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A COMPUTER GENERATED PLOTTING CAPABILITY FOR FAMILIES OF CURVES--ETC(U)
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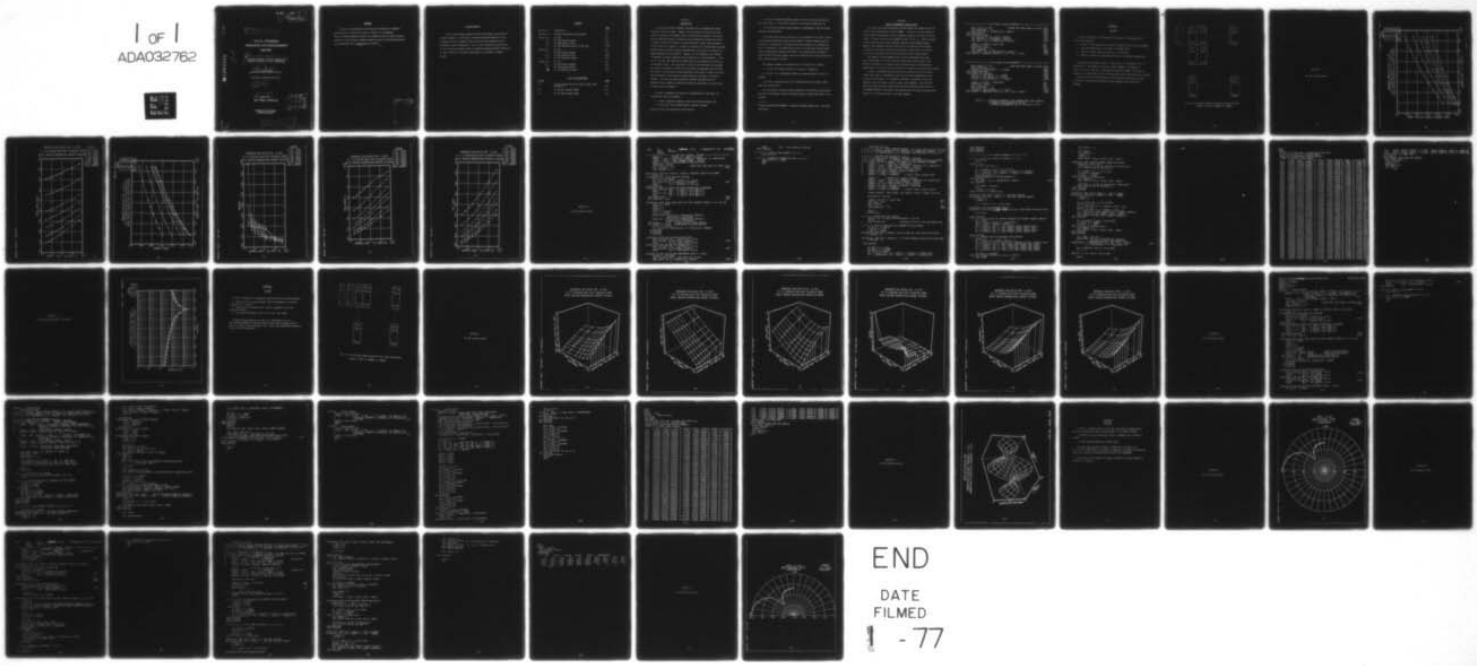

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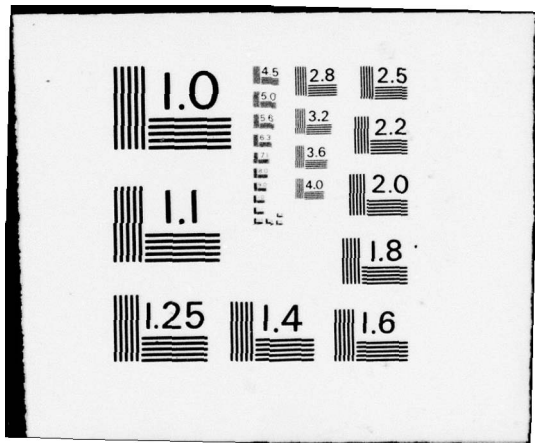
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NAVAL UNDERSEA RESEARCH AND DEVELOPMENT CENTER

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(6) A COMPUTER GENERATED PLOTTING CAPABILITY FOR FAMILIES OF CURVES IN 2 AND 3 DIMENSIONS

by

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Sponsored by NAVSHIPS Code 9012

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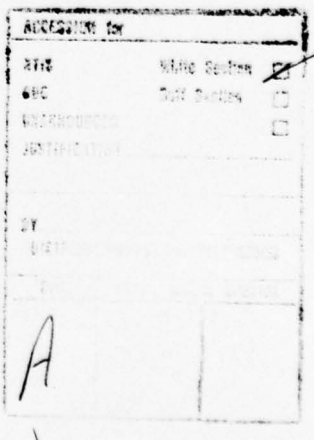
ABSTRACT

A concept is presented which facilitates the production of computer generated plots of families of curves in either 2 or 3 dimensions. Specific computer examples provided are intended to serve as master programs from which a wide variety of general purpose scientific plotting applications can be performed with a minimum amount of effort.



ACKNOWLEDGEMENTS

I wish to thank numerous people who have contributed to the evolution of these programs. In particular, Don Barach and Bruce Wood also of the Transducer and Array Systems Division have used these programs and have offered many helpful suggestions. Also, I wish to express my appreciation to Ian Hirschsohn and Peter Preuss of Integrated Software Systems Corporation for their interest in providing improvements to the DISSPLA software package.

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SECTION 1.

INTRODUCTION

For many years digital computers have been used to implement math models of various physical systems. However, once the delight of obtaining correct numerical printouts from mammoth digital calculations has passed, it has often been an additional burden to effectively and inexpensively display the results in forms such that the scientist can gain additional insight into the behavior of the system he is studying. In order to alleviate this problem there have been numerous digital plotting systems developed which are capable of producing any graph imaginable by the scientist. However, all too frequently the scientist is hampered by various roadblocks which usually exist in such endeavors. First of all, the lead time required to program new plot configurations can often be on the order of days. This lag time in itself can be sufficient to discourage the innovative scientist, without even considering the manpower costs involved. This paper is a description of work performed by the author in order to minimize these bottlenecks and to maximize responsiveness to the needs of scientific projects. This work has been performed by the NUC Transducer and Array Systems Division; however, its generality should be applicable to a wide variety of other scientific projects.

In order to implement the concept to be demonstrated in the paper, the following two items are required:

1. A highly responsive Computer Center with plotting hardware, and
2. A high level user-oriented graphics computer language.

At NUC the items are satisfied by the following:

(a) either the UNIVAC 1230/490 systems with their associated Calcomp 565 and 1136 plotters, or the UNIVAC 1108 and its associated Calcomp 663, and

(b) the Fortran software system DISSPLA* as implemented on the NUC UNIVAC computers mentioned above.

The concept which serves as the basis for the examples to be shown involves a data storage scheme well suited to the problem of either producing families of curves in 2 dimensions, or producing the same information as a perspective view in 3 dimensions. By combining the simplicity of the data storage scheme with the many powerful features of DISSPLA it has been possible to produce highly versatile plotting samples which can be modified for various applications with a minimum amount of effort.

The computer examples to be presented in this paper are as follows:

1. PLT FAM for plotting families of curves in 2 dimensions

2. PLT SRF for 3 dimensional plotting of either families of curves or surfaces

3. PLT PTN, a modified version of PLT FAM specifically oriented towards polar plot applications.

For each example, the data storage scheme will be outlined, the program options will be explained, and the associated computer printout and plots will be included.

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*DISSPLA PLOTTING SYSTEM MANUALS, Integrated Software Systems Corp., San Diego, California.

SECTION 2.

COMPUTER PROGRAMMING CONSIDERATIONS

The programs have been developed on the NUC UNIVAC 1230 computer using ASA Fortran with two exceptions, SFLD and ENCODE. In order to run the programs on the NUC UNIVAC 1108, several Fortran statements (marked in the decks by having "1230" in columns 73-76) must be changed as shown in Fig. 2.1. Similar changes would be required on any other computer system using the DISSPLA package. Actually the statements requiring SFLD (FLD on the 1108) can be eliminated, if desired, since they are used only to provide a safety factor in case the user fails to terminate one of the self-counting title strings properly.

Even though all three examples were originally developed on the 1230, the PLT SRF example will be for the 1108, since the current version of the DISSPLA 3D software is too large for the 1230 when using all of the options demonstrated. PLT SRF can be run on the 1230 if several of the options are deleted.

In order to implement new applications the user must first of all select a data input medium. Although this could involve direct computation of the function to be plotted, it is frequently advisable or necessary to load pre-computed values from tape or cards as shown in the examples. Once the input medium has been selected, the user must then tailor the data input section of the CONTROL ROUTINE to the needs of his problems and also select the appropriate options for his needs from one of the three examples.

```
C * * * * * * * * * * * * NUC UNIVAC 1230 STATEMENTS * * * * * * * * * * * *

      DATA N WRD P C /16/                  @ WORDS PER CARD IMAGE ON UNIVAC 1230
      DATA IDOLAR/5H     $ /                                               1230
      CALL SFLD( 24, 6, I HEAD(12,J), IDOLAR )                             1230
  200 FORMAT(16A5)                                                         1230
  201 FORMAT(1X, 16A5)                                                     1230
      CALL SFLD(24, 6, IHD LPT(6), IDOLAR)                                 1230
      CALL SFLD(24, 6, IHD MEM(6), IDOLAR)                                 1230
      CALL SFLD(  24, 6, IHDFAM(12,N), IDOLAR )                            1230

      COMMON / CM PLOT / I BUF( 200)                                       SET
      DATA NBUF / 200 /                                                    SET
      DATA I PLT UN / 2 /                                                  SET
      DATA IDOLAR/5H     $ /                                               1230
      CALL SFLD(  24, 6, IHDFAM(12,N), IDOLAR )                            1230
 4990 FORMAT(/' COMPLETED PLOT NO.', I3, ' *** ', 12A5 /                   1230


C * * * * * * * * * * * * NUC UNIVAC 1108 STATEMENTS * * * * * * * * * * * *

      DATA N WRD P C /14/                  @ WORDS PER CARD IMAGE ON UNIVAC 1108
      DATA IDOLAR/6H      $/                                               1108
      FLD(30, 6, I HEAD(12,J) ) = I DOLAR                                  1108
  200 FORMAT(13A6,A2)                                                      1108
  201 FORMAT(1X, 13A6,A2)                                                  1108
      FLD(30, 6, IHD LPT(6) ) = I DOLAR                                    1108
      FLD(30, 6, IHD MEM(6) ) = I DOLAR                                    1108
      FLD(30, 6, IHD FAM(12,N) ) = I DOLAR                                 1108

      COMMON / CM PLOT / I BUF(2000)                                       SET
      DATA NBUF / 2000/                                                    SET
      DATA I PLT UN / 8 /                                                  SET
      DATA IDOLAR/6H      $/                                               1108
      FLD(30, 6, IHD FAM(12,N) ) = I DOLAR                                 1108
 4990 FORMAT(/' COMPLETED PLOT NO.', I3, ' *** ', 12A6 /                   1108
```

FIG 2.1 - FORTRAN STATEMENTS TO BE CHANGED FROM 1230 VERSION TO PRODUCE 1108 VERSION OF PLT FAM (SIMILAR REQUIREMENTS FOR PLT SRF AND PLT PTN)

SECTION 3.

PLT FAM

PLT FAM is designed for plotting families of curves in 2 dimensions with the following features:

1. Option for user selected axis scales or automatic self scaling via DISSPLA
2. User supplied headings, axis labels, and legend labels
3. Choice of linear, log-log, log-linear, or linear-log
4. Option to combine two consecutive families of curves onto the same grid

The data storage scheme for the X, Y data points is illustrated in Fig. 3.1, where NFAMLY is the number of families of curves, MEMBER is the number of members per family, and LPTS is the number of points per member of the family. Comments at the beginning of the PLT FAM subroutine explain the array sizes required.

Detailed line by line descriptions of the programs will not be given since an attempt has been made to provide sufficient comments within the Fortran programs.

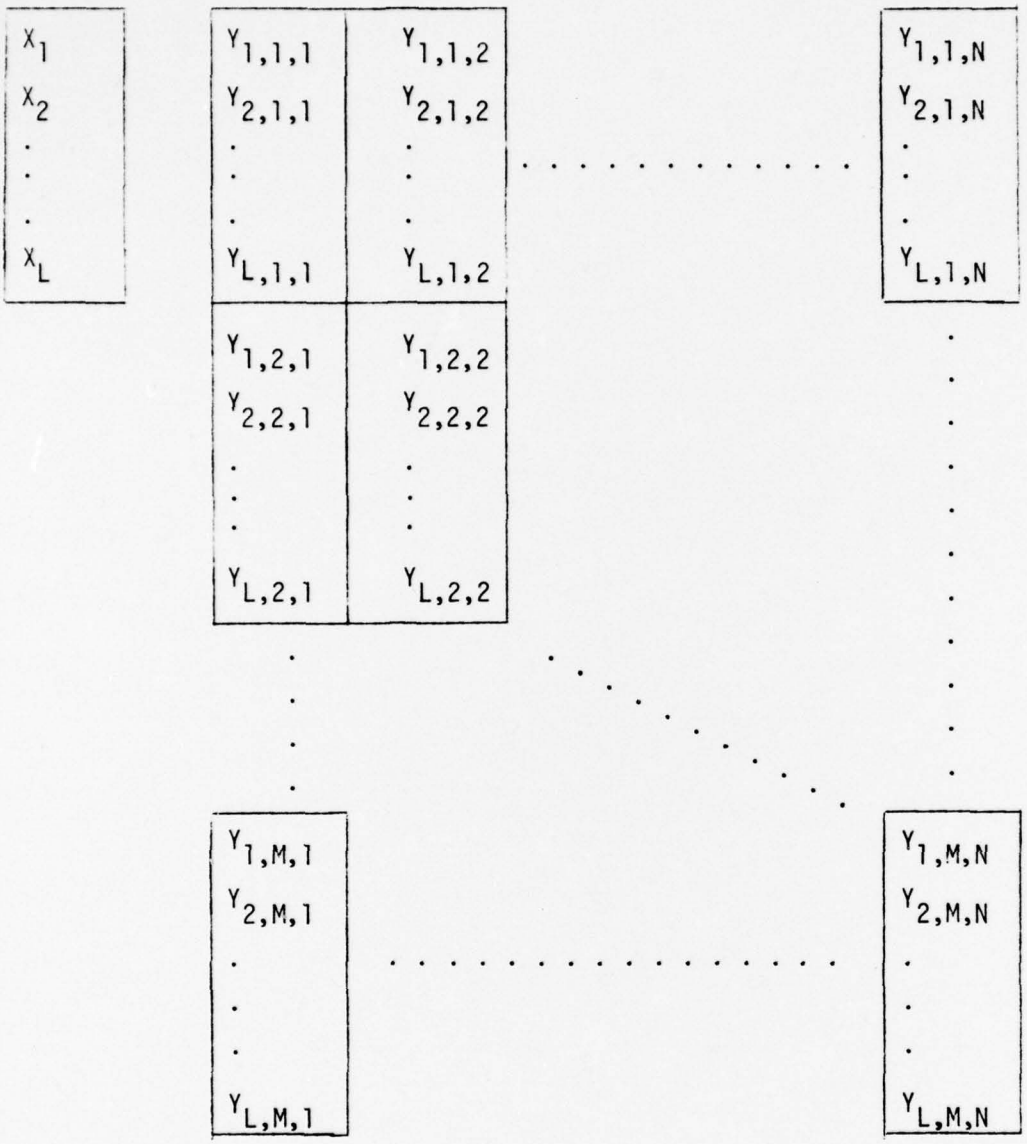
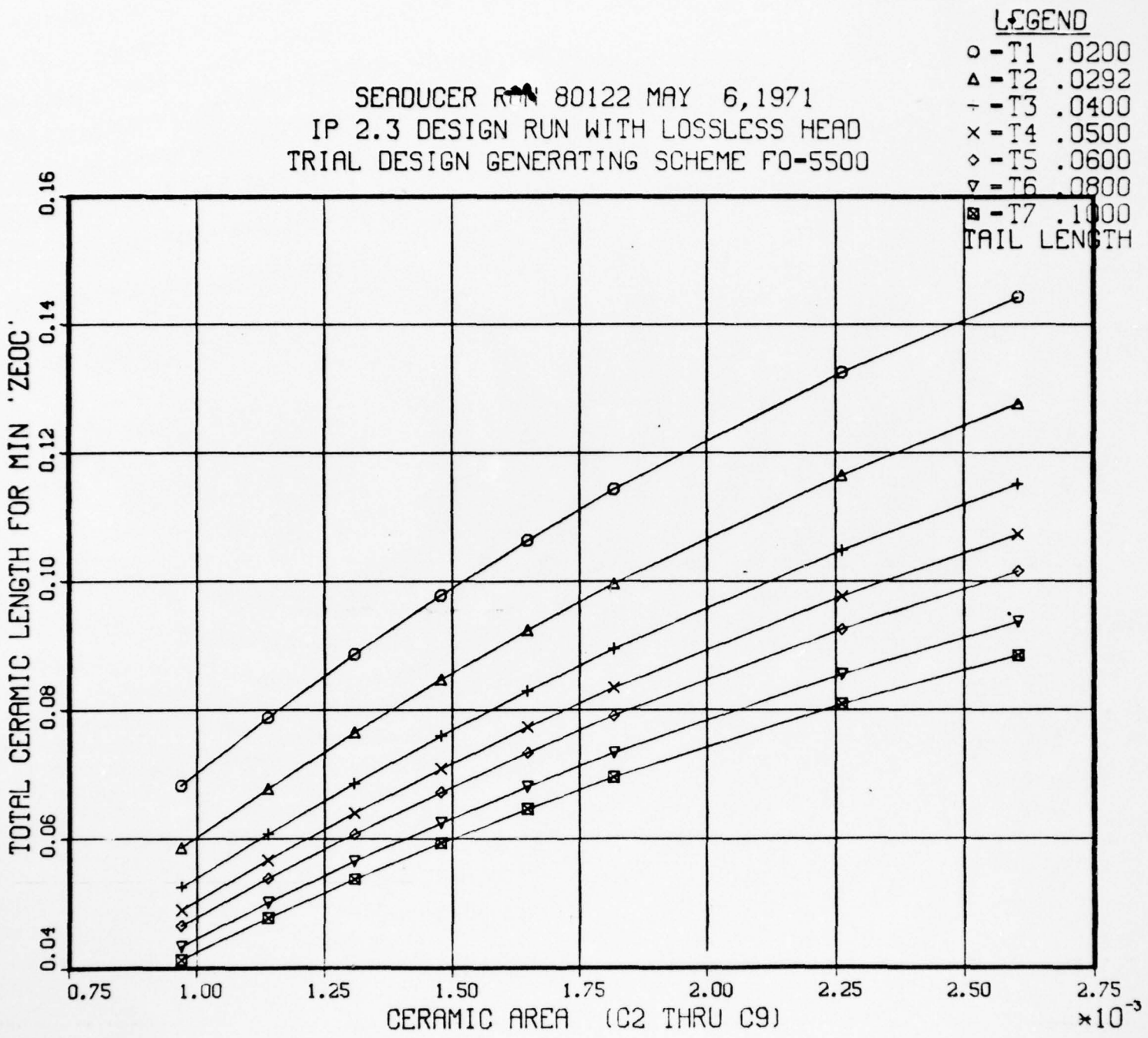


FIG. 3.1 PLT FAM data storage scheme for X(L) and Y(L,M,N)
(where L = LPTS, M = MEMBER, N = NFAMLY)

SECTION 3.1

PLT FAM plotting samples

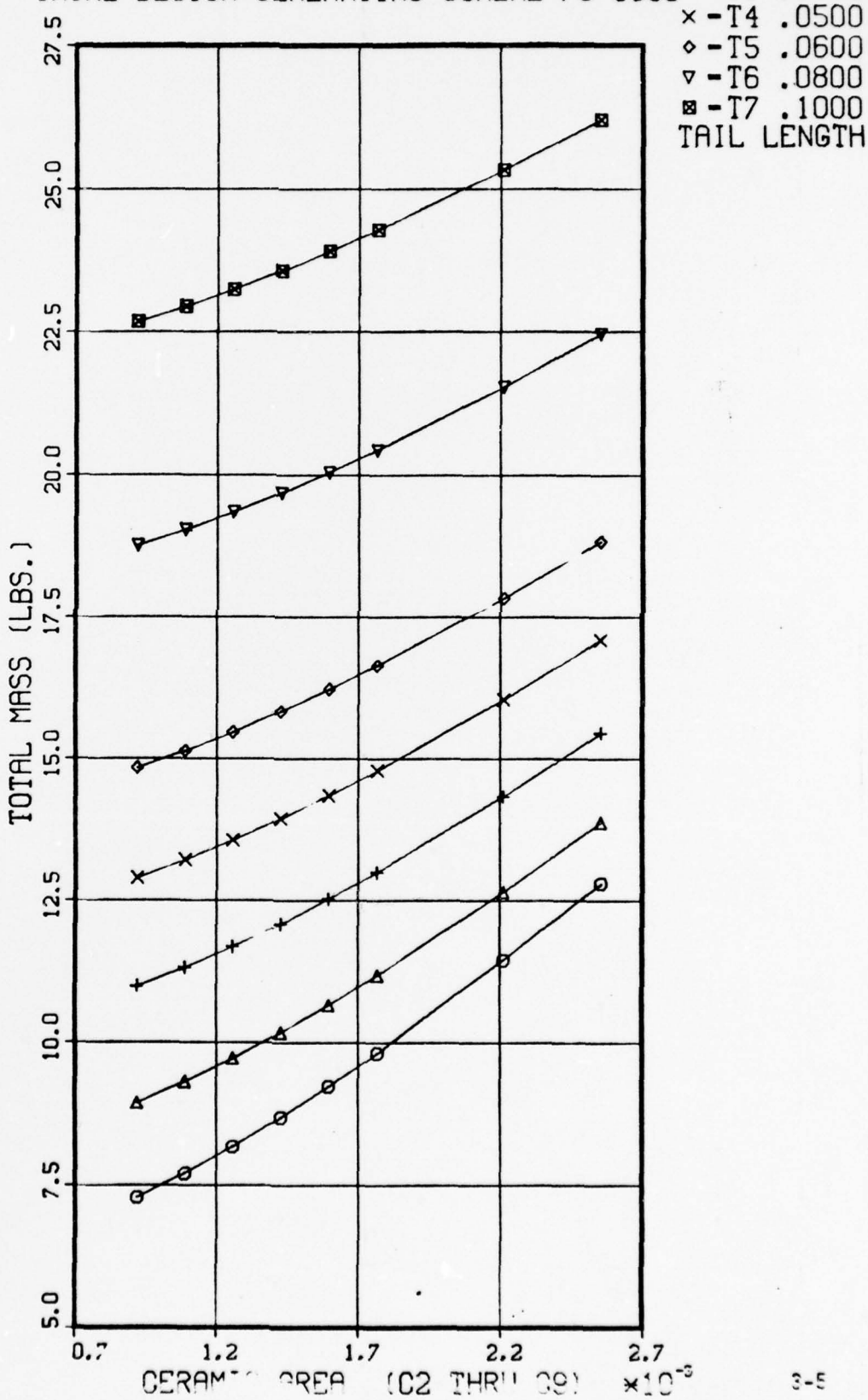
JOB NO 1014 PLOT NO 1 DATE JUL



SEADUCER RUN 80122 MAY 6, 1971

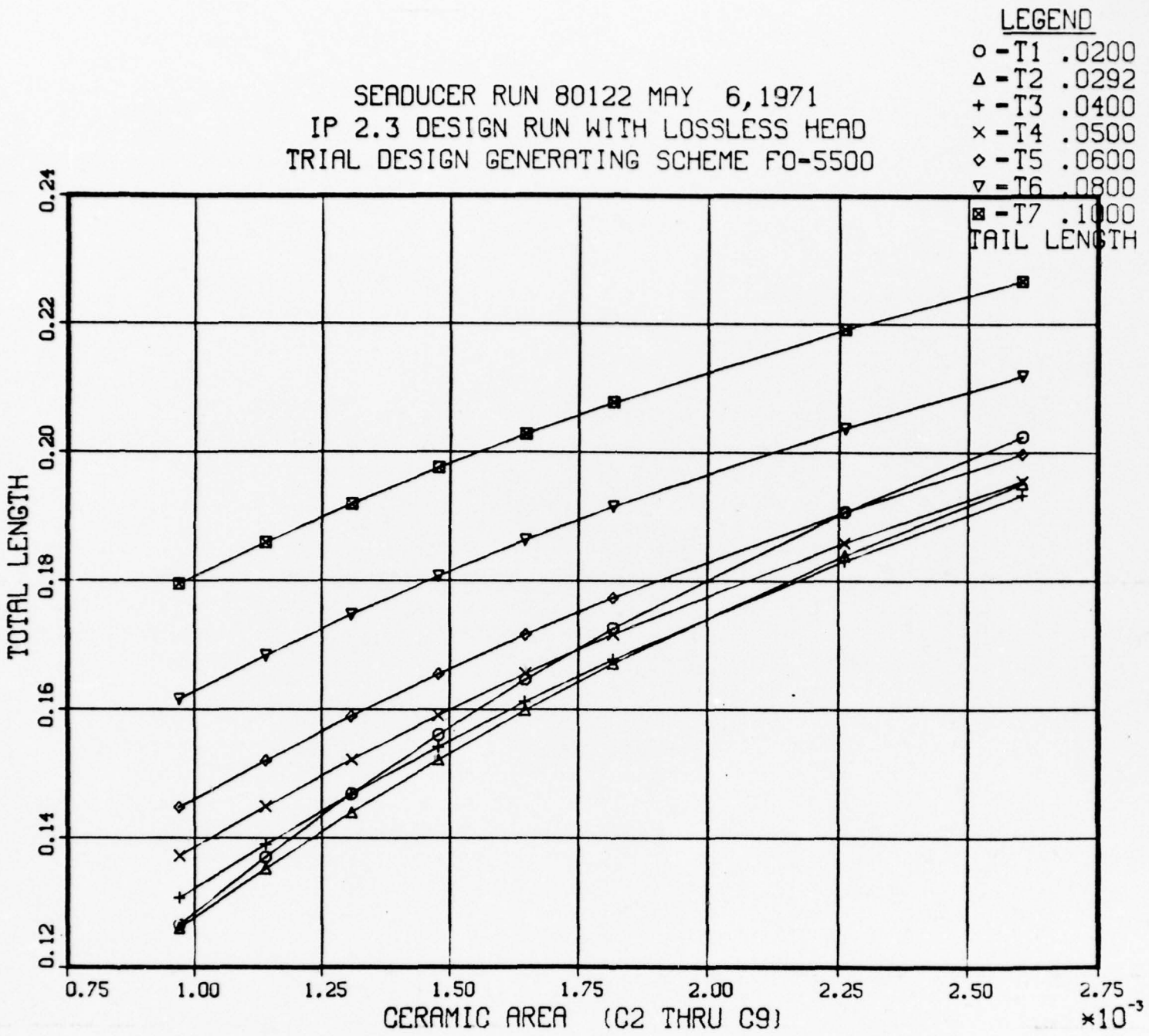
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD

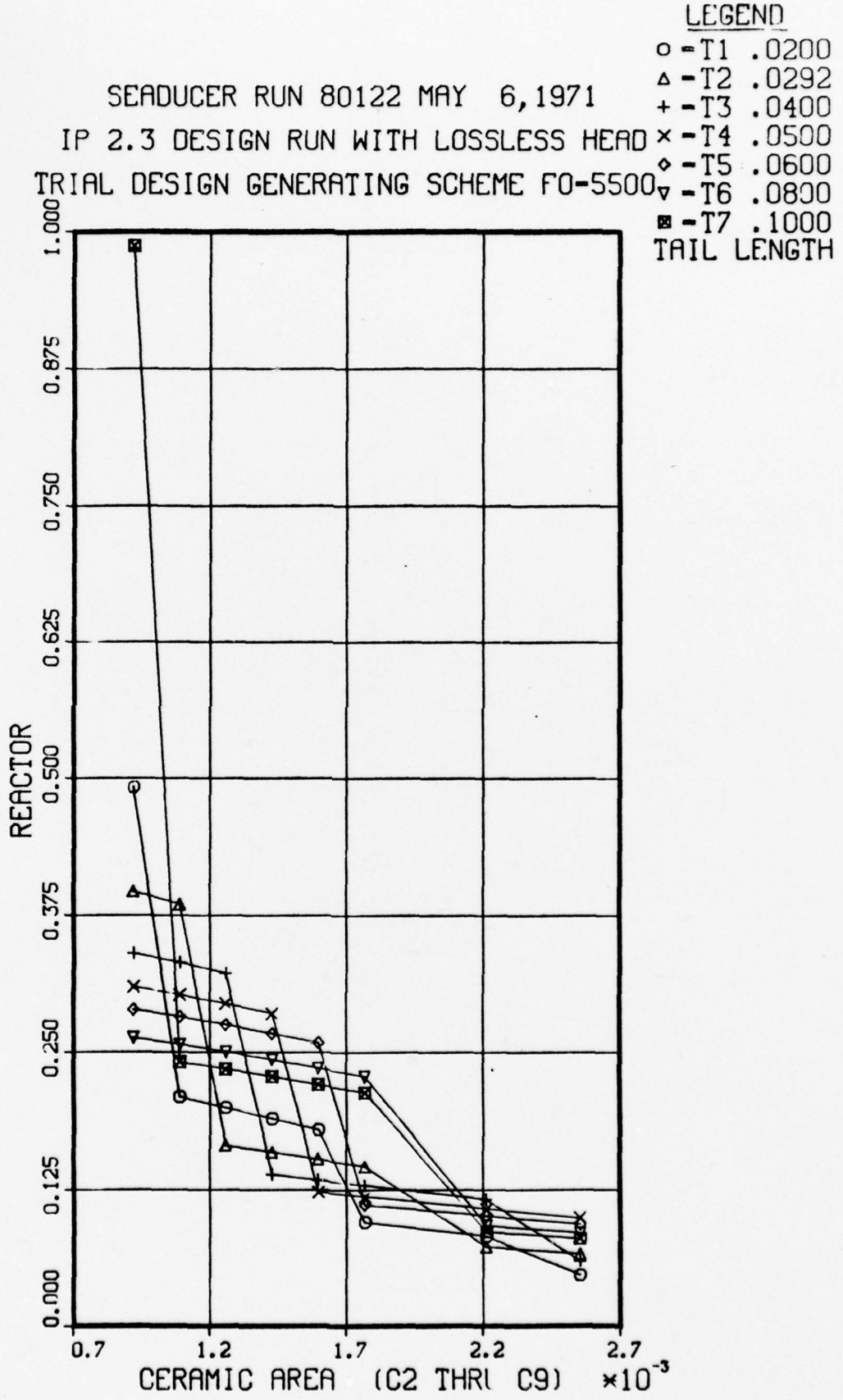
TRIAL DESIGN GENERATING SCHEME FO=5500



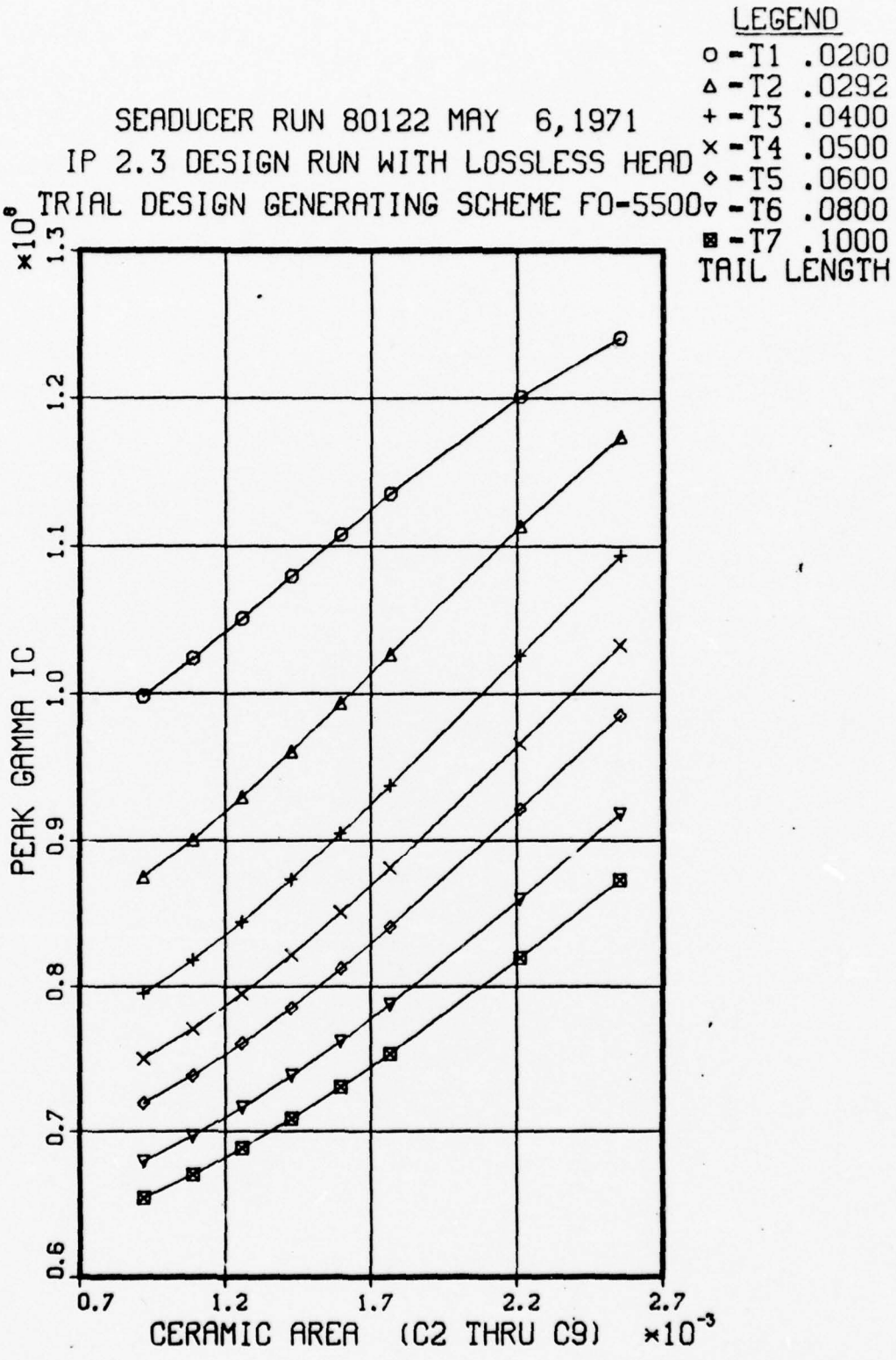
JOB NO 1014 PLOT NO 2 DATE JUL 19

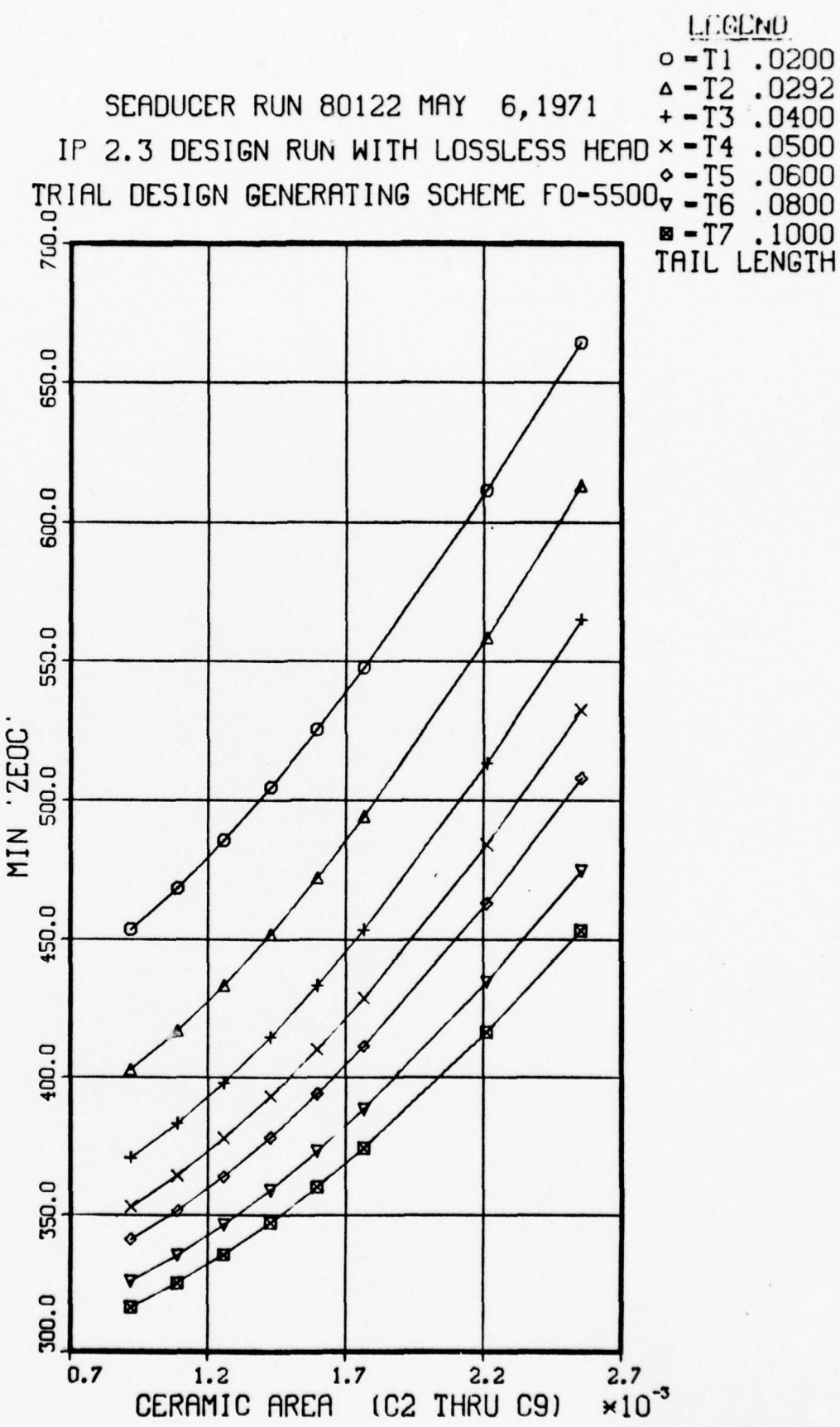
JOB NO 1014 PLOT NO 3 DATE





JOB NO 1014 PLOT NO 4 DATE JUL 19




SEADUCER RUN 80122 MAY 6,1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500
LEGEND
○ -T1 .0200
△ -T2 .0292
+ -T3 .0400
× -T4 .0500
◇ -T5 .0600
▽ -T6 .0800
⊠ -T7 .1000
TAIL LENGTH
MIN 'ZEOC'
700.0
650.0
600.0
550.0
500.0
450.0
400.0
350.0
300.0
0.7
1.2
1.7
2.2
2.7
CERAMIC AREA (C2 THRU C9) ×10⁻³

SECTION 3.2

PLT FAM program listing

```
 2000      JOB        601        [redacted]  00.04      L MCCLEARY PLT FAM    80122DS6N
           MOUNT      M3S=PLOT
           FORTRAN
C * * * * * * * * * * * * * * PLT FAM  CONTROL  ROUTINE  * * * * * * * * * * * *
      COMMON /         / XDATA( 30), YDATA( 30,12,6)
      COMMON / CMHEAD / IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3)
      COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
      COMMON / CPL LBL / DTA LBL(12,2), IPK LBL(12,12)
      DIMENSION I CHK(16)
      DATA N WRD P C /16/                  0 WORDS PER CARD IMAGE ON UNIVAC 1230
      DATA IDOLAR/5H    $ /                                                1230
      DATA IN UNIT / 5 /

C********** USER SETS NHLINS = NUMBER OF HEADING LINES TO BE LOADED
      NHLINS = 3
C********** LOAD IHEAD FOR PLOT HEADINGS
      DO 4100 J = 1,NHLINS
      READ( IN UNIT, 200 )  (IHEAD(I,J), I=1,12)
      CALL SFLD( 24, 6, I HEAD(12,J), IDOLAR )                              1230
      PRINT          201 ,  (IHEAD(I,J), I=1,12)
 4100 CONTINUE
C********** READ AND PRINT ANY EXTRA INFORMATION IF DESIRED
      READ( IN UNIT, 200 )  (I CHK(I), I=1,N WRD P C)
      PRINT          201 ,  (I CHK(I), I=1,N WRD P C)
      READ( IN UNIT, 200 )  (I CHK(I), I=1,N WRD P C)
      PRINT          201 ,  (I CHK(I), I=1,N WRD P C)
  200 FORMAT(16A5)                                                          1230
  201 FORMAT(1X, 16A5)                                                      1230

C********** USER LOADS INPUT DATA FOR LPTS, MEMBER, NFAMLY, X, Y, DTA LBL
      POUNDS = 2.20462
      LPTS = 8
      MEMBER = 7
      NFAMLY = 6
      DO 9 M = 1,MEMBER
      DO 8 L = 1,LPTS
      READ(5,100) DTALBL(M,1), DTALBL(M,2), XDATA(L),
     1            (YDATA(L,M,N), N=1,NFAMLY)
      PRINT 101,  DTALBL(M,1), DTALBL(M,2), XDATA(L),
     1            (YDATA(L,M,N), N=1,NFAMLY)
  100 FORMAT(    1X,A2,    4X,3F8.6,3X,F8.4,F8.5,3E10.4)
  101 FORMAT(1X, 1X,A2,    4X,3F8.6,3X,F8.4,F8.5,3E10.4)
      DO 10 N = 1,NFAMLY
      IF ( N .EQ. 2 ) YDATA(L,M,N) = Y DATA(L,M,N) * POUNDS
   10 CONTINUE
    8 CONTINUE
    9 CONTINUE

C********** LOAD IHD LPT FOR X AXIS TITLE
      READ( IN UNIT, 200 )  (IHD LPT(I), I=1,6)
      CALL SFLD(24, 6, IHD LPT(6), IDOLAR)                                  1230
      PRINT          201 ,  (IHD LPT(I), I=1,6)
C********** LOAD IHD MEM FOR LEGEND TITLE
      READ( IN UNIT, 200 )  (IHD MEM(I), I=1,6)
      CALL SFLD(24, 6, IHD MEM(6), IDOLAR)                                  1230
      PRINT          201 ,  (IHD MEM(I), I=1,6)

C********** LOAD IHD FAM FOR INDIVIDUAL PLOTS ( Y AXIS )
      DO 4000 N = 1,NFAMLY
      READ( IN UNIT, 200 )  (IHD FAM(I,N), I=1,12)
      CALL SFLD(  24, 6, IHDFAM(12,N), IDOLAR )                             1230
```

```
      PRINT          201 ,  (IHD FAM(I,N), I=1,12)
 4000 CONTINUE

C * * * * * INPUT IS NOW LOADED * * * * *
      CALL PLT FAM

C * * * * * TERMINATE ENTIRE PLOT RUN * * * * *
      CALL PLOT(0., 0., 999)
      STOP
      END
```

```
      SUBROUTINE PLT FAM
C * * * * * PLT FAM (USING DISSPLA PACKAGE)  * * * * * * * * * * * * * * * * * *
C * * * * * GENERAL PROGRAM TO PLOT FAMILIES OF CURVES WITH LEGENDS  * * * *
C * * * * * * * PROGRAMMED BY L. E. MCCLEARY  NUC CODE 601 * * * * * * *

C * * * * * DIMENSION AS FOLLOWS * * * * *
C * * * * * WHERE L=LPTS, M=MEMBER, N=NFAMLY, H=NHLINS
C * * * LOAD COMMONS /   /, /CMHEAD/, /NUMS/, AND ARRAY DTA LBL IN CONTROL
C * * * LOAD COMMONS /P CMBIN/, /PL FORM/, IN THIS ROUTINE IF NEEDED
C     COMMON /        / XDATA(L), YDATA(L,M,N)
C     COMMON / CMHEAD / IHDLPT(6), IHDMEM(6), IHDFAM(12, N), IHEAD(12,H)
C     COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
C     COMMON / CPL LBL / DTA LBL( M,2), IPK LBL( M,12)
C     COMMON / NO LOAD / YMIN(N), YMAX(N), YPLOT(L)
C     COMMON / P CMBIN / N CMBIN(N)
C     COMMON / PL FORM / N FORM(N)      @ LIN-0, LOG-1, XLG-2, YLG-3

      COMMON /        / XDATA( 30), YDATA( 30,12,6)
      COMMON / CMHEAD / IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3)
      COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
      COMMON / CPL LBL / DTA LBL(12,2), IPK LBL(12,12)
      COMMON / NO LOAD / YMIN(6), Y MAX(6), Y PLOT(30)
      COMMON / P CMBIN / N CMBIN(6)
      COMMON / PL FORM / N FORM(6)      @ LIN-0, LOG-1, XLG-2, YLG-3

      COMMON/ QQEXTR / XOR, XSTEP, YOR, YSTEP, X AXIS, Y AXIS, LX,LY,IT

      DIMENSION IH LBL M(4)

      COMMON / CM PLOT / I BUF( 200)                                    SET
      DATA NBUF / 200 /                                                 SET
      DATA IFTF/0/
      DATA I PLT UN / 2 /                                               SET
      DATA IDOLAR/5H    $ /                                             1230

      PRINT 1
    1 FORMAT(1H1)

C * * * * * INITIALIZE PLOT BUFFER
      IF(IFTF .EQ. 0) CALL PLOTS(IBUF,NBUF, I PLT UN)
      IFTF=1
C     CALL FACTOR(.85)              @ REDUCE 8 1/2 BY 11 TO VIEW GRAPH SIZE

C * * * * * FIND MAX MIN OVER ALL MEMBERS FOR EACH FAMILY
      DO 500 N = 1, NFAMLY
      Y MIN(N) = 1.E30
      Y MAX(N) = -1.E30
C********** USER SETS N FORM(N) =0,1,2,3 FOR LIN, LOG, XLG OR YLG PLOTS
      N FORM(N) = 0

C********** USER SETS N CMBIN(N) = 1 TO PLOT FAMLIES N AND N+1 ON SAME GRID
      N CMBIN(N) = 0

  500 CONTINUE

      DO 3000 L = 1, LPTS
      DO 2000 M = 1, MEMBER
      DO 1000 N = 1,NFAMLY
      IF ( Y DATA(L,M,N) .LT. Y MIN(N) ) Y MIN(N) = Y DATA(L,M,N)
      IF ( Y DATA(L,M,N) .GT. Y MAX(N) ) Y MAX(N) = Y DATA(L,M,N)
```

```
 1000 CONTINUE
 2000 CONTINUE
 3000 CONTINUE

C * * * * * * * * USE DISSPLA PACKAGE * * * * * * * * *

C * * * * * LOOP ON N FROM 1 TO NFAMLY * * * * *
      NTH PLT = 0
      N = 0
 4999 N = N + 1
      NTH PLT = NTH PLT + 1

      IF ( N CMBIN(N) .EQ. 0 ) GO TO 4101
      IF ( Y MIN(N+1) .LT. Y MIN(N) ) Y MIN(N) = Y MIN(N+1)
      IF ( Y MAX(N+1) .GT. Y MAX(N) ) Y MAX(N) = Y MAX(N+1)
      DO 4100 N HEAD = 1, 6
      IHDFAM(NHEAD+6,N) = IHDFAM(NHEAD,N+1)
 4100 CONTINUE
      CALL SFLD(  24, 6, IHDFAM(12,N), IDOLAR )                          1230
 4101 CONTINUE

      CALL BGNPL( -NTH PLT )
      M = 1
      DO 4400 L = 1,LPTS
 4400 Y PLOT(L) = Y DATA(L,M,N)

C********** USER SETS I SCALE = 0  FOR SELF SCALING
C********** USER SETS I SCALE = 1  FOR USER SUPPLIED SCALES
      I SCALE = 1
      I SCALE = 0

      IF ( I SCALE .EQ. 0 ) GO TO 4440

C********** FOR USER SUPPLIED SCALES,
C********** USER SETS X AXIS, Y AXIS, XOR,YOR, XSTEP,YSTEP FOR EACH FAMILY

      GO TO 4445

 4440 CONTINUE
C * * * * * SELF SCALING TO RETURN VARIABLES IN DISSPLA COMMON /QQEXTR/
      CALL HLOPLT
      CALL X RANGE( X DATA(1), X DATA(LPTS) )
      CALL Y RANGE( Y MIN(N), Y MAX(N) )
      IF ( N FORM(N) .EQ. 0 ) CALL LINPLT( XDATA, YPLOT, LPTS )
      IF ( N FORM(N) .EQ. 1 ) CALL LOGPLT( XDATA, YPLOT, LPTS )
      IF ( N FORM(N) .EQ. 2 ) CALL XLGPLT( XDATA, YPLOT, LPTS )
      IF ( N FORM(N) .EQ. 3 ) CALL YLGPLT( XDATA, YPLOT, LPTS )

 4445 CONTINUE
C * * * * * SCALES ARE NOW AVAILABLE FOR PLOTTING
      ITITLE = 1
      IF ( X AXIS .GT. Y AXIS ) ITITLE = -1
      CALL TITLE(1H ,ITITLE, IHDLPT,100, IHDFAM(1,N),100, X AXIS,Y AXIS)
      IF ( N FORM(N) .EQ. 0 ) CALL GRAPH (XOR, XSTEP, YOR, YSTEP)
      IF ( N FORM(N) .EQ. 1 ) CALL LOGLOG(XOR, XSTEP, YOR, YSTEP)
      IF ( N FORM(N) .EQ. 2 ) CALL X LOG (XOR, XSTEP, YOR, YSTEP)
      IF ( N FORM(N) .EQ. 3 ) CALL Y LOG (XOR, XSTEP, YOR, YSTEP)

      DO 4500 J = 1,NHLINS
 4500 CALL HEADIN( IHEAD(1,J), 100, 2, NHLINS)
      CALL FRAME
```

```
      CALL GRID( 1, 1 )

C     CALL SPLINE
      CALL MARKER( M )
      I MARK = 0
      I MARK = 1
      CALL CURVE( X DATA, Y PLOT, LPTS, I MARK )

C********** USER SELECTS LEGEND FORMAT FOR ENCODE
    4 FORMAT(A2, F6.4, '$')
      ENCODE(20, 4, IH LBL M) DTALBL(M,1), DTALBL(M,2)
      CALL LINES(IH LBL M, IPK LBL, M )

      IF ( MEMBER .EQ. 1 ) GO TO 4901
      DO 4900 M = 2,MEMBER
      DO 4600 L = 1,LPTS
 4600 Y PLOT(L) = Y DATA(L,M,N)
      CALL MARKER(M)
      CALL CURVE( X DATA, Y PLOT, LPTS, I MARK )

      ENCODE(20, 4, IH LBL M) DTALBL(M,1), DTALBL(M,2)
      CALL LINES(IH LBL M, IPK LBL, M )
 4900 CONTINUE
 4901 CONTINUE

C********** USER SETS N LEGND = 0  FOR NO LEGEND
C********** USER SETS N LEGND = 1  FOR    LEGEND
      N LEGND = 0
      N LEGND = 1

      IF ( N LEGND .EQ. 0 ) GO TO 4960
      XLEGND = X AXIS - 1.
      IF ( X AXIS .LT. 6. ) X LEGND = X AXIS + .25
      YLEGND = Y AXIS
      IF ( Y AXIS .GT. 8. ) Y LEGND = Y AXIS - .5
      IF ( ITITLE.NE.1 .AND. YAXIS.GT.5. ) YLEGND = YAXIS-.2
      CALL LEGEND(IPK LBL, MEMBER, XLEGND, YLEGND )
      CALL MESSAG( IHD MEM, 100, XLEGND, YLEGND-.2 )
 4960 CONTINUE

      IF ( N CMBIN(N) .EQ. 0 ) GO TO 4980
      DO 4970 M = 1, MEMBER
      DO 4965 L = 1, LPTS
 4965 Y PLOT(L) = Y DATA(L,M,N+1)
      CALL MARKER( M )
      CALL CURVE( X DATA, Y PLOT, LPTS, I MARK )
 4970 CONTINUE
 4980 CONTINUE

      CALL ENDPL( -NTH PLT )
      PRINT 4990, NTH PLT, (IHD FAM(I,N), I=1,12),
     P            XOR,XSTEP,X AXIS, YOR,YSTEP,Y AXIS
 4990 FORMAT(/' COMPLETED PLOT NO.', I3, ' *** ', 12A5 /                  1230
     F       ' X', 2E10.4,F4.1, ' Y', 2E10.4,F4.1 /)

      IF ( N CMBIN(N) .EQ. 0 ) GO TO 5000
      N = N + 1

 5000 IF ( N .LT. NFAMLY ) GO TO 4999

      RETURN
```

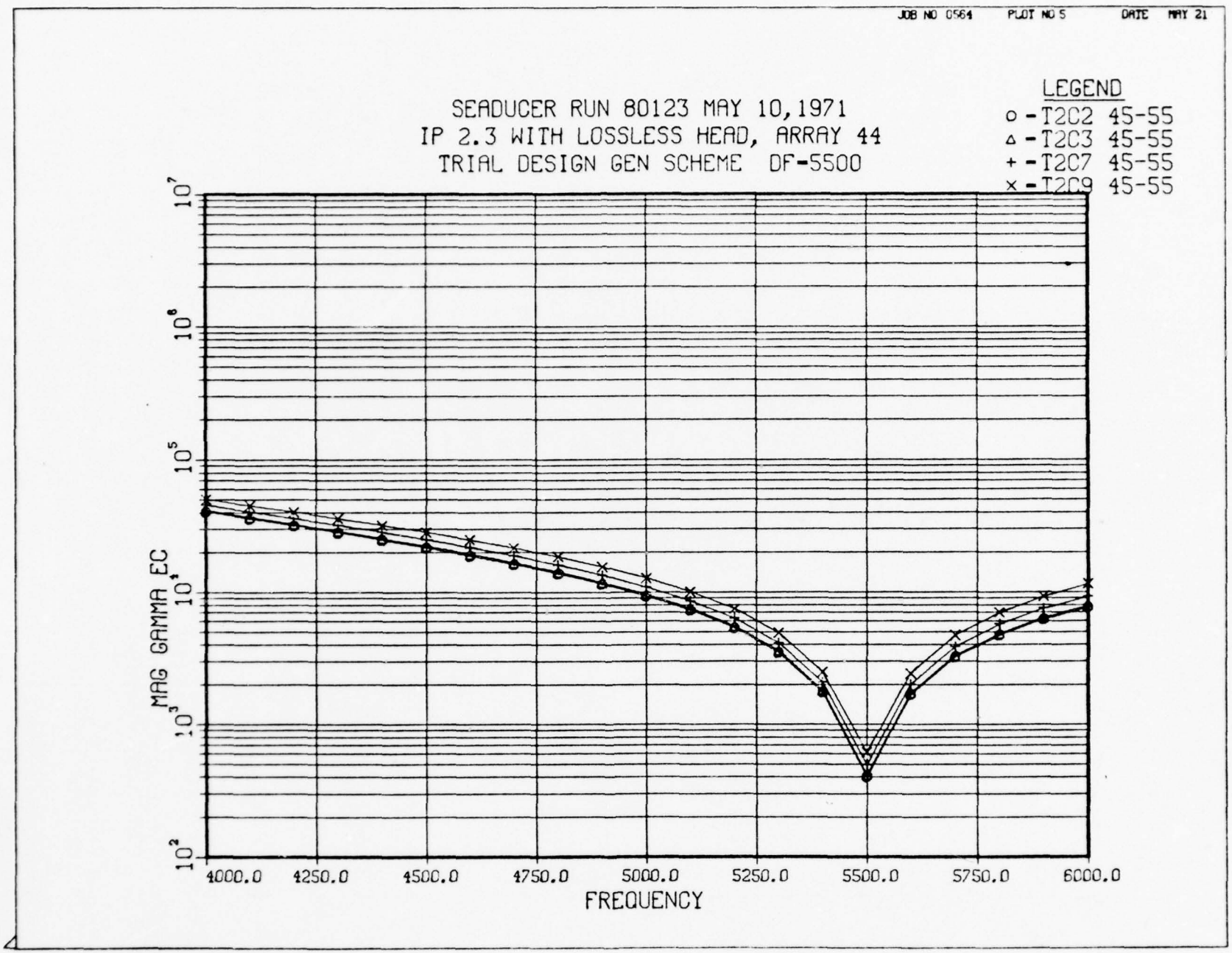
END

```
$END
$DATA
 SEADUCER RUN 80122 MAY  6,1971$ LIKE 80089 Q=50
 IP 2.3 DESIGN RUN WITH LOSSLESS HEAD$
 TRIAL DESIGN GENERATING SCHEME F0=5500 $
 CHARGE TO 16000501 ARRAY DESIGN
        L T2L1   A C3D   T L C3D   NP T MASS T LENGTH   REACTOR   GAMMA IC GAM EC MIN
 T1C2   .020000 .000969 .068308   4  3.3061   .12655 .4923E 00 .9984E 06 .4536E 03
 T1C3   .020000 .001139 .078810   6  3.4973   .13705 .2095E 00 .1024E 07 .4686E 03
 T1C4   .020000 .001308 .088665   6  3.7102   .14690 .1997E 00 .1051E 07 .4857E 03
 T1C5   .020000 .001478 .097868   6  3.9421   .15611 .1897E 00 .1080E 07 .5048E 03
 T1C6   .020000 .001647 .106433   6  4.1905   .16467 .1798E 00 .1108E 07 .5255E 03
 T1C7   .020000 .001817 .114374   8  4.4531   .17261 .9567E-01 .1136E 07 .5478E 03
 T1C8   .020000 .002262 .132576   8  5.1965   .19082 .8253E-01 .1201E 07 .6113E 03
 T1C9   .020000 .002604 .144293  10  5.8091   .20253 .4718E-01 .1241E 07 .6644E 03
 T2C2   .029200 .000969 .058624   4  4.0579   .12606 .3969E 00 .8752E 06 .4028E 03
 T2C3   .029200 .001139 .067846   4  4.2249   .13529 .3853E 00 .9006E 06 .4169E 03
 T2C4   .029200 .001308 .076560   6  4.4116   .14400 .1654E 00 .9296E 06 .4334E 03
 T2C5   .029200 .001478 .084769   6  4.6160   .15221 .1592E 00 .9608E 06 .4519E 03
 T2C6   .029200 .001647 .092480   6  4.8360   .15992 .1528E 00 .9936E 06 .4723E 03
 T2C7   .029200 .001817 .099712   6  5.0700   .16715 .1464E 00 .1027E 07 .4943E 03
 T2C8   .029200 .002262 .116568   8  5.7386   .18401 .7299E-01 .1114E 07 .5586E 03
 T2C9   .029200 .002604 .127729   8  6.2971   .19517 .6631E-01 .1174E 07 .6129E 03
 T3C2   .040000 .000969 .052474   4  4.9809   .13071 .3405E 00 .7952E 06 .3708E 03
 T3C3   .040000 .001139 .060763   4  5.1318   .13900 .3321E 00 .8180E 06 .3833E 03
 T3C4   .040000 .001308 .068613   4  5.3006   .14685 .3227E 00 .8443E 06 .3980E 03
 T3C5   .040000 .001478 .076011   6  5.4853   .15425 .1388E 00 .8735E 06 .4148E 03
 T3C6   .040000 .001647 .082978   6  5.6844   .16122 .1340E 00 .9048E 06 .4334E 03
 T3C7   .040000 .001817 .089527   6  5.8963   .16777 .1291E 00 .9375E 06 .4536E 03
 T3C8   .040000 .002262 .104895   6  6.5037   .18314 .1162E 00 .1026E 07 .5134E 03
 T3C9   .040000 .002604 .115152   8  7.0129   .19339 .6003E-01 .1094E 07 .5651E 03
 T4C2   .050000 .000969 .048974   4  5.8525   .13721 .3098E 00 .7501E 06 .3530E 03
 T4C3   .050000 .001139 .056695   4  5.9941   .14493 .3028E 00 .7708E 06 .3644E 03
 T4C4   .050000 .001308 .064004   4  6.1524   .15224 .2947E 00 .7948E 06 .3778E 03
 T4C5   .050000 .001478 .070896   4  6.3256   .15914 .2859E 00 .8216E 06 .3931E 03
 T4C6   .050000 .001647 .077369   6  6.5119   .16561 .1229E 00 .8507E 06 .4102E 03
 T4C7   .050000 .001817 .083459   6  6.7102   .17170 .1187E 00 .8813E 06 .4288E 03
 T4C8   .050000 .002262 .097744   6  7.2782   .18598 .1075E 00 .9663E 06 .4842E 03
 T4C9   .050000 .002604 .107305   6  7.7547   .19554 .9929E-01 .1033E 07 .5325E 03
 T5C2   .060000 .000969 .046551   4  6.7324   .14479 .2893E 00 .7193E 06 .3411E 03
 T5C3   .060000 .001139 .053863   4  6.8677   .15210 .2828E 00 .7385E 06 .3516E 03
 T5C4   .060000 .001308 .060779   4  7.0187   .15902 .2755E 00 .7607E 06 .3640E 03
 T5C5   .060000 .001478 .067293   4  7.1837   .16553 .2674E 00 .7854E 06 .3782E 03
 T5C6   .060000 .001647 .073414   4  7.3612   .17165 .2590E 00 .8123E 06 .3940E 03
 T5C7   .060000 .001817 .079148   6  7.5497   .17739 .1113E 00 .8411E 06 .4114E 03
 T5C8   .060000 .002262 .092595   6  8.0889   .19083 .1011E 00 .9215E 06 .4631E 03
 T5C9   .060000 .002604 .101576   6  8.5406   .19982 .9366E-01 .9855E 06 .5082E 03
 T6C2   .080000 .000969 .043376   4  8.5052   .16162 .2631E 00 .6797E 06 .3258E 03
 T6C3   .080000 .001139 .050130   4  8.6325   .16837 .2572E 00 .6967E 06 .3353E 03
 T6C4   .080000 .001308 .056505   4  8.7741   .17474 .2505E 00 .7164E 06 .3464E 03
 T6C5   .080000 .001478 .062495   4  8.9285   .18073 .2433E 00 .7384E 06 .3591E 03
 T6C6   .080000 .001647 .068110   4  9.0941   .18635 .2358E 00 .7622E 06 .3731E 03
 T6C7   .080000 .001817 .073367   4  9.2698   .19161 .2280E 00 .7877E 06 .3885E 03
 T6C8   .080000 .002262 .085599   6  9.7700   .20384 .9234E-01 .8599E 06 .4347E 03
 T6C9   .080000 .002604 .093725   6 10.1875   .21196 .8571E-01 .9182E 06 .4749E 03
 T7C2   .100000 .000969 .041342   2 10.2869   .17958 .9872E 00 .6547E 06 .3163E 03
 T7C3   .100000 .001139 .047720   4 10.4093   .18596 .2411E 00 .6705E 06 .3252E 03
 T7C4   .100000 .001308 .053730   4 10.5452   .19197 .2347E 00 .6886E 06 .3355E 03
 T7C5   .100000 .001478 .059367   4 10.6929   .19761 .2278E 00 .7087E 06 .3472E 03
 T7C6   .100000 .001647 .064637   4 10.8511   .20288 .2207E 00 .7305E 06 .3602E 03
 T7C7   .100000 .001817 .069559   4 11.0185   .20780 .2135E 00 .7537E 06 .3743E 03
```

```
 T7C8    .100000 .002262 .080958  6 11.4937  .21920 .8645E-01 .8196E 06 .4165E 0
 T7C9    .100000 .002604 .088481  6 11.8885  .22672 .8028E-01 .8731E 06 .4533E 0
 CERAMIC AREA  (C2 THRU C9)$
TAIL LENGTH$
TOTAL CERAMIC LENGTH FOR MIN 'ZEOC'$
  TOTAL MASS (LBS.) $
  TOTAL LENGTH$
  REACTOR  $
  PEAK GAMMA IC $
  MIN 'ZEOC' $
          END
```

SECTION 3.3

PLT FAM additional sample (linear-log)


JOB NO 0564 PLOT NO 5 DATE MAY 21
SEADUCER RUN 80123 MAY 10, 1971
IP 2.3 WITH LOSSLESS HEAD, ARRAY 44
TRIAL DESIGN GEN SCHEME DF-5500
LEGEND
o - T202 45-55
Δ - T203 45-55
+ - T207 45-55
× - T209 45-55
MAG GAMMA EC
10^7
10^6
10^5
10^4
10^3
10^2
4000.0
4250.0
4500.0
4750.0
5000.0
5250.0
5500.0
5750.0
6000.0
FREQUENCY

SECTION 4.

PLT SRF

PLT SRF is designed for 3 dimensional plotting with the following features:

1) Option to plot a surface (hidden lines are suppressed), or families of curves in 3-D, or both.

2) Option for user selected Z axis scales or automatic Z axis self scaling via DISSPLA.

3) User supplied headings as well as X, Y and Z axis labels.

The data storage scheme for X, Y, and Z is illustrated in Fig. 4.1. LPTS, MEMBER, and NFAMLY are defined as before where now each member corresponds to a separate value along the Y axis. Array sizes required are explained within the PLT SRF subroutine.

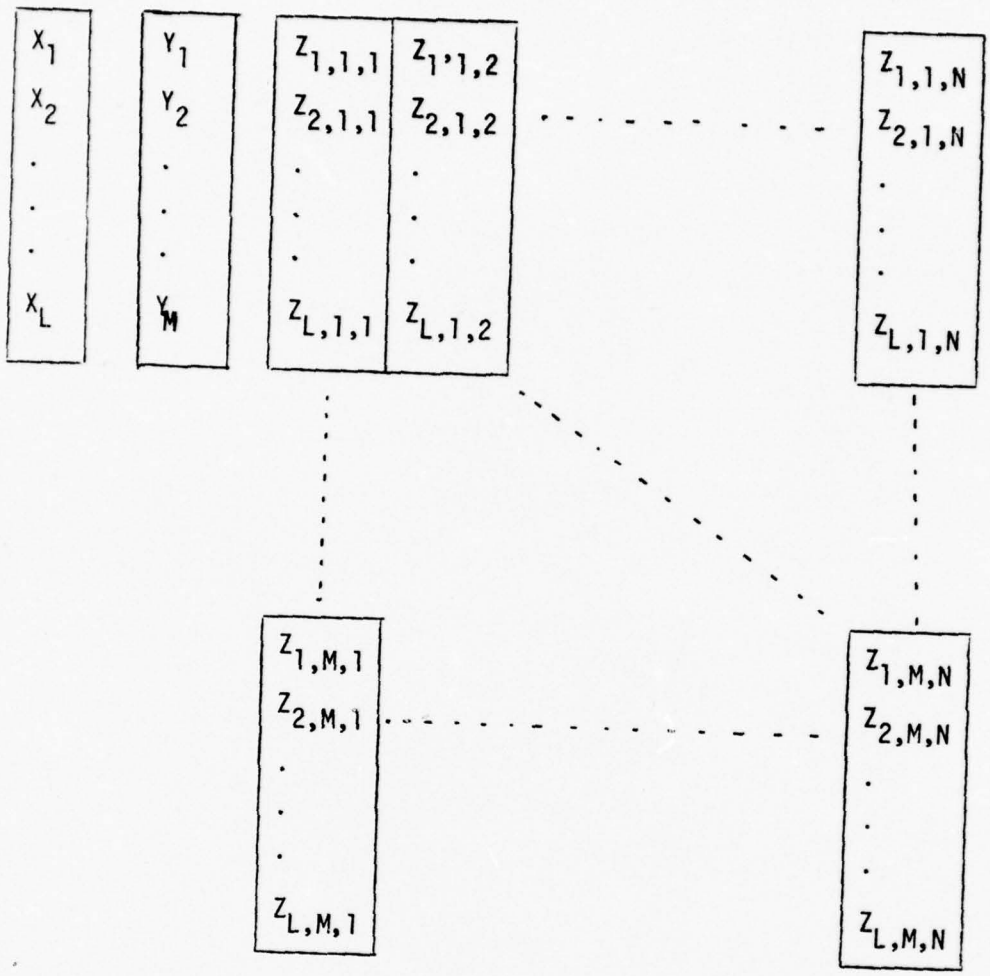
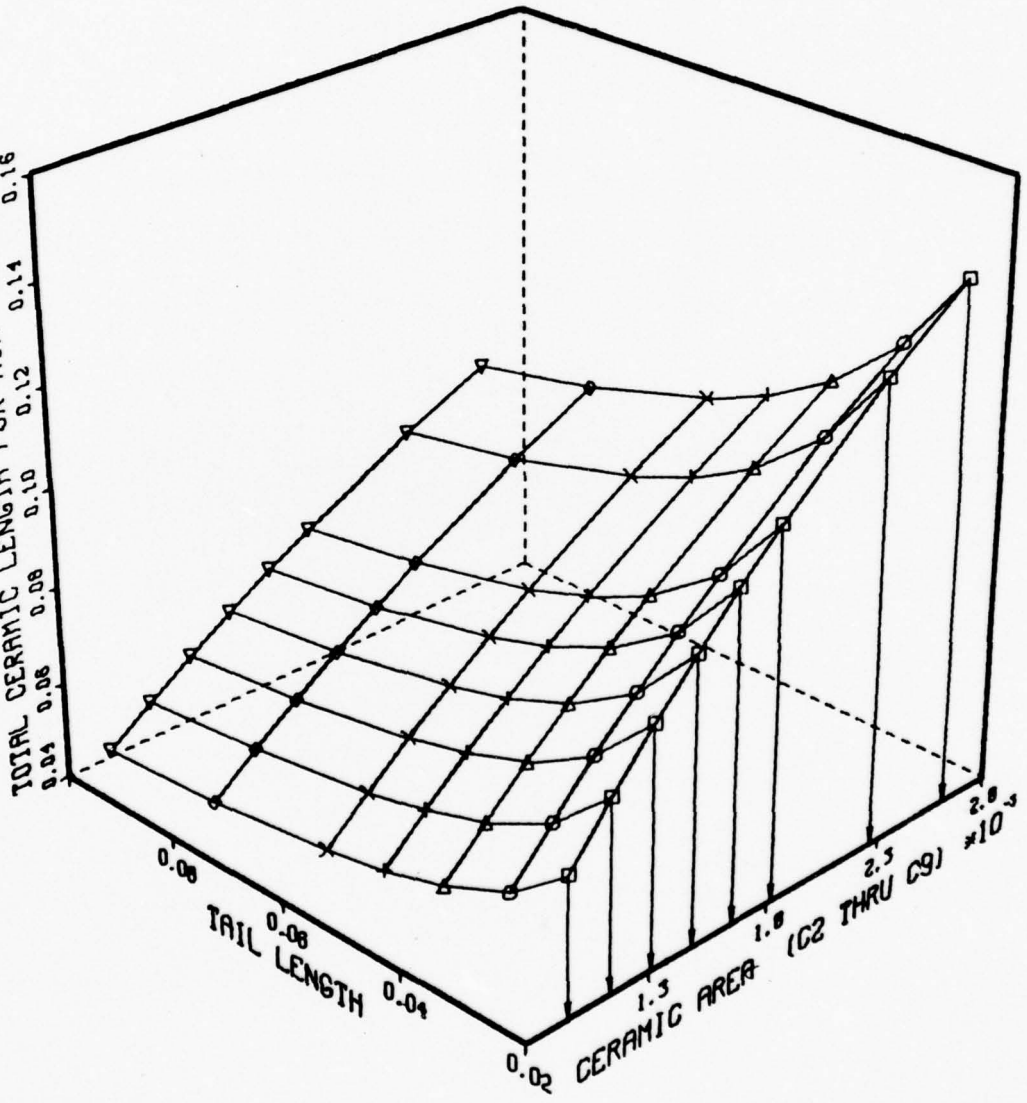


FIG. 4.1 PLT SRF data storage scheme for X(L), Y(M), and Z(L,M,N)
(where L = LPTS, M = MEMBER, N = NFAMLY)

SECTION 4.1

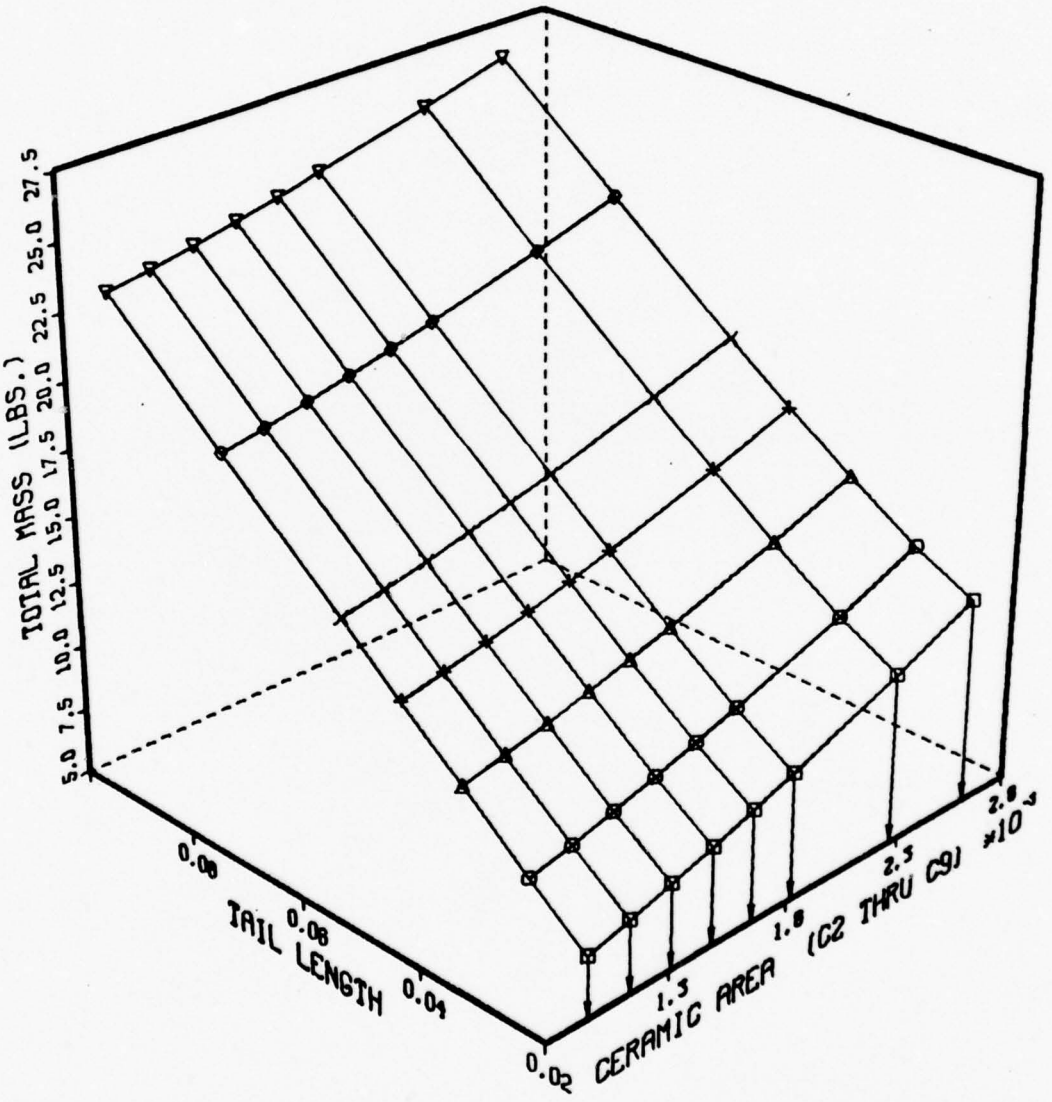
PLT SRF plotting samples

SEADUCER RUN 80122 MAY 6,1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



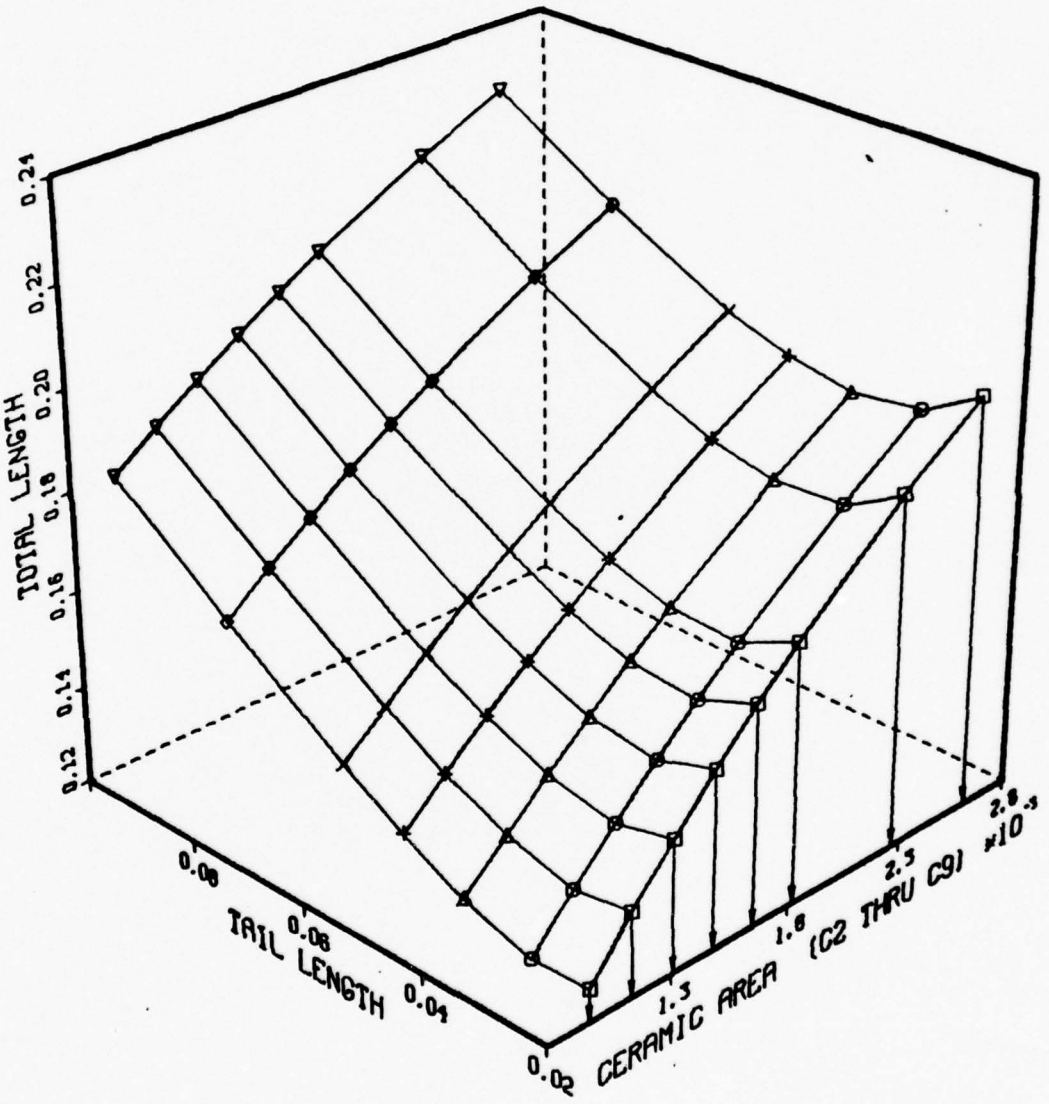
TIME RUN 2238 PLOT NO 1 DATE 06/30/71 N.U.C. DISSPLA VERSION 1

SEADUCER RUN 80122 MAY 6, 1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



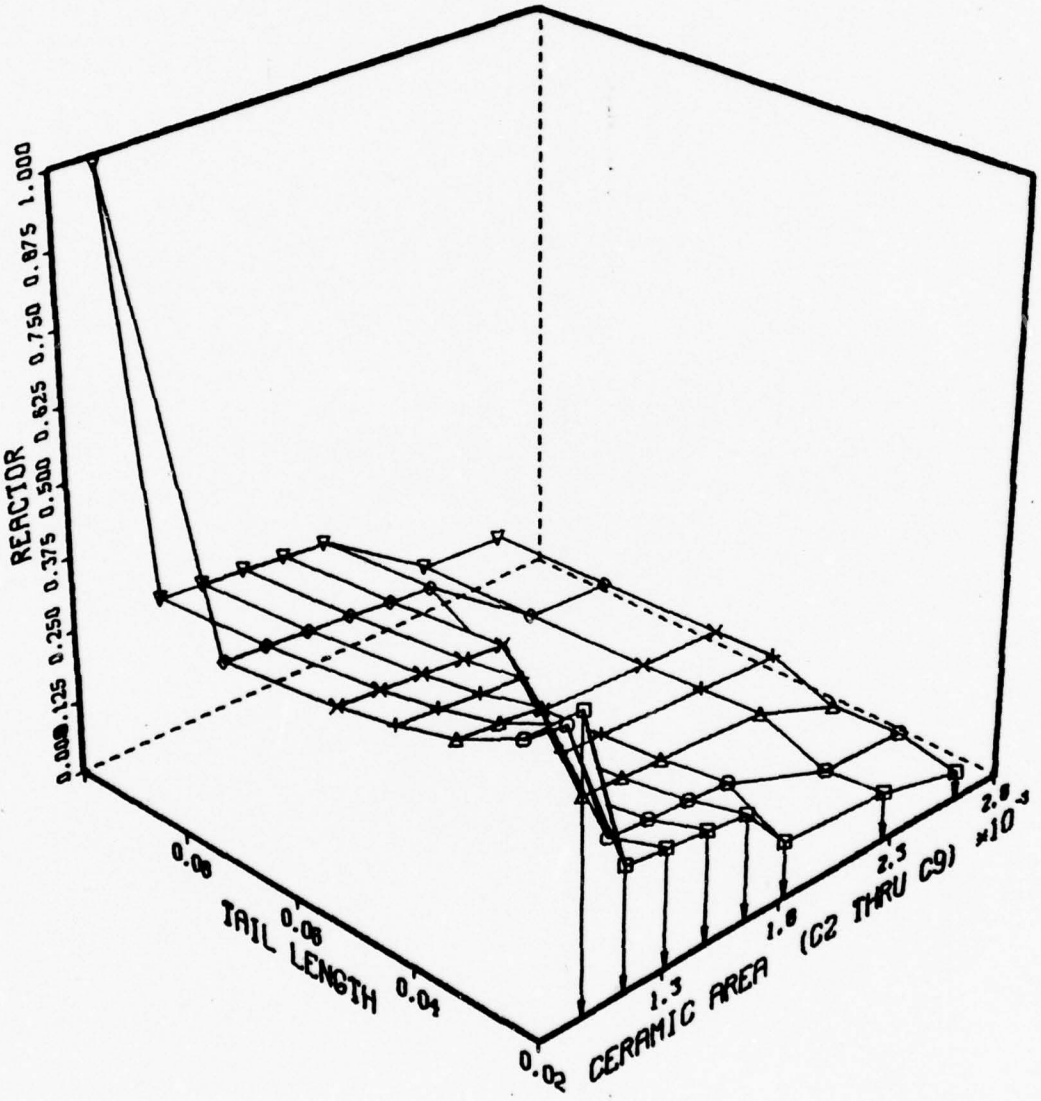
TIME RUN 2238 PLOT NO 2 DATE 06/30/71 N.U.C. DISSPLA VERSION 1

SEADUCER RUN 80122 MAY 6,1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



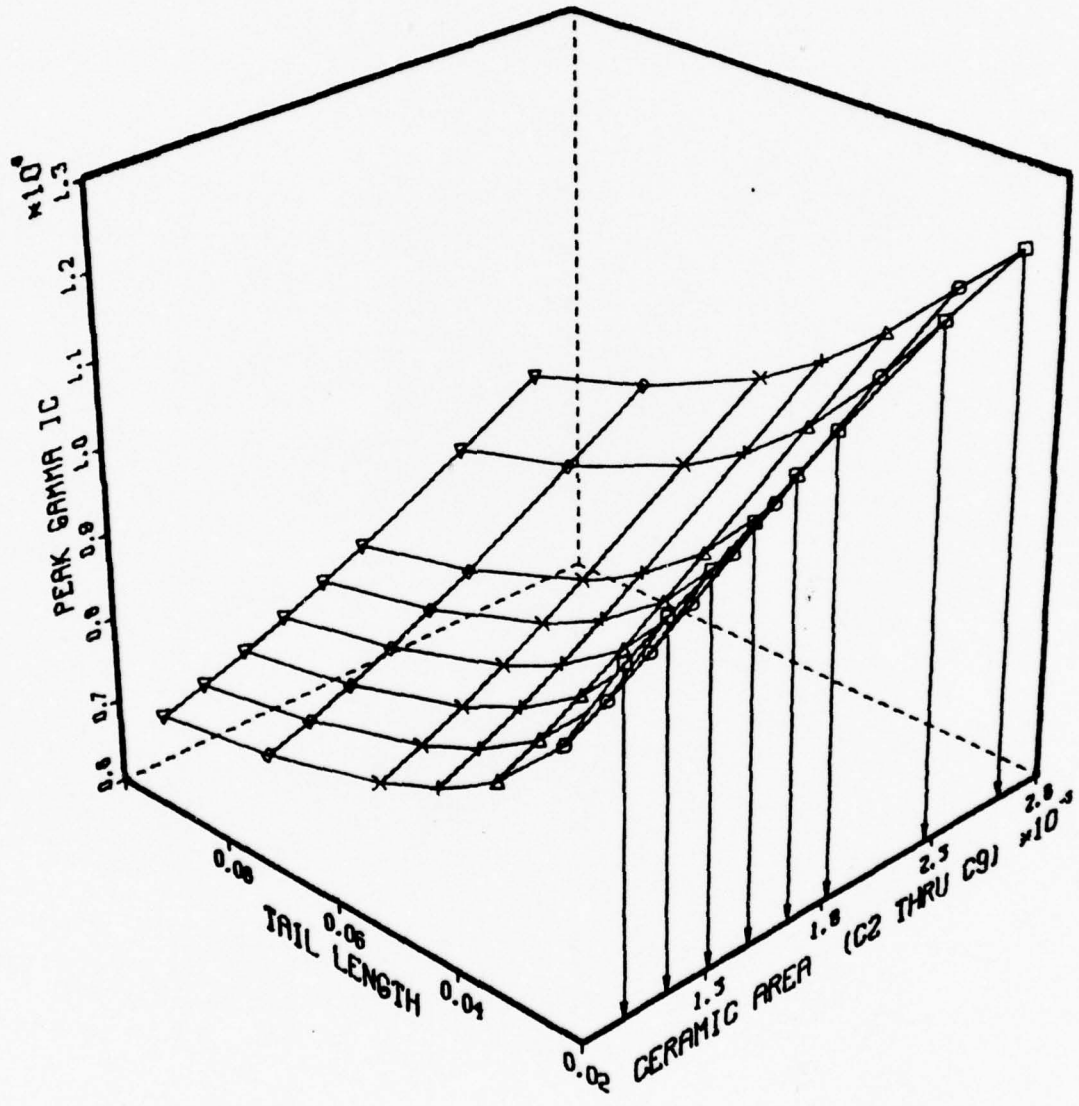
TIME RUN 2230 PLOT NO 3 DATE 06/30/71 N.U.C. DISSPLA VERSION 1

SEADUCER RUN 80122 MAY 6, 1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



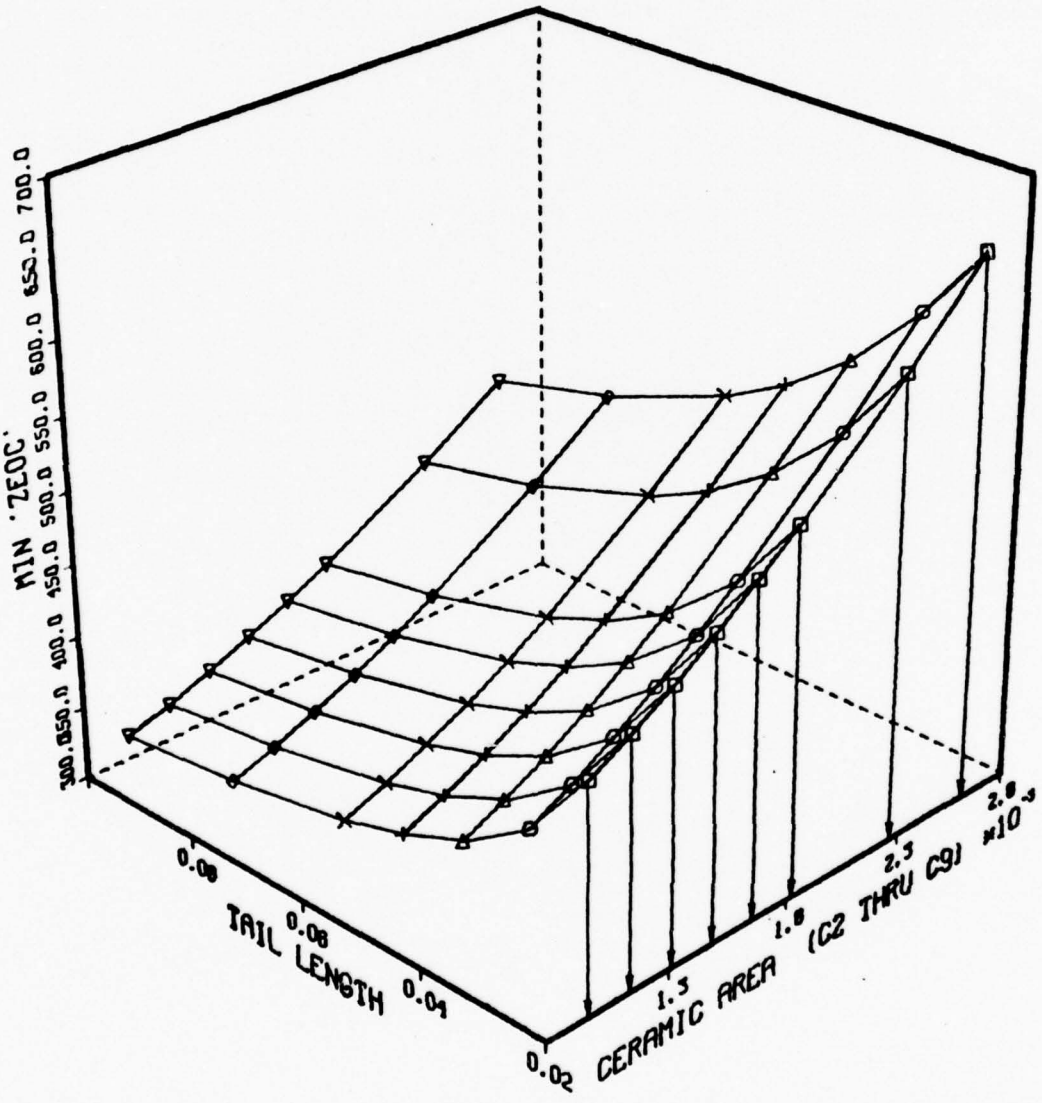
TIME RUN 2230 PLOT NO 4 DATE 08/30/71 N.U.C. DISSPLA VERSION 1

SEADUCER RUN 80122 MAY 6,1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



TIME RUN 2238 PLOT NO 5 DATE 06/30/71 N.U.C. DISPLA VERSION 1

SEADUCER RUN 80122 MAY 6,1971
IP 2.3 DESIGN RUN WITH LOSSLESS HEAD
TRIAL DESIGN GENERATING SCHEME FO-5500



E RUN 2239 PLOT NO 8 DATE 08/30/71 N.U.C. DISSPLA VERSION 1

SECTION 4.2

PLT SRF program listing

```
@RUN,/RN PLTSRF,[illegible]0000,LM6010314522,2,50                    MCCLEARY,60,6331
@ASG,M  8,T,PLOT
@ASG,T  B.,T,2004
@REWIND B.
@COPIN B.,TPF$.
@FREE   B.
@FOR,IS     CONTRL,CONTRL
C * * * * * * * * * * * * * * PLT SRF  CONTROL  ROUTINE  * * * * * * * * * * *
      COMMON   X3D(  8),Y3D(  7),Z3D(  8,  7, 6),ZMAT(  56),WORK3D( 34),
     1                  IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3),
     2                  I BUF(2000)                                          SET
      COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
      DIMENSION I CHK(16)
      DATA N WRD P C /14/                 @ WORDS PER CARD IMAGE ON UNIVAC 1108
      DATA IDOLAR/6H     $/                                                1108
      DATA IN UNIT / 5 /

C********** USER SETS NHLINS = NUMBER OF HEADING LINES TO BE LOADED
      NHLINS = 3
C********** LOAD IHEAD FOR PLOT HEADINGS
      DO 4100 J = 1,NHLINS
      READ( IN UNIT, 200 )  (IHEAD(I,J), I=1,12)
      FLD(30, 6, I HEAD(12,J) ) = I DOLAR                                    1108
      PRINT          201 ,  (IHEAD(I,J), I=1,12)
 4100 CONTINUE
C********** READ AND PRINT ANY EXTRA INFORMATION IF DESIRED
      READ( IN UNIT, 200 )  (I CHK(I), I=1,N WRD P C)
      PRINT          201 ,  (I CHK(I), I=1,N WRD P C)
      READ( IN UNIT, 200 )  (I CHK(I), I=1,N WRD P C)
      PRINT          201 ,  (I CHK(I), I=1,N WRD P C)
  200 FORMAT(13A6,A2)                                                        1108
  201 FORMAT(1X, 13A6,A2)                                                    1108

C********** USER LOADS INPUT DATA FOR LPTS, MEMBER, NFAMLY, X, Y, DTA LBL
      POUNDS = 2.20462
      LPTS = 8
      MEMBER = 7
      NFAMLY = 6
      DO 9 M = 1,MEMBER
      DO 8 L = 1,LPTS
      READ(5,100) Y3D(M), X3D(L),          (Z3D(L,M,N),N=1,NFAMLY)
      PRINT 101,  Y3D(M), X3D(L),          (Z3D(L,M,N),N=1,NFAMLY)
  100 FORMAT(    3X,       4X,3F8.6,3X,F8.4,F8.5,3E10.4)
  101 FORMAT(1X, 3X,       4X,3F8.6,3X,F8.4,F8.5,3E10.4)
      DO 10 N = 1,NFAMLY
      IF (N.EQ.2) Z3D(L,M,N) = Z3D(L,M,N) * POUNDS
   10 CONTINUE
    8 CONTINUE
    9 CONTINUE

C********** LOAD IHD LPT FOR X AXIS TITLE
      READ( IN UNIT, 200 )  (IHD LPT(I), I=1,6)
      FLD(30, 6, IHD LPT(6) ) = I DOLAR                                      1108
      PRINT          201 ,  (IHD LPT(I), I=1,6)
C********** LOAD IHD MEM FOR Y AXIS TITLE
      READ( IN UNIT, 200 )  (IHD MEM(I), I=1,6)
      FLD(30, 6, IHD MEM(6) ) = I DOLAR                                      1108
      PRINT          201 ,  (IHD MEM(I), I=1,6)

C********** LOAD IHD FAM FOR INDIVIDUAL PLOTS ( Z AXIS )
      DO 4000 N = 1,NFAMLY
```

```
      READ( IN UNIT, 200 )  (IHD FAM(I,N), I=1,12)
      FLD(30, 6, IHD FAM(12,N) ) = I DOLAR                          1108
      PRINT          201 ,  (IHD FAM(I,N), I=1,12)
 4000 CONTINUE

C * * * * * INPUT IS NOW LOADED * * * * *
      CALL PLT SRF

C * * * * * TERMINATE ENTIRE PLOT RUN * * * * *
      CALL PLOT(0., 0., 999)
      STOP
      END
```

```
@FOR,IS     PLTSRF,PLTSRF
      SUBROUTINE PLT SRF
C * * * * * PLT SRF (USING DISSPLA PACKAGE)  * * * * * * * * * * * * * * * * * *
C * * * * * GENERAL PROGRAM TO PLOT 3D FAMLIES OF CURVES AND/OR SURFACES * * *
C * * * * * * * PROGRAMMED BY L. E. MCCLEARY  NUC CODE 601 * * * * * * *

C * * * * * DIMENSION AS FOLLOWS * * * * *
C * * * * * WHERE L=LPTS, M=MEMBER, N=NFAMLY, H=NHLINS
C * * * LOAD COMMONS /   /,            /NUMS/  FROM CONTROL
C     COMMON   X3D(L), Y3D(M), Z3D(L,M,N), ZMAT(L*M), WORK3D(2*L+2*M+4),
C    1                 IHDLPT(6), IHDMEM(6), IHDFAM(12, N), IHEAD(12,H),
C    2                 I BUF(200)                                          SET
C     COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
C     COMMON / NOLOAD / ZMIN(N), ZMAX(N), ZPLOT(L), YPLOT(L)

      COMMON   X3D(  8),Y3D(  7),Z3D(  8,  7, 6),ZMAT(  56),WORK3D( 34),
     1                 IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3),
     2                 I BUF(2000)                                         SET
      COMMON /  NUMS  / LPTS, MEMBER, NFAMLY,  NHLINS
      COMMON / NOLOAD / ZMIN(6), ZMAX(6), ZPLOT( 8), YPLOT( 8)

      COMMON / CM VF3D / XORIG,XTOP, YORIG,YTOP, ZORIG,ZTOP,
     1                   XVU,YVU,ZVU, XABS,YABS,ZABS

      DIMENSION Z ORIG L( 6), ZDELTL( 6), ZTOPL( 6)
      DATA NBUF / 2000/                                                    SET
      DATA IFTF/0/
      DATA I PLT UN / 8 /                                                  SET

      DATA(ZORIGL(L),L=1,6)/.04, 5., .14, 0., .6E6, 300./
      DATA(ZDELTL(L),L=1,6)/.04, 5., .04, .2, .2E6, 100./
      DATA(ZTOP L(L),L=1,6)/.20, 30., .26, .8, 1.4E6, 800./

      PRINT 1
    1 FORMAT(1H1)

C * * * * * INITIALIZE PLOT BUFFER
      IF(IFTF .EQ. 0) CALL PLOTS(IBUF,NBUF, I PLT UN)
      IFTF=1

C * * * * * FIND MAX MIN OVER ALL MEMBERS FOR EACH FAMILY
      DO 500 N = 1, NFAMLY
      Z MIN(N) = 1.E30
      Z MAX(N) = -1.E30
  500 CONTINUE
      DO 3000 L = 1, LPTS
      DO 2000 M = 1, MEMBER
      DO 1000 N = 1,NFAMLY
      IF ( Z3D(L,M,N) .LT. Z MIN(N) ) Z MIN(N) = Z3D(L,M,N)
      IF ( Z3D(L,M,N) .GT. Z MAX(N) ) Z MAX(N) = Z3D(L,M,N)
 1000 CONTINUE
 2000 CONTINUE
 3000 CONTINUE

C * * * * * * * * USE DISSPLA PACKAGE * * * * * * * *

      DO 5000 N = 1, NFAMLY
C********** SET N SELF Z = 0  FOR USER SUPPLIED SCALES ON Z
C********** SET N SELF Z = 1  FOR SELF SCALING ON Z
      N SELF Z  = 0
      N SELF Z  = 1
```

```
      IF ( N SELF Z .EQ. 0 ) GO TO 20
C * * * * * * FIND Z SCALES (OPTION)
      CALL AXSPLT( Z MIN(N), Z MAX(N), 9., Z ORIG, Z DELT, Z SCALE )
      Z TOP = Z ORIG + Z DELT * Z SCALE
      GO TO 30

   20 CONTINUE
C********** USER SETS Z SCALES (OPTION)
      Z ORIG = ZORIGL(N)
      Z DELT = ZDELTL(N)
      Z TOP = ZTOPL(N)
   30 CONTINUE
C********** USER SETS X SCALES
      X ORIG = .0008
      X DELT = .0005
      X TOP  = .0028
C********** USER SETS Y SCALES
      Y ORIG = .02
      Y DELT = .02
      Y TOP = .10

      NTH PLT = N
      CALL BGNPL( -NTH PLT )
      CALL TITL3D( 1H , 1, 7.0, 7.0 )
      DO 4500 J = 1,NHLINS
      CALL HEADIN( IHEAD(1,J), 100, 2, NHLINS)
 4500 CONTINUE
      XABS = 1.
      YABS = 1.
      ZABS = 1.
      CALL AXES3D(IHD LPT,100, IHD MEM,100, IHD FAM(1,N),100,
     A            XABS, YABS, ZABS)
      X VU = -3.
      Y VU = -3.
      Z VU =  3.
      CALL VUABS(XVU, YVU, ZVU)
      CALL GRAF3D(XORIG,XDELT,XTOP, YORIG,YDELT,YTOP, ZORIG,ZDELT,ZTOP)

      DO 4900 M = 1, MEMBER
      DO 4800 L = 1, LPTS
      Y PLOT(L) = Y3D(M)
      ZPLOT(L) = Z3D(L,M,N)
      IF ( M .NE. 1      ) GO TO 4800
C * * * * * * ARROW PROJECTIONS FROM CURVE TO AXIS
      CALL RELPT3(X3D(L), YPLOT(L), ZPLOT(L), XFROM, YFROM)
      CALL RELPT3(X3D(L), YPLOT(L), ZORIG, X TO, Y TO)
      CALL QQAROW(XFROM, YFROM, X TO, Y TO)
 4800 CONTINUE
C********** USER SETS N CURV = 0  FOR NOT PLOTTING CURVES OF CONSTANT Y
C********** USER SETS N CURV = 1  FOR     PLOTTING CURVES OF CONSTANT Y
      N CURV = 0
      N CURV = 1
      IF ( N CURV .EQ. 0 ) GO TO 4820
      I MARK = 1
      CALL CURV3D( X3D, YPLOT, ZPLOT, LPTS, I MARK)
 4820 CONTINUE
 4900 CONTINUE

      CALL VUER3D

      CALL SURTRN('BOTH')
```

```
      CALL SURSZE( X3D(1), X3D(LPTS), Y3D(1), Y3D(MEMBER) )

      LM = 1
      DO 4986 M = 1, MEMBER
      DO 4985 L = 1, LPTS
      Z MAT(LM) = Z3D(L,M,N)
      LM = LM + 1
 4985 CONTINUE
 4986 CONTINUE
      IXPTS=1
      IYPTS=1
      CALL SURMAT(Z MAT, IXPTS, LPTS, IYPTS, MEMBER, WORK3D)

      CALL ENDPL( -NTH PLT )
      PRINT 4990, NTH PLT, (IHD FAM(I,N), I=1,12),
     P    XORIG,XDELT,XTOP, YORIG,YDELT,YTOP, ZORIG,ZDELT,ZTOP
 4990 FORMAT(/' COMPLETED PLOT NO.', I3, ' *** ', 12A6 /                    1108
     F       ' X', 3E10.4, ' Y', 3E10.4, ' Z', 3E10.4 / )
 5000 CONTINUE
 6000 CONTINUE

      RETURN
      END
```

```
@FOR,IS     X3DMAT,X3DMAT
      FUNCTION X3DMAT(IX ROW)
      COMMON   X3D(  8),Y3D(  7),Z3D(  8,  7, 6),ZMAT(  56),WORK3D( 34),
     1                  IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3),
     2                  I BUF(200)                                        SET
      X3DMAT = X3D(IX ROW)
      RETURN
      END
@FOR,IS     Y3DMAT,Y3DMAT
      FUNCTION Y3DMAT(IY COL)
      COMMON   X3D(  8),Y3D(  7),Z3D(  8,  7, 6),ZMAT(  56),WORK3D( 34),
     1                  IHDLPT(6), IHDMEM(6), IHDFAM(12, 6), IHEAD(12,3),
     2                  I BUF(200)                                        SET
      Y3DMAT = Y3D(IY COL)
      RETURN
      END
```

```
QFOR,IS     VUER3D,VUER3D
      SUBROUTINE VUER3D
      COMMON / CM VE3D / XORIG,XTOP, YORIG,YTOP, ZORIG,ZTOP,
     1                   XVU,YVU,ZVU, XABS,YABS,ZABS
      DIMENSION XOT(2), YOT(2), ZOT(2), XB(2), YB(2), ZB(2),  BDEL(3)
      DIMENSION IXOTC(7,4), IYOTC(7,4), IZOTC(7  ),  IBXYZC(6,4)
      DATA (BDEL(L),L=1,3) / -.003, 0., .003 /
      DATA ((IXOTC(I,N),I=1,7),N=1,4) /
     X  1,1,2,2,2,1,2,  1,2,2,2,1,1,1,  2,2,1,1,1,2,1,  2,1,1,1,2,2,2/
      DATA ((IYOTC(I,N),I=1,7),N=1,4) /
     Y  2,1,1,1,2,2,2,  1,1,2,2,2,1,2,  1,2,2,2,1,1,1,  2,2,1,1,1,2,1/
      DATA ( IZOTC(I  ),I=1,7)        /
     Z  1,1,1,2,2,2,1/
      DATA((IBXYZC(I,N),I=1,6),N=1,4) /
     B  1,2,2,3,3,1,  2,1,1,3,3,2,  1,2,2,3,3,1,  2,1,1,3,3,2/

      IF ( ZVU .LT. 0. ) RETURN
      N CORNR = 0
      IF ( XVU .LE. 0.    .AND. YVU .LE. 0.  ) N CORNR = 1
      IF ( XVU .GE. XABS .AND. YVU .LE. 0.  ) N CORNR = 2
      IF ( XVU .GE. XABS .AND. YVU .GE. YABS) N CORNR = 3
      IF ( XVU .LE. 0.    .AND. YVU .GE. YABS) N CORNR = 4
      IF ( N CORNR .EQ. 0 ) RETURN

      XOT(1) = XORIG
      XOT(2) = XTOP
      YOT(1) = YORIG
      YOT(2) = YTOP
      ZOT(1) = ZORIG
      ZOT(2) = ZTOP

      DO 260 I DEL = 1,3
      DO 250 I = 1,6
      IC = IXOTC(  I,NCORNR)
      XB(1) = XOT(IC)
      IC = IYOTC(  I,NCORNR)
      YB(1) = YOT(IC)
      IC = IZOTC(  I)
      ZB(1) = ZOT(IC)
      IF ( I .EQ. 6 ) GO TO 205
      IC = IXOTC(I+1,NCORNR)
      XB(2) = XOT(IC)
      IC = IYOTC(I+1,NCORNR)
      YB(2) = YOT(IC)
      IC = IZOTC(I+1)
      ZB(2) = ZOT(IC)
      GO TO 210
  205 CONTINUE
      IC = IXOTC(  1,NCORNR)
      XB(2) = XOT(IC)
      IC = IYOTC(  1,NCORNR)
      YB(2) = YOT(IC)
      IC = IZOTC(  1)
      ZB(2) = ZOT(IC)
  210 CONTINUE
      L WIDE = IBXYZC(I, NCORNR)
      GO TO (211,212,213), L WIDE
  211 XB(1) = XB(1) + B DEL(I DEL) * (XTOP-XORIG)
      XB(2) = XB(1)
      GO TO 215
  212 YB(1) = YB(1) + B DEL(I DEL) * (YTOP-YORIG)
```

```
      YB(2) = YB(1)
      GO TO 215
  213 ZB(1) = ZB(1) + B DEL(I DEL) * (ZTOP-ZORIG)
      ZB(2) = ZB(1)
  215 CONTINUE
      CALL CURV3D(XB, YB, ZB, 2, 0)
  250 CONTINUE
  260 CONTINUE

      CALL DASH
      IC = IXOTC(  7,NCORNR)
      XB(1) = XOT(IC)
      IC = IYOTC(  7,NCORNR)
      YB(1) = YOT(IC)
      IC = IZOTC(  7)
      ZB(1) = ZOT(IC)
      DO 300 I = 1, 5, 2
      IC = IXOTC(  I,NCORNR)
      XB(2) = XOT(IC)
      IC = IYOTC(  I,NCORNR)
      YB(2) = YOT(IC)
      IC = IZOTC(  I)
      ZB(2) = ZOT(IC)
      CALL CURV3D(XB, YB, ZB, 2, 0)
  300 CONTINUE
      CALL RESET('DASH')
      RETURN
      END
```

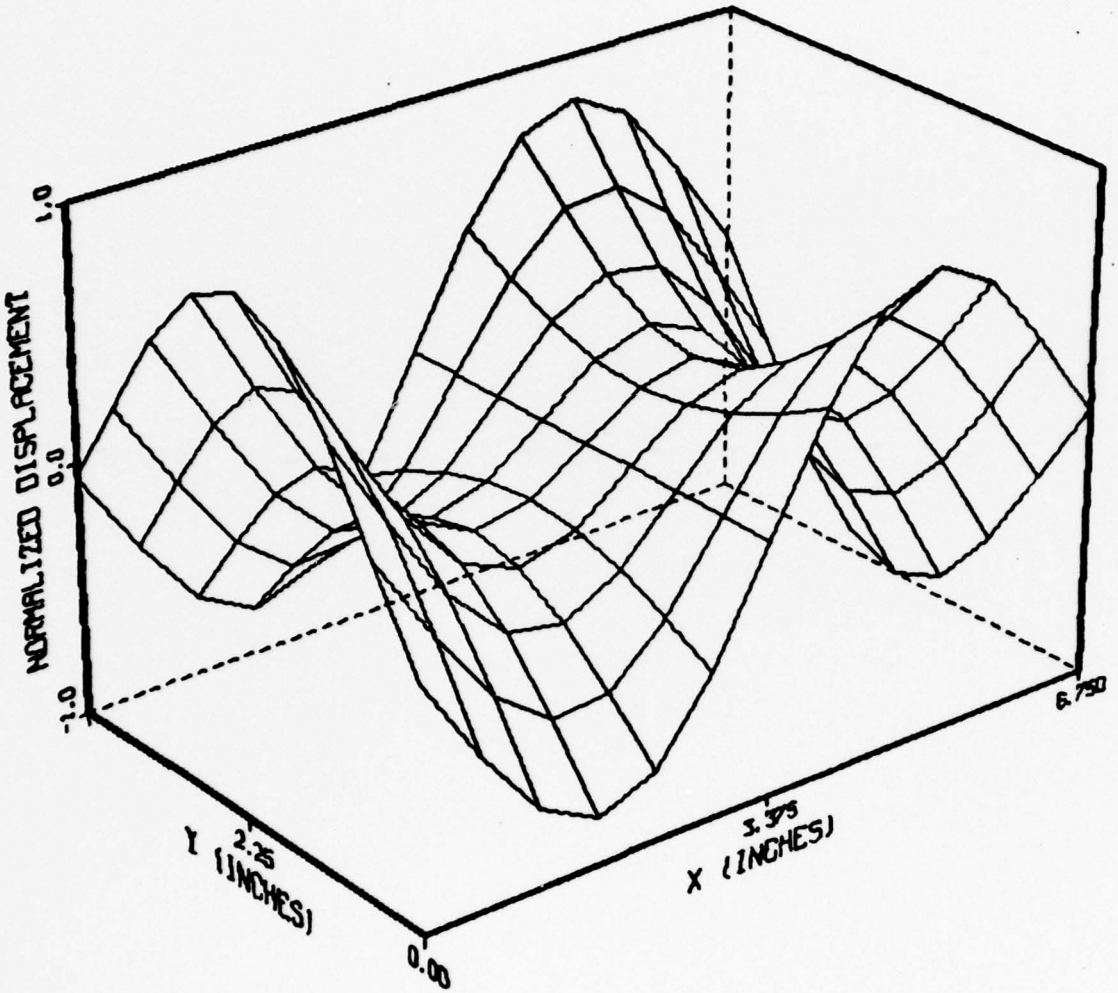
```
@TOP
@PREP
@PRT,T   TPF$.
@MAP,XI      SYMRUN,ABSRUN
 IN CONTRL
@XQT ABSRUN
 SEADUCER RUN 80122 MAY  6,1971$ LIKE 80089 Q=50
 IP 2.3 DESIGN RUN WITH LOSSLESS HEAD$
 TRIAL DESIGN GENERATING SCHEME F0=5500 $
 CHARGE TO 16000501 ARRAY DESIGN
        L T2L1   A C3D   T L C3D  NP T MASS T LENGTH  REACTOR  GAMMA IC GAM EC MIN
 T1C2   .020000 .000969 .068308   4  3.3061  .12655 .4923E 00 .9984E 06 .4536E 03
 T1C3   .020000 .001139 .078810   6  3.4973  .13705 .2095E 00 .1024E 07 .4686E 03
 T1C4   .020000 .001308 .088665   6  3.7102  .14690 .1997E 00 .1051E 07 .4857E 03
 T1C5   .020000 .001478 .097868   6  3.9421  .15611 .1897E 00 .1080E 07 .5048E 03
 T1C6   .020000 .001647 .106433   6  4.1905  .16467 .1798E 00 .1108E 07 .5255E 03
 T1C7   .020000 .001817 .114374   8  4.4531  .17261 .9567E-01 .1136E 07 .5478E 03
 T1C8   .020000 .002262 .132576   8  5.1965  .19082 .8253E-01 .1201E 07 .6113E 03
 T1C9   .020000 .002604 .144293  10  5.8091  .20253 .4718E-01 .1241E 07 .6644E 03
 T2C2   .029200 .000969 .058624   4  4.0579  .12606 .3969E 00 .8752E 06 .4028E 03
 T2C3   .029200 .001139 .067846   4  4.2249  .13529 .3853E 00 .9006E 06 .4169E 03
 T2C4   .029200 .001308 .076560   6  4.4116  .14400 .1654E 00 .9296E 06 .4334E 03
 T2C5   .029200 .001478 .084769   6  4.6160  .15221 .1592E 00 .9608E 06 .4519E 03
 T2C6   .029200 .001647 .092480   6  4.8360  .15992 .1528E 00 .9936E 06 .4723E 03
 T2C7   .029200 .001817 .099712   6  5.0700  .16715 .1464E 00 .1027E 07 .4943E 03
 T2C8   .029200 .002262 .116568   8  5.7386  .18401 .7299E-01 .1114E 07 .5586E 03
 T2C9   .029200 .002604 .127729   8  6.2971  .19517 .6631E-01 .1174E 07 .6129E 03
 T3C2   .040000 .000969 .052474   4  4.9809  .13071 .3405E 00 .7952E 06 .3708E 03
 T3C3   .040000 .001139 .060763   4  5.1318  .13900 .3321E 00 .8180E 06 .3833E 03
 T3C4   .040000 .001308 .068613   4  5.3006  .14685 .3227E 00 .8443E 06 .3980E 03
 T3C5   .040000 .001478 .076011   6  5.4853  .15425 .1388E 00 .8735E 06 .4148E 03
 T3C6   .040000 .001647 .082978   6  5.6844  .16122 .1340E 00 .9048E 06 .4334E 03
 T3C7   .040000 .001817 .089527   6  5.8963  .16777 .1291E 00 .9375E 06 .4536E 03
 T3C8   .040000 .002262 .104895   6  6.5037  .18314 .1162E 00 .1026E 07 .5134E 03
 T3C9   .040000 .002604 .115152   8  7.0129  .19339 .6003E-01 .1094E 07 .5651E 03
 T4C2   .050000 .000969 .048974   4  5.8525  .13721 .3098E 00 .7501E 06 .3530E 03
 T4C3   .050000 .001139 .056695   4  5.9941  .14493 .3028E 00 .7708E 06 .3644E 03
 T4C4   .050000 .001308 .064004   4  6.1524  .15224 .2947E 00 .7948E 06 .3778E 03
 T4C5   .050000 .001478 .070896   4  6.3256  .15914 .2859E 00 .8216E 06 .3931E 03
 T4C6   .050000 .001647 .077369   6  6.5119  .16561 .1229E 00 .8507E 06 .4102E 03
 T4C7   .050000 .001817 .083459   6  6.7102  .17170 .1187E 00 .8813E 06 .4288E 03
 T4C8   .050000 .002262 .097744   6  7.2782  .18598 .1075E 00 .9663E 06 .4842E 03
 T4C9   .050000 .002604 .107305   6  7.7547  .19554 .9929E-01 .1033E 07 .5325E 03
 T5C2   .060000 .000969 .046551   4  6.7324  .14479 .2893E 00 .7193E 06 .3411E 03
 T5C3   .060000 .001139 .053863   4  6.8677  .15210 .2828E 00 .7385E 06 .3516E 03
 T5C4   .060000 .001308 .060779   4  7.0187  .15902 .2755E 00 .7607E 06 .3640E 03
 T5C5   .060000 .001478 .067293   4  7.1837  .16553 .2674E 00 .7854E 06 .3782E 03
 T5C6   .060000 .001647 .073414   4  7.3612  .17165 .2590E 00 .8123E 06 .3940E 03
 T5C7   .060000 .001817 .079148   6  7.5497  .17739 .1113E 00 .8411E 06 .4114E 03
 T5C8   .060000 .002262 .092595   6  8.0889  .19083 .1011E 00 .9215E 06 .4631E 03
 T5C9   .060000 .002604 .101576   6  8.5406  .19982 .9366E-01 .9855E 06 .5082E 03
 T6C2   .080000 .000969 .043376   4  8.5052  .16162 .2631E 00 .6797E 06 .3258E 03
 T6C3   .080000 .001139 .050130   4  8.6325  .16837 .2572E 00 .6967E 06 .3353E 03
 T6C4   .080000 .001308 .056505   4  8.7741  .17474 .2505E 00 .7164E 06 .3464E 03
 T6C5   .080000 .001478 .062495   4  8.9285  .18073 .2433E 00 .7384E 06 .3591E 03
 T6C6   .080000 .001647 .068110   4  9.0941  .18635 .2358E 00 .7622E 06 .3731E 03
 T6C7   .080000 .001817 .073367   4  9.2698  .19161 .2280E 00 .7877E 06 .3885E 03
 T6C8   .080000 .002262 .085599   6  9.7700  .20384 .9234E-01 .8599E 06 .4347E 03
 T6C9   .080000 .002604 .093725   6 10.1875  .21196 .8571E-01 .9182E 06 .4749E 03
 T7C2   .100000 .000969 .041342   2 10.2869  .17958 .9872E 00 .6547E 06 .3163E 03
 T7C3   .100000 .001139 .047720   4 10.4093  .18596 .2411E 00 .6705E 06 .3252E 03
```

```
 T7C4    .100000 .001308 .053730   4 10.5452   .19197 .2347E 00 .6886E 06 .3355E 03
 T7C5    .100000 .001478 .059367   4 10.6929   .19761 .2278E 00 .7087E 06 .3472E 03
 T7C6    .100000 .001647 .064637   4 10.8511   .20288 .2207E 00 .7305E 06 .3602E 03
 T7C7    .100000 .001817 .069559   4 11.0185   .20780 .2135E 00 .7537E 06 .3743E 03
 T7C8    .100000 .002262 .080958   6 11.4937   .21920 .8645E-01 .8196E 06 .4165E 03
 T7C9    .100000 .002604 .088481   6 11.8885   .22672 .8028E-01 .8731E 06 .4533E 03
 CERAMIC AREA  (C2 THRU C9)$
 TAIL LENGTH $
TOTAL CERAMIC LENGTH FOR MIN 'ZEOC'$
  TOTAL MASS (LBS.) $
  TOTAL LENGTH$
  REACTOR  $
  PEAK GAMMA IC $
  MIN 'ZEOC' $
@FIN
```

SECTION 4.3

PLT SRF additional sample

BOS6 RECTANGULAR HEAD
NORMALIZED MEASURED FREQUENCY - 2.41
NORMALIZED THEORETICAL FREQUENCY - 2.44



SECTION 5.
PLT PTN

PLT PTN is a modified version of PLT FAM specifically oriented towards polar plot applications (such as beam patterns). Its features include:

1) Option for user selected axis scales or automatic self scaling via DISSPLA

2) User supplied headings and legend labels.

The data storage scheme for angle vs. magnitude is the same as for Fig. 3.1 of PLT FAM where X corresponds to angle and Y corresponds to magnitude. Array sizes required are explained within the PLT PTN subroutine.

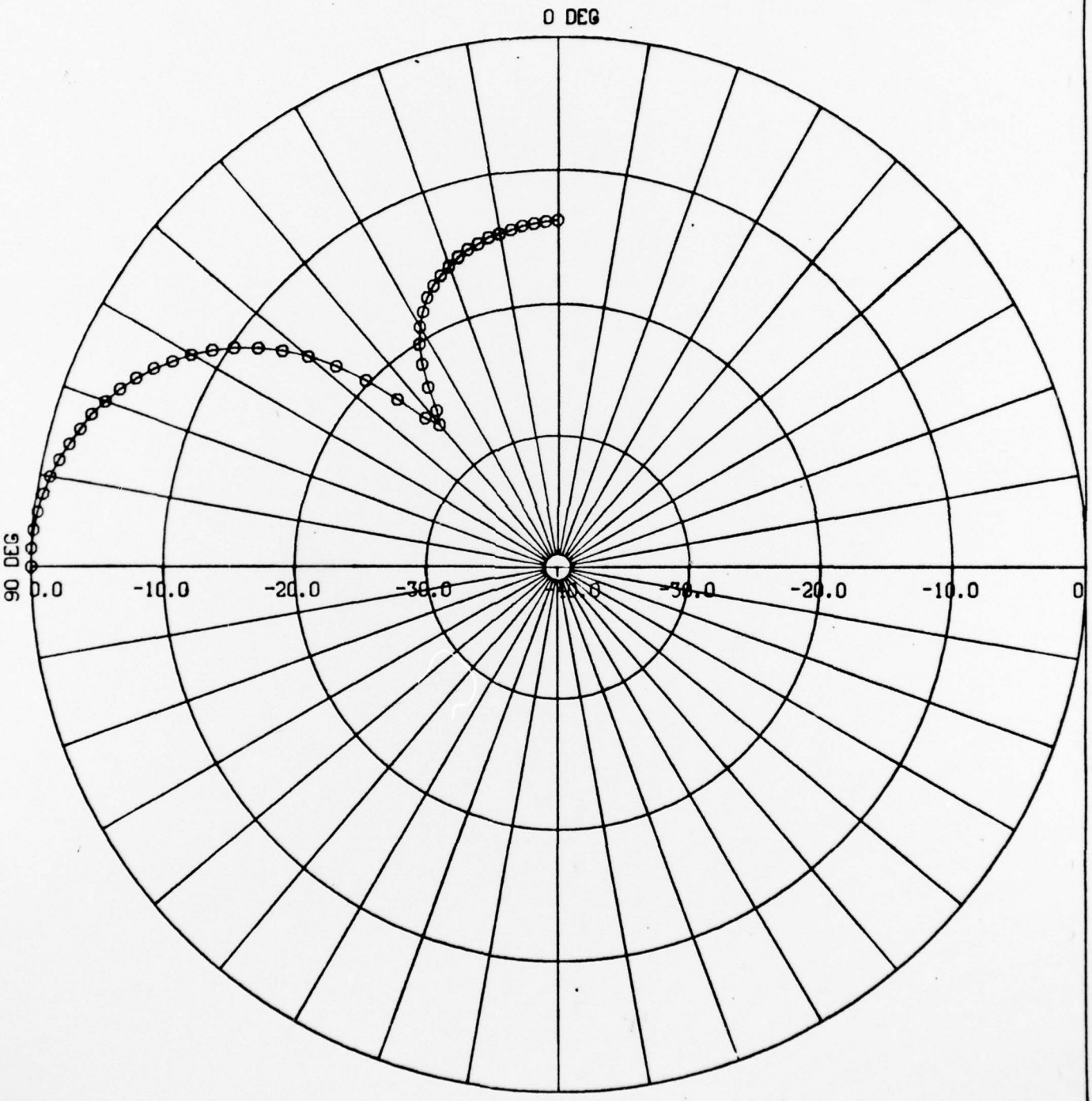
Notice that in this example the angular orientation has been rotated 90° so that 0° is vertical.

SECTION 5.1

PLT PTN plotting sample

MARCH 6, 1971
BEAM PATTERN THETA
TRANSPARENT

LEGEND
o - 500.0
FREQUENCY



JOB NO 0408 PLOT NO 1 DATE AUG 06

SECTION 5.2

PLT PTN program listing

```
 2000      JOB        601        ~~16054304~~  00.03     L MCCLEARY PLT PTN  BEAM PAT1
           MOUNT      M3S=PLOT
           FORTRAN
C * * * * * * * * * * * * * * PLT PTN  CONTROL  ROUTINE * * * * * * * * * * * *
      COMMON /         / XDATA(361), YDATA(361, 4,1)
      COMMON / CMHEAD /              IHDMEM(6),                IHEAD(12,3)
      COMMON /  NUMS   / LPTS, MEMBER, NFAMLY,  NHLINS
      COMMON / CPL LBL / DTA LBL( 4,2), IPK LBL( 4,12)
      DIMENSION IMODE(3)
      DATA IDOLAR/5H    $ /                                                  1230
      DATA IN UNIT / 5 /

C********** USER SETS NHLINS = NUMBER OF HEADING LINES TO BE LOADED
      NHLINS = 3
C********** LOAD IHEAD FOR PLOT HEADINGS
      DO 4100 J = 1,NHLINS
      READ( IN UNIT, 200 )  (IHEAD(I,J), I=1,12)
      CALL SFLD( 24, 6, I HEAD(12,J), IDOLAR )                             1230
      PRINT          201 ,  (IHEAD(I,J), I=1,12)
 4100 CONTINUE
  200 FORMAT(16A5)                                                         1230
  201 FORMAT(1X, 16A5)                                                     1230

C********** LOAD IHD MEM FOR LEGEND TITLE
      READ( IN UNIT, 200 )  (IHD MEM(I), I=1,6)
      CALL SFLD(24, 6, IHD MEM(6), IDOLAR)                                 1230
      PRINT          201 ,  (IHD MEM(I), I=1,6)

      N TIMES = 1
      DO 5000 I TIMES = 1, N TIMES

C********** USER LOADS INPUT DATA FOR LPTS, MEMBER, NFAMLY, X, Y, DTA LBL
      MEMBER = 1
      NFAMLY = 1
      READ(5,99) NANG,ST ANG,DANG, FREQ,IHANG,IMODE(1),IMODE(2),IMODE(3)
      PRINT  99, NANG,ST ANG,DANG, FREQ,IHANG,IMODE(1),IMODE(2),IMODE(3)
   99 FORMAT(I10, 3F10.2, 5X,A5, 5X,3A5)
      LPTS = NANG
      M = 1
      N = 1
      DTA LBL(M,1) = FREQ
      DO 8 L = 1, LPTS, 10
      LLO = L
      LHI = L+9
      IF ( LHI .GT. NANG ) LHI = NANG
      READ(5,100) (Y DATA(LL,M,N), LL=LLO,LHI)
      PRINT  100, (Y DATA(LL,M,N), LL=LLO,LHI)
  100 FORMAT(10F8.1)
    8 CONTINUE
      R QUAD = 90.
      X = ST ANG + R QUAD
      DO18 L = 1,LPTS
      IF ( Y DATA(L,M,N) .LT. -39.5 ) Y DATA(L,M,N) = -39.5
      X DATA(L) = X * 3.14159 / 180.
      X = X + DANG
   18 CONTINUE

C * * * * * INPUT IS NOW LOADED * * * * *
      CALL PLT PTN

 5000 CONTINUE
```

```
C * * * * * TERMINATE ENTIRE PLOT RUN * * * * *
      CALL PLOT(0., 0., 999)
      STOP
      END
```

```
      SUBROUTINE PLT PTN
C * * * * * * PLT PTN (USING DISSPLA PACKAGE)  * * * * * * * * * * * * * * * * * *
C * * * * * * GENERAL PROGRAM TO PLOT FAMILIES OF CURVES WITH LEGENDS  * * * * *
C * * * * * * * PROGRAMMED BY L. E. MCCLEARY  NUC CODE 601 * * * * * * *

C * * * * * DIMENSION AS FOLLOWS * * * * *
C * * * LOAD COMMONS /    /, /CMHEAD/, /NUMS/, AND ARRAY DTA LBL IN CONTROL
C * * * * * WHERE L=LPTS, M=MEMBER, N=NFAMLY, H=NHLINS
C      COMMON /         / XDATA(L), YDATA(L,M,N)
C      COMMON / CMHEAD /              IHDMEM(6),                    IHEAD(12,H)
C      COMMON /  NUMS   / LPTS, MEMBER, NFAMLY,  NHLINS
C      COMMON / CPL LBL / DTA LBL( M,2), IPK LBL( M,12)
C      COMMON / NO LOAD / YMIN(N), YMAX(N), YPLOT(L)

       COMMON /         / XDATA(361), YDATA(361, 4,1)
       COMMON / CMHEAD /              IHDMEM(6),                    IHEAD(12,3)
       COMMON /  NUMS   / LPTS, MEMBER, NFAMLY,  NHLINS
       COMMON / CPL LBL / DTA LBL( 4,2), IPK LBL( 4,12)
       COMMON / NO LOAD / YMIN(1), Y MAX(1), Y PLOT(361)

       DIMENSION IH LBL M(4)

       COMMON / CM PLOT / I BUF( 200)                                    SET
       DATA NBUF / 200 /                                                 SET
       DATA IFTF/0/
       DATA I PLT UN / 2 /                                               SET

C * * * * * INITIALIZE PLOT BUFFER
       IF(IFTF .EQ. 0) CALL PLOTS(IBUF,NBUF, I PLT UN)
       IFTF=1

C * * * * * FIND MAX MIN OVER ALL MEMBERS FOR EACH FAMILY
       DO 500 N = 1, NFAMLY
       Y MIN(N) = 1.E30
       Y MAX(N) = -1.E30
  500  CONTINUE
       DO 3000 L = 1, LPTS
       DO 2000 M = 1, MEMBER
       DO 1000 N = 1,NFAMLY
       IF ( Y DATA(L,M,N) .LT. Y MIN(N) ) Y MIN(N) = Y DATA(L,M,N)
       IF ( Y DATA(L,M,N) .GT. Y MAX(N) ) Y MAX(N) = Y DATA(L,M,N)
 1000  CONTINUE
 2000  CONTINUE
 3000  CONTINUE

C * * * * * * * * * USE DISSPLA PACKAGE * * * * * * * * *

       DO 5000 N = 1, NFAMLY
       CALL BGNPL( N )
       M = 1
       DO 4400 L = 1,LPTS
 4400  Y PLOT(L) = Y DATA(L,M,N)

C********** USER SETS I SCALE = 0  FOR SELF SCALING
C********** USER SETS I SCALE = 1  FOR USER SUPPLIED SCALES
       I SCALE = 0
       I SCALE = 1

       IF ( I SCALE .EQ. 0 ) GO TO 4440

C********** FOR USER SUPPLIED SCALES,
```

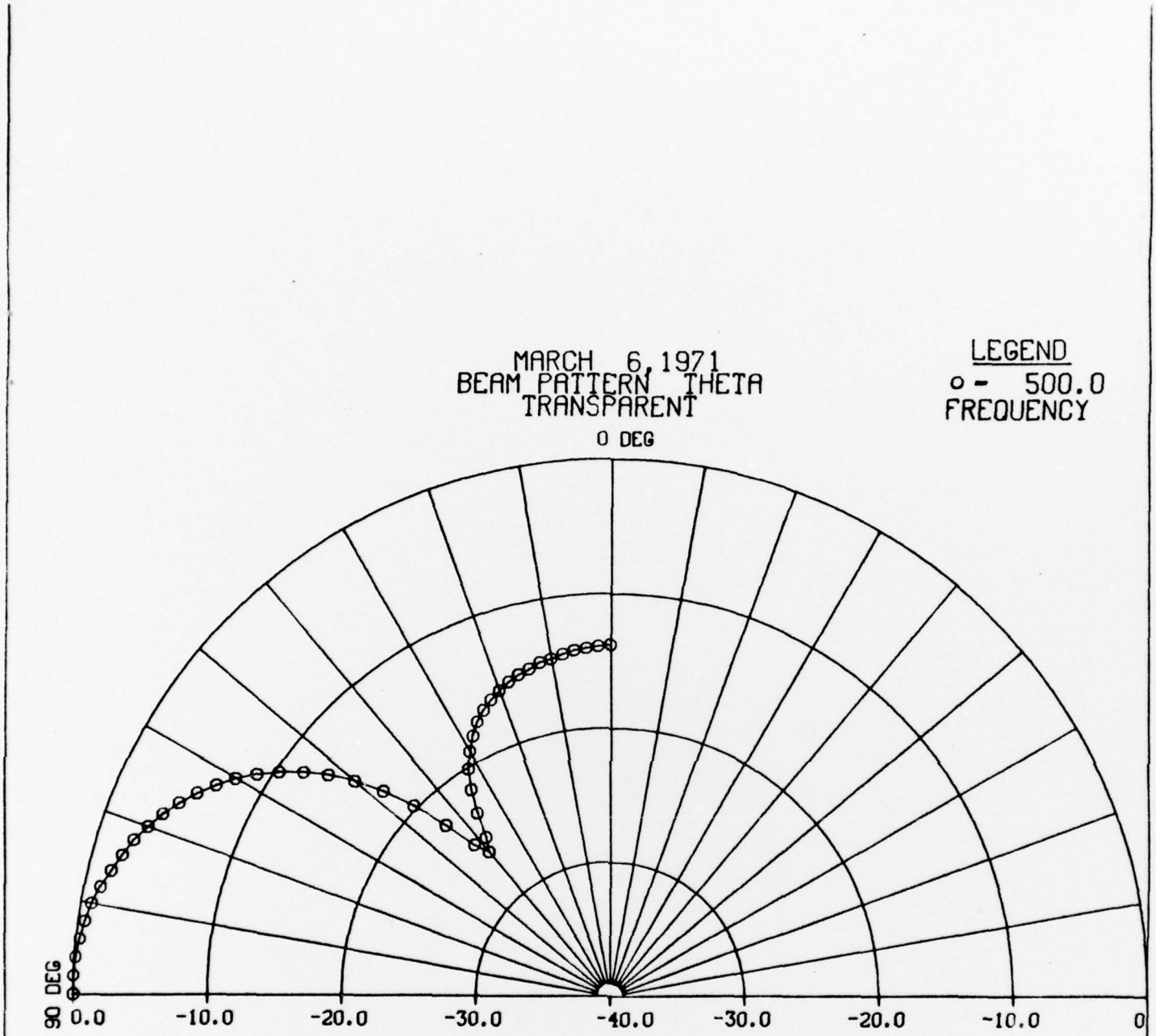
```
C********** USER SETS R ORIG, R STEP, R INCH  FOR EACH FAMILY
      R ORIG = -40.
      R STEP = 10.
      R INCH = 4.

      GO TO 4445

 4440 CONTINUE
C * * * * * SELF SCALING
      CALL AXSPLT(Y MIN(N), Y MAX(N), 4., R ORIG, R STEP, R INCH)

 4445 CONTINUE
C * * * * * SCALES ARE NOW AVAILABLE FOR PLOTTING
      R TOP = R ORIG + R STEP * R INCH
      CALL R RANGE(R TOP)
      CALL POLORG(R ORIG)
      D INCH = R INCH + R INCH
      ITITLE = 1
      CALL TITLE(1H ,ITITLE, 1H ,1, 1H ,0,  D INCH, D INCH)
      TH CONV = 1.
      CALL POLAR(TH CONV, R STEP, R INCH, R INCH)

      DO 4500 J = 1,NHLINS
 4500 CALL HEADIN( IHEAD(1,J), 100, 2, NHLINS+1)
      CALL HEADIN(1H ,1, 2, NHLINS+1)
      CALL GRID( 1, 1 )

      CALL MARKER( M )
      I MARK = 0
      I MARK = 1
      CALL CURVE( X DATA, Y PLOT, LPTS, I MARK )

C********** USER SELECTS LEGEND FORMAT FOR ENCODE
    4 FORMAT(F7.1,      '$')
      ENCODE(20, 4, IH LBL M) DTALBL(M,1)
      CALL LINES(IH LBL M, IPK LBL, M )

      IF ( MEMBER .EQ. 1 ) GO TO 4901
      DO 4900 M = 2,MEMBER
      DO 4600 L = 1,LPTS
 4600 Y PLOT(L) = Y DATA(L,M,N)
      CALL MARKER(M)
      CALL CURVE( X DATA, Y PLOT, LPTS, I MARK )

      ENCODE(20, 4, IH LBL M) DTALBL(M,1)
      CALL LINES(IH LBL M, IPK LBL, M )
 4900 CONTINUE
 4901 CONTINUE

C********** USER SETS N LEGND = 0  FOR NO LEGEND
C********** USER SETS N LEGND = 1  FOR    LEGEND
      N LEGND = 0
      N LEGND = 1

      IF ( N LEGND .EQ. 0 ) GO TO 4960
      XLEGND = D INCH - 1.5
      YLEGND = D INCH + .5
      CALL LEGEND(IPK LBL, MEMBER, XLEGND, YLEGND )
      CALL MESSAG( IHD MEM, 100, XLEGND, YLEGND-.2 )
 4960 CONTINUE
```

```
      CALL HEIGHT(.10)
      CALL MESSAG('0 DEG',  5,  0 INCH*.5-.10, 0 INCH+.10)
      CALL ANGLE(90.)
      CALL MESSAG('90 DEG',  6,  -.1,  0 INCH*.5-.25)
      CALL RESET('ANGLE')
      CALL RESET('HEIGHT')

      CALL ENDPL( 1 )

 5000 CONTINUE

      RETURN
      END
```

```
$END
$DATA
 MARCH  6,1971$
 BEAM PATTERN  THETA $
 TRANSPARENT $
FREQUENCY$
         46      90.00      -2.00     500.00      THETA      TRANSPARENT
       .0       -.0        -.1        -.3        -.5        -.8       -1.2       -1.7       -2.2       -2.
     -3.4       -4.1       -4.9       -5.8       -6.8       -7.8       -9.0      -10.3      -11.8      -13.
    -15.2      -17.3      -19.7      -22.4      -24.9      -26.0      -25.0      -23.2      -21.5      -20.
    -19.0      -18.1      -17.3      -16.7      -16.2      -15.8      -15.4      -15.1      -14.9      -14.
    -14.5      -14.3      -14.1      -14.0      -13.9      -13.8        .0         .0         .0         .
           END
```

SECTION 5.3

PLT PTN additional sample


MARCH 6, 1971
BEAM PATTERN THETA
TRANSPARENT
LEGEND
o - 500.0
FREQUENCY
0 DEG
90 DEG
0.0
-10.0
-20.0
-30.0
-40.0
-30.0
-20.0
-10.0
0
JOB NO 0726
PLOT NO 1
DATE AUG 11