

NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

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Title: MICROSTRIP IMPEDANCE CALCULATIONS

Author(s): James R. Coe

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MICROSTRIP IMPEDANCE CALCULATIONS

James R. Coe

A FORTRAN program which computes the characteristic impedance of a microstrip line is attached.

The executable program is stored on the Green Bank Laboratory MASSCOMP computer in the file Micro.z located in my directory cad.

JRC/cjd

```

* *****
PROGRAM MICROZ
* Written by J.R. Coe, December 20, 1984
* *****

REAL PI

PARAMETER (PI = 3.14159)

DATA ER , T , H , STARF , STOPF , STEPF /
:      0. , 0. , 0. , 0. , 0. , 0. /

PRINT *, 'THIS PROGRAM COMPUTES THE IMPEDANCE OF A'
PRINT *, 'SINGLE MICROSTRIP LINE USING THE EQUATIONS'
PRINT *, 'DESCRIBED BY J. D. Woermbke "SOFT SUBSTRATES'
PRINT *, 'CONQUER HARD DESIGNS" in MICROWAVES JANUARY 1982'
PRINT *, ' '

PRINT *, 'THE USER ENTERS THE RELATIVE DIELECTRIC CONSTANT, Er'
PRINT *, 'THE DIELECTRIC THICKNESS ,H, IN MILLIMETERS AND THE'
PRINT *, 'CONDUCTOR THICKNESS ,T, AND WIDTH ,w.'

PRINT *, ' '

PRINT *, 'THE PROGRAM DETERMINES THE EFFECTIVE WIDTH AND'
PRINT *, 'DIELECTRIC CONSTANT AND LOW FREQUENCY IMPEDANCE ZOL'
PRINT *, 'USING EQUATIONS SELECTED BY THE W/H RATIO.'

PRINT *, ' '

PRINT *, 'THE ERRORS IN ZOL ARE LESS THAN 2% FOR '
PRINT *, '.05 < W/H < 20, Er < 16, and T/H < .15'

PRINT *, ' '

100 PRINT *, 'ENTER VALUES Er,H(mm),T(mm)'

READ *, ER,H,T

IF (ER.GT.16) THEN

PRINT *, 'EQUATIONS NOT ACCURATE FOR Er > 16'

ENDIF

PRINT *, ' '

IF (T/H.GT.0.15) THEN

```

```
PRINT *, 'THESE EQUATIONS NOT ACCURATE FOR T/H > .15'
```

```
ENDIF
```

```
200 PRINT *, 'ENTER VALUE W(mm)'
```

```
READ *, W
```

```
* *****
* EFFECTIVE WIDTH WEFF
* *****
```

```
IF (T.EQ.0) THEN
```

```
WEFF = W
```

```
ELSE
```

```
IF (W/H.GT.0.159) THEN
```

```
WEFF = W + (T/PI)*(1 + LOG(2*H/T))
```

```
ELSE
```

```
WEFF = W + (T/PI)*(1 + LOG(4*PI*W/T))
```

```
ENDIF
```

```
ENDIF
```

```
PRINT *, 'THE EFFECTIVE WIDTH OF THE MICROSTRIP LINE ',  
:WEFF, ' mm'
```

```
PRINT *, ' '
```

```
IF(WEFF/H.GT.20) THEN
```

```
PRINT *, 'MICROSTRIP EFFECTIVE WIDTH/HEIGHT IS'  
PRINT *, 'GREATER THAN 20 AND ZOL IS NOT ACCURATE'
```

```
ENDIF
```

```
IF(WEFF/H.LT.0.05) THEN
```

```
PRINT *, 'MICROSTRIP EFFECTIVE WIDTH/HEIGHT IS'  
PRINT *, 'LESS THAN 0.05 AND THE EQUATIONS FOR'  
PRINT *, 'ZOL ARE INACCURATE'
```

```
GOTO 200
```

```
ENDIF
```

```

* *****
*   LOW FREQUENCY CHARACTERISTIC IMPEDANCE ZOL
* *****

```

```
IF (WEFF/H.LT.1.0) THEN
```

```

:   EEF0 = (ER + 1)/2 + ((ER - 1)/2)*((1 + 12* H/WEFF)**
      -.5 + 0.04 * (1 - WEFF/H)**2)

```

```
      ZOL = (60/SQRT(EEF0))*LOG(8*H/WEFF+0.25*WEFF/H)
```

```
ELSE
```

```

:   EEF0 = (ER + 1)/2 + ((ER - 1)/2)*(1 + 12* H/WEFF)**
      -.5

```

```

:   ZOL = ((120*PI)/SQRT(EEF0))/(WEFF/H + 1.393 + 0.667*LOG
      (WEFF/H + 1.444))

```

```
ENDIF
```

```

PRINT *, 'THE LOW FREQUENCY CHARACTERISTIC IMPEDANCE IS ',
:ZOL, ' ohms'

```

```
PRINT *, ''
```

```
PRINT *, ' AND THE EFFECTIVE DIELECTRIC CONSTANT IS ',EEF0
```

```
PRINT *, ' '
```

```
PRINT *, 'TO CHANGE WIDTH, ENTER 1'
```

```
PRINT *, 'TO CALCULATE ZO VS FREQUENCY, ENTER 2'
```

```
PRINT *, 'TO END, ENTER 3'
```

```
READ *, N
```

```
GO TO (200,400,600), N
```

```

* *****
*   CHARACTERISTIC IMPEDANCE VS FREQUENCY
* *****

```

```

400 PRINT *, 'TO DETERMINE THE MICROSTRIP CHARACTERISTIC IMPEDANCE'
PRINT *, 'VS FREQUENCY ENTER START, STOP, AND STEP FREQUENCIES
: IN (GHZ)'
```

```

      READ *, STARF,STOPF,STEPF
*   compute max number of freq steps
      FMAX = INT((STOPF - STARF)/STEPF)
      PRINT *, '      Zo(f),          FREQ(GHz)  '
      DO 500 F = 0, FMAX
*
*       calculate frequency
      FREQ = STARF + F*STEPF
*
*       effective dielectric constant with frequency
*        $Z_{01}/2*4\pi*h$  in cm gives Fp in Ghz
      FP = ZOL/(.8*PI*H)
      G = 0.6 + 0.009*ZOL
      EEFF = ER - (ER - EEF0)/(1 + G*(FREQ/FP)**2)
      ZOF = ZOL*(EEF0/EEFF)**0.5

      PRINT *, ZOF,'      ', FREQ

500      CONTINUE

      GO TO 200

600      END

```