)
          END
```

APPENDIX F
SUBROUTINE UNPACK PROGRAM LISTING

```
         CSECT
         ENTRY UNPACK
UNPACK   SAVEL
         DROP  15
         CNOP  0,4
         BALR  2,0
         USING START,2,3
START    L     3,BASA
         L     4,DUBUF
         L     5,DUBUF
         L     6,DUBUF
         A     5,=F'4096'
         A     6,=F'8192'
         USING DBUF,4,5,6
         B     START1
DUBUF    DC    V(ICOM)
BASA     DC    A(START+4096)
START1   LA    B,INBUF   NUMPRI=8*(NPR-1)+JCON
         MVC   TEMP(3),0(B)
         MVC   TEMP2(3),0(B)
         L     9,TEMP
         SLL   9,8
         SRL   9,16
         S     9,ONE
         SR    8,8
         M     8,EIGHT
         A     9,JCON
         ST    9,NUMPRI
         L     9,NBEG
         C     9,NUMPRI
         BH    CDELTAR
         SPACE
         LA    B,WD273
         A     B,INDEX
         MVC   TEMP(3),0(B)
         L     9,TEMP
         N     9,=X'F0000000'
         SRL   9,28
         ST    9,ICODE                    COMPUTE THE CODE FOR PRI
         C     9,THREE                    SLAVED OR NOT
         BE    CDELTAR
         C     9,SEVEN
         BE    CDELTAR
         C     9,TWO
         BE    CDELTAR
         L     9,TEMP
         N     9,=X'08000000'
         SRL   9,27
         ST    9,I273B5                   WBS MODE INDICATOR
         L     9,TEMP
         N     9,=X'04000000'
         SRL   9,26
         ST    9,I273B6                   ENDO-EXO SCAN INDICATOR
         L     9,TEMP
         N     9,=X'02000000'
         SRL   9,25
         ST    9,I273B7                   WBS SCAN MODE INDICATOR
```

```
         SPACE
         L      9,TEMP
         N      9,=X'01000000'
         SRL    9,24
         ST     9,I273B8                  DOUBLET MODE INDICATOR
         L      9,TEMP
         N      9,=X'00100000'
         SRL    9,20
         ST     9,I27B12                  NB/WB INDICATOR
         SPACE
GOODI    LA     8,WD233  COMPUTE GMT
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'1FC00000'
         SRL    9,24
         ST     9,IHRS                     STORE HRS
         L      9,TEMP
         N      9,=X'003F0000'
         SRA    9,16
         ST     9,IMIN                     STORE MINS
         L      9,TEMP
         N      9,=X'00003F00'
         SRA    9,8
         ST     9,ISEC                     STORE SECS
         LA     8,WD234
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'7FE00000'
         SRL    9,21
         ST     9,IMSEC                    STORE MSEC
         L      8,NSW
         C      8,ZERO
         BNE    S9
         SR     8,8
         SR     9,9
         LA     8,WD275
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      8,TEMP
         LA     9,WD276
         A      9,INDEX
         MVC    TEMP(3),0(9)
         L      9,TEMP
         SLL    9,1
         SLL    8,1
         SRL    8,9
         SRDL   8,6
         ST     9,FLMASK+4
         ST     8,FLMASK
         MVI    FLMASK,X'46'
         LD     0,FLMASK
         AD     0,DZERO
         STD    0,XDPTIM
         SPACE
S9       LA     8,WD264                   PRF CALCULATION
```

```
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         ST     9,WCRD64
         LA     8,WD273
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         ST     9,WCRD73
         L      9,WCRD64
         N      9,=X'FFFFE000'
         SRL    9,13
NZSTMP   ST     9,STEMP
         L      9,=F'10000000'
         SR     8,8
         D      8,STEMP
         ST     9,STEMP                    TRANSMITTED PRF
         SPACE
         L      9,INBUF
         SRL    9,31
         C      9,ZERO
         BNE    WBAND
         SPACE
         L      9,WCRD73                   IN NARROW BAND
         N      9,=X'01C00000'             BIT 8
         SRL    9,24
         C      9,ZERO
         BE     SLVDUB1
         SPACE
XDIV     L      8,FOUR                     IN DOUBLET MODE
XDIV1    ST     8,DIVSR
         B      NEWPRF
         SPACE
SLVDUB1  L      9,WCRD73
         N      9,=X'08C00000'             BIT 5
         SRL    9,27
         C      9,ZERO
         BE     NBNWBN
         B      XDIV                       IN SLAVED DOUBLET MODE
NBNWBN   L      9,WCRD73
         N      9,=X'00100000'             BIT 12
         SRL    9,20
         C      9,ZERO
         BE     NODIVS
         L      8,TWO
         B      XDIV1                      NB/WB E.O.P.
NODIVS   L      8,ONE
         B      XDIV1                      NB ONLY
         SPACE
WBAND    L      9,WCRD73
         N      9,=X'01C00000'             BIT 8
         SRL    9,24
         C      9,ZERO
         BNE    SLVDUB2
         L      8,TWO                      IN DOUBLET MODE
         B      XDIV1
SLVDUB2  L      9,WCRD73
```

```
         N      9,=X'08000000'          BIT 5
         SRL    9,27
         C      9,ZERO
         BNE    XDIV
         L      8,TWO                   IN SLAVED DOURLET MODE
         B      XDIV1
         SPACE                          WB ONLY
NEWPRF   SR     8,8
         L      9,STEMP
         D      8,DIVSR
         ST     9,IPRF
         SPACE
NEXTW    LA     8,WD237
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'7FFFC000'
         SRL    9,14
         ST     9,IAZ
         LA     8,WD236                 STORE A2
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'7FFFC000'
         SRL    9,14
         ST     9,IEL
GOCON    LA     8,WD265                 STORE ELEV
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFFFE000'
         SRL    9,13
         ST     9,TEMP2
         LA     8,WD267
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFFF0000'
         SRL    9,16
         A      9,TEMP2
         SRL    9,11
         ST     9,TEMP2
         LA     8,WD266
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFE00000'
         SRL    9,21
         A      9,TEMP2
         ST     9,IRANGE                STORE RANGE
         LA     8,WD115
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'00FFC000'
         SRA    9,16
         ST     9,IPKPWR                STORE PEAK POWER
```

```
         LA     8,WD269
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         C      9,=F'0'
         BNL    DOTG1
         N      9,=X'7FF5FF00'
         SRA    9,8
         LCR    9,9
         B      DOTG2
DOTG1    SRA    9,8
DOTG2    ST     9,IRDOT                    STORE R-DOT
         SPACE
         LA     8,WD117
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'FFC00000'
         SRL    9,24
         ST     9,IMOVP                    ARE PRIMARY AND OFFSET MOVING
         SPACE
         L      9,TEMP
         N      9,=X'0CC0FF00'
         SRL    9,8
         ST     9,IMOVO                    IS OFFSET WINDOW MOVING
         SR     9,9
         ST     9,IOFFST
         L      9,ICODE
         C      9,THREE
         BE     OFFCOM
         C      9,SEVEN
         BE     OFFCOM
         B      OFFSKP
         SPACE
OFFCOM   LA     8,WD278
         A      8,INDEX
         MVC    TEMP(3),0(8)
         SR     9,9
         L      9,TEMP
         C      9,ZERO
         BNL    RPLUS
         N      9,=X'7FFFFF00'
         SRA    9,8
         LCR    9,9
         B      RNEG
RPLUS    SRA    9,8
RNEG     ST     9,IOFFST                   RANGE OFFSET FOR SLAVED WINDOW
         SPACE
OFFSKP   LA     8,WD263
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'F0000000'
         SRL    9,26
         LA     11,PIFA
         LE     0,0(9,11)                  GET VALUE FROM PIFA TABLE
         STE    0,XPPAGC
```

```
         L      9,TEMP
         N      9,=X'0FC00000'
         SRL    9,22
         LA     11,OIFA
         LE     0,0(9,11)                GET VALUE FROM OIFA TABLE
         STE    0,XOPAGC
         L      9,ZERO
         ST     9,ISWSSP
         ST     9,ISWSSC
         ST     9,ISSERR
         LA     8,WD239
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'00000200'           CHECK BIT 23 (PFSA)
         C      9,ZERO
         BE     CKFSOP
         LE     0,PFSA
         AE     0,XPPAGC
         STE    0,XPPAGC                 ADD IN PFSA VALUE
CKFSOP   L      9,TEMP
         N      9,=X'00000100'           CHECK BIT 24 (OFSA)
         C      9,ZERO
         BE     CKSSPP
         LE     0,OFSA
         AE     0,XOPAGC
         STE    0,XOPAGC                 ADD IN OFSA VALUE
CKSSPP   L      11,TEMP
         N      11,=X'00802000'
         C      11,=F'0'
         BNE    CKSSOP
INDET    L      8,ONE                    INDETERMINATE SITUATION
         ST     8,ISSERR
         B      CDELTAR
CKSSOP   L      11,TEMP
         N      11,=X'0C4C1000'
         C      11,=F'0'
         BE     INDET
PPTEST   LA     9,WD239
         A      9,INDEX
         MVC    TEMP(3),0(9)
         L      10,TEMP                  AUX.MICR.WORD INTO REG.10
         LA     9,WD252                  AUX.MICROWAVE WORD INTO REG.11
         A      9,INDEX
         MVC    TEMP(3),0(9)
         L      11,TEMP
         LA     9,WD272
         A      9,INDEX
         MVC    TEMP(3),0(9)             RANGE TR.WORD INTO TEMP
         N      10,=X'0C802000'
         C      10,=X'00800000'
         BNE    S74
         LE     0,PSSL                   ADD IN PSSL (COND.8)
         AE     0,XPPAGC
         STE    0,XPPAGC
         L      9,ONE
         ST     9,ISWSSP
```

```
S74       L     8,NEWA                    OLD OR NEW ATTEN.
          C     8,ZERO
          BE    OPTEST
          L     9,TEMP
          N     9,=X'00080000'
          C     9,=F'0'
          BE    RDBKLC                    ATTENUATOR READBACK
          N     11,=X'08000000'           S74 ARMED
          C     11,ZERO                   STATUS READ BACK
          BNE   SLC
NOATTLC   LE    0,PREVLC
          STE   0,XPPAGC
          MVC   JSWLC(4),ONE
          MVC   ISSERR(4),ONE
          B     OPTEST
RDBKLC    N     11,=X'04000000'           S74 NOT ARMED
          C     11,ZERO                   STATUS READBACK
          BE    NOATTLC
          B     OPTEST
SLC       LE    0,PSSA
          AE    0,XPPAGC                  ADD IN PSSA (COND.B)
STORLC    STE   0,XPPAGC
          MVC   ISWSSP(4),ONE
OPTEST    LA    9,WD239
          A     9,INDEX
          MVC   TEMP(3),0(9)
          L     10,TEMP                   AUX.MICR.WORD INTO REG.10
          LA    9,WD252                   AUX.MICROWAVE WORD INTO REG.11
          A     9,INDEX
          MVC   TEMP(3),0(9)
          L     11,TEMP
          LA    9,WD272
          A     9,INDEX
          MVC   TEMP(3),0(9)              RANGE TR.WORD INTO TEMP
          N     10,=X'004C1000'
          C     10,=X'004C0000'
          BNE   S75
     LE         0,OSSL                    ADD IN OSSL (COND.B)
          AE    0,XOPAGC
          STE   0,XOPAGC
          L     9,ONE
          ST    9,ISWSSC
S75       L     8,NEWA                    OLD OR NEW ATTEN.
          C     8,ZERO
          BE    OUT1
          L     9,TEMP
          N     9,=X'0004C000'
          C     9,=F'0'
          BE    RDBKRC                    ATTENUATOR READBACK
          N     11,=X'02000000'           S75 ARMED
          C     11,ZERO                   STATUS READ BACK
          BNE   SRC
NOATTRC   LE    0,PREVRC
          STE   0,XOPAGC
          MVC   JSWRC(4),ONE
          MVC   ISSERR(4),ONE
          B     OUT1
```

```
RDBKRC   N      11,=X'01000000'        S75 NOT ARMED
         C      11,ZERO                 STATUS READBACK
         BE     NOATTRC
         B      CUT1
SRC      LE     0,OSSA
         AE     0,XOPAGC                ADD IN OSSA (COND.8)
STCRCC   STE    0,XOPAGC
         MVC    ISWSSO(4),ONE
CUT1     L      9,JSWLC
         C      9,ZERO
         BNE    OUT2
         LE     0,XPPAGC
         SE     0,=E'16'
         STE    0,XPPAGC
         STE    0,PREVLC
CUT2     L      9,JSWRC
         C      9,ZERO
         BNE    ENDALERT
         LE     0,XOPAGC
         SE     0,=E'16'
         STE    0,XOPAGC
         STE    0,PREVRC
ENDALERT MVC    JSWLC(4),ZERO
         MVC    JSWRC(4),ZERO
         L      9,ITBAND                COMPUTE RANGE BIASES
         C      9,ZERO
         BE     NBAND
         LE     2,RBIAS+16              WIDE BAND TAPE
         STE    2,TRBIAS
         L      9,IPOLAR
         C      9,ZERO
         BE     LCPOLAR
         LE     2,RBIAS+20              OP POLARIZATION
         AE     2,TRBIAS                ADD WB OP BIAS
         STE    2,TRBIAS
         L      9,ISWSSC                ISWSSC WAS SET IN AGC COMP.
         C      9,ONE                   =1,ADD 32 DB (OP)
         BNE    CDELTAR
         LE     2,RBIAS+28              ADD IN OPSSA- RBIAS(8)
         AE     2,TRBIAS
         STE    2,TRBIAS
         B      CDELTAR
LCPOLAR  L      9,ISWSSP
         C      9,ONE
         BNE    CDELTAR
         LE     2,RBIAS+24
         AE     2,TRBIAS                ADD IN PSSA-RBIAS(7)
         STE    2,TRBIAS
         B      CDELTAR
NBAND    LE     2,RBIAS                 NARROW BAND
         STE    2,TRBIAS
         LA     8,WD273                 CENTER OR EDGE TRACK
         A      8,INDEX
         MVC    TEMP(3),0(8)
         L      9,TEMP
         N      9,=X'00010000'
         C      9,ZERO
```

```
         BNE    CKNBEDGE                EDGE TRACKING
         B      CKPOLAR                 CENTER TRACK
CKNBEDGE L      8,IRDCT                 CHECK SIGN OF R DCT
         C      8,ZERO
         BH     CKNBLOW
         LE     2,RBIAS+4               LEADING EDGE BIAS
         AE     2,TRBIAS
         STE    2,TRBIAS
         B      CKPOLAR
CKNBLOW  LE     2,RBIAS+8               TRAILING EDGE BIAS
         AE     2,TRBIAS
         STE    2,TRBIAS
CKPOLAR  L      9,IPOLAR                CHECK POLARIZATION DESIRED
         C      9,ZERO
         BE     ODELTAR
         LE     2,RBIAS+12              ADD NP OP BIAS
         AE     2,TRBIAS
         STE    2,TRBIAS
ODELTAR  RETL
TEMP     DC     F'0'
TEMP2    DC     F'0'
IXC      DC     F'0'
NPTAPE   DC     F'0'
PRINUM   DC     F'0'
IPASS    DC     F'0'
ISWSSO   DC     F'0'
ISWSSP   DC     F'0'
DIVSR    DC     F'0'
WORD64   DC     F'0'
WORD73   DC     F'0'
STEMP    DC     F'0'
PREVLC   DC     E'0.0'
PREVRC   DC     E'0.0'
JSWLC    DC     F'0'
JSWRC    DC     F'0'
ZERO     DC     F'0'
ONE      DC     F'1'
TWO      DC     F'2'
THREE    DC     F'3'
FOUR     DC     F'4'
SEVEN    DC     F'7'
EIGHT    DC     F'8'
C10      DC     F'10'
C100     DC     F'100'
C1000    DC     F'1000'
DZERO    DC     D'0.0'
FLMASK   DC     X'4600000000000000'
DBUF     DSECT
INBUF    DS     CL3
WD1      DS     CL3        PP LOG D.
         DS     CL48
WD18     DS     CL3
WD19     DS     CL3
         DS     CL27
WD29     DS     CL3
WD30     DS     CL3
         DS     CL81
```

```
WD58      DS    CL171     PP PHASE D.
WD115     DS    CL3
WD116     DS    CL3
WD117     DS    CL3
WD118     DS    CL171     OP LOG D.
WD175     DS    CL171     OP PHASE D.
WD232     DS    CL3
WD233     DS    CL3
WD234     DS    CL3
          DS    CL3
WD236     DS    CL3
WD237     DS    CL3
          DS    CL3
WD239     DS    CL3
WD240     DS    CL3
WD241     DS    CL3
WD242     DS    CL3
          DS    CL27
WD252     DS    CL3
WD253     DS    CL3
          DS    CL27
WD263     DS    CL3
WD264     DS    CL3
WD265     DS    CL3
WD266     DS    CL3
WD267     DS    CL3
WD268     DS    CL3
WD269     DS    CL3
WD270     DS    CL3
WD271     DS    CL3
WD272     DS    CL3
WD273     DS    CL3
WD274     DS    CL3
WD275     DS    CL3
WD276     DS    CL3
WD277     DS    CL3
WD278     DS    CL3
WD279     DS    CL3
WD280     DS    CL3
          DS    CL6369
IAZ       DS    1F
IEL       DS    1F
INDEX     DS    1F
IPPRCS    DS    1F
IORS      DS    1F
IRANGE    DS    1F
IPKPWR    DS    1F
IRDOT     DS    1F
IALT      DS    1F
INDAZ     DS    1F
JNDAZ     DS    1F
INDEL     DS    1F
IRB54     DS    1F
IRBB5     DS    1F
IOPRCS    DS    1F
I240B1    DS    1F
I240B2    DS    1F
I240B3    DS    1F
I241B1    DS    1F
I241B2    DS    1F
```

```
I241B3    DS    1F
XPPAGC    DS    1F
IBETA     DS    1F
NEWA      DS    1F
BAND      DS    1F
NSW       DS    1F
RBIAS     DS    8F
ISVPRI    DS    1F
IHRS      DS    1F
IMIN      DS    1F
ISEC      DS    1F
IMSEC     DS    1F
STAT      DS    21F
TRBIAS    DS    1F
ISTAT1    DS    1F
ISTAT2    DS    1F
ISTAT3    DS    1F
ISTAT4    DS    1F
IALSW     DS    1F
ISTSW     DS    1F
NBWB      DS    1F
ISIGNO    DS    1F
I27B12    DS    1F
JCCN      DS    1F
NBEG      DS    1F
NEND      DS    1F
ITST      DS    1F
NUMPRI    DS    1F
XOPAGC    DS    1F
ITBAND    DS    1F
ITAPNO    DS    1F
IPRF      DS    1F
IPOLAR    DS    F
ISSERR    DS    F
PIFA      DS    16F
CIFA      DS    16F
PFSA      DS    1F
CFSA      DS    1F
PSSA      DS    1F
CSSA      DS    1F
PSSL      DS    1F
CSSL      DS    1F
ICODE     DS    F
I273B5    DS    F
I273B6    DS    F
I273B7    DS    F
I273B8    DS    F
IMOVP     DS    F
IMOVC     DS    F
IOFFST    DS    F
XDPTIM    DS    D
IDAT      DS    682F
          END
```

APPENDIX G

SUBROUTINE TIMDP PROGRAM LISTING

```
SUBROUTINE TIMDP(TIME,IHR,MIN,ISEC,IFRAC)
DOUBLE PRECISION TIME,TIME2,XCON,FRAC
DATA XCON/1000000.0/
IX=TIME
IHR=IX/3600
MIN=MOD(IX,3600)/60
ISEC=MOD(IX,60)
TIME2=DFLOAT(IX)*XCON
TIME=TIME*XCON
FRAC=TIME-TIME2
IFRAC=FRAC
RETURN
END
```

APPENDIX H

SUBROUTINE SMOOTH PROGRAM LISTING

```
      SUBROUTINE SMOOTH (N,L,X,NO,ZH)
C SMOOTH OS/360 DIMENSION RR,C1,VEL INCREASED TO  700          30JUN67
CSMOOTH  OS/360    COMMON CHANGED AND ARGUMENTS AS WELL        12 JULY 66
CSMOOTH  OS/360                                                20 JUNE 66
CSMOOTH       DIMENSION REDUCED TO 500                          17 AUG 65
CSMOOTH                                                         24 MAY 65
C      SMOOTH REPLACES THE POSITION MEASUREMENT X(I) AT THE MIDPOINT OF
C      THE INTERVAL T(I-N)LESS THAN T LESS THAN T(I+N) BY THE ORDINATE
C      OF THE PARABOLA AT THAT POINT. THE SMOOTHED VALUE X(I) THUS
C      OBTAINED IS EXPRESSED AS A WEIGHTED AVERAGE OF THE MEASURED
C      VALUES. THE SLIDING PARABOLA TECHNIQUE CONSISTS MERELY OF
C     APPLYING THIS OPERATION TO EACH INTERVAL BETWEEN T(I-N)AND T(I+N),
C      SLIDING ONE POINT AT A TIME, AS I=N+1,N+2,....,L-N.
C     ZH,THE TIME INTERVAL BETWEEN POINTS
C      L,THE TOTAL NUMBER OF POINTS
C      N,THE NUMBER OF POINTS ON EACH SIDE OF X(I)
C      NO, A PARAMETER WHICH INDICATES WHETHER THAT WHICH IS BEING READ
C     IS POSITION, VELOCITY, OR ACCELERATION.
C      X(I), THE X-COORDINATE
C      Y(I), THE Y-COORDINATE
C      Z(I), THE Z-COORDINATE
      IMPLICIT REAL*8 (A-H,O-X)
      COMMON RR
      DIMENSION X(1),RR(1)
C
      M=2*N+1
      S=M
      JO=N+1
      KO=L-N
      SQ=S*S
      H = ZH
    4 IF (NO) 5,10,20
C                    SET UP THE COEFFICIENTS FOR POSITION
    5 O=3.000/(4.000*S*(SQ-4.000))
      Q1 = SQ-4.000
      Q2 = 4.000*S
      Q3 = Q1*Q2
      Q4 =  3.000/Q3
      D2=D*O
      A = 3.000*SQ-7.000
      B=0.D
      C=-20.D
      GO TO 5757
C                    SET UP THE COEFFICIENTS FOR VELOCITY
   10 O=12.000/(H*S*(SQ-1.000))
      Q1 = SQ-1.000
      Q2 = H*S
      Q3 = Q1*Q2
      Q4 = 12.000/Q3
      D2=D*O
      A=0.0
      B=1.0
      C=0.D
      GO TO 5757
C                    SET UP T[illegible] COEFFICIENTS FOR ACCELERATION
   20 D=30.000/(H*H*S*(SQ-1.[illegible]*(SQ-4.000))
      D2=D*O
      A = 1.000-SQ
      B=0.D
      C=12.0
 5757 DO 500 I=JO,KO
      SUMX=A*X(I)
      DO 600 K=1,N
      J=I+K
      LIK = I - K
      T=K
      V = -2.000*B*T
      SUMX=SUMX+(A+B*T+C*T*T)*(X(J)+X(LIK))+V*X(LIK)
  600 CONTINUE
C                    FORM THE SMOOTHED VALUE FOR EACH COORDINATE
      ADJX=D*SUMX
   59 RR(I) = ADJX
  500 CONTINUE
  157 RETURN
      END
```

APPENDIX J

SUBROUTINE DREFC PROGRAM LISTING

```
      SUBROUTINE DREFC(E,R,DEE,DRR)          VERSION: 6/15/70
      IMPLICIT REAL * 8 (A-H,O-Z)
      DIMENSION DE(16,8),DR(16,8),ED(16),RD(8)
      DATA DE/0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,
     10.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0    ,0.0313,
     20.0303,0.0292,0.0287,0.0282,0.0272,0.0262,0.0253,0.0243,0.0223,
     30.0214,0.0195,0.0171,0.0135,0.0075,0.0    ,0.0937,0.0848,0.0770,
     40.0732,0.0694,0.0627,0.0571,0.0522,0.0480,0.0412,0.0385,0.0337,
     50.0278 0.0205,0.0105,0.0    ,0.1850,0.1520,0.1250,0.1140,0.1050,
     60.0904,0.0795,0.0708,0.0636,0.0523,0.0478,0.0405,0.0323,0.0229,
     70.0114,0.0    ,0.5310,0.3070,0.2120,0.1830,0.1600,0.1280,0.1060,
     80.0899,0.0780,0.0612,0.0550,0.0455,0.0354,0.0246,0.0120,0.0    ,
     90.7550,0.3720,0.2400,0.2020,0.1750,0.1370,0.1120,0.0942,0.0811,
     A0.0631,0.0566,0.0466,0.0361,0.0250,0.0122,0.0    ,0.9120,0.4110,
     B0.2560,0.2140,0.1840,0.1420,0.1150,0.0967,0.0830,0.0643,0.0575,
     C0.0472,0.0365,0.0252,0.0122,0.0    ,0.9700,0.4200,0.2600,0.2200,
     00.1900,0.1460,0.1170,0.0980,0.0840,0.0653,0.0584,0.0478,0.0369,
     E0.0254,0.0123,0.0 /
      DATA DR/  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,
     1  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0, 22.6, 21.5, 20.4, 19.9,
     2 19.4, 18.5, 17.6, 16.8, 16.1, 14.8, 14.2, 13.2, 12.0, 10.4,  8.6,
     3  7.7, 67.3, 57.9, 50.2, 47.0, 44.1, 39.3, 35.4, 32.1, 29.3, 24.8,
     4 22.9, 19.7, 16.3, 12.7,  9.4,  8.1,132.0, 98.5, 77.4, 69.7, 63.2,
     5 52.9, 44.7, 38.4, 33.4, 26.4, 23.9, 20.1, 16.4, 12.7,  9.4,  8.1,
     6340.0,167.0,103.0, 86.1, 73.4, 56.7, 46.2, 38.9, 33.6, 26.4, 24.0,
     7 20.2, 16.4, 12.8,  9.5,  8.2,405.0,170.0,104.0, 86.3, 73.6, 56.8,
     8 46.3, 38.9, 33.7, 26.5, 24.1, 20.3, 16.5. 12.8,  9.5,  8.2,421.0,
     9171.0,104.0, 86.6, 73.9, 57.1, 46.4, 39.0, 33.8, 26.8, 24.3, 20.5,
     A 16.6, 13.0,  9.8,  8.4,446.0,172.0,105.0, 87.4, 74.0, 58.0, 46.6,
     8 39.2, 34.0, 27.0, 24.6, 20.7, 16.7, 13.0, 10.0,  8.4/
      DATA EO,RTOEG/0.01,2.0,4.0,5.0,6.0,8.0,10.0,12.0,14.0,18.,20.,
     124.,30.,40.,60.,90.,57.29578/
      DATA RO/0.01,10.,30.,60.,200.,400.,1000.,2000./
      IF(R.LE.0.0)GO TO 300
      RG=R/1.8520+00
      DO 100 IEO=2,15
      I=17-IEO
      IF(E.GE.EO(I))GO TO 120
100   CONTINUE
      I=1
120   DO 200 JRO=2,8
      J=10-JRO
      IF(RG.GE.RO(J))GO TO 220
200   CONTINUE
      J=1
220   IF(J.EQ.8)GO TO 340
      ZR=DLOG(RG/RO(J))/DLOG(RO(J+1)/RO(J))
      IF(E.LE.0.0)GO TO 320
      ZE=DLOG(E/EO(I))/DLOG(EO(I+1)/EO(I))
      DE1=((DE(I+1,J)-DE(I,J))*(1.-ZR)+(DE(I,J+1)-DE(I,J))*ZR)*ZE
      DE2=((DE(I,J+1)-DE(I,J))*(1.-ZE)+(DE(I+1,J+1)-DE(I,J+1))*ZE)*ZR
      DEE=DE1+DE2+DE(I,J)
      DR1=((DR(I+1,J)-DR(I,J))*(1.-ZR)+(DR(I,J+1)-DR(I,J))*ZR)*ZE
      DR2=((DR(I,J+1)-DR(I,J))*(1.-ZE)+(DR(I+1,J+1)-DR(I,J+1))*ZE)*ZR
      DRR=(DR1+DR2+DR(I,J))
      GO TO 400
300   DEE=0.0
      DRR=0.0
      GO TO 400
320   DEE=DE(I,J)+(DE(I,J+1)-DE(I,J))*ZR
      DRR=DR(I,J)+(DR(I,J+1)-DR(I,J))*ZR
      GO TO 400
340   DELT=(E-ED(I))/(ED(I+1)-ED(I))
      DEE=DELT*(DE(I+1,J)-DE(I,J))+DE(I,J)
      DRR=DELT*(DR(I+1,J)-DR(I,J))+DR(I,J)
400   DRR=DRR*.3048D-03
      END
```