OSA

CONTIGUOUS BAND MULTIPLEXER SIMULATION AND OPTIMIZATION

OSA-84-MX-1-L

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Optimization Systems Associates

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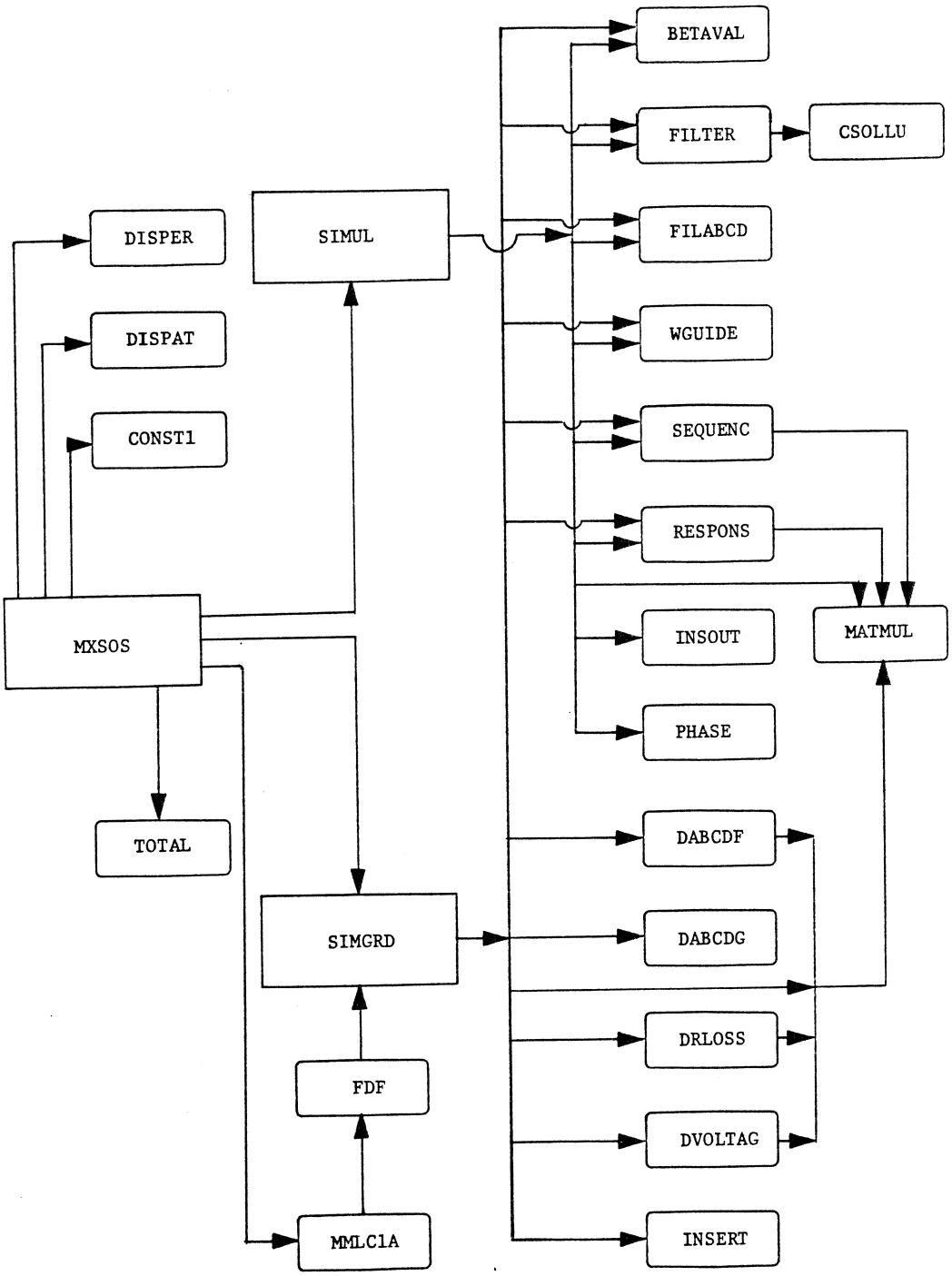

Eight channel version

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

```
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(8,4),YP(8,4),YIN(8),Y3(8),Y3SQ(8),TF(8,4)               000059
      COMPLEX P(8,8),Q(8,8),Y1(8),YC(8)                                 000060
      COMPLEX H7(8),H8(8),H13(8),H14(8)                                 000061
      REAL PN1(8),PN2(8),GL(8)                                          000062
      REAL PN11(8),PN12(8),PN22(8)                                      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(8,4),A(9,9,4)                                           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(8),A(9,9,4),HMX(4)                                     000173
      COMPLEX H2(8),H3(8),H4(8),H5(8),H6(8),H7(8),H9(8),H10(8)          000174
      COMPLEX YC(8),YP(8,4),TG(8,4),Y1(8)                               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(8,4),DTG(8,4)                                          000221
      REAL WGL(8)                                                       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
C                                                                       000306
C     CALCULATE DERIVATIVES OF THE FILTER-JUNCTION ABCD MATRICES        000307
C     W.R.T. VARIABLE COUPLING ELEMENTS, AND STORE THEM IN A            000308
C     DESIGNATED ARRAY FOR THE DERIVATIVES OF THE ABCD MATRICES         000309
C     OF THE SECTIONS W.R.T. ALL VARIABLES CONTAINED IN THEM            000310
C                                                                       000311
      INTEGER IR(8),IRT(8),LC(8,36),KC(8,36)                            000312
      REAL PN11(8),PN12(8),PN22(8),LAMR(8)                              000313
      INTEGER CEL(8,8,8)                                                000314
      COMPLEX DY11(296),DY21(296),DY22(296),DYP11(296),DYP21(296)       000315
      COMPLEX DYP22(296),DYIN(296),DAF(296),DBF(296),DCF(296),DDF(296)  000316
      COMPLEX P(8,8),Q(8,8),Y1(8),H15,H7(8),H13(8),H14(8)               000317
      COMPLEX TG(8,4),D(296,4),YIN(8),YINSQ,JPLX,Y3SQ(8),YP(8,4)        000318
      COMMON/BLK7/CEL                                                   000319
      JPLX=CMPLX(0.0,1.0)                                               000320
C                                                                       000321
      DO 21 I=1,N                                                       000322
      IF(IR(I).EQ.0)GO TO 21                                            000323
      IM1=I-1                                                           000324
      YINSQ=YIN(I)*YIN(I)                                               000325
C                                                                       000326
      KP=IR(I)                                                          000327
      DO 22 J=1,KP                                                      000328
C                                                                       000329
      IX3=LC(I,J)                                                       000330
      IX4=KC(I,J)                                                       000331
C                                                                       000332
      IF(I.EQ.1)GO TO 23                                                000333
      IV=IRT(IM1)+J                                                     000334
      GO TO 24                                                          000335
   23 IV=J                                                              000336
   24 CONTINUE                                                          000337
C                                                                       000338
      IF(IX3.EQ.IX4)GO TO 35                                            000339
C                                                                       000340
      DY11(IV)=-2.0*JPLX*P(I,IX3)*P(I,IX4)                              000341
      DY21(IV)=-JPLX*(P(I,IX3)*Q(I,IX4)+P(I,IX4)*Q(I,IX3))              000342
      DY22(IV)=-2.0*JPLX*Q(I,IX3)*Q(I,IX4)                              000343
C                                                                       000344
      IF(IDISPER.NE.1)GO TO 36                                          000345
      CF=LAMR(I)**CEL(I,IX3,IX4)                                        000346
      DY11(IV)=DY11(IV)*CF                                              000347
      DY21(IV)=DY21(IV)*CF                                              000348
      DY22(IV)=DY22(IV)*CF                                              000349
      GO TO 36                                                          000350
C                                                                       000351
   35 DY11(IV)=-JPLX*P(I,IX3)*P(I,IX3)                                  000352
      DY21(IV)=-JPLX*P(I,IX3)*Q(I,IX3)                                  000353
      DY22(IV)=-JPLX*Q(I,IX3)*Q(I,IX3)                                  000354
C                                                                       000355
   36 CONTINUE                                                          000356
C                                                                       000357
      DYP11(IV)=PN11(I)*DY11(IV)                                        000358
      DYP21(IV)=PN12(I)*DY21(IV)                                        000359
      DYP22(IV)=PN22(I)*DY22(IV)                                        000360
C                                                                       000361
      DYIN(IV)=DYP11(IV)-DYP21(IV)*(2.0*YP(I,2)/H7(I))+DYP22(IV)*H13(I) 000362
C                                                                       000363
C     USE AN IMPEDANCE INVERTER                                         000364
C                                                                       000365
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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
C                                                                       000382
```

```
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(8),H20                                                000391
      COMPLEX D(296,4),DG(8,4)                                          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(8)                                                    000411
      COMPLEX E(296,4),F(296,4),A(9,9,4),D(296,4),H23,RCOEFF            000412
      COMPLEX DZIN,H21,DRCFF,H212                                       000413
      REAL DRTLOSS(296)                                                 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
C                                                                       000466
C     CALCULATE SENSITIVITIES OF ALL OUTPUT VOLTAGES W.R.T. ALL         000467
C     VARIABLES                                                         000468
C                                                                       000469
      INTEGER IRT(8),IR(8),UPB,UPBM1,UPBP1                              000470
      COMPLEX A(9,9,4),E(296,4),DAI(296,4),Y1(8),TG(8,4)                000471
      COMPLEX DVL(8,296),F(296,4),YC(8),YP(8,4)                         000472
      COMPLEX DH2(296),DYP21(296),DYP22(296),DYP11(296),DTG(8,4)        000473
      COMPLEX H3(8),H4(8),H5(8),H6(8),H7(8),H8(8),H9(8),H10(8),JPLX,H1  000474
      COMPLEX H29,H30,H31,H32,H35,H36,H37,H50,H51,H52,H40,H41,H42,H43    000475
      JPLX=CMPLX(0.0,1.0)                                               000476
C                                                                       000477
      DO 60 I=1,N                                                       000478
C                                                                       000479
      H29=-VS*H4(I)                                                     000480
      H30=(Y1(I)*TG(I,1)+TG(I,3))*H29                                   000481
      H31=(Y1(I)*TG(I,2)+TG(I,4))*H29                                   000482
      H32=H6(I)*RS                                                      000483
C                                                                       000484
      H35=H3(I)*H1/H5(I)                                                000485
      H36=H6(I)/H5(I)                                                   000486
      H37=H36*RS                                                        000487
C                                                                       000488
      H40=(Y1(I)*DTG(I,1)+DTG(I,3))*A(1,I,2)                            000489
      H41=(Y1(I)*DTG(I,2)+DTG(I,4))*A(1,I,4)                            000490
      H42=VS*(H40+H41)                                                  000491
      H43=-H42/H4(I)                                                    000492
C                                                                       000493
      H50=-YC(I)-H10(I)/H8(I)                                           000494
      H51=H9(I)/YP(I,2)                                                 000495
      H52=H7(I)*YC(I)/YP(I,2)                                           000496
C                                                                       000497
      IM1=I-1                                                           000498
      UPB=IRT(I)                                                        000499
      UPBM1=UPB-1                                                       000500
      IF(I.EQ.1)GO TO 70                                                000501
C                                                                       000502
      LOB=IRT(IM1)                                                      000503
C                                                                       000504
      LL=0                                                              000505
      DO 62 JJ=1,IM1                                                    000506
      LL=LL+IR(JJ)+1                                                    000507
      KK=LL-IR(JJ)                                                      000508
C                                                                       000509
      JJP1=JJ+1                                                         000510
      DO 63 J=KK,LL                                                     000511
C                                                                       000512
      CALL MATMUL(A(JJP1,I,1),A(JJP1,I,2),A(JJP1,I,3),A(JJP1,I,4),     000513
     +            E(J,1),E(J,2),E(J,3),E(J,4),DAI(J,1),DAI(J,2),       000514
     +            DAI(J,3),DAI(J,4))                                    000515
C                                                                       000516
   63 CONTINUE                                                          000517
   62 CONTINUE                                                          000518
C                                                                       000519
      DO 65 J=1,LOB                                                     000520
      DVL(I,J)=(H30*DAI(J,2)+H31*DAI(J,4)+H6(I)*F(J,2)+H32*F(J,4))/H5(I) 000521
      DVL(I,J)=-JPLX*DVL(I,J)                                           000522
   65 CONTINUE                                                          000523
C                                                                       000524
      GO TO 72                                                          000525
C                                                                       000526
   70 LOB=0                                                             000527
```

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

```
C                                                                       000555
      SUBROUTINE SIMGRD(OMEG,RLOSS,DRTLOSS,INLOSS,DINLOSS,N,M,          000556
     +                  ICOUNT,IFLAGJS,IFLAGDP,IDISPER)                 000557
C                                                                       000558
C     THIS SUBROUTINE CALLS ALL OTHER SUBROUTINES NECESSARY TO          000559
C     CALCULATE THE RESPONSE AND EXACT SENSITIVITIES                    000560
C                                                                       000561
      COMPLEX Z(8,8,8),P(8,8),Q(8,8)                                    000562
      COMPLEX Y(8,4),YP(8,4),YIN(8),Y1(8),Y3(8),YC(8)                   000563
      COMPLEX TF(8,4),TG(8,4),T(8,4),A(9,9,4),Y3SQ(8)                   000564
      COMPLEX H2(8),H3(8),H4(8),H5(8),H6(8),H7(8),H8(8)                 000565
      COMPLEX H9(8),H10(8),H13(8),H14(8)                                000566
      COMPLEX VL(8)                                                     000567
      COMPLEX H1,H23,ZIN,RCOEFF                                         000568
      COMPLEX S,SD                                                      000569
      REAL WO(8),BW(8)                                                  000570
      REAL CM(8,8,8),PN1(8),PN2(8),PN11(8),PN12(8)                      000571
      REAL PN22(8),GL(8),WGL(8)                                         000572
      REAL INLOSS(8),DINLOSS(8,296)                                     000573
      REAL DISP(8),LAMR(8)                                              000574
      REAL FCNST(8),LAMRES(8),LAMDEL(8),LAMFIL,LREAC                    000575
      INTEGER IR(8),IRT(8),LC(8,36),KC(8,36),CEL(8,8,8)                 000576
      COMPLEX DY11(296),DY21(296),DY22(296),DYP11(296),DYP21(296)       000577
      COMPLEX DYP22(296),DYIN(296),DAF(296),DBF(296),DCF(296)           000578
      COMPLEX DDF(296),D(296,4)                                         000579
      COMPLEX DTG(8,4),DG(8,4)                                          000580
      COMPLEX E(296,4),F(296,4)                                         000581
      REAL DRTLOSS(296)                                                 000582
      COMPLEX DVL(8,296)                                                000583
C                                                                       000584
      COMMON/BLK1/WO,BW,PN1,PN2,GL,VS,RS,PI2,WIDTH,NP1                  000585
      COMMON/BLK2/CM,WGL                                                000586
      COMMON/BLK4/CBR,FCUT                                              000587
      COMMON/BLK5/DISP                                                  000588
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000589
      COMMON/BLK7/CEL                                                   000590
      COMMON/BLK8/IR,IRT,LC,KC                                          000591
C                                                                       000592
      IF(ICOUNT.NE.1)GO TO 5                                            000593
C                                                                       000594
      DO 100 I=1,N                                                      000595
      DO 100 J=1,M                                                      000596
      DO 100 KK=1,J                                                     000597
      CM(I,J,KK)=CM(I,KK,J)                                             000598
  100 CONTINUE                                                          000599
C                                                                       000600
      DO 99 I=1,N                                                       000601
      DO 99 J=1,M                                                       000602
      DO 99 K=1,M                                                       000603
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))                                     000604
   99 CONTINUE                                                          000605
C                                                                       000606
      C1=11802.85                                                       000607
      C2=4.0*WIDTH*WIDTH                                                000608
C                                                                       000609
    5 CONTINUE                                                          000610
C                                                                       000611
      IF(IDISPER.NE.1)GO TO 500                                         000612
C                                                                       000613
      DO 51 I=1,N                                                       000614
      LAMFIL=C1/SQRT(OMEG*OMEG-FCNST(I))                                000615
      LAMR(I)=LAMFIL/LAMRES(I)                                          000616
      LREAC=2.0*(LAMRES(I)-LAMFIL)/LAMDEL(I)                            000617
C                                                                       000618
C     SET UP THE COMPLEX IMPEDANCE MATRIX OF THE FILTERS                000619
```

```
C                                                                       000620
      DO 52 J=1,M                                                       000621
      DO 52 K=1,M                                                       000622
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))*LAMR(I)**CEL(I,J,K)                 000623
   52 CONTINUE                                                          000624
C                                                                       000625
C     SET UP DIAGONAL ELEMENTS INCLUDING FILTER DISPERSION              000626
C                                                                       000627
      DO 53 J=1,M                                                       000628
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J)+LREAC)                               000629
C                                                                       000630
C     INCLUDE FILTER DISSIPATION                                        000631
C                                                                       000632
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000633
   53 CONTINUE                                                          000634
   51 CONTINUE                                                          000635
      GO TO 75                                                          000636
C                                                                       000637
  500 CONTINUE                                                          000638
      DO 106 I=1,N                                                      000639
      XR=WO(I)/BW(I)                                                    000640
      C3=(OMEG/WO(I))-(WO(I)/OMEG)                                      000641
      S=CMPLX(0.0,C3)                                                   000642
      SD=S*XR                                                           000643
C                                                                       000644
C     SET UP DIAGONAL ELEMENTS FOR ZERO FILTER DISPERSION               000645
C                                                                       000646
      DO 106 J=1,M                                                      000647
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J))+SD                                  000648
C                                                                       000649
C     INCLUDE FILTER DISSIPATION                                        000650
C                                                                       000651
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000652
  106 CONTINUE                                                          000653
C                                                                       000654
   75 CONTINUE                                                          000655
      IF(IFLAGJS.EQ.1)GO TO 68                                          000656
      DO 66 I=1,N                                                       000657
      YC(I)=CMPLX(0.0,0.0)                                              000658
      Y1(I)=CMPLX(0.0,0.0)                                              000659
   66 CONTINUE                                                          000660
      GO TO 70                                                          000661
C                                                                       000662
   68 CONTINUE                                                          000663
C                                                                       000664
C     THE JUNCTION SUSCEPTANCE IS CALCULATED                            000665
C                                                                       000666
      BETAJS=FCUT/(((20.0*(CBR/OMEG)**2)-1.0)*SQRT(OMEG*OMEG-FCUT*FCUT)) 000667
      DO 69 I=1,N                                                       000668
      YC(I)=(0.0,0.0)                                                   000669
      Y1(I)=CMPLX(0.0,-BETAJS)                                          000670
   69 CONTINUE                                                          000671
C                                                                       000672
   70 CONTINUE                                                          000673
C                                                                       000674
      CALL BETAVAL(C1,C2,OMEG,PI2,BETA)                                 000675
C                                                                       000676
      CALL FILTER(N,M,Z,P,Q)                                            000677
C                                                                       000678
      CALL FILABCD(N,M,P,Q,PN1,PN2,Y1,GL,YC,Y,YP,YIN,Y3,                000679
     +             Y3SQ,TF,H7,H8,H13,H14,PN11,PN12,PN22)                000680
C                                                                       000681
      CALL WGUIDE(N,BETA,WGL,TG,DTG)                                    000682
C                                                                       000683
      DO 121 I=1,N                                                      000684
```

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C                                                                       000685
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),TG(I,1),TG(I,2),      000686
     +           TG(I,3),TG(I,4),T(I,1),T(I,2),T(I,3),T(I,4))          000687
C                                                                       000688
  121 CONTINUE                                                          000689
C                                                                       000690
      CALL SEQUENC(N,NP1,T,A)                                           000691
C                                                                       000692
      CALL RESPONS(N,NP1,RS,ZIN,RLOSS,VL,A,H23,H1,RO,RCOEFF,            000693
     +             YC,YP,TG,Y1,VS,H2,H3,H4,H5,H6,H7,H9,H10)             000694
C                                                                       000695
      CALL DABCDF(N,IR,IRT,LC,KC,DY11,DY21,DY22,DYP11,                  000696
     +            DYP21,DYP22,DYIN,YIN,DAF,DBF,DCF,DDF,P,Q,             000697
     +            PN11,PN12,PN22,H7,H13,H14,Y1,TG,D,YSSQ,YP,            000698
     +            LAMR,IDISPER)                                         000699
C                                                                       000700
      DO 125 I=1,N                                                      000701
C                                                                       000702
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),DTG(I,1),DTG(I,2),    000703
     +           DTG(I,3),DTG(I,4),DG(I,1),DG(I,2),DG(I,3),DG(I,4))    000704
C                                                                       000705
  125 CONTINUE                                                          000706
C                                                                       000707
      CALL DABCDG(N,IRT,D,DG)                                           000708
C                                                                       000709
      CALL DRLOSS(N,NP1,IRT,E,F,A,D,H23,RCOEFF,RO,DRTLOSS)              000710
C                                                                       000711
      CALL DVOLTAG(N,IRT,IR,VS,H4,TG,H6,RS,DVL,F,H5,H3,H1,YC,Y1,        000712
     +             H10,H8,H9,YP,H7,DYP21,DYP22,DYP11,DTG,A,E)           000713
C                                                                       000714
      CALL INSERT(N,VL,DVL,INLOSS,DINLOSS,IRT)                          000715
C                                                                       000716
      RETURN                                                            000717
      END                                                               000718
C                                                                       000719
```

```
C                                                                       000720
      SUBROUTINE INSERT(N,VL,DVL,INLOSS,DINLOSS,IRT)                    000721
C                                                                       000722
C     CHANNEL INSERTION LOSS AND ITS SENSITIVITIES ARE CALCULATED       000723
C                                                                       000724
      COMPLEX VL(8),DVL(8,296),HH2                                      000725
      REAL INLOSS(8),DINLOSS(8,296)                                     000726
      INTEGER IRT(8)                                                    000727
C                                                                       000728
C     THIS SUBROUTINE IS WRITTEN FOR VS=1.0, RS=1.0, GL(I)=1.0          000729
C                                                                       000730
      HH0=-20.0/ALOG(10.0)                                              000731
      KP=IRT(N)                                                         000732
      DO 10 I=1,N                                                       000733
      VABS=CABS(VL(I))                                                  000734
      INLOSS(I)=-20.0*ALOG10(2.0*VABS)                                  000735
      HH1=HH0/(VABS*VABS)                                               000736
      HH2=CONJG(VL(I))                                                  000737
C                                                                       000738
      DO 20 J=1,KP                                                      000739
      DINLOSS(I,J)=HH1*REAL(HH2*DVL(I,J))                               000740
   20 CONTINUE                                                          000741
   10 CONTINUE                                                          000742
      RETURN                                                            000743
      END                                                               000744
C                                                                       000745
```

```
C                                                                       000746
      SUBROUTINE SIMUL(OMEG,N,M,ICOUNT,IFLAGJS,IFLAGDP,IDISPER,         000747
     +                 RLOSS,INLOSS,ANGLE)                              000748
C                                                                       000749
C     THIS SUBROUTINE CALLS ALL SUBROUTINES NECESSARY FOR RESPONSE      000750
C     CALCULATIONS ONLY                                                 000751
C                                                                       000752
      COMPLEX Z(8,8,8),P(8,8),Q(8,8)                                    000753
      COMPLEX Y(8,4),YP(8,4),YIN(8),Y1(8),Y3(8),YC(8)                   000754
      COMPLEX TF(8,4),TG(8,4),T(8,4),A(9,9,4),Y3SQ(8)                   000755
      COMPLEX DTG(8,4)                                                  000756
      COMPLEX H2(8),H3(8),H4(8),H5(8),H6(8),H7(8),H8(8)                 000757
      COMPLEX H9(8),H10(8),H13(8),H14(8)                                000758
      COMPLEX VL(8)                                                     000759
      COMPLEX H1,H23,ZIN,RCOEFF                                         000760
      COMPLEX S,SD                                                      000761
      REAL WO(8),BW(8)                                                  000762
      REAL CM(8,8,8),PN1(8),PN2(8),PN11(8),PN12(8)                      000763
      REAL PN22(8),GL(8),WGL(8),INLOSS(8),ANGLE(8)                      000764
      REAL DISP(8),LAMR(8)                                              000765
      REAL FCNST(8),LAMRES(8),LAMDEL(8),LAMFIL,LREAC                    000766
      INTEGER CEL(8,8,8)                                                000767
C                                                                       000768
      COMMON/BLK1/WO,BW,PN1,PN2,GL,VS,RS,PI2,WIDTH,NP1                  000769
      COMMON/BLK2/CM,WGL                                                000770
      COMMON/BLK4/CBR,FCUT                                              000771
      COMMON/BLK5/DISP                                                  000772
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000773
      COMMON/BLK7/CEL                                                   000774
C                                                                       000775
      IF(ICOUNT.NE.1)GO TO 5                                            000776
C                                                                       000777
      DO 100 I=1,N                                                      000778
      DO 100 J=1,M                                                      000779
      DO 100 KK=1,J                                                     000780
      CM(I,J,KK)=CM(I,KK,J)                                             000781
  100 CONTINUE                                                          000782
C                                                                       000783
      DO 99 I=1,N                                                       000784
      DO 99 J=1,M                                                       000785
      DO 99 K=1,M                                                       000786
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))                                     000787
   99 CONTINUE                                                          000788
C                                                                       000789
      C1=11802.85                                                       000790
      C2=4.0*WIDTH*WIDTH                                                000791
C                                                                       000792
    5 CONTINUE                                                          000793
C                                                                       000794
      IF(IDISPER.NE.1)GO TO 500                                         000795
C                                                                       000796
      DO 51 I=1,N                                                       000797
      LAMFIL=C1/SQRT(OMEG*OMEG-FCNST(I))                                000798
      LAMR(I)=LAMFIL/LAMRES(I)                                          000799
      LREAC=2.0*(LAMRES(I)-LAMFIL)/LAMDEL(I)                            000800
C                                                                       000801
C     SET UP THE COMPLEX IMPEDANCE MATRIX OF THE FILTERS                000802
C                                                                       000803
      DO 52 J=1,M                                                       000804
      DO 52 K=1,M                                                       000805
      Z(I,J,K)=CMPLX(0.0,CM(I,J,K))*LAMR(I)**CEL(I,J,K)                 000806
   52 CONTINUE                                                          000807
C                                                                       000808
C     SET UP DIAGONAL ELEMENTS INCLUDING FILTER DISPERSION              000809
C                                                                       000810
```

```
      DO 53 J=1,M                                                       000811
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J)+LREAC)                               000812
C                                                                       000813
C     INCLUDE FILTER DISSIPATION                                        000814
C                                                                       000815
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000816
   53 CONTINUE                                                          000817
   51 CONTINUE                                                          000818
      GO TO 75                                                          000819
C                                                                       000820
  500 CONTINUE                                                          000821
      DO 106 I=1,N                                                      000822
      XR=WO(I)/BW(I)                                                    000823
      C3=(OMEG/WO(I))-(WO(I)/OMEG)                                      000824
      S=CMPLX(0.0,C3)                                                   000825
      SD=S*XR                                                           000826
C                                                                       000827
C     SET UP DIAGONAL ELEMENTS FOR ZERO FILTER DISPERSION               000828
C                                                                       000829
      DO 106 J=1,M                                                      000830
      Z(I,J,J)=CMPLX(0.0,CM(I,J,J))+SD                                  000831
C                                                                       000832
C     INCLUDE FILTER DISSIPATION                                        000833
C                                                                       000834
      IF(IFLAGDP.EQ.1)Z(I,J,J)=Z(I,J,J)+DISP(I)                         000835
  106 CONTINUE                                                          000836
C                                                                       000837
   75 CONTINUE                                                          000838
      IF(IFLAGJS.EQ.1)GO TO 68                                          000839
      DO 66 I=1,N                                                       000840
      YC(I)=CMPLX(0.0,0.0)                                              000841
      Y1(I)=CMPLX(0.0,0.0)                                              000842
   66 CONTINUE                                                          000843
      GO TO 70                                                          000844
C                                                                       000845
   68 CONTINUE                                                          000846
C                                                                       000847
C     THE JUNCTION SUSCEPTANCE IS CALCULATED                            000848
C                                                                       000849
      BETAJS=FCUT/(((20.0*(CBR/OMEG)**2)-1.0)*SQRT(OMEG*OMEG-FCUT*FCUT)) 000850
      DO 69 I=1,N                                                       000851
      YC(I)=(0.0,0.0)                                                   000852
      Y1(I)=CMPLX(0.0,-BETAJS)                                          000853
   69 CONTINUE                                                          000854
C                                                                       000855
   70 CONTINUE                                                          000856
C                                                                       000857
      CALL BETAVAL(C1,C2,OMEG,PI2,BETA)                                 000858
C                                                                       000859
      CALL FILTER(N,M,Z,P,Q)                                            000860
C                                                                       000861
      CALL FILABCD(N,M,P,Q,PN1,PN2,Y1,GL,YC,Y,YP,YIN,Y3,                000862
     +             Y3SQ,TF,H7,H8,H13,H14,PN11,PN12,PN22)                000863
C                                                                       000864
      CALL WGUIDE(N,BETA,WGL,TG,DTG)                                    000865
C                                                                       000866
      DO 121 I=1,N                                                      000867
C                                                                       000868
      CALL MATMUL(TF(I,1),TF(I,2),TF(I,3),TF(I,4),TG(I,1),TG(I,2),      000869
     +           TG(I,3),TG(I,4),T(I,1),T(I,2),T(I,3),T(I,4))           000870
C                                                                       000871
  121 CONTINUE                                                          000872
C                                                                       000873
      CALL SEQUENC(N,NP1,T,A)                                           000874
C                                                                       000875
```

```
      CALL RESPONS(N,NP1,RS,ZIN,RLOSS,VL,A,H23,H1,RO,RCOEFF,          000876
     +             YC,YP,TG,Y1,VS,H2,H3,H4,H5,H6,H7,H9,H10)           000877
C                                                                     000878
      CALL INSOUT(N,VL,INLOSS)                                        000879
C                                                                     000880
      CALL PHASE(N,VL,ANGLE)                                          000881
C                                                                     000882
      RETURN                                                          000883
      END                                                             000884
C                                                                     000885
```

```
C                                                                       000886
      SUBROUTINE BETAVAL(C1,C2,OMEG,PI2,BETA)                           000887
C                                                                       000888
C     WAVEGUIDE MANIFOLD PROPAGATION PHASE CONSTANT IS CALCULATED.      000889
C                                                                       000890
      REAL LAM,LAMG                                                     000891
      LAM=C1/OMEG                                                       000892
      LAMG=LAM/SQRT(1.0-LAM*LAM/C2)                                     000893
      BETA=PI2/LAMG                                                     000894
      RETURN                                                            000895
      END                                                               000896
C                                                                       000897
```

```
C                                                                       000898
      SUBROUTINE INSOUT(N,VL,INLOSS)                                    000899
C                                                                       000900
C     CHANNEL INSERTION LOSS IS CALCULATED                              000901
C                                                                       000902
      COMPLEX VL(8)                                                     000903
      REAL INLOSS(8)                                                    000904
C                                                                       000905
C     THIS SUBROUTINE IS WRITTEN FOR VS=1.0, RS=1.0, GL(I)=1.0          000906
C                                                                       000907
      DO 10 I=1,N                                                       000908
      VABS=CABS(VL(I))                                                  000909
      INLOSS(I)=-20.0*ALOG10(2.0*VABS)                                  000910
   10 CONTINUE                                                          000911
      RETURN                                                            000912
      END                                                               000913
C                                                                       000914
```

```
C                                                                       000915
      SUBROUTINE CONST1(WIDTH)                                          000916
C                                                                       000917
C     WAVEGUIDE MANIFOLD CUTOFF FREQUENCY IS CALCULATED                 000918
C                                                                       000919
      COMMON/BLK4/CBR,FCUT                                              000920
      CBR=11802.85                                                      000921
      FCUT=CBR/(2.0*WIDTH)                                              000922
      RETURN                                                            000923
      END                                                               000924
C                                                                       000925
```

```
C                                                                       000926
      SUBROUTINE DISPAT(N,WO,BW,QO)                                     000927
C                                                                       000928
C     FILTER DISSIPATION IS CALCULATED USING UNLOADED Q, BANDWIDTHS     000929
C     AND CENTER FREQUENCIES                                            000930
C                                                                       000931
      REAL WO(8),BW(8),DISP(8),QO(8)                                    000932
      COMMON/BLK5/DISP                                                  000933
C                                                                       000934
      DO 10 I=1,N                                                       000935
      DISP(I)=WO(I)/(BW(I)*QO(I))                                       000936
   10 CONTINUE                                                          000937
      RETURN                                                            000938
      END                                                               000939
C                                                                       000940
```

```
C                                                                       000941
      SUBROUTINE DISPER(N,WO,BW,DIA)                                    000942
C                                                                       000943
C     CALCULATES THE DISPERSIVE EFFECTS IN EACH FILTER                  000944
C     THE OUTPUT FROM THIS SUBROUTINE  INCLUDES  FILTER  GUIDE          000945
C     WAVELENGTH CORRESPONDING TO THE FILTER RESONANT FREQUENCY         000946
C     AND THE DIFFERENCE IN FILTER GUIDE WAVELENGTHS CORRESPONDING      000947
C     TO THE BAND EDGES.                                                000948
C                                                                       000949
      REAL WO(8),BW(8),DIA(8),FCNST(8),LAMRES(8),LAMDEL(8)              000950
      REAL LAMLOG,LAMHIG                                                000951
      COMMON/BLK6/FCNST,LAMRES,LAMDEL                                   000952
      CB=11802.85                                                       000953
      CDIA=CB/1.7063                                                    000954
C                                                                       000955
      DO 10 I=1,N                                                       000956
      FCNST(I)=CDIA/(DIA(I)*DIA(I))                                     000957
C                                                                       000958
      FLO=WO(I)-BW(I)/2.0                                               000959
      FHI=FLO+BW(I)                                                     000960
C                                                                       000961
      LAMLOG=CB/(SQRT(FLO*FLO-FCNST(I)))                                000962
      LAMHIG=CB/(SQRT(FHI*FHI-FCNST(I)))                                000963
C                                                                       000964
      LAMRES(I)=(LAMLOG+LAMHIG)/2.0                                     000965
      LAMDEL(I)=LAMLOG-LAMHIG                                           000966
C                                                                       000967
   10 CONTINUE                                                          000968
      RETURN                                                            000969
      END                                                               000970
C                                                                       000971
```

```
C                                                                       000972
      SUBROUTINE TOTAL(N,IR,IRT)                                        000973
C                                                                       000974
C     CALCULATE THE TOTAL NUMBER OF VARIABLES ACCUMULATED AFTER         000975
C     EACH SECTION                                                      000976
C                                                                       000977
      INTEGER IR(8),IRT(8)                                              000978
      IRT(1)=IR(1)+1                                                    000979
      IF(N.EQ.1)GO TO 5                                                 000980
      DO 15 I=2,N                                                       000981
      IM1=I-1                                                           000982
      IRT(I)=IRT(IM1)+IR(I)+1                                           000983
   15 CONTINUE                                                          000984
    5 CONTINUE                                                          000985
      RETURN                                                            000986
      END                                                               000987
C                                                                       000988
```

```
C                                                                       000989
      SUBROUTINE PHASE(N,VL,ANGLE)                                      000990
C                                                                       000991
C     GIVEN THE COMPLEX CHANNEL OUTPUT VOLTAGE CALCULATE THE            000992
C     CORRESPONDING PHASE                                               000993
C                                                                       000994
      COMPLEX VL(8)                                                     000995
      REAL ANGLE(8)                                                     000996
C                                                                       000997
      DO 10 I=1,N                                                       000998
      HRE=REAL(VL(I))                                                   000999
      HIM=AIMAG(VL(I))                                                  001000
      ANGLE(I)=ATAN2(HIM,HRE)                                           001001
   10 CONTINUE                                                          001002
      RETURN                                                            001003
      END                                                               001004
```

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