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LUNAR COMMUNICATIONS

(LUNCOM) PROGRAM

HV016A

VOLUME II - PROGRAMMER'S MANUAL

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ABSTRACT

The Lunar Communications (LUNCOM) Program simulates a communication link between two "close" points on a two-dimensional, geometrically and electromagnetically continuous lunar terrain. Four basic terrain profiles may be simulated. These are: exponential hill and valley, N^{th} degree grade, and terrain wave. The output of the LUNCOM Program is an attenuation function which may be printed or output on a plot tape for use with the TRWPLT General Plot Program.

The LUNCOM Program is written in FORTRAN V for use on the UNIVAC 1108 EXEC II computing system.

CONTENTS

TABLES

1. INTRODUCTION

The main program, LUNCOM, and the individual subroutines are discussed in separate sections. Each section contains the applicable information for the following:

a) Identification (The main program identification data are applicable to each of the subroutines.)

b) Deck identification

c) Purpose

d) Storage (not including named COMMON storage)

e) Library usage

f) Subroutine usage (refer to Table 1.1 for subroutine cross reference)

g) Named COMMON usage (refer to Table 1.2 for named COMMON cross reference)

h) Arguments

i) Flowchart

Table 1.1 Subroutine Usage

CALLING ROUTINE	Called Routines						
		LUNCOM	ATTEN	BLOCK	C	F	FPRIME	K	
	LUNCOM		X			X			
	ATTEN				X				
	C							X	
	K					X	X		

Table 1,2 Named Common Usage

NAMED COMMON BLOCK	Subroutine						
		LUNCOM	ATTEN	BLOCK	C	F FPRIME	K
	ANTCOM	X	X	X			
	DATA	X	X				X
	INCRMT	X	X		X		
	MISL	X		X			
	TERAIN	X	X	X		X X	

2. MAIN PROGRAM, LUNCOM

IDENTIFICATION

Program Number: HV016A

Title: LUNCOM

Programming Language: FORTRAN V

Machine: UNIVAC 1108 (EXEC II)

DECK IDENTIFICATION

LSD

PURPOSE

This routine serves as the overall driver, handling general input and output for the LUNCOM Program.

DESCRIPTION

Each data case is read in and interrogated. A header page is printed out with the input options for each data case. Certain standard program initialization is performed, and control is then transferred to the routine which performs the actual LUNCOM calculations. Upon completion of all data cases, a summary page is printed out.

STORAGE

This routine requires 1366_8 locations.

LIBRARY USAGE

ALOG10
ATAN2
CABS
CSQRT
FSBSFL
QQUFOF
SQRT

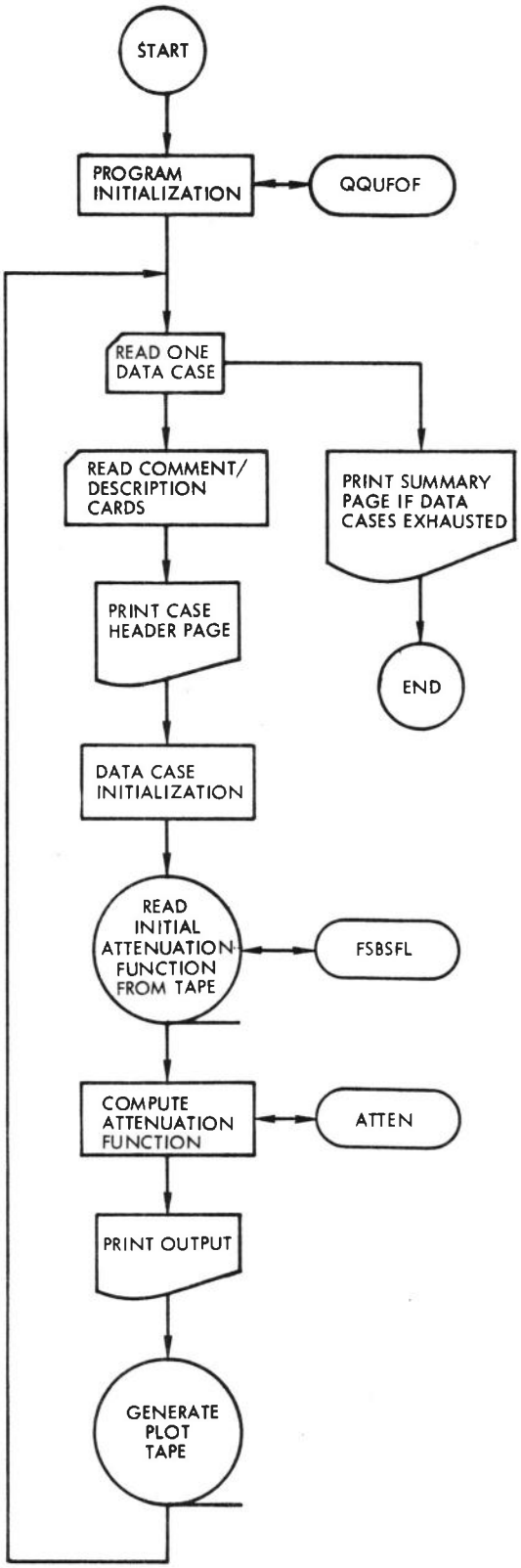
SUBROUTINE USAGE

ATTEN
F

NAMED COMMON USAGE

ANTCOM
DATA
INCRMT
MISL
TERAIN

FLOWCHART


START
PROGRAM INITIALIZATION
QQUFOF
READ ONE DATA CASE
READ COMMENT/ DESCRIPTION CARDS
PRINT SUMMARY PAGE IF DATA CASES EXHAUSTED
PRINT CASE HEADER PAGE
END
DATA CASE INITIALIZATION
READ INITIAL ATTENUATION FUNCTION FROM TAPE
FSBSFL
COMPUTE ATTENUATION FUNCTION
ATTEN
PRINT OUTPUT
GENERATE PLOT TAPE

3. SUBROUTINE ATTEN

DECK IDENTIFICATION

ATTEN

PURPOSE

This routine computes the attneuation function, W, for the Lunar Communications (LUNCOM) Program.

STORAGE

This routine requires 242_8 locations.

LIBRARY USAGE

CEXP

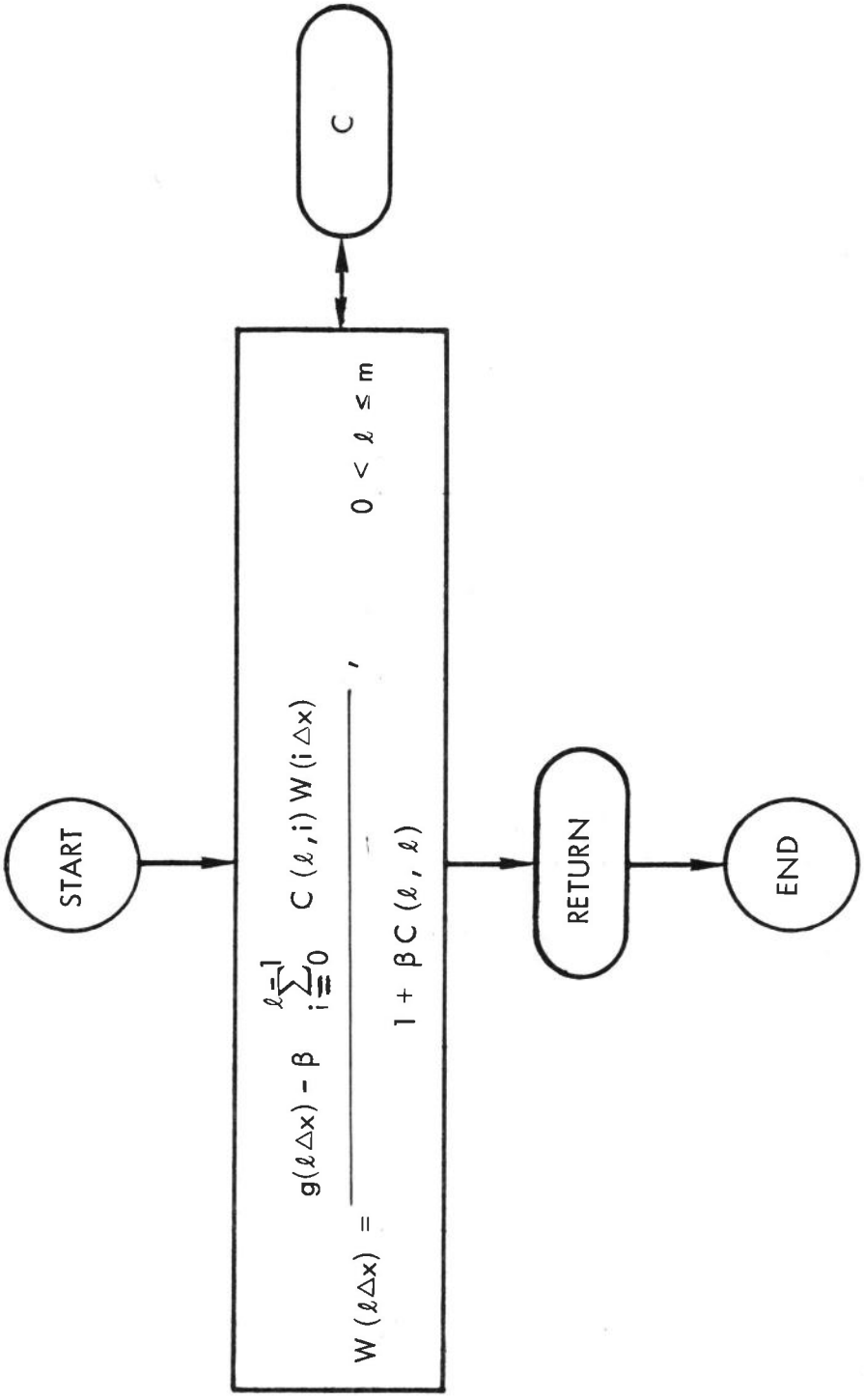
SUBROUTINE USAGE

C

NAMED COMMON USAGE

ANTCOM
DATA
INCRMT
TERAIN

FLOWCHART


C
START
$W(\ell\Delta x) = g(\ell\Delta x) - \beta \sum_{i=0}^{\ell-1} C(\ell, i)\, W(i\Delta x) \Big/ 1 + \beta C(\ell, \ell)$,
$0 < \ell \leq m$
RETURN
END

4. SUBROUTINE BLOCK

DECK IDENTIFICATION

BLOCK

PURPOSE

This is a BLOCK data subroutine for the LUNCOM Program.

NAMED COMMON USAGE

ANTCOM
MISL
TERAIN

5. SUBROUTINE C

DECK IDENTIFICATION

C

PURPOSE

This routine computes the integral coefficients, C(I,J), for the Lunar Communications (LUNCOM) Program.

STORAGE

This routine requires 756_8 locations.

SUBROUTINE USAGE

K

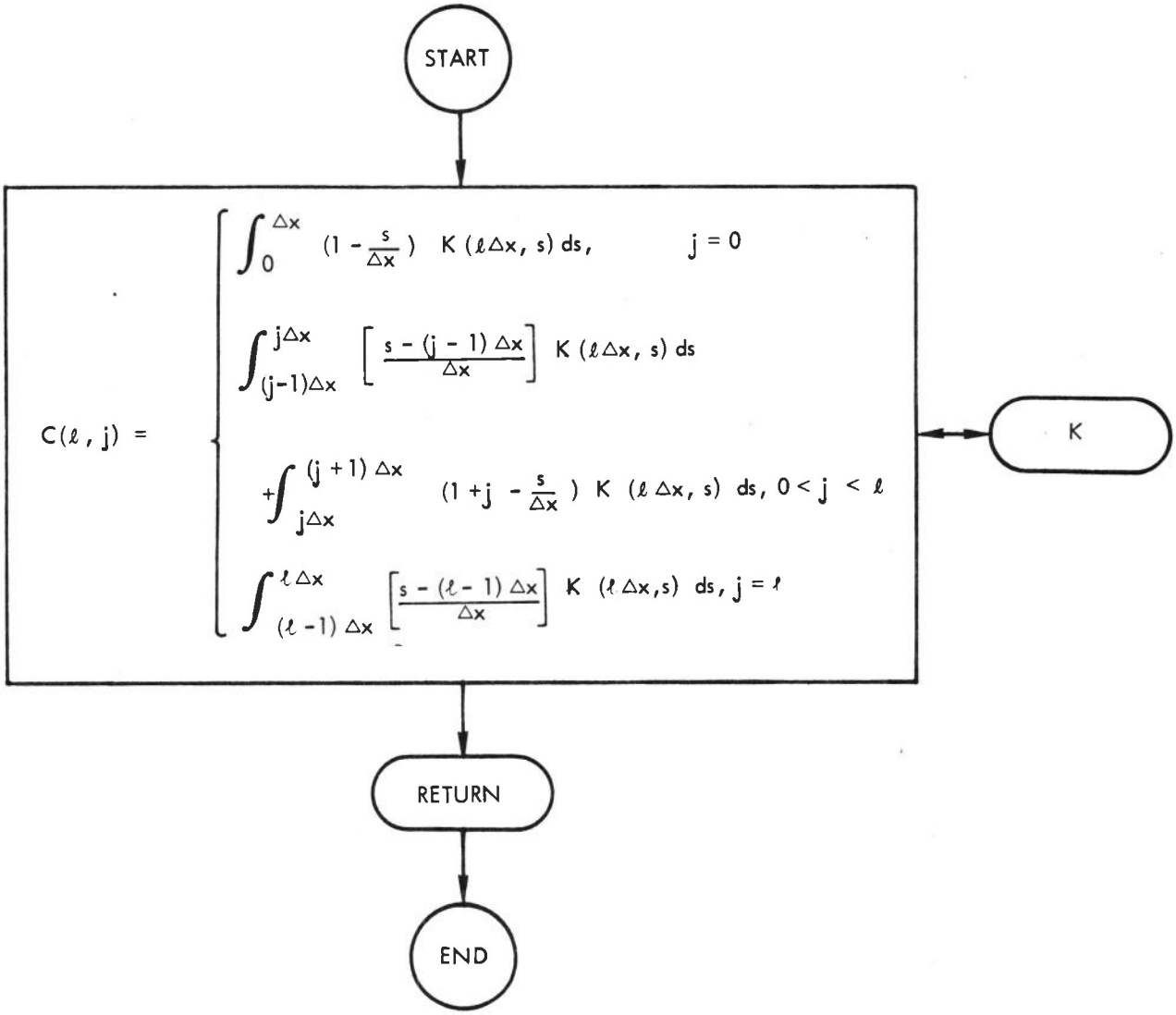
NAMED COMMON USAGE

INCRMT

ARGUMENTS

I
J

FLOWCHART


START
$C(\ell, j) =$
$\int_0^{\Delta x} (1 - \frac{s}{\Delta x})\ K(\ell\Delta x, s)\, ds, \quad j = 0$
$\int_{(j-1)\Delta x}^{j\Delta x} \left[\frac{s - (j-1)\Delta x}{\Delta x}\right] K(\ell\Delta x, s)\, ds$
$+\int_{j\Delta x}^{(j+1)\Delta x} (1 + j - \frac{s}{\Delta x})\ K(\ell\Delta x, s)\, ds, \quad 0 < j < \ell$
$\int_{(\ell-1)\Delta x}^{\ell\Delta x} \left[\frac{s - (\ell-1)\Delta x}{\Delta x}\right] K(\ell\Delta x, s)\, ds, \quad j = \ell$
K
RETURN
END

6. SUBROUTINE F

DECK IDENTIFICATION

F

PURPOSE

This function subroutine computes the terrain function, F, for the Lunar Communications (LUNCOM) Program.

STORAGE

This subroutine requires 153_8 locations.

LIBRARY USAGE

EXP
SIN

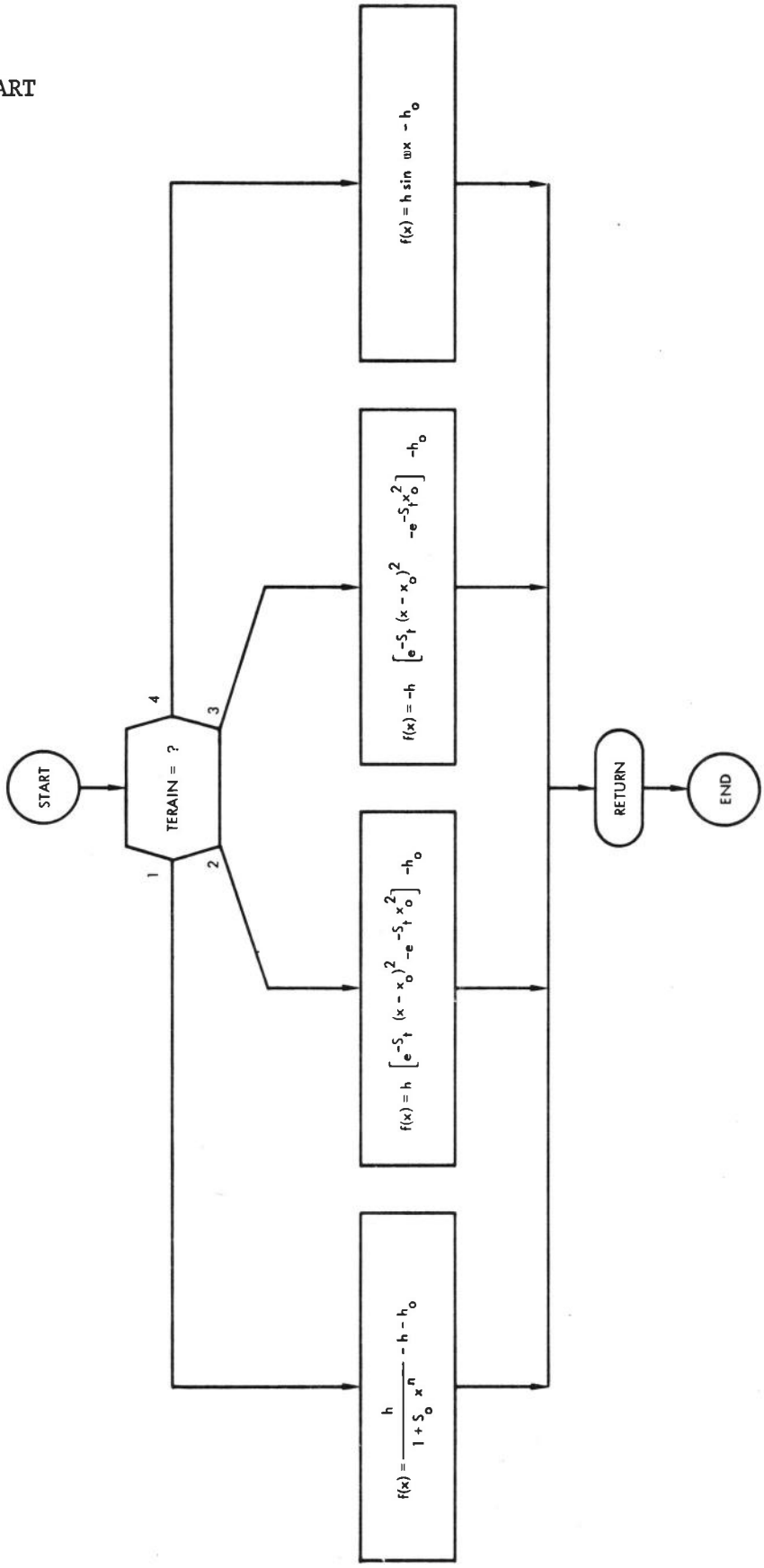
NAMED COMMON USAGE

TERAIN

ARGUMENTS

X	Distance from the transmitting source

FLOWCHART


START
TERAIN = ?
1
2
3
4
$f(x) = \frac{h}{1 + S_o x^n} - h - h_o$
$f(x) = h \left[e^{-S_f (x - x_o)^2} - e^{-S_f x_o^2} \right] - h_o$
$f(x) = -h \left[e^{-S_f (x - x_o)^2} - e^{-S_f x_o^2} \right] - h_o$
$f(x) = h \sin \omega x - h_o$
RETURN
END

7. SUBROUTINE FPRIME

DECK IDENTIFICATION

FPRIME

PURPOSE

This function subroutine computes the derivative of the terrain function for the Lunar Communications (LUNCOM) Program.

STORAGE

This routine requires 151_8 locations

LIBRARY USAGE

EXP

COS

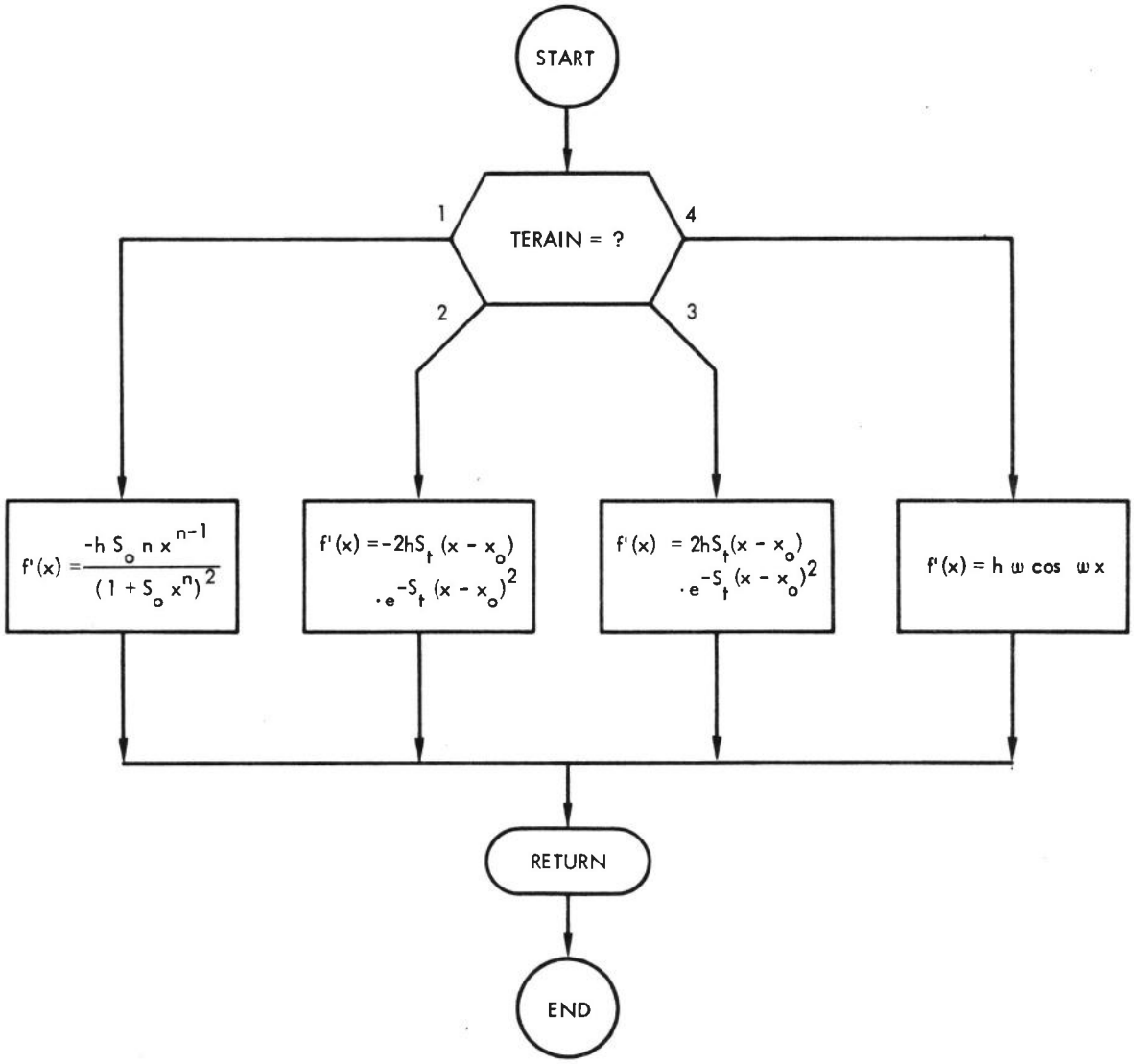
NAMED COMMON USAGE

TERAIN

ARGUMENTS

X	Distance from the transmitting source

FLOWCHART


START
TERAIN = ?
1
2
3
4
$f'(x) = \frac{-h\, S_o\, n\, x^{n-1}}{(1 + S_o\, x^n)^2}$
$f'(x) = -2hS_t\,(x - x_o) \cdot e^{-S_t (x - x_o)^2}$
$f'(x) = 2hS_t\,(x - x_o) \cdot e^{-S_t (x - x_o)^2}$
$f'(x) = h\, \omega \cos\, \omega x$
RETURN
END

8. SUBROUTINE K

DECK IDENTIFICATION

K

PURPOSE

This complex function subroutine computes the Kernel, K(x,s), for the Lunar Communications (LUNCOM) Program.

STORAGE

This routine requires 174_8 locations.

LIBRARY USAGE

CEXP
SQRT

SUBROUTINE USAGE

F
FPRIME

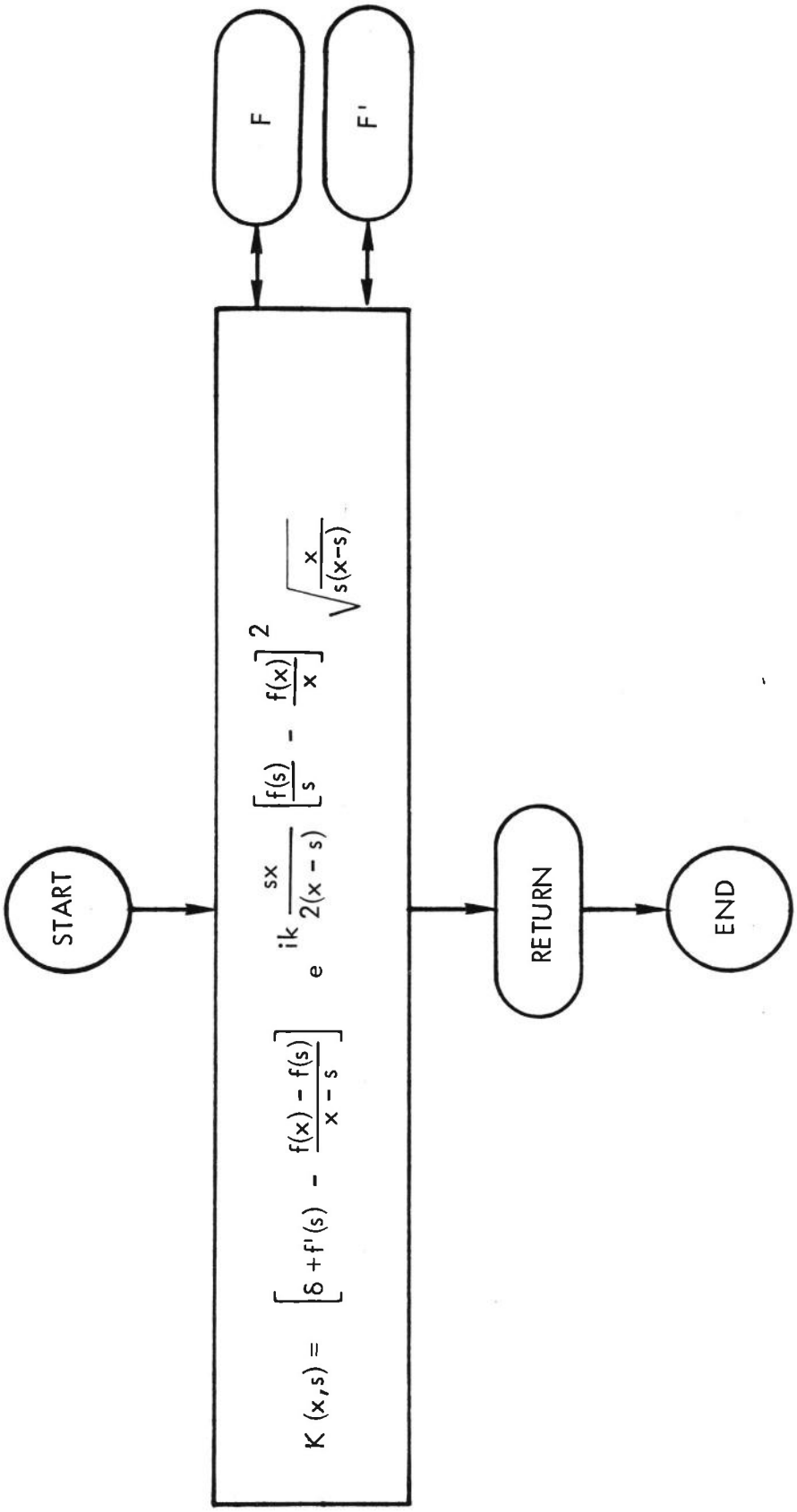
NAMED COMMON USAGE

DATA

ARGUMENTS

X
S

FLOWCHART


F
F'
START
$K(x,s) = \left[\delta + f'(s) - \frac{f(x) - f(s)}{x - s}\right] e^{ik\frac{sx}{2(x-s)}} \left[\frac{f(s)}{s} - \frac{f(x)}{x}\right]^2 \sqrt{\frac{x}{s(x-s)}}$
RETURN
END

THE MAIN DRIVER, LUNCOM DATE 150269 PAGE 1

```
& FOR LUNCOM,LUNCOM                                    16&26&03
UNIVAC 1108 FORTRAN V LEVEL   22.6  18 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16&26&03


   MAIN PROGRAM

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE    000672
        0002   *DATA    000474
        0003   *BLANK   000000
        0004   ATNCOM   003722
        0005   DATA     000005
        0006   INCRMT   000006
        0007   MISL     000016
        0008   TERAIN   000010


   EXTERNAL REFERENCES (BLOCK, NAME)

        0010   QQUFOF
        0011   FSBSFL
        0012   ATTEN
        0013   F
        0014   ALOG10
        0015   NREW$
        0016   NRNL$
        0017   NRDU$
        0020   NIO1$
        0021   NIO2$
        0022   NWDU$
        0023   NEXPD$
        0024   CSQRT
        0025   SQRT
        0026   NRBU$
        0027   CABS
        0030   ATAN2
        0031   NWBU$
        0032   NWEF$
```

0033 NSTOP$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000013	1L	0000	000424	100F	0001	000042	126G	0001	000050	130G	0001	000110	146G	
0001	000116	150G	0000	000225	2F	0001	000372	245G	0001	000461	275G	0001	000467	277G	
0000	000227	3F	0001	000521	314G	0000	000242	4F	0000	000244	5F	0000	000346	51F	
0001	000344	52L	0001	000421	54L	0000	000365	55F	0001	000423	56L	0000	000366	6F	
0001	000513	7L	0001	000577	75L	0000	000421	8F	0001	000620	9L	0001	000654	99L	
C014	R 000000	ALOG10	0006	R 000000	CLIGHT	0006	I 000001	COMENT	0004	C 000000	CONST1	0004	R 000002	CONST2	
0004	C 000003	CONST3	0005	R 000001	C1	0005	R 000002	C2	0005	R 000003	C3	0005	R 000004	C4	
0005	R 000005	C5	0000	R 000113	DB	0007	R 000000	DEGREE	0005	R 000000	DELTAX	0006	R 000002	EO	
0006	R 000003	ER	0006	R 000002	EO	0013	R 000000	F	0006	R 000004	FREQ	0007	R 000001	HEIGHT	
0007	R 000002	HO	0007	R 000002	HO	0000	I 000106	I	0006	I 000005	ICNT	0000	I 000107	J	
0003	I 000000	KSTART	0006	I 000006	NCASE	0000	I 000115	NLINES	0003	I 000001	NPOINT	0007	R 000003	OMEGA	
0000	R 000114	PHASE	0006	I 000007	PLOT	0006	I 000010	POLAR	0006	I 000011	PRINT	0000	R 000112	RATIO	
0006	R 000012	SIGMA	0007	R 000004	SLOPE	0007	R 000005	STEEP	0006	I 000013	TAPEIN	0001	R 000110	TEMP	
0000	R 000111	TEMP1	0007	I 000006	TERAIN	0000	R 000000	TITLES	0006	R 000014	TWOPI	0003	C 000002	W	
0006	R 000015	XMAX	0007	R 000007	XO	0007	R 000007	XO							


```
00100     1*   C
00100     2*   C .....................................................................
00100     3*   C .   LUNAR COMMUNICATIONS (LUNCOM) PROGRAM        C. ARGILA, JAN. '69      .
00100     4*   C .                                                                      .
00100     5*   C .   DESCRIPTION-                                                       .
00100     6*   C .      THE LUNAR COMMUNICATIONS (LUNCOM) PROGRAM SIMULATES A COMMUNICATIONS .
00100     7*   C .   LINK BETWEEN TWO 'CLOSE' POINTS ON A TWO-DIMENSIONAL, GEOMETRICALLY AND .
00100     8*   C .   ELECTROMAGNETICALLY CONTINUOUS LUNAR TERRAIN.  FOUR BASIC TERRAIN    .
00100     9*   C .   PROFILES MAY BE SIMULATED.  THESE ARE- EXPONENTIAL HILL AND VALLEY, N-TH .
00100    10*   C .   DEGREE GRADE AND TERRAIN WAVE.  THE OUTPUT OF THE LUNCOM PROGRAM IS AN .
00100    11*   C .   ATTENUATION FUNCTION WHICH MAY BE PRINTED OR OUTPUT ON A PLOT TAPE FOR .
00100    12*   C .   USE WITH THE TRWPLT GENERAL PLOT PROGRAM.                           .
00100    13*   C .      THE LUNCOM PROGRAM IS WRITTEN IN FORTRAN V FOR USE ON THE SRU 1108 .
00100    14*   C .   EXEC II SYSTEM.                                                    .
00100    15*   C .                                                                      .
00100    16*   C .   INPUT-
```

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00100    17*   C .      INPUT IS VIA THE NAME LIST 'INPUT'.  ALL PARAMETERS ARE INITIALIZED   .
00100    18*   C .   TO ZERO UNLESS OTHERWISE INDICATED.                                      .
00100    19*   C .      CLIGHT-SPEED OF LIGHT IN FREE SPACE                                   .
00100    20*   C .             CLIGHT IS INITIALIZED TO 3.0E+08.                              .
00100    21*   C .      COMENT-NUMBER OF COMMENT/DESCRIPTION CARDS FOR THIS DATA CASE         .
00100    22*   C .      DEGREE-DEGREE OF GRADE                                                .
00100    23*   C .             DEGREE IS INITIALIZED TO 1.                                    .
00100    24*   C .      DELTAX-INCREMENT OF DISTANCE (IN METERS) ALONG TERRAIN.               .
00100    25*   C .      EO     -PERMEATIVITY OF FREE SPACE                                    .
00100    26*   C .             EO IS INITIALIZED TO 0.88419414E-11.                           .
00100    27*   C .      ER     -RELATIVE PERMEATIVITY OF THE LUNAR SURFACE                    .
00100    28*   C .             ER IS INITIALIZED TO 2.8.                                      .
00100    29*   C .      FREQ   -FREQUENCY OF LINK (IN HZ)                                     .
00100    30*   C .      HEIGHT-PEAK HEIGHT (IN METERS) OF TERRAIN ABOVE OR BELOW ITS HEIGHT   .
00100    31*   C .             AT THE ORIGIN.                                                 .
00100    32*   C .      HO     -HEIGHT OF THE TRANSMITTING SOURCE (IN METERS) ABOVE THE TERRAIN.
00100    33*   C .             AT THE ORIGIN.                                                 .
00100    34*   C .      OMEGA -FREQUENCY OF THE TERRAIN WAVE (IN RADIANS PER METER)           .
00100    35*   C .      PLOT   =0, NO EFFECT                                                  .
00100    36*   C .             =1, PLOT TAPE WILL BE GENERATEN ON UNIT F (FORTRAN ID 8)       .
00100    37*   C .             PLOT IS INITIALIZED TO 1.                                      .
00100    38*   C .      POLAR =1, WAVES ARE HORIZONTALLY POLARIZED                            .
00100    39*   C .             =-1,WAVES ARE VERTICALLY POLARIZED                             .
00100    40*   C .             POLAR IS INITIALIZED TO 1.                                     .
00100    41*   C .      PRINT =0, NO EFFECT                                                   .
00100    42*   C .             =1, ATTENUATION FUNCTION WILL BE PRINTED OUT                   .
00100    43*   C .             PRINT IS INITIALIZED TO 1.                                     .
00100    44*   C .      SIGMA -CONDUCTIVITY OF THE LUNAR SURFACE                              .
00100    45*   C .             SIGMA IS INITIALIZED TO 1.0E-05.                               .
00100    46*   C .      SLOPE -SLOPE OF GRADE                                                 .
00100    47*   C .             SLOPE IS INITIALIZED TO 1.                                     .
00100    48*   C .      STEEP -STEEPNESS OF EXPONENTIAL HILL OR VALLEY                        .
00100    49*   C .             STEEP IS INITIALIZED TO 1.                                     .
00100    50*   C .      TAPEIN=0, NO EFFECT                                                   .
00100    51*   C .             =N, INDICATES THAT INITIAL VALUES OF THE ATTENUATION FUNCTION   .
00100    52*   C .             WILL BE READ IN FROM THE N-TH FILE OF A PREVIOUSLY GENERATED   .
00100    53*   C .             PLOT TAPE MOUNTED ON UNIT E (FORTRAN ID 7)                     .
00100    54*   C .      TERAIN=1, TERRAIN IS A GRADE OF DEGREE 'DEGREE' AND SLOPE 'SLOPE'     .
00100    55*   C .             =2, TERRAIN IS AN EXPONENTIAL HILL OF STEEPNESS 'STEEP'        .
00100    56*   C .             =3, TERRAIN IS AN EXPONENTIAL VALLEY OF STEEPNESS 'STEEP'      .
00100    57*   C .             =4, TERRAIN IS A WAVE OF FREQUENCY 'OMEGA'                     .
```

```
00100  C .           TERAIN IS INITIALIZED TO 2.
00100  C .      XMAX  -MAXIMUM DISTANCE (IN METERS) FROM THE ORIGIN TO BE CONSIDERED  .
00100  C .      XO     -DISTANCE FROM THE ORIGIN (IN METERS) AT WHICH HILL PEAK OR     .
00100  C .             VALLEY NULL OCCURS.                                             .
00100  C .                                                                             .
00100  C .   PRINT OUTPUT-                                                             .
00100  C .      THE INPUT PARAMETERS ARE PRINTED ON A HEADER PAGE FOR EACH DATA CASE.  .
00100  C .   IF PRINT=1 THE ATTENUATION FUNCTION WILL BE PRINTED IN SEVEN COLUMNS      .
00100  C .   HEADED- DISTANCE TO ORIGIN, TERRAIN FUNCTION, ATTENUATION FUNCTION (REAL  .
00100  C .   AND IMAGINARY PARTS), GAIN (RATIO AND DB) AND PHASE (DEGREES).  OUTPUT    .
00100  C .   IS HEADED BY THE COMMENT/DESCRIPTION CARDS FOR THAT DATA CASE.            .
00100  C .      AT THE CONCLUSION OF THE RUN A SUMMARY PAGE IS PRINTED.                .
00100  C .                                                                             .
00100  C .   PLOT TAPE OUTPUT-                                                         .
00100  C .      WHEN PLOT=1 ONE FILE ON A PLOT TAPE WILL BE GENERATED FOR THIS DATA    .
00100  C .   CASE.  ONE SEVEN WORD RECORD WILL BE GENERATED FOR EACH POINT.  THE       .
00100  C .   SEVEN WORDS OF EACH RECORD CORRESPOND, RESPECTIVELY, TO THE SEVEN COLUMNS.
00100  C .   OF PRINTED OUTPUT.                                                        .
00100  C .                                                                             .
00100  C .   SUBROUTINE USAGE-                                                         .
00100  C .      ATTEN                                                                  .
00100  C .      BLOCK                                                                  .
00100  C .      F                                                                      .
00100  C .      FSBSFL                                                                 .
00100  C .      QQUFCF                                                                 .
00100  C .                                                                             .
00100  C .   NAMED COMMON USAGE-                                                       .
00100  C .      ATNCOM                                                                 .
00100  C .      DATA                                                                   .
00100  C .      INCRMT                                                                 .
00100  C .      MISL                                                                   .
00100  C .      TERAIN                                                                 .
00100  C .                                                                             .
00100  C .   RESTRICTIONS-                                                             .
00100  C .      A MAXIMUM OF 1000 POINTS ONLY CAN BE CALCULATED, HENCE XMAX/DELTAX     .
00100  C .   .LT. 1000.                                                                .
00100  C .      A MAXIMUM OF 5 COMMENT/DESCRIPTION CARDS CAN BE READ.                  .
00100  C .                                                                             .
00100  C ...............................................................................
00100  C
00101        INTEGER COMENT, PLOT  , POLAR , PRINT , TAPEIN, TERAIN
```

```
00103    99*         COMPLEX CONST1, CONST3, W
00104   100*         COMMON /ATNCOM/ KSTART, NPOINT, W(1000)
00105   101*         COMMON /DATA  / CONST1, CONST2, CONST3
00106   102*         COMMON /INCRMT/ DELTAX, C1    , C2    , C3    , C4    , C5
00107   103*         COMMON /MISL  / CLIGHT, COMENT, EO    , ER    , FREQ  , ICNT  ,
00107   104*        $NCASE , PLOT  , POLAR , PRINT , SIGMA , TAPEIN, TWOPI , XMAX
00110   105*         COMMON /TERAIN/ DEGREE, HEIGHT, HO    , OMEGA , SLOPE , STEEP ,
00110   106*        $TERAIN, XO
00111   107*         DIMENSION       TITLES(14,5)
00112   108*         EQUIVALENCE     (EC,EO)       , (HO,HO)       , (XO,XO)
00113   109*         NAME LIST /INPUT /      CLIGHT, COMENT, DEGREE, DELTAX, EO    ,
00113   110*        $EO    , ER    , FREQ  , HEIGHT, HO    , HO    , OMEGA , PLOT  ,
00113   111*        $POLAR , PRINT , SIGMA , SLOPE , STEEP , TAPEIN, TERAIN, XMAX  ,
00113   112*        $XO    , XO
00113   113*   C
00113   114*   C *** ESTABLISH OVERFLOW/UNDERFLOW MONITOR
00114   115*         CALL QOUFOF(ICNT,ICNT,0)
00114   116*   C
00114   117*   C *** REWIND TAPES
00115   118*         REWIND 7
00116   119*         REWIND 8
00116   120*   C
00116   121*   C *** READ INPUT DATA
00117   122*       1 READ(5,INPUT,END=99)
00117   123*   C
00117   124*   C *** READ COMMENT/DESCRIPTION CARDS
00122   125*         COMENT = MIN0(5,COMENT)
00123   126*         IF(COMENT .GT. 0)
00123   127*        $READ(5,2) ((TITLES(I,J),I=1,14),J=1,COMENT)
00135   128*       2 FORMAT(13A6,A2)
00135   129*   C
00135   130*   C *** PRINT PAGE HEADING
00136   131*         NCASE = NCASE + 1
00137   132*         WRITE(6,3) NCASE
00142   133*       3 FORMAT(1H1 40X 28HLUNAR COMMUNICATIONS PROGRAM//47X 13HDATA CASE N
00142   134*        $O.I3/)
00143   135*         IF(COMENT .GT. 0)
00143   136*        $WRITE(6,4) ((TITLES(I,J),I=1,14),J=1,COMENT)
00155   137*       4 FORMAT(15X 13A6,A2)
00156   138*         WRITE(6,5)      CLIGHT, COMENT, DEGREE, DELTAX, EO    , ER    ,
00156   139*        $FREQ  , HEIGHT, HO    , OMEGA , PLOT  , POLAR , PRINT , SIGMA ,
```

```
00156  140*       $SLOPE , STEEP , TAPEIN, TERAIN, XMAX  , XO
00204  141*      5 FORMAT(/49X 13HINPUT OPTIONS          /46X 8HCLIGHT =1PE10.4
00204  142*       $        /46X 8HCOMENT =I10           /46X 8HDEGREE =E10.4
00204  143*       $        /46X 8HDELTAX =E10.4         /46X 8HE0     =E10.4
00204  144*       $        /46X 8HER     =E10.4         /46X 8HFREQ   =E10.4
00204  145*       $        /46X 8HHEIGHT =E10.4         /46X 8HHO     =E10.4
00204  146*       $        /46X 8HOMEGA  =E10.4         /46X 8HPLOT   =I10
00204  147*       $        /46X 8HPOLAR  =I10           /46X 8HPRINT  =I10
00204  148*       $        /46X 8HSIGMA  =E10.4         /46X 8HSLOPE  =E10.4
00204  149*       $        /46X 8HSTEEP  =E10.4         /46X 8HTAPEIN =I10
00204  150*       $        /46X 8HTERAIN =I10           /46X 8HXMAX   =E10.4
00204  151*       $        /46X 8HXO     =E10.4)
00204  152*  C
00204  153*  C *** COMPUTE PROGRAM CONSTANTS
00205  154*        TEMP = TWOPI * FREQ
00206  155*        CONST1 = CSQRT(CMPLX(ER,SIGMA/(TEMP*E0))**POLAR)
00207  156*        CONST2 = TEMP / CLIGHT
00210  157*        CONST3 = CMPLX(.707106781,-.707106781) * SQRT(FREQ / CLIGHT)
00211  158*        C1 = .4869533 * DELTAX
00212  159*        C2 = .4325317 * DELTAX
00213  160*        C3 = .3397048 * DELTAX
00214  161*        C4 = .2166977 * DELTAX
00215  162*        C5 = .07443717* DELTAX
00216  163*        NPOINT = XMAX / DELTAX
00217  164*        NPOINT = MIN0(1000,NPOINT+1)
00217  165*  C
00217  166*  C *** READ INITIAL ATTENUATION FUNCTION VALUES FROM TAPE
00220  167*        KSTART = 2
00221  168*        IF(TAPEIN .EQ. 0)
00221  169*       $GO TO 54
00223  170*        CALL FSBSFL(7,TAPEIN-1,I)
00224  171*        IF(I .EQ. 0)
00224  172*       $GO TO 52
00226  173*        WRITE(6,51)
00230  174*     51 FORMAT(85HOERROR OCCURRED IN ATTEMPTING TO POSITION THE INPUT TAPE
00230  175*       $.  THIS CASE WILL BE ABORTED.)
00231  176*        REWIND 7
00232  177*        GO TO 1
00233  178*     52 READ(7) TEMP, TEMP1, W(1), RATIO, DB, PHASE, KSTART
00244  179*        DO 53 I = 2, KSTART
00247  180*     53 READ(7) TEMP, TEMP1, W(I)
```

```
00255   181*          REWIND 7
00256   182*          KSTART = KSTART + 1
00257   183*          IF(KSTART .GT. NPOINT)
00257   184*         $GO TO 56
00257   185*    C
00257   186*    C *** COMPUTE ATTENUATION FUNCTION
00261   187*       54 CALL ATTEN
00261   188*    C
00261   189*    C *** PRINT OUTPUT HEADER PAGE
00262   190*       56 IF(PRINT .EQ. 0)
00262   191*         $GO TO 7
00264   192*          NLINES = 6
00265   193*          IF(COMENT .GT. 0)
00265   194*         $NLINES = COMENT + 7
00267   195*          WRITE(6,3) NCASE
00272   196*          IF(COMENT .GT. 0)
00272   197*         $WRITE(6,4) ((TITLES(I,J),I=1,14),J=1,COMENT)
00304   198*          WRITE(6,55)
00306   199*       55 FORMAT(1H )
00307   200*          WRITE(6,6)
00311   201*        6 FORMAT(19H DISTANCE TO ORIGIN 3X 7HTERRAIN 9X 20HATTENUATION FUNCT
00311   202*         $ION 18X 4HGAIN 18X 5HPHASE/ 6X 8H(METERS) 8X 8HFUNCTION 7X 6H(REAL
00311   203*         $) 7X 11H(IMAGINARY) 6X 7H(RATIO) 9X 4H(DB) 11X 5H(DEG))
00311   204*    C
00311   205*    C *** GENERATE OUTPUT PRINT AND PLOT TAPE
00312   206*        7 TEMP = -DELTAX
00313   207*          DO 9 I = 1, NPOINT
00316   208*          TEMP = TEMP + DELTAX
00317   209*          TEMP1 = F(TEMP)
00320   210*          RATIO = CABS(W(I))
00321   211*          DB = 20.0 * ALOG10(RATIO)
00322   212*          PHASE = 57.2957795 * ATAN2(AIMAG(W(I)),REAL(W(I)))
00323   213*          IF(PRINT .EQ. 0)
00323   214*         $GO TO 9
00325   215*          NLINES = NLINES + 1
00326   216*          IF(NLINES .LE. 41)
00326   217*         $GO TO 75
00330   218*          NLINES = 3
00331   219*          WRITE(6,6)
00333   220*       75 WRITE(6,8) TEMP, TEMP1, W(I), RATIO, DB, PHASE
00343   221*        8 FORMAT(7(5X 1PE10.4))
```

```
00344   222*       9 IF(PLOT .NE. 0)
00344   223*        $WRITE(8) TEMP, TEMP1, W(I), RATIO, DB, PHASE, NPOINT
00357   224*         IF(PLOT .NE. 0)
00357   225*        $ENDFILE 8
00357   226*   C
00357   227*   C *** PROCESS ANOTHER DATA CASE
00361   228*         GO TO 1
00361   229*   C
00361   230*   C *** PRINT SUMMARY PAGE AND TERMINATE EXECUTION
00362   231*      99 WRITE(6,100) NCASE
00365   232*     100 FORMAT(46H1END OF LUNCOM EXECUTION.  NORMAL TERMINATION.I3,24H DAT
00365   233*        $A CASE(S) PROCESSED.)
00366   234*         REWIND 8
00367   235*         STOP
00370   236*         END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
```

```
                    SUBROUTINE ATTEN                                DATE  150269  PAGE      1

& FOR ATTEN,ATTEN                                                       16&26&06
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16&26&06


   SUBROUTINE ATTEN      ENTRY POINT 000175

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE    000204
         0000   *DATA    000036
         0002   *BLANK   000000
         0003   ATNCOM   003722
         0004   DATA     000005
         0005   INCRMT   000006
         0006   TERAIN   000010


   EXTERNAL REFERENCES (BLOCK, NAME)

         0007   C
         0010   CEXP
         0011   CDV$
         0012   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000010 111G       0001   000022 116G       0007 C 000000 C          0004 C 000000 CONST1      0004 R 000002 CONST2
    0004 C 000003 CONST3     0006 R 000000 DEGREE     0005 R 000000 DELTAX     0005 R 000001 DUMMY2      0006 R 000001 HEIGHT
    0006 R 000002 HO         0000 I 000004 I          0000 I 000003 J          0000 I 000002 K           0003 I 000000 KSTART
    0003 I 000001 NPOINT     0006 R 000003 OMEGA      0006 R 000004 SLOPE      0006 R 000005 STEEP       0000 C 000000 TEMP
    0006 R 000006 TERAIN     0003 C 000002 W          0006 R 000007 X0


00100      1*   C
00100      2*   C ..............................................................................
```

```
00100     3*   C .   SUBROUTINE ATTEN                                C. ARGILA, JAN. '69        .
00100     4*   C .                                                                              .
00100     5*   C .   DESCRIPTION-                                                               .
00100     6*   C .      THIS ROUTINE COMPUTES THE ATTENUATION FUNCTION, W, FOR THE LUNAR       .
00100     7*   C .   COMMUNICATIONS (LUNCOM) PROGRAM.                                          .
00100     8*   C .                                                                              .
00100     9*   C .   NAMED COMMON USAGE-                                                        .
00100    10*   C .      ATNCOM                                                                 .
00100    11*   C .      DATA                                                                   .
00100    12*   C .      INCRMT                                                                 .
00100    13*   C .      TERAIN                                                                 .
00100    14*   C .                                                                              .
00100    15*   C .   SUBROUTINE USAGE-                                                         .
00100    16*   C .      C                                                                      .
00100    17*   C .                                                                              .
00100    18*   C ..............................................................................
00100    19*   C
00101    20*         SUBROUTINE ATTEN
00103    21*         COMPLEX C, CONST1, CONST3, TEMP, W
00104    22*         COMMON /ATNCOM/ KSTART, NPOINT, W(1000)
00105    23*         COMMON /DATA/ CONST1, CONST2, CONST3
00106    24*         COMMON /INCRMT/ DELTAX, DUMMY2(5)
00107    25*         COMMON /TERAIN/ DEGREE, HEIGHT, H0     , OMEGA , SLOPE , STEEP ,
00107    26*        $TERAIN, X0
00110    27*         DO 10 K = KSTART, NPOINT
00113    28*         TEMP = (0.0,0.0)
00114    29*         J = K - 1
00115    30*         DO 1 I = 1, J
00120    31*       1 TEMP = TEMP + C(J,I-1) * W(I)
00122    32*      10 W(K) = (CEXP(CMPLX(0.0,CONST2 * H0**2/(2.0 * J * DELTAX))) -
00122    33*        $       CONST3 * TEMP) / (1.0 + CONST3 * C(J,J))
00124    34*         RETURN
00125    35*         END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

```
                SUBROUTINE BLOCK                                        DATE  150269  PAGE      1

& FOR BLOCK,BLOCK                                                          16626607
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16626608


   BLOCK DATA

   STORAGE USED (BLOCK, NAME, LENGTH)

         0003   ATNCOM  003722
         0004   MISL    000016
         0005   TERAIN  000010


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0004 R 000000 CLIGHT     0004 I 000001 COMENT     0005 R 000000 DEGREE     0004 R 000003 ER         0004 R 000002 EO
    0004 R 000004 FREQ       0005 R 000001 HEIGHT     0005 R 000002 HO         0004 I 000005 ICNT       0003 I 000000 KSTART
    0004 I 000006 NCASE      0003 I 000001 NPOINT     0005 R 000003 OMEGA      0004 I 000007 PLOT       0004 I 000010 POLAR
    0004 I 000011 PRINT      0004 R 000012 SIGMA      0005 R 000004 SLOPE      0005 R 000005 STEEP      0004 I 000013 TAPEIN
    0005 I 000006 TERAIN     0004 R 000014 TWOPI      0003 C 000002 W          0004 R 000015 XMAX       0005 R 000007 XO
```



```
00100     1*   C
00100     2*   C ..............................................................................
00100     3*   C .   SUBROUTINE BLOCK                                C. ARGILA, JAN. '69       .
00100     4*   C .                                                                             .
00100     5*   C .   DESCRIPTION-                                                             .
00100     6*   C .      THIS ROUTINE IS A BLOCK DATA SUBROUTINE FOR THE LUNCOM PROGRAM.        .
00100     7*   C .                                                                             .
00100     8*   C ..............................................................................
00100     9*   C
00101    10*         BLOCK DATA
00102    11*         INTEGER COMENT, PLOT  , POLAR , PRINT , TAPEIN, TERAIN
00103    12*         COMPLEX W
00104    13*         COMMON /ATNCOM/ KSTART, NPOINT, W(1000)
00105    14*         COMMON /MISL  / CLIGHT, COMENT, EO    , ER    , FREQ  , ICNT  ,
00105    15*        $NCASE , PLOT  , POLAR , PRINT , SIGMA , TAPEIN, TWOPI , XMAX
```

```
00106    16*        COMMON /TERAIN/ DEGREE, HEIGHT, HO    , OMEGA , SLOPE , STEEP ,
00106    17*       $TERAIN, XO
00107    18*        DATA CLIGHT /3.0E+08/
00111    19*        DATA COMENT /0/
00113    20*        DATA DEGREE /1.0/
00115    21*        DATA EO     /.88419414E-11/
00117    22*        DATA ER     /2.8/
00121    23*        DATA FREQ   /0.0/
00123    24*        DATA HEIGHT /0.0/
00125    25*        DATA HO     /0.0/
00127    26*        DATA ICNT   /077/
00131    27*        DATA NCASE  /0/
00133    28*        DATA OMEGA  /0.0/
00135    29*        DATA PLOT   /1/
00137    30*        DATA POLAR  /1/
00141    31*        DATA PRINT  /1/
00143    32*        DATA SIGMA  /1.0E-05/
00145    33*        DATA SLOPE  /1.0/
00147    34*        DATA STEEP  /1.0/
00151    35*        DATA TAPEIN /0/
00153    36*        DATA TERAIN /2/
00155    37*        DATA TWOPI  /6.2831853/
00157    38*        DATA W(1)   /(1.0,0.0)/
00161    39*        DATA XMAX   /0.0/
00163    40*        DATA XO     /0.0/
00165    41*        END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

```
                SUBROUTINE C                                    DATE  150269  PAGE      1

& FOR C,C                                                          16&26&09
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16&26&09


   FUNCTION C           ENTRY POINT 000674

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000710
        0000   *DATA   000046
        0002   *BLANK  000000
        0003   INCRMT  000006


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   K
        0005   NERR2$
        0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000035 1CL       0001   000203 100L      0001   000512 1000L     0001   000037 120G      0001   000222 131G
    0001   000517 141G      0000 R 000012 A         0000 R 000016 APRIME    0003 R 000000 B         0000 C 000000 C
    0000 R 000004 CONS1     0003 R 000001 CONS2     0000 R 000013 D         0000 I 000014 IGOTO     0000 I 000011 I$
    0004 C 000000 K         0000 I 000015 L         0000 C 000002 TEMP


00100     1*   C .....................................................................
00100     2*   C .   FUNCTION C                                  C. ARGILA, JAN. '69   .
00100     3*   C .                                                                     .
00100     4*   C .   DESCRIPTION-                                                     .
00100     5*   C .      THIS ROUTINE COMPUTES THE INTEGRAL COEFFICIENTS, C(I,J), FOR THE .
00100     6*   C .   LUNAR COMMUNICATIONS (LUNCOM) PROGRAM.                           .
00100     7*   C .                                                                     .
```

```
00100     8*   C .   ARGUMENTS-                                                .
00100     9*   C .      I                                                      .
00100    10*   C .      J                                                      .
00100    11*   C .                                                             .
00100    12*   C .   RESTRICTIONS-                                            .
00100    13*   C .      0 .LE. J .LE. I                                        .
00100    14*   C .                                                             .
00100    15*   C .   NAMED COMMON USAGE-                                       .
00100    16*   C .      INCRMT                                                 .
00100    17*   C .                                                             .
00100    18*   C .   SUBROUTINE USAGE-                                         .
00100    19*   C .      K                                                      .
00100    20*   C .                                                             .
00100    21*   C ..............................................................
00100    22*   C
00101    23*         COMPLEX FUNCTION C(I,J)
00103    24*         COMPLEX K, TEMP
00104    25*         COMMON /INCRMT/ B, CONS2(5)
00105    26*         DIMENSION CONS1(5)
00106    27*         DATA CONS1 /.03333567, .07472567, .1095432, .1346334, .1477621/
00110    28*         C = (0.0,0.0)
00111    29*         A = ABS((J - 0.5) * B)
00112    30*         D = I * B
00113    31*         IF(J .EQ. 0)
00113    32*        $GO TO 10
00115    33*         IGOTO = J / I + 1
00116    34*         GO TO (100,1000), IGOTO
00117    35*      10 DO 11 L = 1, 5
00122    36*      11 C = C + CONS1(L) * ((1.0 - (A + CONS2(L)) / B) * K(D,A+CONS2(L)) +
00122    37*        $   (1.0 - (A - CONS2(L)) / B) * K(D,A-CONS2(L)))
00124    38*         C = B * C
00125    39*         RETURN
00126    40*     100 APRIME = A + B
00127    41*         TEMP = (0.0,0.0)
00130    42*         DO 110 L = 1, 5
00133    43*         C = C + CONS1(L) * (((A + CONS2(L)) / B + 1.0 - J) * K(D,A+CONS2(L
00133    44*        $   )) + ((A - CONS2(L)) / B + 1.0 - J) * K(D,A-CONS2(L)))
00134    45*     110 TEMP = TEMP + CONS1(L) * ((1.0 + J - (APRIME + CONS2(L)) / B) *
00134    46*        $       K(D,APRIME+CONS2(L)) + (1.0 + J - (APRIME - CONS2(L)) / B) *
00134    47*        $       K(D,APRIME-CONS2(L)))
00136    48*         C = (C + TEMP) * B
```

```
00137    49*          RETURN
00140    50*     1000 DO 1100 L = 1, 5
00143    51*     1100 C = C + CONS1(L) * (((A + CONS2(L)) / B + 1.0 - J) * K(D,A+CONS2(L
00143    52*         $    )) + ((A - CONS2(L)) / B + 1.0 - J) * K(D,A-CONS2(L)))
00145    53*          C = B * C
00146    54*          RETURN
00147    55*          END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

```
                SUBROUTINE F                                          DATE  150269  PAGE      1

& FOR F,F                                                                 16&26&11
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16&26&11


   FUNCTION F           ENTRY POINT 000134

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000140
        0000   *DATA   000013
        0002   *BLANK  000000
        0003   TERAIN  000010


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   NERR2$
        0005   NEXP6$
        0006   EXP
        0007   SIN
        0010   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000012 1L          0001   000031 2L          0001   000062 3L          0001   000113 4L          0003 R 000000 DEGREE
    0000 R 000000 F           0003 R 000001 HEIGHT      0003 R 000002 HO          0003 R 000003 OMEGA       0003 R 000004 SLOPE
    0003 R 000005 STEEP       0003 I 000006 TERAIN      0003 R 000007 XO


00100      1*   C
00100      2*   C ..........................................................................
00100      3*   C .   FUNCTION F                                    C. ARGILA, JAN. '69      .
00100      4*   C .                                                                          .
00100      5*   C .   DESCRIPTION-                                                          .
00100      6*   C .      THIS FUNCTION SUBROUTINE COMPUTES THE TERRAIN FUNCTION, F, FOR THE  .
```

```
C0100     7*   C .   LUNAR COMMUNICATIONS (LUNCOM) PROGRAM.                    .
C0100     8*   C .                                                            .
0010C     9*   C .   ARGUMENT-                                                .
C0100    10*   C .      X     DISTANCE FROM THE TRANSMITTING SOURCE           .
C0100    11*   C .                                                            .
C0100    12*   C .   NAMED COMMON USAGE-                                      .
C0100    13*   C .      TERAIN                                                .
C0100    14*   C .                                                            .
C0100    15*   C ....................................................................
00100    16*   C
00101    17*         REAL FUNCTION F(X)
00103    18*         INTEGER TERAIN
00104    19*         COMMON /TERAIN/ DEGREE, HEIGHT, HO     , OMEGA , SLOPE , STEEP ,
00104    20*        $TERAIN, XO
00105    21*         GO TO (1,2,3,4), TERAIN
00106    22*       1 F = HEIGHT * (1.0 / (1.0 + SLOPE * X**DEGREE) - 1.0) - HO
00107    23*         RETURN
00110    24*       2 F = HEIGHT * (EXP(-STEEP * (X - XO)**2) - EXP(-STEEP * XO**2)) -HO
00111    25*         RETURN
00112    26*       3 F = -HEIGHT * (EXP(-STEEP * (X - XO)**2) - EXP(-STEEP * XO**2))-HO
00113    27*         RETURN
00114    28*       4 F = HEIGHT * SIN(OMEGA * X) - HO
00115    29*         RETURN
00116    30*         END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
```

```
                    SUBROUTINE FPRIME                                   DATE  150269  PAGE      1

& FOR FPRIME,FPRIME                                                        16&26&12
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16&26&12


   FUNCTION FPRIME      ENTRY POINT 000131

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000135
        0000   *DATA   000014
        0002   *BLANK  000000
        0003   TERAIN  000010


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   NERR2$
        0005   NEXP6$
        0006   EXP
        0007   COS
        0010   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000012 1L          0001   000043 2L          0001   000065 3L          0001   000107 4L          0003 R 000000 DEGREE
    0000 R 000000 FPRIME      0003 R 000001 HEIGHT      0003 R 000002 HO          0003 R 000003 OMEGA       0003 R 000004 SLOPE
    0003 R 000005 STEEP       0003 I 000006 TERAIN      0003 R 000007 XO


00100     1*   C
00100     2*   C ..................................................................
00100     3*   C .   FUNCTION FPRIME                          C. ARGILA, JAN. '69   .
00100     4*   C .                                                                  .
00100     5*   C .   DESCRIPTION-                                                  .
00100     6*   C .      THIS FUNCTION SUBROUTINE COMPUTES THE DERIVATIVE OF THE TERRAIN .
```

```
00100     7*   C .   FUNCTION FOR THE LUNAR COMMUNICATIONS (LUNCOM) PROGRAM.                .
00100     8*   C .                                                                          .
00100     9*   C .   ARGUMENT-                                                             .
00100    10*   C .      X     DISTANCE FROM THE TRANSMITTING SOURCE                         .
00100    11*   C .                                                                          .
00100    12*   C .   NAMED COMMON USAGE-                                                   .
00100    13*   C .      TERAIN                                                            .
00100    14*   C .                                                                          .
00100    15*   C ..........................................................................
00100    16*   C
00101    17*         REAL FUNCTION FPRIME(X)
00103    18*         INTEGER TERAIN
00104    19*         COMMON /TERAIN/ DEGREE, HEIGHT, HO     , OMEGA , SLOPE , STEEP ,
00104    20*        $TERAIN, XO
00105    21*         GO TO (1,2,3,4), TERAIN
00106    22*        1 FPRIME =-HEIGHT * SLOPE * DEGREE * X**(DEGREE - 1) / (1.0 + SLOPE
00106    23*        $         * X**DEGREE)**2
00107    24*         RETURN
00110    25*        2 FPRIME = -2.*HEIGHT * STEEP * (X - XO) * EXP(-STEEP * (X - XO)**2)
00111    26*         RETURN
00112    27*        3 FPRIME = 2.*HEIGHT * STEEP * (X - XO) * EXP(-STEEP * (X - XO)**2)
00113    28*         RETURN
00114    29*        4 FPRIME = HEIGHT * OMEGA * COS(OMEGA * X)
00115    30*         RETURN
00116    31*         END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

```
                SUBROUTINE K                                          DATE  150269  PAGE      1

& FOR K,K                                                                 16626613
UNIVAC 1108 FORTRAN V LEVEL   2206 3018 F5018H
THIS COMPILATION WAS DONE ON 15 FEB 69 AT 16626614

   FUNCTION K           ENTRY POINT 000134

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000153
        0000   *DATA   000021
        0002   *BLANK  000000
        0003   DATA    000005


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   F
        0005   FPRIME
        0006   CEXP
        0007   SQRT
        0010   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0003 C 000000 CONST1     0003 R 000002 CONST2     0003 R 000003 CONST3     0004 R 000000 F          0005 R 000000 FPRIME
    0000 C 000000 K          0000 R 000002 TEMP1      0000 R 000003 TEMP2      0000 R 000004 TEMP3


00100      1*   C
00100      2*   C ..........................................................................
00100      3*   C .   FUNCTION K                                    C. ARGILA, JAN. '69      .
00100      4*   C .                                                                           .
00100      5*   C .   DESCRIPTION-                                                           .
00100      6*   C .      THIS COMPLEX FUNCTION SUBROUTINE COMPUTES THE KERNEL, K(X,S),        .
00100      7*   C .   FOR THE LUNAR COMMUNICATIONS (LUNCOM) PROGRAM.                         .
```

```
00100     8*    C .                                                                .
00100     9*    C .   ARGUMENTS-                                                   .
00100    10*    C .      X                                                         .
00100    11*    C .      S                                                         .
00100    12*    C .                                                                .
00100    13*    C .   NAMED COMMON USAGE-                                          .
00100    14*    C .      DATA                                                      .
00100    15*    C .                                                                .
00100    16*    C .   SUBROUTINE USAGE-                                            .
00100    17*    C .      F                                                         .
00100    18*    C .      FPRIME                                                    .
00100    19*    C .                                                                .
00100    20*    C ................................................................
00100    21*    C
00101    22*          COMPLEX FUNCTION K(X,S)
00103    23*          COMPLEX CONST1
00104    24*          COMMON /DATA/ CONST1, CONST2, CONST3(2)
00105    25*          TEMP1 = F(X)
00106    26*          TEMP2 = F(S)
00107    27*          TEMP3 = X - S
00110    28*          K = (CONST1 + FPRIME(S) - (TEMP1 - TEMP2) / TEMP3) * CEXP(CMPLX(
00110    29*         $     0.0,CONST2 * S * X / (2.0 * TEMP3) * (TEMP1 / X - TEMP2 / S)
00110    30*         $     **2)) * SQRT(X / (S * TEMP3))
00111    31*          RETURN
00112    32*          END

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
```

```
          STARTING ADDRESS  014000

          CORE LIMITS 014000 027645     100000 110030     163772 163777


LUNCOM/CODE
0    100000-100473
1    014000-014671

NSTOP$/CODE
1    014672-014707

NFOUT$/CODE
1    014710-015114
2    100474-100474

NTAB$ /CODE
0    100475-100616

NBUFF$/CODE
1    015115-015151
2    100617-101625

ATAN  /CODE
1    015152-015251
2    101626-101677

NERR$ /CODE
```

```
0    101700-102027
1    015252-015650

CABS  /CODE
1    015651-015675
2    102030-102033

NFINP$/CODE
1    015676-016114

SQRT  /CODE
0    102034-102070
2    102071-102132

CSQRT /CODE
1    016115-016252
2    102133-102142

NEXPD$/CODE
1    016253-016350
2    102143-102144

NXPCX$/CODE
1    016351-016460
2    102145-102155

NXPCF$/CODE
1    016461-016601
2    102156-102165

EXP   /CODE
1    016602-016672
2    102166-102205

CEXP  /CODE
1    016673-016754
2    102206-102246

SINCOS/CODE
1    016755-017044
2    102247-102302
```

```
CLOG  /CODE
1    017045-017145
2    102303-102315

ALOG  /CODE
1    017146-017233
2    102316-102372

NOUT$ /CODE
0    102373-102374
1    017234-020276
2    102375-102435

NFTV$ /CODE
1    020277-020321

NIOIN$/CODE
1    020322-020365
2    102436-102466

NOTIN$/CODE
0    102467-102467
1    020366-020711
2    102470-102530

FPACK$/CODE
1    020712-020755

DEPTH /******
0    102531-102536

NFMT$ /CODE
1    020756-021740
2    102537-102657

NIER$ /CODE
0    102660-102660
1    021741-022077
2    102661-102744
```

```
NINPT$/CODE
0    102745-102745
1    022100-023271
2    102746-103000

FLOATX/CODE
0    103001-103114

NEXP$X/CODE
0    103115-103222

CONVTX/CODE
0    103223-103275

NININ$/CODE
1    023272-023435
2    103276-103301

NLINP /CODE
0    103302-103310
1    023436-025347
2    103311-103460

NRWND$/CODE
1    025350-025434

ALOG10/CODE
1    025435-025503
2    103461-103514

F      /CODE
0    103515-103527
1    025504-025643

NEXP6$/CODE
1    025644-025661
2    103530-103530

NXPAF$/CODE
1    025662-026040
2    103531-103535
```

```
NXPAX$/CODE
1    026041-026063
2    103536-103536

ATTEN /CODE
0    103537-103574
1    026064-026267

CDV$  /CODE
0    103575-103576
1    026270-026337

C     /CODE
0    103577-103644
1    026340-027247

K     /CODE
0    103645-103665
1    027250-027422

FPRIME/CODE
0    103666-103701
1    027423-027557

FSBSFL/CODE
0    103702-103754

QQUFOF/CODE
0    103755-104045
1    027560-027645

TERAIN/******
0    104046-104055

MISL  /******
0    104056-104073

INCRMT/******
0    104074-104101
```

```
DATA  /******
0    104102-104106

ATNCOM/******
0    104107-110030


END OF ALLOCATION 1103 0036
```