CONTIGUOUS BAND MULTIPLEXER

SIMULATION AND OPTIMIZATION

OSA-84-MX-5-L

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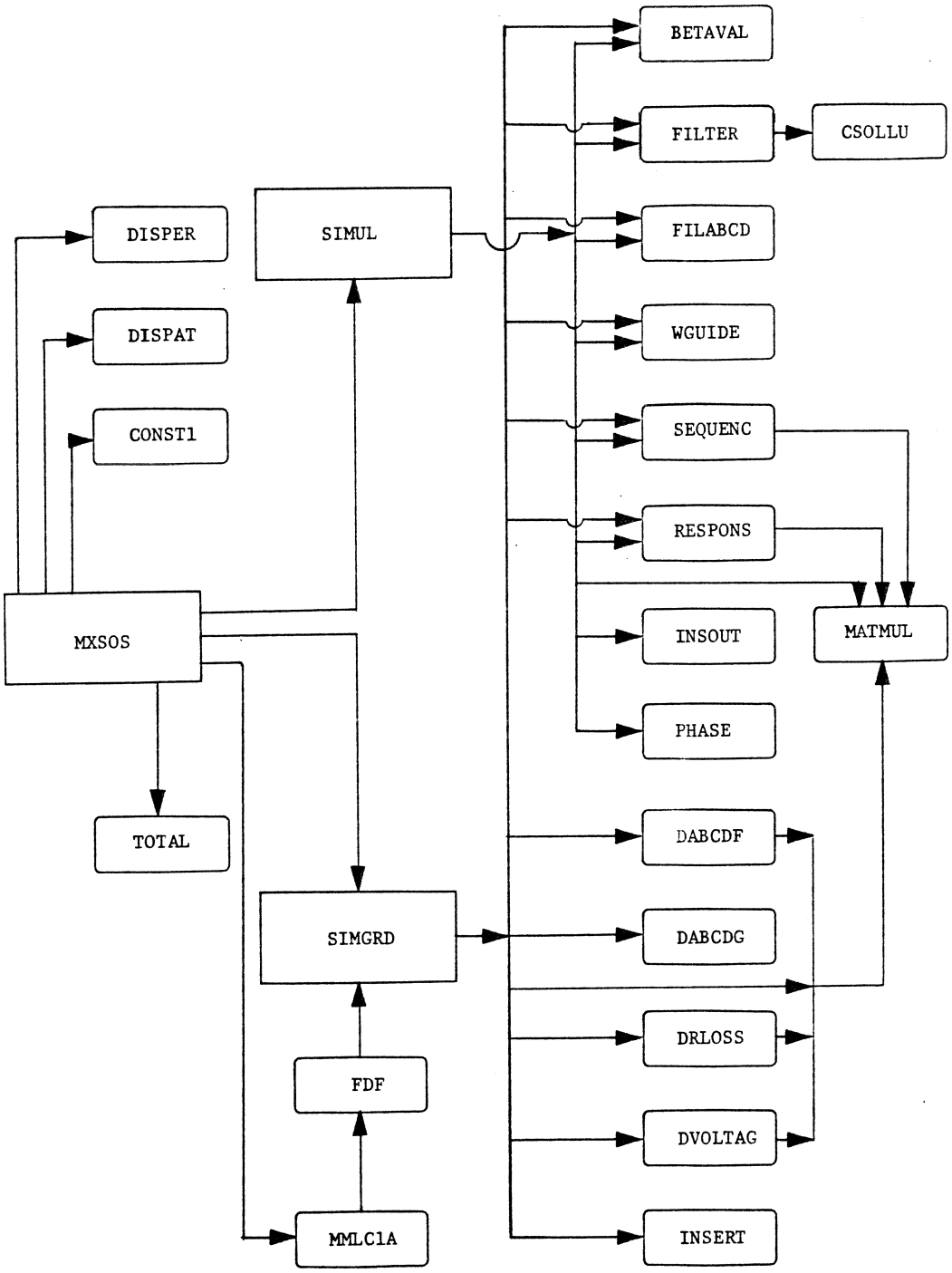

Sixteen channel version

```
      SUBROUTINE FILTER(N,M,Z,P,Q)                                      000001
                                                                        000002
C                                                                       000003
C     PERFORM ANALYSES FOR ALL CHANNELS                                 000004
C                                                                       000005
C     N  NUMBER OF CHANNELS                                             000006
C     M  ORDER OF MATRIX                                                000007
C     Z  IMPEDANCE MATRIX                                               000008
C                                                                       000009
      COMPLEX Z(16,8,8),ZT(8,8),P(16,8),Q(16,8),PT(8),QT(8)             000010
C                                                                       000011
      DO 10 I=1,N                                                       000012
C                                                                       000013
      DO 11 J=1,M                                                       000014
C                                                                       000015
      PT(J)=(0.0,0.0)                                                   000016
      QT(J)=(0.0,0.0)                                                   000017
      PT(1)=(1.0,0.0)                                                   000018
      QT(M)=(1.0,0.0)                                                   000019
C                                                                       000020
C     SET TWO-DIMENSIONAL Z MATRIX                                      000021
C                                                                       000022
      DO 11 K=1,M                                                       000023
      ZT(J,K)=Z(I,J,K)                                                  000024
   11 CONTINUE                                                          000025
C                                                                       000026
C     SET PARAMETER TO PERFORM LU FACTORIZATION AND FORWARD-            000027
C     BACKWARD SUBSTITUTION FOR UNIT VOLTAGE AT INPUT                   000028
C                                                                       000029
      IPAR=0                                                            000030
C                                                                       000031
      CALL CSOLLU(M,ZT,PT,IFALL,IPAR)                                   000032
C                                                                       000033
C     SET PARAMETER TO PERFORM ONLY FORWARD-BACKWARD SUBSTITUTION       000034
C     FOR UNIT VOLTAGE AT OUTPUT                                        000035
C                                                                       000036
      IPAR=1                                                            000037
C                                                                       000038
      CALL CSOLLU(M,ZT,QT,IFALL,IPAR)                                   000039
C                                                                       000040
C     SET TWO DIMENSIONAL SOLUTION VECTORS,EACH COLUMN                  000041
C     CORRESPONDING TO ONE CHANNEL                                      000042
C                                                                       000043
      DO 12 J=1,M                                                       000044
      P(I,J)=PT(J)                                                      000045
      Q(I,J)=QT(J)                                                      000046
   12 CONTINUE                                                          000047
C                                                                       000048
   10 CONTINUE                                                          000049
      RETURN                                                            000050
      END                                                               000051
C
```

```
C                                                                       000052
      SUBROUTINE FILABCD(N,M,P,Q,PN1,PN2,Y1,GL,YC,Y,YP,YIN,Y3,          000053
     +                   Y3SQ,TF,H7,H8,H13,H14,PN11,PN12,PN22)          000054
C                                                                       000055
C     CALCULATION OF EQUIVALENT ABCD MATRICES OF FILTER-                000056
C     JUNCTION COMBINATIONS AS SEEN IN THE WAVEGUIDE MANIFOLD           000057
C                                                                       000058
      COMPLEX Y(16,4),YP(16,4),YIN(16),Y3(16),Y3SQ(16),TF(16,4)         000059
      COMPLEX P(16,8),Q(16,8),Y1(16),YC(16)                             000060
      COMPLEX H7(16),H8(16),H13(16),H14(16)                             000061
      REAL PN1(16),PN2(16),GL(16)                                       000062
      REAL PN11(16),PN12(16),PN22(16)                                   000063
C                                                                       000064
C     CALCULATION OF SHORT-CIRCUIT ADMITTANCE MATRIX "Y" OF             000065
C     EACH FILTER                                                       000066
C                                                                       000067
      DO 13 I=1,N                                                       000068
C                                                                       000069
      Y(I,1)=P(I,1)                                                     000070
      Y(I,2)=Q(I,1)                                                     000071
      Y(I,3)=Y(I,2)                                                     000072
      Y(I,4)=Q(I,M)                                                     000073
C                                                                       000074
C     PREPARATION FOR INCLUSION OF IDEAL TRANSFORMERS                   000075
C                                                                       000076
      PN11(I)=PN1(I)*PN1(I)                                             000077
      PN12(I)=PN1(I)*PN2(I)                                             000078
      PN22(I)=PN2(I)*PN2(I)                                             000079
C                                                                       000080
C     INCLUSION INTO Y MATRIX OF THE INPUT-OUTPUT TRANSFORMERS          000081
C                                                                       000082
      YP(I,1)=PN11(I)*Y(I,1)                                            000083
      YP(I,2)=PN12(I)*Y(I,2)                                            000084
      YP(I,3)=YP(I,2)                                                   000085
      YP(I,4)=PN22(I)*Y(I,4)                                            000086
C                                                                       000087
C     SAVE COMMON FACTORS FOR USE WITH SENSITIVITY FORMULAS             000088
C                                                                       000089
      H7(I)=YP(I,4)+GL(I)                                               000090
      H8(I)=YP(I,2)*YP(I,2)                                             000091
      H13(I)=H8(I)/(H7(I)*H7(I))                                        000092
      H14(I)=Y1(I)*Y1(I)                                                000093
C                                                                       000094
      YIN(I)=YP(I,1)-H8(I)/H7(I)                                        000095
C                                                                       000096
C     USE AN IMPEDANCE INVERTER                                         000097
C                                                                       000098
      YIN(I)=1.0/YIN(I)                                                 000099
C                                                                       000100
C     CONNECT THE FILTER TO THE MANIFOLD JUNCTION                       000101
C                                                                       000102
      Y3(I)=YC(I)+YIN(I)                                                000103
      Y3SQ(I)=Y3(I)*Y3(I)                                               000104
C                                                                       000105
      TF(I,1)=1.0+Y1(I)/Y3(I)                                           000106
      TF(I,2)=1.0/Y3(I)                                                 000107
      TF(I,3)=Y1(I)*TF(I,1)+Y1(I)                                       000108
      TF(I,4)=1.0+Y1(I)/Y3(I)                                           000109
C                                                                       000110
   13 CONTINUE                                                          000111
      RETURN                                                            000112
      END                                                               000113
C                                                                       000114
```

```
C                                                                       000115
      SUBROUTINE MATMUL(V1,V2,V3,V4,V5,V6,V7,V8,V9,V10,V11,V12)         000116
C                                                                       000117
C     COMPLEX 2X2 MATRIX MULTIPLICATION                                 000118
C                                                                       000119
      COMPLEX V1,V2,V3,V4,V5,V6,V7,V8,V9,V10,V11,V12                    000120
      V9=V1*V5+V2*V7                                                    000121
      V10=V1*V6+V2*V8                                                   000122
      V11=V3*V5+V4*V7                                                   000123
      V12=V3*V6+V4*V8                                                   000124
      RETURN                                                            000125
      END                                                               000126
C                                                                       000127
```

```
C                                                                       000128
      SUBROUTINE SEQUENC(N,NP1,T,A)                                     000129
C                                                                       000130
C     CALCULATE THE EQUIVALENT ABCD MATRICES OF ALL POSSIBLE            000131
C     ADJACENT CASCADED SECTIONS AND STORE THEM IN THE A MATRICES.      000132
C     MATRIX A(I,J,.) INDICATES CALCULATIONS FROM REFERENCE             000133
C     PLANE I TO REFERENCE PLANE J ,WHERE J>I.                          000134
C     T IS THE  ABCD MATRIX OF A SECTION(FILTER-JUNCTION COMBINATION    000135
C     AND WAVEGUIDE SPACING)                                            000136
C                                                                       000137
      COMPLEX T(16,4),A(17,17,4)                                        000138
C                                                                       000139
C     INITIALIZE UNIT MATRICES                                          000140
C                                                                       000141
      DO 16 I=1,NP1                                                     000142
C                                                                       000143
      A(I,I,1)=CMPLX(1.0,0.0)                                           000144
      A(I,I,2)=CMPLX(0.0,0.0)                                           000145
      A(I,I,3)=A(I,I,2)                                                 000146
      A(I,I,4)=A(I,I,1)                                                 000147
C                                                                       000148
   16 CONTINUE                                                          000149
C                                                                       000150
      DO 17 I=1,N                                                       000151
      IP1=I+1                                                           000152
C                                                                       000153
      DO 18 J=IP1,NP1                                                   000154
      JM1=J-1                                                           000155
C                                                                       000156
      CALL MATMUL(T(JM1,1),T(JM1,2),T(JM1,3),T(JM1,4),A(I,JM1,1),       000157
     +           A(I,JM1,2),A(I,JM1,3),A(I,JM1,4),A(I,J,1),            000158
     +           A(I,J,2),A(I,J,3),A(I,J,4))                           000159
C                                                                       000160
   18 CONTINUE                                                          000161
   17 CONTINUE                                                          000162
      RETURN                                                            000163
      END                                                               000164
C                                                                       000165
```

```
C                                                                       000166
      SUBROUTINE RESPONS(N,NP1,RS,ZIN,RLOSS,VL,A,H23,H1,RO,RCOEFF,      000167
     +                   YC,YP,TG,Y1,VS,H2,H3,H4,H5,H6,H7,H9,H10)       000168
C                                                                       000169
C     CALCULATE COMMON PORT RETURN LOSS AND OUTPUT VOLTAGE              000170
C     OF EACH CHANNEL                                                   000171
C                                                                       000172
      COMPLEX VL(16),A(17,17,4),HMX(4)                                  000173
      COMPLEX H2(16),H3(16),H4(16),H5(16),H6(16),H7(16),H9(16),H10(16)  000174
      COMPLEX YC(16),YP(16,4),TG(16,4),Y1(16)                           000175
      COMPLEX RCOEFF,ZIN,H22,H23,H1,JPLX                                000176
      JPLX=CMPLX(0.0,1.0)                                               000177
C                                                                       000178
C     CALCULATION OF INPUT IMPEDANCE USING ABCD MATRIX FROM             000179
C     REFERENCE PLANE 1 (SHORT CIRCUIT) TO REFERENCE PLANE N+1          000180
C                                                                       000181
      ZIN=A(1,NP1,2)/A(1,NP1,4)                                         000182
      H22=(ZIN+RS)*(ZIN+RS)                                             000183
      H23=2.0*RS/H22                                                    000184
      RCOEFF=(ZIN-RS)/(ZIN+RS)                                          000185
      RO=CABS(RCOEFF)                                                   000186
      RLOSS=-20.0*ALOG10(RO)                                            000187
C                                                                       000188
      H1=A(1,NP1,2)+RS*A(1,NP1,4)                                       000189
C                                                                       000190
      DO 19 I=1,N                                                       000191
C                                                                       000192
      H9(I)=1.0+YC(I)*YP(I,1)                                           000193
      H10(I)=H7(I)*H9(I)                                                000194
      H2(I)=H10(I)/YP(I,2)-YC(I)*YP(I,2)                                000195
C                                                                       000196
C     CALCULATE ABCD MATRICES FROM THE SHORT CIRCUIT REFERENCE          000197
C     PLANE TO THE REFERENCE PLANE I                                    000198
C                                                                       000199
      CALL MATMUL(TG(I,1),TG(I,2),TG(I,3),TG(I,4),A(1,I,1),A(1,I,2),    000200
     +          A(1,I,3),A(1,I,4),HMX(1),HMX(2),HMX(3),HMX(4))          000201
C                                                                       000202
      H3(I)=VS*(HMX(4)+Y1(I)*HMX(2))                                    000203
      H4(I)=H2(I)*H1                                                    000204
      H5(I)=H4(I)*H4(I)                                                 000205
      H6(I)=H3(I)*H2(I)                                                 000206
C                                                                       000207
C     CALCULATE OUTPUT VOLTAGES OF CHANNELS                             000208
C                                                                       000209
      VL(I)=JPLX*H3(I)/H4(I)                                            000210
   19 CONTINUE                                                          000211
      RETURN                                                            000212
      END                                                               000213
C                                                                       000214
```

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C                                                                       000215
      SUBROUTINE WGUIDE(N,BETA,WGL,TG,DTG)                              000216
C                                                                       000217
C     CALCULATE ABCD MATRICES OF THE WAVEGUIDE SPACINGS AND             000218
C     THEIR DERIVATIVES W.R.T. SPACINGS(SECTION LENGTHS)                000219
C                                                                       000220
      COMPLEX TG(16,4),DTG(16,4)                                        000221
      REAL WGL(16)                                                      000222
C                                                                       000223
      CZ=1.0                                                            000224
      CZ2=CZ*CZ                                                         000225
C                                                                       000226
      DO 77 I=1,N                                                       000227
      TETA=BETA*WGL(I)                                                  000228
C                                                                       000229
      TG(I,1)=CMPLX(COS(TETA),0.0)                                      000230
      TG(I,2)=CMPLX(0.0,SIN(TETA)*CZ)                                   000231
      TG(I,3)=TG(I,2)/CZ2                                               000232
      TG(I,4)=TG(I,1)                                                   000233
C                                                                       000234
      DTG(I,1)=CMPLX(-BETA*SIN(TETA),0.0)                               000235
      DTG(I,2)=CMPLX(0.0,COS(TETA)*CZ*BETA)                             000236
      DTG(I,3)=DTG(I,2)/CZ2                                             000237
      DTG(I,4)=DTG(I,1)                                                 000238
   77 CONTINUE                                                          000239
C                                                                       000240
      RETURN                                                            000241
      END                                                               000242
C                                                                       000243
```

```
C                                                                       000244
      SUBROUTINE CSOLLU(M,A,B,IFALL,IPAR)                               000245
C                                                                       000246
C     PERFORM LU FACTORIZATION, FORWARD AND BACKWARD SUBSTITUTION       000247
C     IN THE COMPLEX MODE.                                              000248
C                                                                       000249
      COMPLEX A(8,8),B(8),ZZ                                            000250
C                                                                       000251
C     CROUT'S ALGORITHM FOR LU FACTORIZATION                            000252
C                                                                       000253
      IFALL=0                                                           000254
      M2=M-1                                                            000255
      M1=M+1                                                            000256
      IF(IPAR.EQ.1)GO TO 290                                            000257
C                                                                       000258
C     BEGIN FACTORIZATION                                               000259
C                                                                       000260
      DO 82 II=1,M2                                                     000261
      ZZ=A(II,II)                                                       000262
      IF(ZZ.EQ.(0.0,0.0))GO TO 100                                      000263
      MM=II+1                                                           000264
      DO 82 J=MM,M                                                      000265
      A(II,J)=A(II,J)/ZZ                                                000266
      DO 80 K=MM,M                                                      000267
   80 A(K,J)=A(K,J)-A(K,II)*A(II,J)                                     000268
   82 CONTINUE                                                          000269
C                                                                       000270
C     FORWARD SUBSTITUTION                                              000271
C                                                                       000272
  290 CONTINUE                                                          000273
      IF(A(1,1).EQ.(0.0,0.0))GO TO 100                                  000274
      B(1)=B(1)/A(1,1)                                                  000275
      DO 88 II=2,M                                                      000276
      ZZ=A(II,II)                                                       000277
      IF(ZZ.EQ.(0.0,0.0))GO TO 100                                      000278
      IM=II-1                                                           000279
      DO 86 K=1,IM                                                      000280
   86 B(II)=B(II)-A(II,K)*B(K)                                          000281
      B(II)=B(II)/ZZ                                                    000282
   88 CONTINUE                                                          000283
C                                                                       000284
C     BACKWARD SUBSTITUTION                                             000285
C                                                                       000286
      DO 92 L=2,M                                                       000287
      II=M1-L                                                           000288
      IP=II+1                                                           000289
      DO 90 K=IP,M                                                      000290
   90 B(II)=B(II)-A(II,K)*B(K)                                          000291
   92 CONTINUE                                                          000292
      GO TO 120                                                         000293
  100 IFALL=-1                                                          000294
      WRITE 200                                                         000295
  200 FORMAT(/"INDEFINITE VALUE IN CSOLLU DUE TO ZERO ON THE DIAGONAL") 000296
  120 CONTINUE                                                          000297
      RETURN                                                            000298
      END                                                               000299
C                                                                       000300
```

```
C                                                                       000301
      SUBROUTINE DABCDF(N,IR,IRT,LC,KC,DY11,DY21,DY22,DYP11,            000302
     +                  DYP21,DYP22,DYIN,YIN,DAF,DBF,DCF,DDF,P,Q,       000303
     +                  PN11,PN12,PN22,H7,H13,H14,Y1,TG,D,Y3SQ,YP,       000304
     +                  LAMR,IDISPER)                                   000305
                                                                        000306
C                                                                       000307
C     CALCULATE DERIVATIVES OF THE FILTER-JUNCTION ABCD MATRICES        000308
C     W.R.T. VARIABLE COUPLING ELEMENTS, AND STORE  THEM  IN  A         000309
C     DESIGNATED ARRAY FOR THE DERIVATIVES OF THE ABCD MATRICES         000310
C     OF THE SECTIONS W.R.T. ALL VARIABLES CONTAINED IN THEM            000311
C                                                                       000312
      INTEGER IR(16),IRT(16),LC(16,36),KC(16,36)                        000313
      REAL PN11(16),PN12(16),PN22(16),LAMR(16)                          000314
      INTEGER CEL(16,8,8)                                               000315
      COMPLEX DY11(100),DY21(100),DY22(100),DYP11(100),DYP21(100)       000316
      COMPLEX DYP22(100),DYIN(100),DAF(100),DBF(100),DCF(100),DDF(100)  000317
      COMPLEX P(16,8),Q(16,8),Y1(16),H15,H7(16),H13(16),H14(16)         000318
      COMPLEX TG(16,4),D(100,4),YIN(16),YINSQ,JPLX,Y3SQ(16),YP(16,4)    000319
      COMMON/BLK7/CEL                                                   000320
      JPLX=CMPLX(0.0,1.0)                                               000321
C                                                                       000322
      DO 21 I=1,N                                                       000323
      IF(IR(I).EQ.0)GO TO 21                                            000324
      IM1=I-1                                                           000325
      YINSQ=YIN(I)*YIN(I)                                               000326
C                                                                       000327
      KP=IR(I)                                                          000328
      DO 22 J=1,KP                                                      000329
C                                                                       000330
      IX3=LC(I,J)                                                       000331
      IX4=KC(I,J)                                                       000332
C                                                                       000333
      IF(I.EQ.1)GO TO 23                                                000334
      IV=IRT(IM1)+J                                                     000335
      GO TO 24                                                          000336
   23 IV=J                                                              000337
   24 CONTINUE                                                          000338
C                                                                       000339
      IF(IX3.EQ.IX4)GO TO 35                                            000340
C                                                                       000341
      DY11(IV)=-2.0*JPLX*P(I,IX3)*P(I,IX4)                              000342
      DY21(IV)=-JPLX*(P(I,IX3)*Q(I,IX4)+P(I,IX4)*Q(I,IX3))              000343
      DY22(IV)=-2.0*JPLX*Q(I,IX3)*Q(I,IX4)                              000344
C                                                                       000345
      IF(IDISPER.NE.1)GO TO 36                                          000346
      CF=LAMR(I)**CEL(I,IX3,IX4)                                        000347
      DY11(IV)=DY11(IV)*CF                                              000348
      DY21(IV)=DY21(IV)*CF                                              000349
      DY22(IV)=DY22(IV)*CF                                              000350
      GO TO 36                                                          000351
C                                                                       000352
   35 DY11(IV)=-JPLX*P(I,IX3)*P(I,IX3)                                  000353
      DY21(IV)=-JPLX*P(I,IX3)*Q(I,IX3)                                  000354
      DY22(IV)=-JPLX*Q(I,IX3)*Q(I,IX3)                                  000355
C                                                                       000356
   36 CONTINUE                                                          000357
C                                                                       000358
      DYP11(IV)=PN11(I)*DY11(IV)                                        000359
      DYP21(IV)=PN12(I)*DY21(IV)                                        000360
      DYP22(IV)=PN22(I)*DY22(IV)                                        000361
C                                                                       000362
      DYIN(IV)=DYP11(IV)-DYP21(IV)*(2.0*YP(I,2)/H7(I))+DYP22(IV)*H13(I) 000363
C                                                                       000364
C     USE AN IMPEDANCE INVERTER                                         000365
C
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```
      DYIN(IV)=-YINSQ*DYIN(IV)                                          000366
                                                                        000367
C
      H15=-DYIN(IV)/Y3SQ(I)                                             000368
                                                                        000369
C
      DAF(IV)=Y1(I)*H15                                                 000370
      DBF(IV)=H15                                                       000371
      DCF(IV)=H15*H14(I)                                                000372
      DDF(IV)=DAF(IV)                                                   000373
                                                                        000374
C
      CALL MATMUL(DAF(IV),DBF(IV),DCF(IV),DDF(IV),TG(I,1),TG(I,2),      000375
     +            TG(I,3),TG(I,4),D(IV,1),D(IV,2),D(IV,3),D(IV,4))      000376
                                                                        000377
C
   22 CONTINUE                                                          000378
   21 CONTINUE                                                          000379
      RETURN                                                            000380
      END                                                               000381
                                                                        000382
C
```

```
C                                                                       000383
      SUBROUTINE DABCDG(N,IRT,D,DG)                                     000384
C                                                                       000385
C     STORE THE CALCULATED DERIVATIVES OF THE ABCD MATRICES OF THE      000386
C     WAVEGUIDE SPACINGS W.R.T. SPACINGS (FROM SUBROUTINE WGUIDE)       000387
C     IN THE DESIGNATED DERIVATIVE ARRAY OF THE ABCD MATRICES OF        000388
C     THE SECTIONS                                                      000389
C                                                                       000390
      INTEGER IRT(16),H20                                               000391
      COMPLEX D(100,4),DG(16,4)                                         000392
C                                                                       000393
      DO 40 I=1,N                                                       000394
C                                                                       000395
      H20=IRT(I)                                                        000396
C                                                                       000397
      DO 42 J=1,4                                                       000398
      D(H20,J)=DG(I,J)                                                  000399
   42 CONTINUE                                                          000400
   40 CONTINUE                                                          000401
      RETURN                                                            000402
      END                                                               000403
C                                                                       000404
```

```
C                                                                       000405
      SUBROUTINE DRLOSS(N,NP1,IRT,E,F,A,D,H23,RCOEFF,RO,DRTLOSS)        000406
C                                                                       000407
C     CALCULATE SENSITIVITIES OF COMMON PORT RETURN LOSS W.R.T.         000408
C     ALL VARIABLES                                                     000409
C                                                                       000410
      INTEGER IRT(16)                                                   000411
      COMPLEX E(100,4),F(100,4),A(17,17,4),D(100,4),H23,RCOEFF          000412
      COMPLEX DZIN,H21,DRCFF,H212                                       000413
      REAL DRTLOSS(100)                                                 000414
C                                                                       000415
      KP=IRT(1)                                                         000416
C                                                                       000417
      DO 50 J=1,KP                                                      000418
      DO 53 K=1,4                                                       000419
C                                                                       000420
      E(J,K)=D(J,K)                                                     000421
   53 CONTINUE                                                          000422
C                                                                       000423
      CALL MATMUL(A(2,NP1,1),A(2,NP1,2),A(2,NP1,3),A(2,NP1,4),D(J,1),   000424
     +            D(J,2),D(J,3),D(J,4),F(J,1),F(J,2),F(J,3),F(J,4))     000425
C                                                                       000426
   50 CONTINUE                                                          000427
C                                                                       000428
      IF(N.EQ.1)GO TO 54                                                000429
      DO 51 I=2,N                                                       000430
      IM1=I-1                                                           000431
      JB=IRT(IM1)+1                                                     000432
      JE=IRT(I)                                                         000433
      IP1=I+1                                                           000434
C                                                                       000435
      DO 52 J=JB,JE                                                     000436
C                                                                       000437
      CALL MATMUL(D(J,1),D(J,2),D(J,3),D(J,4),A(1,I,1),A(1,I,2),        000438
     +            A(1,I,3),A(1,I,4),E(J,1),E(J,2),E(J,3),E(J,4))        000439
C                                                                       000440
      CALL MATMUL(A(IP1,NP1,1),A(IP1,NP1,2),A(IP1,NP1,3),A(IP1,NP1,4),  000441
     +            E(J,1),E(J,2),E(J,3),E(J,4),F(J,1),F(J,2),F(J,3),     000442
     +            F(J,4))                                               000443
C                                                                       000444
   52 CONTINUE                                                          000445
   51 CONTINUE                                                          000446
   54 CONTINUE                                                          000447
C                                                                       000448
      H21=1.0/(A(1,NP1,4)*A(1,NP1,4))                                   000449
      H211=-20.0/(ALOG(10.0)*RO*RO)                                     000450
      H212=CONJG(RCOEFF)                                                000451
C                                                                       000452
      KP=IRT(N)                                                         000453
      DO 55 J=1,KP                                                      000454
C                                                                       000455
      DZIN=H21*(A(1,NP1,4)*F(J,2)-A(1,NP1,2)*F(J,4))                    000456
      DRCFF=H23*DZIN                                                    000457
      DRTLOSS(J)=H211*REAL(H212*DRCFF)                                  000458
   55 CONTINUE                                                          000459
      RETURN                                                            000460
      END                                                               000461
C                                                                       000462
```

```
C                                                                       000463
      SUBROUTINE DVOLTAG(N,IRT,IR,VS,H4,TG,H6,RS,DVL,F,H5,H3,H1,YC,Y1,  000464
     +                   H10,H8,H9,YP,H7,DYP21,DYP22,DYP11,DTG,A,E)     000465
                                                                        000466
C                                                                       000467
C     CALCULATE SENSITIVITIES OF ALL OUTPUT VOLTAGES W.R.T. ALL         000468
C     VARIABLES                                                         000469
C                                                                       000470
      INTEGER IRT(16),IR(16),UPB,UPBM1,UPBP1                            000471
      COMPLEX A(17,17,4),E(100,4),DAI(100,4),Y1(16),TG(16,4)            000472
      COMPLEX DVL(16,100),F(100,4),YC(16),YP(16,4)                      000473
      COMPLEX DH2(100),DYP21(100),DYP22(100),DYP11(100),DTG(16,4)       000474
      COMPLEX H3(16),H4(16),H5(16),H6(16),H7(16),H8(16),H9(16),H10(16)  000475
      COMPLEX JPLX,H1                                                   000476
      COMPLEX H29,H30,H31,H32,H35,H36,H37,H50,H51,H52,H40,H41,H42,H43   000477
      JPLX=CMPLX(0.0,1.0)                                               000478
C                                                                       000479
      DO 60 I=1,N                                                       000480
C                                                                       000481
      H29=-VS*H4(I)                                                     000482
      H30=(Y1(I)*TG(I,1)+TG(I,3))*H29                                   000483
      H31=(Y1(I)*TG(I,2)+TG(I,4))*H29                                   000484
      H32=H6(I)*RS                                                      000485
C                                                                       000486
      H35=H3(I)*H1/H5(I)                                                000487
      H36=H6(I)/H5(I)                                                   000488
      H37=H36*RS                                                        000489
C                                                                       000490
      H40=(Y1(I)*DTG(I,1)+DTG(I,3))*A(1,I,2)                            000491
      H41=(Y1(I)*DTG(I,2)+DTG(I,4))*A(1,I,4)                            000492
      H42=VS*(H40+H41)                                                  000493
      H43=-H42/H4(I)                                                    000494
C                                                                       000495
      H50=-YC(I)-H10(I)/H8(I)                                           000496
      H51=H9(I)/YP(I,2)                                                 000497
      H52=H7(I)*YC(I)/YP(I,2)                                           000498
C                                                                       000499
      IM1=I-1                                                           000500
      UPB=IRT(I)                                                        000501
      UPBM1=UPB-1                                                       000502
      IF(I.EQ.1)GO TO 70                                                000503
C                                                                       000504
      LOB=IRT(IM1)                                                      000505
C                                                                       000506
      LL=0                                                              000507
      DO 62 JJ=1,IM1                                                    000508
      LL=LL+IR(JJ)+1                                                    000509
      KK=LL-IR(JJ)                                                      000510
C                                                                       000511
      JJP1=JJ+1                                                         000512
      DO 63 J=KK,LL                                                     000513
C                                                                       000514
      CALL MATMUL(A(JJP1,I,1),A(JJP1,I,2),A(JJP1,I,3),A(JJP1,I,4),     000515
     +            E(J,1),E(J,2),E(J,3),E(J,4),DAI(J,1),DAI(J,2),       000516
     +            DAI(J,3),DAI(J,4))                                    000517
C                                                                       000518
   63 CONTINUE                                                          000519
   62 CONTINUE                                                          000520
C                                                                       000521
      DO 65 J=1,LOB                                                     000522
      DVL(I,J)=(H30*DAI(J,2)+H31*DAI(J,4)+H6(I)*F(J,2)+H32*F(J,4))/H5(I) 000523
      DVL(I,J)=-JPLX*DVL(I,J)                                           000524
   65 CONTINUE                                                          000525
C                                                                       000526
      GO TO 72                                                          000527
C
```

```
   70 LOB=0                                                              000528
C                                                                        000529
   72 LOB1=LOB+1                                                         000530
      IF(IR(I).EQ.0)GO TO 69                                             000531
      DO 66 J=LOB1,UPBM1                                                 000532
      DH2(J)=H50*DYP21(J)+H51*DYP22(J)+H52*DYP11(J)                      000533
C                                                                        000534
      DVL(I,J)=H35*DH2(J)+H36*F(J,2)+H37*F(J,4)                          000535
      DVL(I,J)=-JPLX*DVL(I,J)                                            000536
   66 CONTINUE                                                           000537
   69 CONTINUE                                                           000538
      J=UPB                                                              000539
C                                                                        000540
      DVL(I,J)=H43+H36*F(J,2)+H37*F(J,4)                                 000541
      DVL(I,J)=-JPLX*DVL(I,J)                                            000542
      IF(I.EQ.N)GO TO 60                                                 000543
      UPBP1=UPB+1                                                        000544
C                                                                        000545
      KP=IRT(N)                                                          000546
      DO 67 J=UPBP1,KP                                                   000547
      DVL(I,J)=H36*F(J,2)+H37*F(J,4)                                     000548
      DVL(I,J)=-JPLX*DVL(I,J)                                            000549
C                                                                        000550
   67 CONTINUE                                                           000551
   60 CONTINUE                                                           000552
      RETURN                                                             000553
      END                                                                000554
C                                                                        000555
```

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C                                                                       000556
      SUBROUTINE SIMGRD(OMEG,RLOSS,DRTLOSS,INLOSS,DINLOSS,N,M,          000557
     +                  ICOUNT,IFLAGJS,IFLAGDP,IDISPER)                 000558
C                                                                       000559
C     THIS SUBROUTINE CALLS ALL OTHER SUBROUTINES NECESSARY TO          000560
C     CALCULATE THE RESPONSE AND EXACT SENSITIVITIES                    000561
C                                                                       000562
      COMPLEX Z(16,8,8),P(16,8),Q(16,8)                                 000563
      COMPLEX Y(16,4),YP(16,4),YIN(16),Y1(16),Y3(16),YC(16)             000564
      COMPLEX TF(16,4),TG(16,4),T(16,4),A(17,17,4),Y3SQ(16)             000565
      COMPLEX H2(16),H3(16),H4(16),H5(16),H6(16),H7(16),H8(16)          000566
      COMPLEX H9(16),H10(16),H13(16),H14(16)                            000567
      COMPLEX VL(16)                                                    000568
      COMPLEX H1,H23,ZIN,RCOEFF                                         000569
      COMPLEX S,SD                                                      000570
      REAL WO(16),BW(16)                                                000571
      REAL CM(16,8,8),PN1(16),PN2(16),PN11(16),PN12(16)                 000572
      REAL PN22(16),GL(16),WGL(16)                                      000573
      REAL INLOSS(16),DINLOSS(16,100)                                   000574
      REAL DISP(16),LAMR(16)                                            000575
      REAL FCNST(16),LAMRES(16),LAMDEL(16),LAMFIL,LREAC                 000576
      INTEGER IR(16),IRT(16),LC(16,36),KC(16,36),CEL(16,8,8)            000577
      COMPLEX DY11(100),DY21(100),DY22(100),DYP11(100),DYP21(100)       000578
      COMPLEX DYP22(100),DYIN(100),DAF(100),DBF(100),DCF(100)           000579
      COMPLEX DDF(100),D(100,4)                                         000580
      COMPLEX DTG(16,4),DG(16,4)                                        000581
      COMPLEX E(100,4),F(100,4)                                         000582
      REAL DRTLOSS(100)                                                 000583
      COMPLEX DVL(16,100)                                               000584
C                                                                       000585
      COMMON/BLK1/WO,BW,PN1,PN2,GL,VS,RS,PI2,WIDTH,NP1                  000586
      COMMON/BLK2/CM,WGL                                                000587
      COMMON/BLK4/CBR,FCUT                                              000588
      COMMON/BLK5/DISP                                                  000589
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000590
      COMMON/BLK7/CEL                                                   000591
      COMMON/BLK8/IR,IRT,LC,KC                                          000592
C                                                                       000593
      IF(ICOUNT.NE.1)GO TO 5                                            000594
C                                                                       000595
      DO 100 I=1,N                                                      000596
      DO 100 J=1,M                                                      000597
      DO 100 KK=1,J                                                     000598
      CM(I,J,KK)=CM(I,KK,J)                                             000599
  100 CONTINUE                                                          000600
C                                                                       000601
      DO 99 I=1,N                                                       000602
      DO 99 J=1,M                                                       000603
      DO 99 K=1,M                                                       000604
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))                                     000605
   99 CONTINUE                                                          000606
C                                                                       000607
      C1=11802.85                                                       000608
      C2=4.0*WIDTH*WIDTH                                                000609
C                                                                       000610
    5 CONTINUE                                                          000611
C                                                                       000612
      IF(IDISPER.NE.1)GO TO 500                                         000613
C                                                                       000614
      DO 51 I=1,N                                                       000615
      LAMFIL=C1/SQRT(OMEG*OMEG-FCNST(I))                                000616
      LAMR(I)=LAMFIL/LAMRES(I)                                          000617
      LREAC=2.0*(LAMRES(I)-LAMFIL)/LAMDEL(I)                            000618
C                                                                       000619
C     SET UP THE COMPLEX IMPEDANCE MATRIX OF THE FILTERS                000620
```

```
C                                                                       000621
      DO 52 J=1,M                                                       000622
      DO 52 K=1,M                                                       000623
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))*LAMR(I)**CEL(I,J,K)                 000624
   52 CONTINUE                                                          000625
C                                                                       000626
C     SET UP DIAGONAL ELEMENTS INCLUDING FILTER DISPERSION              000627
C                                                                       000628
      DO 53 J=1,M                                                       000629
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J)+LREAC)                               000630
C                                                                       000631
C     INCLUDE FILTER DISSIPATION                                        000632
C                                                                       000633
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000634
   53 CONTINUE                                                          000635
   51 CONTINUE                                                          000636
      GO TO 75                                                          000637
C                                                                       000638
  500 CONTINUE                                                          000639
      DO 106 I=1,N                                                      000640
      XR=WO(I)/BW(I)                                                    000641
      C3=(OMEG/WO(I))-(WO(I)/OMEG)                                      000642
      S=CMPLX(0.0,C3)                                                   000643
      SD=S*XR                                                           000644
C                                                                       000645
C     SET UP DIAGONAL ELEMENTS FOR ZERO FILTER DISPERSION               000646
C                                                                       000647
      DO 106 J=1,M                                                      000648
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J))+SD                                  000649
C                                                                       000650
C     INCLUDE FILTER DISSIPATION                                        000651
C                                                                       000652
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000653
  106 CONTINUE                                                          000654
C                                                                       000655
   75 CONTINUE                                                          000656
      IF(IFLAGJS.EQ.1)GO TO 68                                          000657
      DO 66 I=1,N                                                       000658
      YC(I)=CMPLX(0.0,0.0)                                              000659
      Y1(I)=CMPLX(0.0,0.0)                                              000660
   66 CONTINUE                                                          000661
      GO TO 70                                                          000662
C                                                                       000663
   68 CONTINUE                                                          000664
C                                                                       000665
C     THE JUNCTION SUSCEPTANCE IS CALCULATED                            000666
C                                                                       000667
      BETAJS=FCUT/(((20.0*(CBR/OMEG)**2)-1.0)*SQRT(OMEG*OMEG-FCUT*FCUT)) 000668
      DO 69 I=1,N                                                       000669
      YC(I)=(0.0,0.0)                                                   000670
      Y1(I)=CMPLX(0.0,-BETAJS)                                          000671
   69 CONTINUE                                                          000672
C                                                                       000673
   70 CONTINUE                                                          000674
C                                                                       000675
      CALL BETAVAL(C1,C2,OMEG,PI2,BETA)                                 000676
C                                                                       000677
      CALL FILTER(N,M,Z,P,Q)                                            000678
C                                                                       000679
      CALL FILABCD(N,M,P,Q,PN1,PN2,Y1,GL,YC,Y,YP,YIN,Y3,                000680
     +             Y3SQ,TF,H7,H8,H13,H14,PN11,PN12,PN22)                000681
C                                                                       000682
      CALL WGUIDE(N,BETA,WGL,TG,DTG)                                    000683
C                                                                       000684
      DO 121 I=1,N                                                      000685
```

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C                                                                       000686
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),TG(I,1),TG(I,2),      000687
     +           TG(I,3),TG(I,4),T(I,1),T(I,2),T(I,3),T(I,4))          000688
C                                                                       000689
  121 CONTINUE                                                          000690
C                                                                       000691
      CALL SEQUENC(N,NP1,T,A)                                           000692
C                                                                       000693
      CALL RESPONS(N,NP1,RS,ZIN,RLOSS,VL,A,H23,H1,RO,RCOEFF,            000694
     +             YC,YP,TG,Y1,VS,H2,H3,H4,H5,H6,H7,H9,H10)             000695
C                                                                       000696
      CALL DABCDF(N,IR,IRT,LC,KC,DY11,DY21,DY22,DYP11,                  000697
     +            DYP21,DYP22,DYIN,YIN,DAF,DBF,DCF,DDF,P,Q,             000698
     +            PN11,PN12,PN22,H7,H13,H14,Y1,TG,D,Y3SQ,YP,            000699
     +            LAMR,IDISPER)                                         000700
C                                                                       000701
      DO 125 I=1,N                                                      000702
C                                                                       000703
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),DTG(I,1),DTG(I,2),    000704
     +            DTG(I,3),DTG(I,4),DG(I,1),DG(I,2),DG(I,3),DG(I,4))    000705
C                                                                       000706
  125 CONTINUE                                                          000707
C                                                                       000708
      CALL DABCDG(N,IRT,D,DG)                                           000709
C                                                                       000710
      CALL DRLOSS(N,NP1,IRT,E,F,A,D,H23,RCOEFF,RO,DRTLOSS)              000711
C                                                                       000712
      CALL DVOLTAG(N,IRT,IR,VS,H4,TG,H6,RS,DVL,F,H5,H3,H1,YC,Y1,        000713
     +             H10,H8,H9,YP,H7,DYP21,DYP22,DYP11,DTG,A,E)           000714
C                                                                       000715
      CALL INSERT(N,VL,DVL,INLOSS,DINLOSS,IRT)                          000716
C                                                                       000717
      RETURN                                                            000718
      END                                                               000719
C                                                                       000720
```

```
C                                                                       000721
      SUBROUTINE INSERT(N,VL,DVL,INLOSS,DINLOSS,IRT)                    000722
C                                                                       000723
C     CHANNEL INSERTION LOSS AND ITS SENSITIVITIES ARE CALCULATED       000724
C                                                                       000725
      COMPLEX VL(16),DVL(16,100),HH2                                    000726
      REAL INLOSS(16),DINLOSS(16,100)                                   000727
      INTEGER IRT(16)                                                   000728
C                                                                       000729
C     THIS SUBROUTINE IS WRITTEN FOR VS=1.0, RS=1.0, GL(I)=1.0          000730
C                                                                       000731
      HH0=-20.0/ALOG(10.0)                                              000732
      KP=IRT(N)                                                         000733
      DO 10 I=1,N                                                       000734
      VABS=CABS(VL(I))                                                  000735
      INLOSS(I)=-20.0*ALOG10(2.0*VABS)                                  000736
      HH1=HH0/(VABS*VABS)                                               000737
      HH2=CONJG(VL(I))                                                  000738
C                                                                       000739
      DO 20 J=1,KP                                                      000740
      DINLOSS(I,J)=HH1*REAL(HH2*DVL(I,J))                               000741
   20 CONTINUE                                                          000742
   10 CONTINUE                                                          000743
      RETURN                                                            000744
      END                                                               000745
C                                                                       000746
```

```
C                                                                       000747
      SUBROUTINE SIMUL(OMEG,N,M,ICOUNT,IFLAGJS,IFLAGDP,IDISPER,         000748
     +                 RLOSS,INLOSS,ANGLE)                              000749
C                                                                       000750
C     THIS SUBROUTINE CALLS ALL SUBROUTINES NECESSARY FOR RESPONSE      000751
C     CALCULATIONS ONLY                                                 000752
C                                                                       000753
      COMPLEX Z(16,8,8),P(16,8),Q(16,8)                                 000754
      COMPLEX Y(16,4),YP(16,4),YIN(16),Y1(16),Y3(16),YC(16)             000755
      COMPLEX TF(16,4),TG(16,4),T(16,4),A(17,17,4),Y3SQ(16)             000756
      COMPLEX DTG(16,4)                                                 000757
      COMPLEX H2(16),H3(16),H4(16),H5(16),H6(16),H7(16),H8(16)          000758
      COMPLEX H9(16),H10(16),H13(16),H14(16)                            000759
      COMPLEX VL(16)                                                    000760
      COMPLEX H1,H23,ZIN,RCOEFF                                         000761
      COMPLEX S,SD                                                      000762
      REAL WO(16),BW(16)                                                000763
      REAL CM(16,8,8),PN1(16),PN2(16),PN11(16),PN12(16)                 000764
      REAL PN22(16),GL(16),WGL(16),INLOSS(16),ANGLE(16)                 000765
      REAL DISP(16),LAMR(16)                                            000766
      REAL FCNST(16),LAMRES(16),LAMDEL(16),LAMFIL,LREAC                 000767
      INTEGER CEL(16,8,8)                                               000768
C                                                                       000769
      COMMON/BLK1/WO,BW,PN1,PN2,GL,VS,RS,PI2,WIDTH,NP1                  000770
      COMMON/BLK2/CM,WGL                                                000771
      COMMON/BLK4/CBR,FCUT                                              000772
      COMMON/BLK5/DISP                                                  000773
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000774
      COMMON/BLK7/CEL                                                   000775
C                                                                       000776
      IF(ICOUNT.NE.1)GO TO 5                                            000777
C                                                                       000778
      DO 100 I=1,N                                                      000779
      DO 100 J=1,M                                                      000780
      DO 100 KK=1,J                                                     000781
      CM(I,J,KK)=CM(I,KK,J)                                             000782
  100 CONTINUE                                                          000783
C                                                                       000784
      DO 99 I=1,N                                                       000785
      DO 99 J=1,M                                                       000786
      DO 99 K=1,M                                                       000787
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))                                     000788
   99 CONTINUE                                                          000789
C                                                                       000790
      C1=11802.85                                                       000791
      C2=4.0*WIDTH*WIDTH                                                000792
C                                                                       000793
    5 CONTINUE                                                          000794
C                                                                       000795
      IF(IDISPER.NE.1)GO TO 500                                         000796
C                                                                       000797
      DO 51 I=1,N                                                       000798
      LAMFIL=C1/SQRT(OMEG*OMEG-FCNST(I))                                000799
      LAMR(I)=LAMFIL/LAMRES(I)                                          000800
      LREAC=2.0*(LAMRES(I)-LAMFIL)/LAMDEL(I)                            000801
C                                                                       000802
C     SET UP THE COMPLEX IMPEDANCE MATRIX OF THE FILTERS                000803
C                                                                       000804
      DO 52 J=1,M                                                       000805
      DO 52 K=1,M                                                       000806
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))*LAMR(I)**CEL(I,J,K)                 000807
   52 CONTINUE                                                          000808
C                                                                       000809
C     SET UP DIAGONAL ELEMENTS INCLUDING FILTER DISPERSION              000810
C                                                                       000811
```

```
      DO 53 J=1,M                                                       000812
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J)+LREAC)                               000813
                                                                        000814
C                                                                       000815
C     INCLUDE FILTER DISSIPATION                                        000816
C                                                                       000817
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000818
   53 CONTINUE                                                          000819
   51 CONTINUE                                                          000820
      GO TO 75                                                          000821
C                                                                       000822
  500 CONTINUE                                                          000823
      DO 106 I=1,N                                                      000824
      XR=WO(I)/BW(I)                                                    000825
      C3=(OMEG/WO(I))-(WO(I)/OMEG)                                      000826
      S=CMPLX(0.0,C3)                                                   000827
      SD=S*XR                                                           000828
C                                                                       000829
C     SET UP DIAGONAL ELEMENTS FOR ZERO FILTER DISPERSION               000830
C                                                                       000831
      DO 106 J=1,M                                                      000832
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J))+SD                                  000833
C                                                                       000834
C     INCLUDE FILTER DISSIPATION                                        000835
C                                                                       000836
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000837
  106 CONTINUE                                                          000838
C                                                                       000839
   75 CONTINUE                                                          000840
      IF(IFLAGJS.EQ.1)GO TO 68                                          000841
      DO 66 I=1,N                                                       000842
      YC(I)=CMPLX(0.0,0.0)                                              000843
      Y1(I)=CMPLX(0.0,0.0)                                              000844
   66 CONTINUE                                                          000845
      GO TO 70                                                          000846
C                                                                       000847
   68 CONTINUE                                                          000848
C                                                                       000849
C     THE JUNCTION SUSCEPTANCE IS CALCULATED                            000850
C                                                                       000851
      BETAJS=FCUT/(((20.0*(CBR/OMEG)**2)-1.0)*SQRT(OMEG*OMEG-FCUT*FCUT))000852
      DO 69 I=1,N                                                       000853
      YC(I)=(0.0,0.0)                                                   000854
      Y1(I)=CMPLX(0.0,-BETAJS)                                          000855
   69 CONTINUE                                                          000856
C                                                                       000857
   70 CONTINUE                                                          000858
C                                                                       000859
      CALL BETAVAL(C1,C2,OMEG,PI2,BETA)                                 000860
C                                                                       000861
      CALL FILTER(N,M,Z,P,Q)                                            000862
C                                                                       000863
      CALL FILABCD(N,M,P,Q,PN1,PN2,Y1,GL,YC,Y,YP,YIN,Y3,                000864
     +             Y3SQ,TF,H7,H8,H13,H14,PN11,PN12,PN22)                000865
C                                                                       000866
      CALL WGUIDE(N,BETA,WGL,TG,DTG)                                    000867
C                                                                       000868
      DO 121 I=1,N                                                      000869
C                                                                       000870
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),TG(I,1),TG(I,2),      000871
     +            TG(I,3),TG(I,4),T(I,1),T(I,2),T(I,3),T(I,4))          000872
C                                                                       000873
  121 CONTINUE                                                          000874
C                                                                       000875
      CALL SEQUENC(N,NP1,T,A)                                           000876
C
```

```
      CALL RESPONS(N,NP1,RS,ZIN,RLOSS,VL,A,H23,H1,RO,RCOEFF,          000877
     +             YC,YP,TG,Y1,VS,H2,H3,H4,H5,H6,H7,H9,H10)           000878
                                                                      000879
C                                                                     000880
      CALL INSOUT(N,VL,INLOSS)                                        000881
C                                                                     000882
      CALL PHASE(N,VL,ANGLE)                                          000883
C                                                                     000884
      RETURN                                                          000885
      END                                                             000886
C
```

```
C                                                                       000887
      SUBROUTINE BETAVAL(C1,C2,OMEG,PI2,BETA)                           000888
C                                                                       000889
C     WAVEGUIDE MANIFOLD PROPAGATION PHASE CONSTANT IS CALCULATED       000890
C                                                                       000891
      REAL LAM,LAMG                                                     000892
      LAM=C1/OMEG                                                       000893
      LAMG=LAM/SQRT(1.0-LAM*LAM/C2)                                     000894
      BETA=PI2/LAMG                                                     000895
      RETURN                                                            000896
      END                                                               000897
C                                                                       000898
```

```
C                                                                       000899
      SUBROUTINE INSOUT(N,VL,INLOSS)                                    000900
C                                                                       000901
C     CHANNEL INSERTION LOSS IS CALCULATED                              000902
C                                                                       000903
      COMPLEX VL(16)                                                    000904
      REAL INLOSS(16)                                                   000905
C                                                                       000906
C     THIS SUBROUTINE IS WRITTEN FOR VS=1.0, RS=1.0, GL(I)=1.0          000907
C                                                                       000908
      DO 10 I=1,N                                                       000909
      VABS=CABS(VL(I))                                                  000910
      INLOSS(I)=-20.0*ALOG10(2.0*VABS)                                  000911
   10 CONTINUE                                                          000912
      RETURN                                                            000913
      END                                                               000914
C                                                                       000915
```

```
C                                                                       000916
      SUBROUTINE CONST1(WIDTH)                                          000917
C                                                                       000918
C     WAVEGUIDE MANIFOLD CUTOFF FREQUENCY IS CALCULATED                 000919
C                                                                       000920
      COMMON/BLK4/CBR,FCUT                                              000921
      CBR=11802.85                                                      000922
      FCUT=CBR/(2.0*WIDTH)                                              000923
      RETURN                                                            000924
      END                                                               000925
C                                                                       000926
```

```
C                                                                       000927
      SUBROUTINE DISPAT(N,WO,BW,QO)                                     000928
C                                                                       000929
C     FILTER DISSIPATION IS CALCULATED USING UNLOADED Q, BANDWIDTHS     000930
C     AND CENTER FREQUENCIES                                            000931
C                                                                       000932
      REAL WO(16),BW(16),DISP(16),QO(16)                                000933
      COMMON/BLK3/DISP                                                  000934
C                                                                       000935
      DO 10 I=1,N                                                       000936
      DISP(I)=WO(I)/(BW(I)*QO(I))                                       000937
   10 CONTINUE                                                          000938
      RETURN                                                            000939
      END                                                               000940
C                                                                       000941
```

```
C                                                                       000942
      SUBROUTINE DISPER(N,WO,BW,DIA)                                    000943
C                                                                       000944
C     CALCULATES THE DISPERSIVE EFFECTS IN EACH FILTER                  000945
C     THE OUTPUT FROM THIS SUBROUTINE  INCLUDES  FILTER  GUIDE          000946
C     WAVELENGTH CORRESPONDING TO THE FILTER RESONANT FREQUENCY         000947
C     AND THE DIFFERENCE IN FILTER GUIDE WAVELENGTHS CORRESPONDING      000948
C     TO THE BAND EDGES.                                                000949
C                                                                       000950
      REAL WO(16),BW(16),DIA(16),FCNST(16),LAMRES(16),LAMDEL(16)        000951
      REAL LAMLOG,LAMHIG                                                000952
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000953
      CB=11802.85                                                       000954
      CDIA=CB/1.7063                                                    000955
C                                                                       000956
      DO 10 I=1,N                                                       000957
      FCNST(I)=CDIA/(DIA(I)*DIA(I))                                     000958
C                                                                       000959
      FLO=WO(I)-BW(I)/2.0                                               000960
      FHI=FLO+BW(I)                                                     000961
C                                                                       000962
      LAMLOG=CB/(SQRT(FLO*FLO-FCNST(I)))                                000963
      LAMHIG=CB/(SQRT(FHI*FHI-FCNST(I)))                                000964
C                                                                       000965
      LAMRES(I)=(LAMLOG+LAMHIG)/2.0                                     000966
      LAMDEL(I)=LAMLOG-LAMHIG                                           000967
C                                                                       000968
   10 CONTINUE                                                          000969
      RETURN                                                            000970
      END                                                               000971
C                                                                       000972
```

```
C                                                                       000973
      SUBROUTINE TOTAL(N,IR,IRT)                                        000974
C                                                                       000975
C     CALCULATE THE TOTAL NUMBER OF VARIABLES ACCUMULATED AFTER         000976
C     EACH SECTION                                                      000977
C                                                                       000978
      INTEGER IR(16),IRT(16)                                            000979
      IRT(1)=IR(1)+1                                                    000980
      IF(N.EQ.1)GO TO 5                                                 000981
      DO 15 I=2,N                                                       000982
      IM1=I-1                                                           000983
      IRT(I)=IRT(IM1)+IR(I)+1                                           000984
   15 CONTINUE                                                          000985
    5 CONTINUE                                                          000986
      RETURN                                                            000987
      END                                                               000988
C                                                                       000989
```

```
C                                                                       000990
      SUBROUTINE PHASE(N,VL,ANGLE)                                      000991
C                                                                       000992
C     GIVEN THE COMPLEX CHANNEL OUTPUT VOLTAGE CALCULATE THE            000993
C     CORRESPONDING PHASE.                                              000994
C                                                                       000995
      COMPLEX VL(16)                                                    000996
      REAL ANGLE(16)                                                    000997
C                                                                       000998
      DO 10 I=1,N                                                       000999
      HRE=REAL(VL(I))                                                   001000
      HIM=AIMAG(VL(I))                                                  001001
      ANGLE(I)=ATAN2(HIM,HRE)                                           001002
   10 CONTINUE                                                          001003
      RETURN                                                            001004
      END                                                               001005
```

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