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AD 913126

Project Report

PA-229-10
(RSP)

C. R. Berndtson
R. H. French 19686
D. E. Nessman

Data Reduction Program Documentation ALCPOD

(Effective: May 1971)

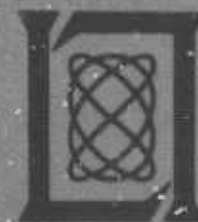
24 May 1971

Prepared for the Advanced Research Projects Agency,
the Department of the Army, and the Department of the Air Force
under Electronic Systems Division Contract F19628-70-C-0230 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts



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100-441000-100
WATER SECTION
BETTER SERVICE
JAN 10 1964
ENTER YOUR OWN CODES
GIVE YOUR OWN SPECIAL
13

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

6 DATA REDUCTION PROGRAM DOCUMENTATION
ALCPØD

(EFFECTIVE: MAY 1971),

10 Charles
C. R. BERNDTSON,

~~Group 92~~

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Philco-Ford Corporation
Editors

14 PA-229-1Ø

9 PROJECT REPORT, PA-229-10 (RSP)

11 24 MAY 1971

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15 F14628-7Ø-C-Ø23Ø,
ARPA Order-6ØØ

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The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology. This work was sponsored by the Advanced Research Projects Agency of the Department of Defense (ARPA Order 600), the Department of the Army, and the Department of the Air Force under Air Force Contract F19628-70-C-0230.

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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 No implication is made that this program will not subsequently be modified, amended, or superseded; on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been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

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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.)

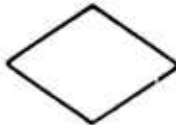
ADT	ALCOR Data Tape
ALCOR	ARPA-Lincoln C-band Observables Radar
ALTAIR	ARPA Long-Range Tracking and Instrumentation Radar
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
c	Speed of Light
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR 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

$\dot{R}$	Range (km)
$\ddot{R}$	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



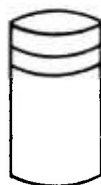
INPUT/OUTPUT OPERATION



MAGNETIC TAPE



PUNCHED CARD



DISK

ALCPOD

1. PURPOSE AND UTILIZATION

A. Source of Data

ALCOR¹

B. Data Input

ALCOR Data Tape (ADT)

C. Description

radar
body targets in a format suitable for input to *Beta* ~~NRTPOD~~. The data are ultimately used to obtain a *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 ^{narrowband} NB or ^{wideband} WB 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 μ s) 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:

$$R = \text{IRANGE} + \text{TRBIAS} + \text{TTCOR} + \text{RRCOR} - \text{RCORF}$$

$$\text{Az} = \text{IAZ} + \text{AZBIAS}$$

$$\text{El} = \text{IEL} + \text{ELBIAS} - \text{ECORF}$$

where

IRANGE is uncorrected R

TRBIAS is range bias

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

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. $1/(\text{primary pulse PRF})$

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 μ s (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 ≤ 50 processing intervals

Length of run If $\dot{R}$ is desired, no. of pulses ≤ 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. READJS²

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 μ s.

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	μ s

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
A LCPOD INPUT

0 0 1 0 5 ALC

CARD 1

[illegible]

27191

27691

9

CARD 2

[illegible]

APPENDIX B

ALCPOD OUTPUTS

POD-ALCOR POLAR = LC BAFO = NO REEL NO. = 2 TITLE = ALC DATE = 3/ 3/74
ITLUSE = 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 BY PROGRAM 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	AZIOEG)	ELIOEG)	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	8.00909	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	-6.69926	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	9.00906	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	544	10.00904	0	61.683	19.873	546.6828	-6.70332	27461
ALC	71	3	3	544	10.10904	0	61.692	19.881	546.0125	-6.70382	27471
ALC	71	3	3	544	10.20904	0	61.694	19.884	545.3415	-6.70907	27481
ALC	71	3	3	544	10.30903	0	61.697	19.889	544.6710	-6.70542	27491
ALC	71	3	3	544	10.40903	0	61.703	19.892	544.0005	-6.70482	27501
ALC	71	3	3	544	10.50903	0	61.708	19.897	543.3300	-6.70529	27511
ALC	71	3	3	544	10.60903	0	61.714	19.903	542.6587	-6.71180	27521
ALC	71	3	3	544	10.70902	0	61.716	19.906	541.9881	-6.70636	27531
ALC	71	3	3	544	10.80902	0	61.719	19.911	541.3177	-6.70463	27541
ALC	71	3	3	544	10.90902	0	61.725	19.914	540.6470	-6.70724	27551
ALC	71	3	3	544	11.00902	0	61.730	19.922	539.9763	-6.70721	27561
ALC	71	3	3	544	11.10901	0	61.735	19.925	539.3056	-6.70743	27571
ALC	71	3	3	544	11.20901	0	61.738	19.930	538.6348	-6.70739	27581
ALC	71	3	3	544	11.30901	0	61.741	19.936	537.9641	-6.70793	27591
ALC	71	3	3	544	11.40901	0	61.746	19.939	537.2932	-6.70872	27601
ALC	71	3	3	544	11.50900	0	61.752	19.944	536.6224	-6.70855	27611

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 NSTA(5),NSTOP(5),NSKIP(5)  
DIMENSION XATBL(128),QB(18),IPRS(8),IADD(8)  
DIMENSION XNBUF(1803),PIFA(16),OIFA(16),XKPLS(5)  
DIMENSION IEQM(9),ITDESG(3)
```

COMMON RR
COMMON/ICOM/INPUF(1803), IAZ, IEL, INDEX, IPPRCS, IORS, IRANGE, IPKPWR, IR
IDOT, IALT, INDAZ, JNDAZ, INDEL, IRB54, IRB85, IOPRCS, I240B1, I240B2, I240B3
I, I241B1, I241B2, I241B3, XPPAGC, IBETA, NEWA, IBAND, NSW, RBIAS(8), ISVPRI,
IHRS, IMIN, ISEC, IMSEC, ISTAT(21), TRBIAS, ISTAT1, ISTAT2, ISTAT3, ISTAT4,
IITALSW, ISTSW, NBWB, ISIGNC, I27B12, JCON, NBEG, NEND, ITST, NUMPRI, XOPAGC,
ITBAND, ITAPNC, IPRE, IPOLAR, ISSERR, PIFA, CIFA, PFSA, OFSA, PSSA, CSSA,
IPSSL, QSSL, ICCDF, I273B5, I273B6, I273B7, I273B8, IMOV, IMCVC, IOFFST,
IXDPTIM, ICAT(682)

```
C      EQUIVALENCE(XNPUF(1),INBUF(1))
      EQUIVALENCE (IEQM(1),IZBAND),(IEQM(2),ITREEL),(IEQM(3),ITWTR),
2      IEQM(4) ,ITMNTN),(IEQM(5),ITDAY),(IEQM(6),ITYEAR),
3      IEQM(7),ITDESG(1))
```

```

C DATA ZLC/'LC ' ',ZRC/'RC ' ',ZWB/'WB ' ',ZNB/'NB ' ',ATCT/O/
DATA IFST3/O/,IFST4/O/,INTAV/1/,IFST2/O/
DATA ALG/'ALC' ',ICN/1/,IZERO/O/,IFST1/O/,IMSAVE/O/,BLAKK/' ' '
DATA IPRS/20C,16C,100,80,50,40,25,20/
DATA IADD/10,13,10,13,20,25,40,50/

```

```

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

```

```

      READ(5,1)NBAND,ITLUSE,NVALS,NINT,NSMOO1,TITL,
      2(NSTART(1),NSTOP(1),NSKIP(1),I=1,NVALS)
1  FORMAT(5I5,          2X,A3/(6I10))
      IF(NSMOO1.LE.0)NSMOO1=5

```

```

NSMOD=NSMOD1
MSVE=NSKIP(1)
IF (TITL.NE.BLNKK)ALC=TITL
NSW=ITLUSE
C
IEOF=0
IERR=0
CALL READJS(INPUF,IEOF,IERR)
ISIG=1
CALL HEADCT (ISIG,INBUF(1),IEGM(1))
ITBAND=IZBAND
NEWA=0
IF (ITYEAR.GT.70)GO TO 282
IF (ITYEAR.LT.70)GO TO 283
IF (ITMNTN.GT.10)GO TO 282
IF (ITMNTN.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
ARIAS=XNBUF(602)
EBIAS=XNBUF(603)
DEGCON=(180.*.0479369)/3141.59
AZBIAS=DEGCON*ABIAS
ELBIAS=DEGCON*FBIAS
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(627)
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(IPULAR.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('IPOD-ALCCR  POLAR = ',A2,4X,'BAND = ',A2,4X,'REEL NO. = ',
1,15,'  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('O START  STOP  SKIP',10X,'START  STOP  SKIP',10X,
1 'START  STOP  SKIP',10X,'START  STOP  SKIP')

```

```

      2 (4(2X,15,2X,15,2X,15,8X)))
      WRITE(6,201)
201  FORMAT('0ITLUSE = 0 0 USE GMT AS COMPUTED BY DOUBLE PREC.WCRDS ON
      ITAPE ((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('CNINT = 0 (SMOOTHING IS TO OCCUR) '/' 1X,'NO. OF POINTS ON E
      IACH SIDE OF INTERPOLATED POINT = ',I4)
218  CONTINUE
C
      IF(NRAND.NE.(TRAND)GO TO 695
      IFIRST=1
92  CONTINUE
      IF(ITLUSE.NE.1)GO TO 619
      IF(NUMPRI.LT.NSTART(IJ))GO TO 616
      IF(IFIRST.EQ.1)GO TO 617
      IADMS=0
      DO 612 K=1,8
612  IF(IPRS(K).EQ.(PRF))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=IHRN
      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  IFIRST=1
      GO TO 616
617  IADMS=0
      DO 613 K=1,8
      IF(IPRS(K).EQ.(PRF))IADMS=IADD(K)
613  CONTINUE
      IF(IADMS.LE.0)GO TO 599
586  IHRN=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(IPDCT)/(8192.00+00))*14.9896250+00
RZOT=RDOT/1000.
DTRB=TRBIAS
RANGE=(DFLOAT(RANGE)/2048000.D+00)*14.9896250+00+DTRB*.1498962500
IF(ITLUSE.NE.0)GO TO 663
IDELTM=(RANGE/299776.D+00)*1.00+06
IMSEC=DFLOAT(IMSEC+IDELTM)/10.00+00+.50+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/1000.00+00)
RANGE=RANGE+TTCOR
664 CONTINUE
DRRUSE=RRUSE
RRCOR=DRRUSE*RDOT
RANGE=RANGE+RRCOR/1000.D+00
ZZ=(DFLOAT(IAZ)*2.D+00*3141.59265350+00)/(2.00+00**17)
XAZ=ZZ*.C5729500+00
DAZB=AZBIAS

```

```

XAZ=XAZ+DAZB
ZL=(DFLOAT(IEL)*2.D+00*3141.5926535D+0C)/(2.0D+00**17)
XEL=ZL*.057295D+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('OTITLE   DATE H M S  MS      AZ(DEG)      EL(DEG)      RANG
1E(KM)   RCCT(KM/S)')
ION=0
IF(NINT.NE.0)GO TO 681
NTOT=NTOT+1
IYEAR(NTOT)=IYEAR
MONTH(NTOT)=ITMNTN
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(ITLUSE.NE.0)GO TO 117
WRITE(6 ,645)ALC,IYEAR,ITMNTN,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
1XAZ,ELVF,RNGF,PZCT,NUMPRI
645 FORMAT(1X,A3,3X,6I2,',' ,15,1X,11,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
1110)
WRITE(7 ,644)ALC,IYEAR,ITMNTN,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
1XAZ,ELVF,RNGF
644 FORMAT(A3,3X,6I2,',' ,15,1X,11,F8.3,4X,F8.3,4X,F12.4,5X,F8.5)
GO TO 118
117 WRITE(6 ,650)ALC,IYEAR,ITMNTN,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
1XAZ,ELVF,RNGF,RZCT,NUMPRI
650 FORMAT(1X,A3,3X,6I2,',' ,13,1X,11,F8.3,4X,F8.3,4X,F12.4,5X,F8.5,
1110)
WRITE(7 ,649)ALC,IYEAR,ITMNTN,ITDAY,IHRS,IMIN,ISEC,IMSEC,IZERO,
1XAZ,ELVF,RNGF
649 FORMAT(A3,3X,6I2,',' ,13,3X,11,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 CCNTINUE
C
121 IF(NINT.NE.0)GO TO 125
NUSE=MSVE+1
WRITE(6,128)NTOT,DTIME,NUSE

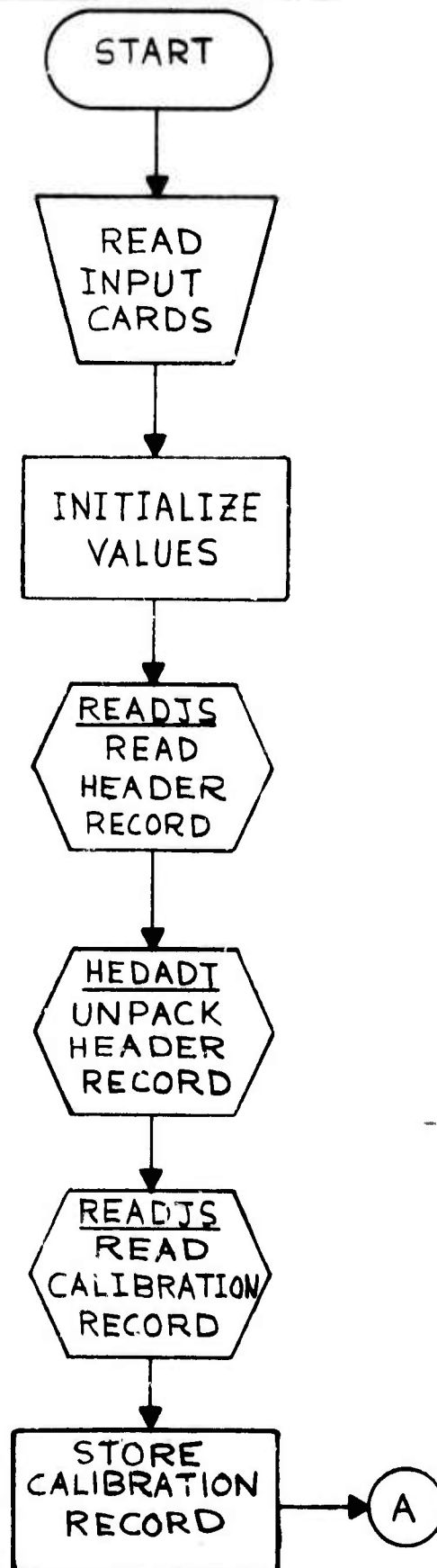
```

```

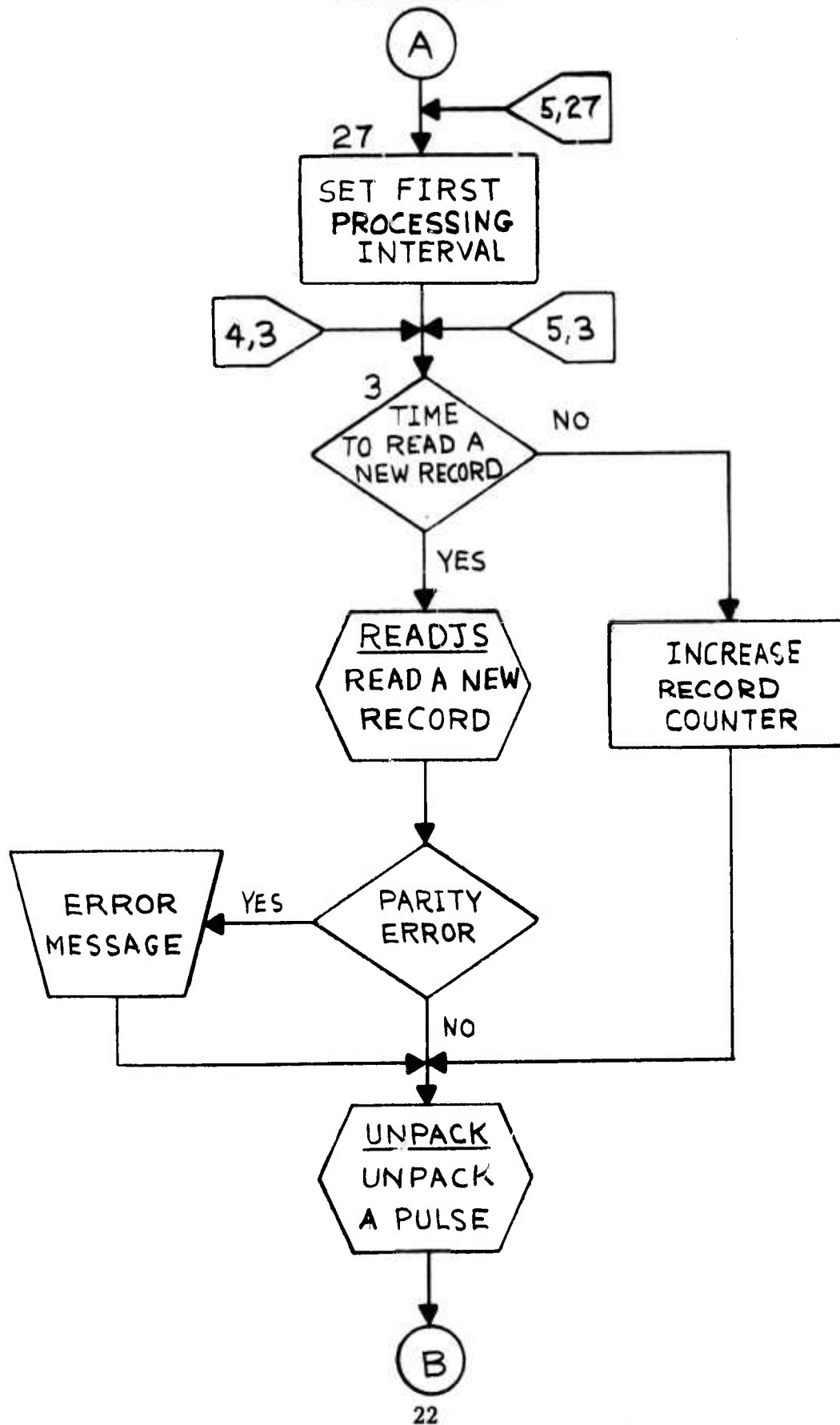
128 FORMAT('OREADY TO SMOOTH',I6,'  POINTS WITH A DELTA TIME(SEC) = '
1,F6.3,' THEN PUNCH EVERY ',I6)
WRITE(6,647)
NCARDS=NTOT
CALL SMOOTH(NSMOO,NCARDS,RANG,0,DTIME)
ITESS=-1
DO 6 I=1,NCARDS
ITESS=ITESS+1
IF(ITLUSE.EQ.0)GO TO 704
IF(MOD(ITESS,NUSE).NE.0)GO TO 6
WRITE(6,650)ALC,IYEAR(I),MONTH(I),IDAY(I),IHOURL(I),MIN(I),ISEC1(I)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

```

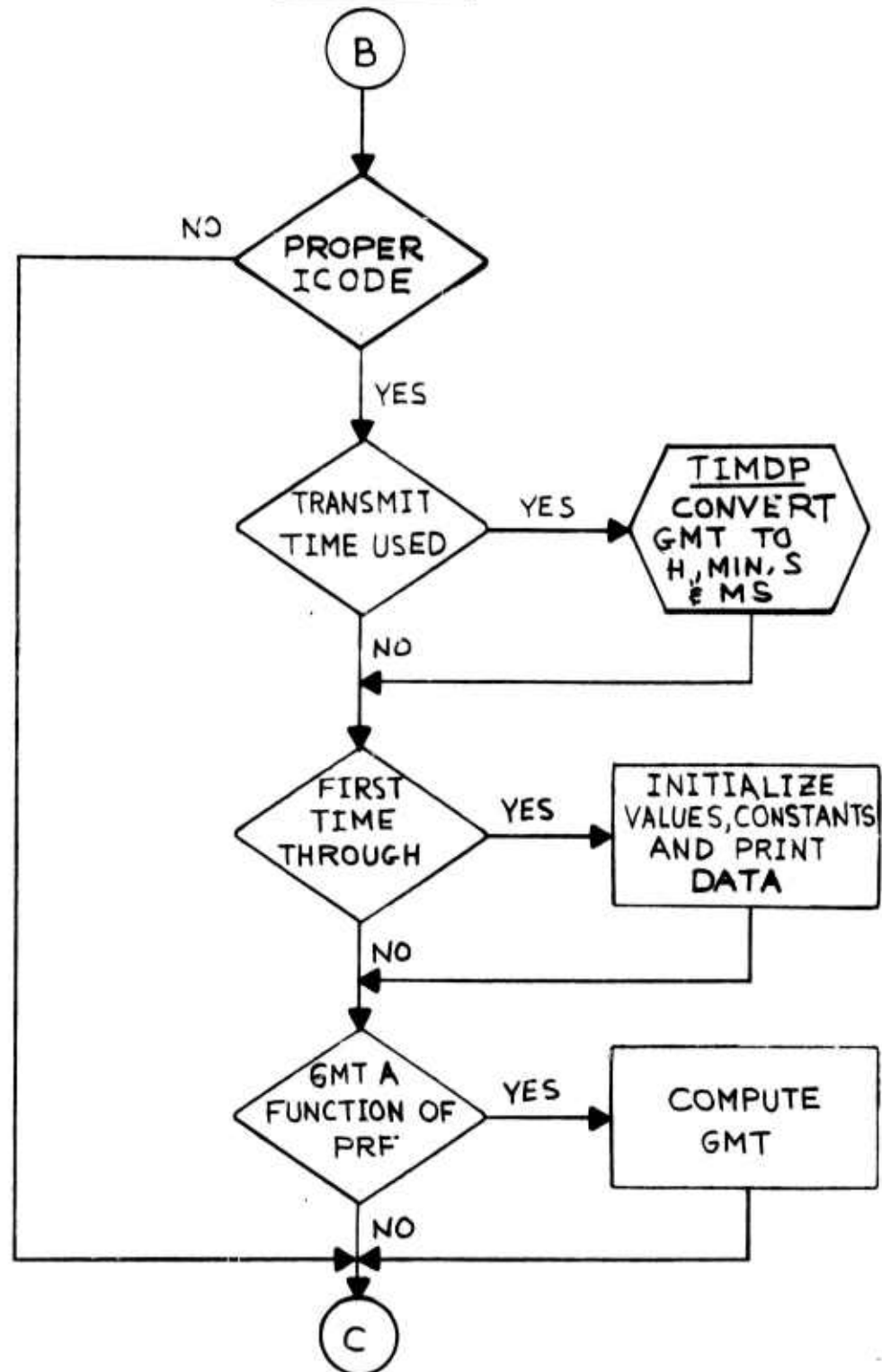
APPENDIX D
ALCPOD FLOW DIAGRAM



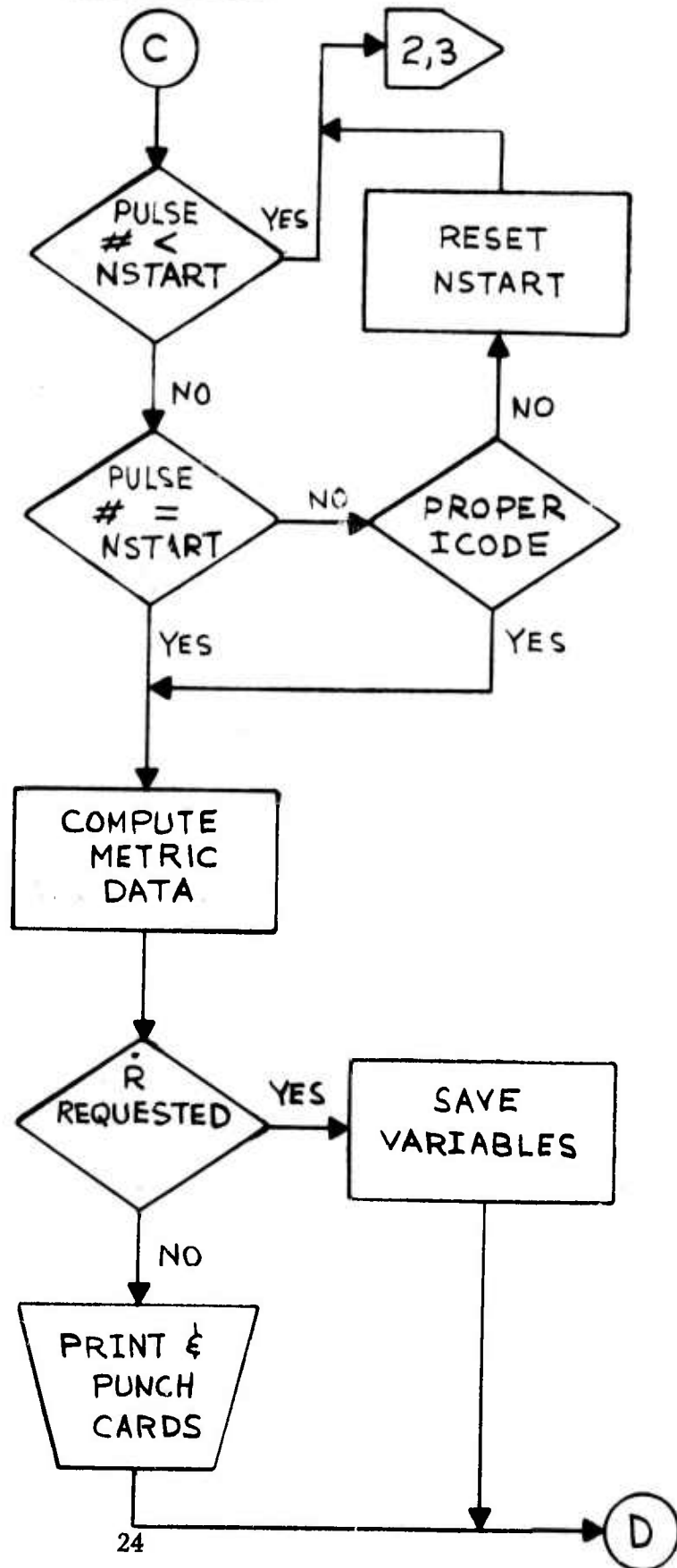
APPENDIX D-2



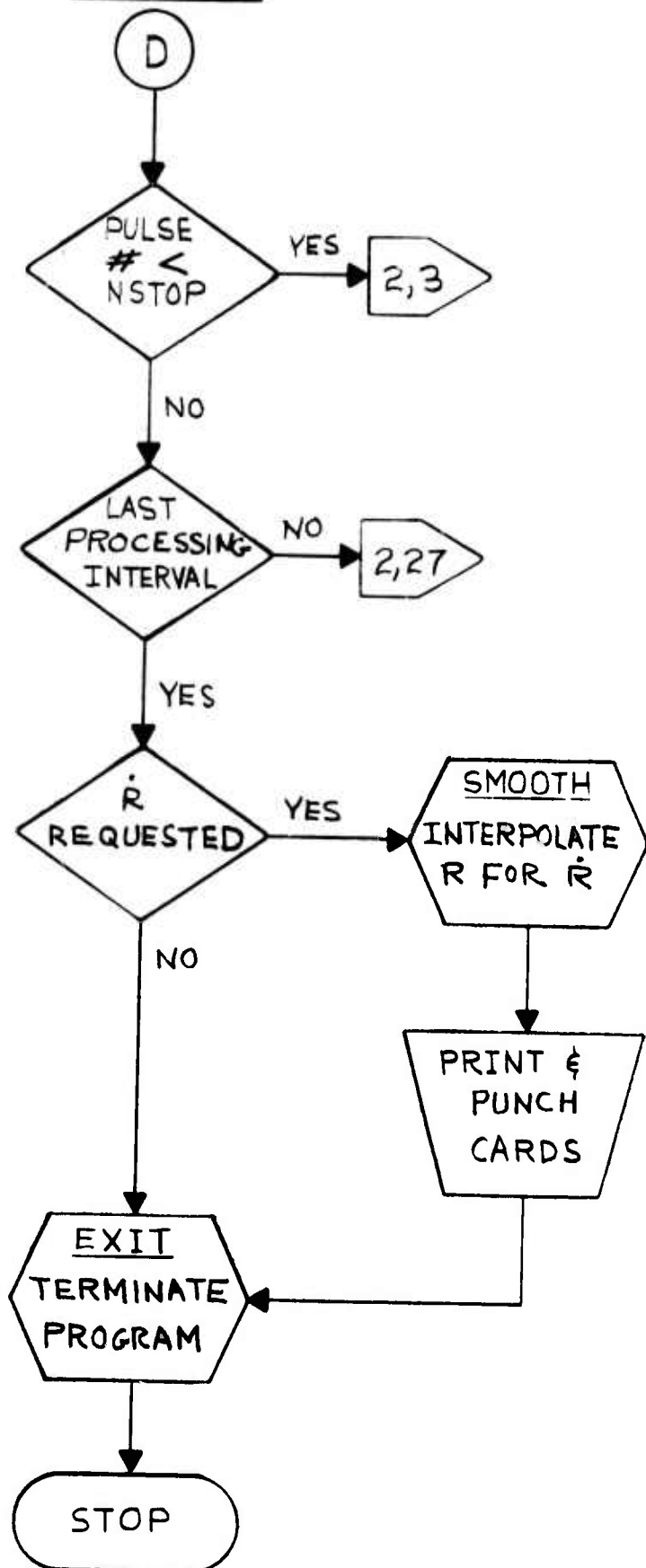
APPENDIX D-3



APPENDIX D-4



APPENDIX D-5



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,C
          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)      MRAND
          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)      MCTR
          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'R192'		
	USING DBUF,4,5,6		
	B START1		
CUBUF	DC V(ICOM)		
BASA	DC A(START+4C96)		
START1	LA B,INBUF NUMPRI=8*(NPR-1)+JCON		
	MVC TEMP(3),0(8)		
	MVC TEMP2(3),0(8)		
	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,INDFX		
	MVC TEMP(3),0(8)		
	L 9,TEMP		
	N 9,=X'FOC00000'		
	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'0BC00000'		
	SRL 9,27		
	ST 9,I273B5	WBS MCDE INDICATOR	
	L 9,TEMP		
	N 9,=X'04C00000'		
	SRL 9,26		
	ST 9,I273B6	ENDO-EXC SCAN INDICATOR	
	L 9,TEMP		
	N 9,=X'02000000'		
	SRL 9,25		
	ST 9,I273B7	WBS SCAN MCDE INDICATOR	

	SPACE		
	L	9,TEMP	
	N	9,=X'01000000'	
	SRL	9,24	
	ST	9,I271B8	DOUBLET MODE INDICATOR
	L	9,TEMP	
	N	9,=X'00100000'	
	SRL	9,20	
	ST	9,I27H12	NB/WB INDICATOR
	SPACE		
GOODI	LA	8,WC233	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,WC234	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'7FE00000'	
	SRL	9,21	
	ST	9,IMSFC	STORE MSEC
	L	8,NSW	
	C	8,ZERO	
	BNE	S9	
	SR	8,8	
	SR	9,9	
	LA	8,WC275	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	8,TEMP	
	LA	9,WC276	
	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,XOPTIM	
	SPACE		
S9	LA	8,WC264	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'10C0C000'	
	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	SLVDUP1	
	SPACE		
XDIV	L	8, FCUP	IN DOUBLET MODE
XDIV1	ST	8, DIVSR	
	B	NEWPRF	
	SPACE		
SLVDUB1	L	9, WCRD73	
	N	9, =X'08C0C000'	BIT 5
	SRL	9, 27	
	C	9, ZERO	
	BE	NBNWBN	
	B	XDIV	IN SLAVED DOUBLET MODE
NBNWBN	L	9, WCRD73	
	N	9, =X'0010C000'	BIT 12
	SRL	9, 20	
	C	9, ZERO	
	BE	NCDIVS	
	L	8, TWO	
	B	XDIV1	NB/WB E.O.P.
NCDIVS	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	SLVDUP2	
	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	IN SLAVED DQURLET MCDE
	L	8,TWO	
	B	XDIV1	WB ONLY
	SPACE		
NEWPRF	SR	8,8	
	L	9,STEMP	
	D	8,DIVSR	
	ST	9,IPRF	
	SPACE		
NEXTW	LA	8,WC277	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'7FFFC000'	
	SRL	9,14	
	ST	9,IAZ	STORE A2
	LA	8,WC236	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'7FFFCC00'	
	SRL	9,14	
	ST	9,IEL	STORE ELEV
GOCON	LA	8,WC265	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'FFFFE000'	
	SRL	9,13	
	ST	9,TEMP2	
	LA	8,WC267	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'FFFF0C00'	
	SRL	9,16	
	A	9,TEMP2	
	S.L	9,11	
	ST	9,TEMP2	
	LA	8,WC266	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'FFE00C00'	
	SRL	9,21	
	A	9,TEMP2	
	ST	9,IRANGE	STORE RANGE
	LA	8,WC115	
	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-DCT
	SPACE		
	LA	8,WD117	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'FFC00000'	
	SRL	9,24	
	ST	9,IMQVP	ARE PRIMARY AND OFFSET MOVING
	SPACE		
	L	9,TEMP	
	N	9,=X'0CCGFF00'	
	SRL	9,8	
	ST	9,IMQVO	IS OFFSET WINDOW MOVING
	SR	9,9	
	ST	9,ICFFST	
	L	9,ICOFE	
	C	9,THRFE	
	BE	CFFCOM	
	C	9,SEVEN	
	BE	OFFCOM	
	B	OFFSKP	
	SPACE		
CFFCOM	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'7FFFFFF00'	
	SRA	9,8	
	LCR	9,9	
	B	RNEG	
RPLUS	SRA	9,8	
RNEG	ST	9,ICFFST	RANGE CFFSET FOR SLAVED WINDOW
	SPACE		
CFFSKP	LA	8,WD263	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'FOC00000'	
	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,ISSFRR	
	LA	8,WD239	
	A	8,INDEX	
	MVC	TEMP(3),0(8)	
	L	9,TEMP	
	N	9,=X'00C00200'	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'00C00100'	CHECK BIT 24 (OFSA)
	C	9,ZERO	
	BE	CKSSPP	
	LE	0,OFSA	
	AE	0,XCPAGC	
	STE	0,XOPAGC	ADD IN OFSA VALUE
CKSSPP	L	11,TEMP	
	N	11,=X'00802C00'	
	C	11,=F'0'	
	BNE	CKSSOP	
INDET	L	8,ONE	INDETERMINATE SITUATION
	ST	8,ISSFRR	
	B	CDELTAR	
CKSSOP	L	11,TEMP	
	N	11,=X'0C4C100C'	
	C	11,=F'0'	
	BE	INDET	
PPTTEST	LA	9,WD239	
	A	9,INDEX	
	MVC	TEMP(3),0(9)	
	L	10,TEMP	AUX.MICR.WCRD 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.WCRD INTO TEMP
	N	10,=X'0C802000'	
	C	10,=X'0C800000'	
	BNE	S74	
	LE	0,PSSL	ADD IN PSSL (CCND.8)
	AE	0,XPPAGC	
	STE	0,XPPAGC	
	L	9,ONE	
	ST	9,ISWSSP	

S74	L	8,NEWA	ULD OR NEW ATTN.
	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
NOATTLC	BNE	SLC	
	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)
STCRLC	STE	0,XPPAGC	
	MVC	ISWSSP(4),ONE	
CPTEST	LA	9,WD239	
	A	9,INDEX	
	MVC	TEMP(3),0(9)	
	L	10,TEMP	AUX.MICR.WCRD 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.WCRD INTO TEMP
	N	10,=X'00401000'	
	C	10,=X'00400000'	
	BNE	S75	
	LE	0,OSSL	ADD IN OSSL (COND.B)
	AE	0,XCPAGC	
	STE	0,XOPAGC	
	L	9,ONE	
	ST	9,ISWSSC	
S75	L	8,NEWA	OLD OR NEW ATTN.
	C	8,ZERO	
	BE	OUT1	
	L	9,TEMP	
	N	9,=X'00040000'	
	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,XCPAGC	
	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	1SWSSC(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	CCMPUTE RANGE BIASES
	C	9,ZERO	
	BE	NBAND	WIDE BAND TAPE
	LE	2,RBIAS+16	
	STE	2,TRBIAS	
	L	9,IPOLAR	
	C	9,ZERO	
	BE	LCPOLAR	OP POLARIZATION
	LE	2,RBIAS+20	ADD WB OP BIAS
	AE	2,TRBIAS	
	STE	2,TRBIAS	
	L	9,1SWSSC	1SWSSC WAS SET IN AGC CCMP.
	C	9,ONE	=1,ADC 32 DB (OP)
	BNE	CDELTA	
	LE	2,RBIAS+28	ADD IN CPSSA- RBIAS(8)
	AE	2,TRBIAS	
	STE	2,TRBIAS	
	B	CDELTA	
LCPOLAR	L	9,1SWSSP	
	C	9,ONE	
	BNE	CDELTA	
	LE	2,RBIAS+24	ADD IN PSSA-RBIAS(7)
	AE	2,TRBIAS	
	STE	2,TRBIAS	
	B	CDELTA	
NBAND	LE	2,RBIAS	NARROW BAND
	STE	2,TRBIAS	
	LA	8,WD273	CENTER OR EDGE TRACK
	A	8,INDFX	
	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,IRDO	CHECK SIGN OF R DCT
	C	8,ZERO	
	BH	CKNBLOW	LEADING EDGE BIAS
	LE	2,RBIAS+4	
	AE	2,TRBIAS	
	STE	2,TRBIAS	
	B	CKPOLAR	TRAILING EDGE BIAS
CKNBLOW	LE	2,RBIAS+8	
	AE	2,TRBIAS	
	STE	2,TRBIAS	
CKPOLAR	L	3,IPOLAR	CHECK POLARIZATION DESIRED
	C	9,ZERO	
	BE	CDELTA	
	LE	2,RBIAS+12	ADD NR OP BIAS
	AE	2,TRBIAS	
	STE	2,TRBIAS	
CDELTA	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'	
CNE	DC	F'1'	
TWC	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'460C0C0000000000'	
CBUF	CSECT		
INBUF	DS	CL3	
WD1	DS	CL3	PP LCG 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	CP LOG D.
WD175	DS	CL171	CP 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	
IRB85	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	CS	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	CS	1F
ISIGNO	DS	1F
I27812	DS	1F
JCCN	DS	1F
NBEG	DS	1F
NEND	DS	1F
ITST	DS	1F
NUMPRI	DS	1F
XOPAGC	DS	1F
ITBAND	DS	1F
ITAPNC	DS	1F
IPRF	DS	1F
IPOLAR	DS	F
ISSERR	DS	F
PIFA	DS	16F
CIFA	DS	16F
PFSA	DS	1F
CFSA	DS	1F
PSSA	CS	1F
CSSA	DS	1F
PSSL	DS	1F
CSSL	DS	1F
ICODE	DS	F
I27385	DS	F
I27386	DS	F
I27387	DS	F
I27388	DS	F
IMCVP	DS	F
IMCVC	DS	F
IOFFST	DS	F
XOPTIM	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)-NILESS THAN T LESS THAN T(I+N) BY THE COORDINATE
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 SLICING PARABOLA TECHNIQUE CONSISTS MERELY OF
C APPLYING THIS OPERATION TO EACH INTERVAL BETWEEN T(I)-N AND T(I+N),
C SLICING 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
C IMPLICIT REAL*8 (A-H,O-X)
COMMON RR
DIMENSION X(1,RR(1))
C
M=2*N+1
S=M
JG=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=0.0
C=-2D.0
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=0.0
GO TO 5757
C SET UP THE COEFFICIENTS FOR ACCELERATION
20 D=30.000/(H*H*S*(SQ-1.000))
D2=D*O
A = 1.000-SQ
B=0.0
C=12.0
5757 DO 500 I=JG,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=C*SUMX
59 RR(1) = 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 CE(16,8),CR(16,8),ED(16),RD(8)
DATA DE/0.0 ,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 ,0.0 ,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,
80.2560,0.2140,0.1840,0.1420,0.1150,0.0967,0.0830,0.0643,0.0575,
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,
EO.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, 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, 35.3, 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,
6 340.0,167.0,103.0, 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, 31.7, 26.5, 24.1, 20.3, 16.5, 12.8, 9.5, 8.2,421.0,
9 171.0,104.0, 86.6, 73.9, 57.1, 46.4, 35.0, 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 EC,RTOE6/7.01,2.0,4.0,5.0,6.0,8.0,10.0,12.0,14.0,18.,20.,
124.,30.,40.,60.,90.,57.29578/
DATA RC/0.01,10.,30.,60.,200.,400.,1000.,2000./
IF(R.LE.0.0)GO TC 300
RG=R/1.8520+C0
OD 100 IE0=2,15
I=17-IE0
IF(E.GE.E0(I))GO TC 120
100 CONTINUE
I=1
120 OD 200 JRC=2,8
J=10-JRC
IF(RG.GE.R0(J))GC TC 220
200 CCNTINUE
J=1
220 IF(J.EQ.8)GO TO 340
ZR=DLOG(RG/RC(J))/DLOG(RC(J+1)/RD(J))
IF(E.LE.C.0)GO TC 320
ZE=DLOG(E/E0(I))/DLOG(E0(I+1)/ED(I))
OE1=((DE(I+1,J)-DE(I,J))*(1.-ZR)+(OE(I,J+1)-OE(I,J))*ZR)*ZE
OE2=((OE(I,J+1)-OE(I,J))*(1.-ZE)+(DE(I+1,J+1)-DE(I,J+1))*ZE)*ZR
DEE=OE1+OE2+DE(I,J)
OR1=((CR(I+1,J)-CR(I,J))*(1.-ZR)+(CR(I,J+1)-OR(I,J))*ZR)*ZE
OR2=((CR(I,J+1)-CR(I,J))*(1.-ZE)+(OR(I+1,J+1)-OR(I,J+1))*ZE)*ZR
ORR=(OR1+CR2+OR(I,J))
GO TO 400
300 OEE=0.0
DRR=0.0
GO TO 400
320 DEE=OE(I,J)+(OF(I,J+1)-DE(I,J))*ZR
ORR=OR(I,J)+(OR(I,J+1)-OR(I,J))*ZR
GO TO 400
340 OELT=(E-ED(I))/(E0(I+1)-ED(I))
OEE=DELT*(CE(I+1,J)-OE(I,J))+DE(I,J)
ORR=DELT*(OR(I+1,J)-OR(I,J))+OR(I,J)
400 ORR*ORR*.30480-03
END

```