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MEASUREMENTS OF ANTENNA PULSE RESPONSE:(U)
JUL 81 P R CARON
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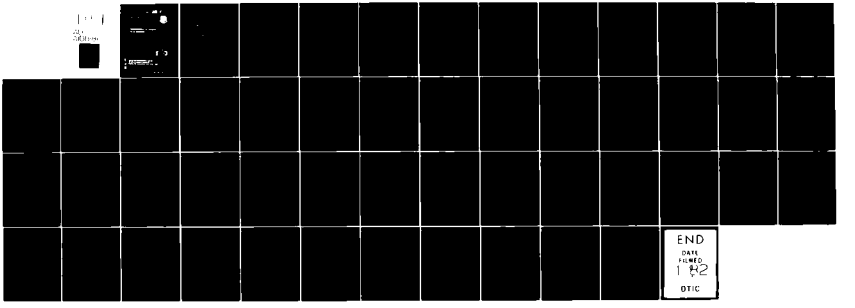

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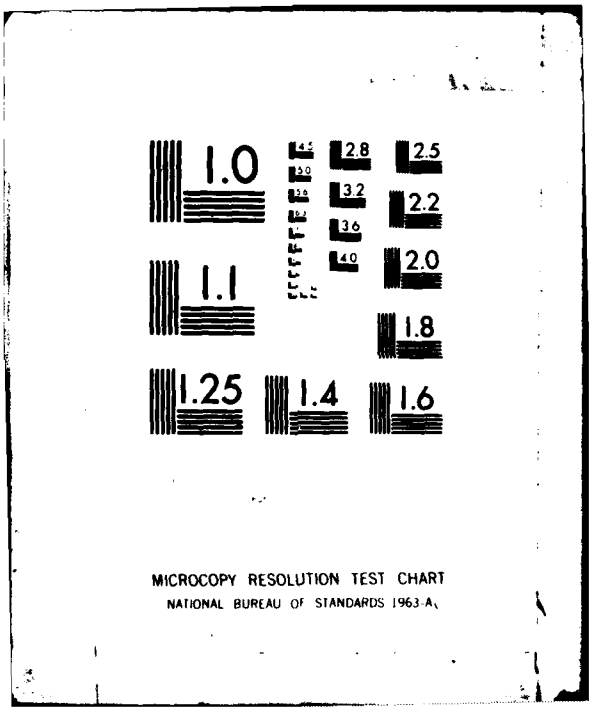
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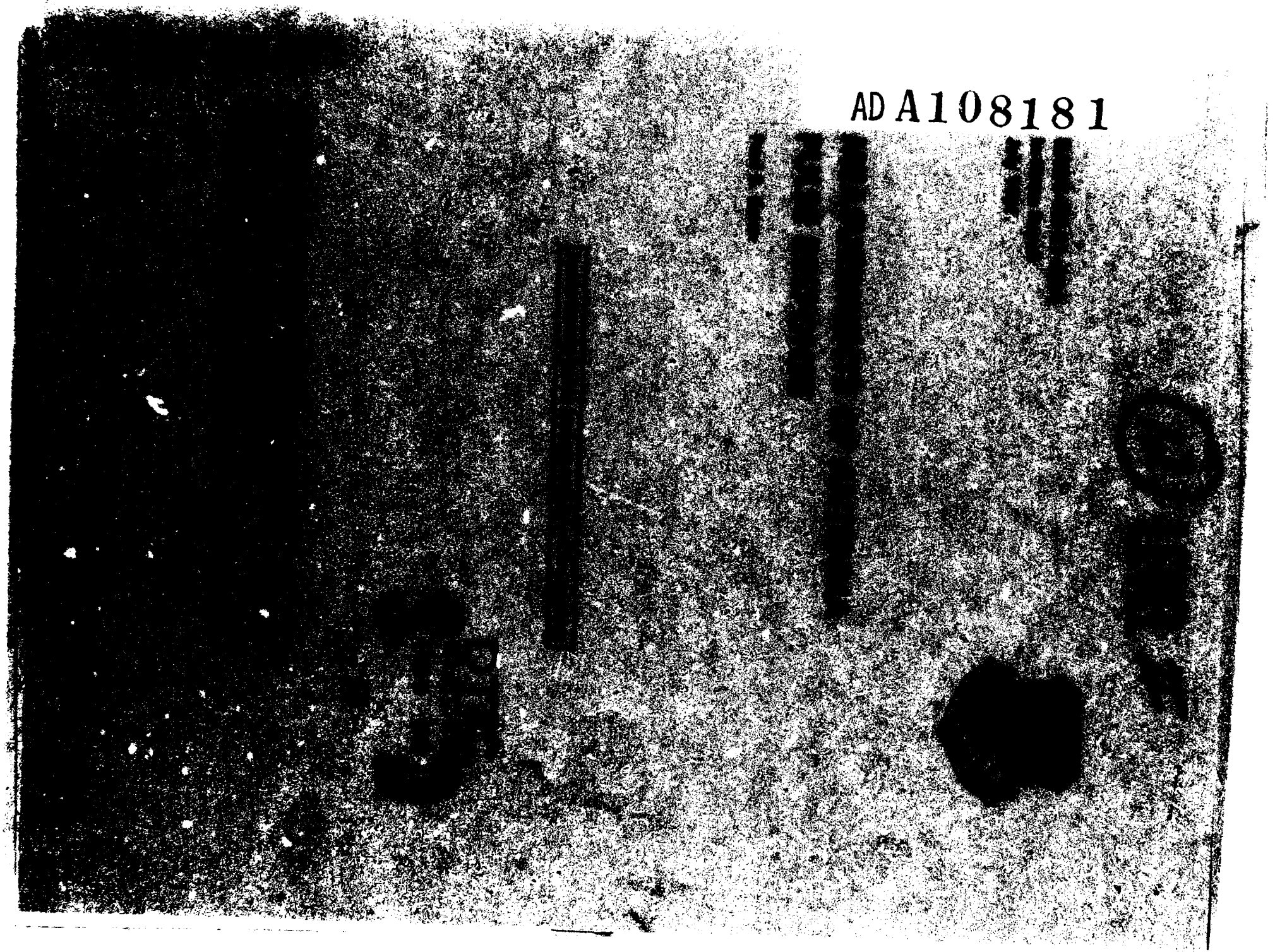
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Chief, Electromagnetic Systems Division

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

A technique for obtaining the pulse response of antennas utilizing steady-state measurements on a Scientific-Atlanta 2020 antenna range is described. The method involves making wideband frequency measurements, both amplitude and phase, centered about the defined carrier frequency and transforming the data to low frequency. This result is multiplied by the complex Fourier Transform of a pulse (the modulating pulse) utilizing Fast-Fourier-Transforms and the inverse FFT yields the desired pulse response. All computations are done on the 2020 System Computer (Hp 21 MX Series 1000).

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20. Abstract (Continued)

Techniques for eliminating the frequency response of system components are described. The technique essentially treats the antenna on a "transfer function" basis. Therefore, results are presented on the response of a transmission line system and this is compared with theory. Finally, results on the pulse response of various antennas are presented.

## Preface

The author wishes to express his appreciation to Dr. Robert Mailloux and Mr. John Strom for their suggestions, interest, and encouragement throughout the course of this work. The help of Mr. John Van Bobo with the experimental apparatus is also acknowledged.

## Contents



## Illustrations

## Illustrations

# Measurements of Antenna Pulse Response

## 1. INTRODUCTION

The objective of the work described in the paper is to obtain the pulse response of antennas. This is accomplished by measuring the steady-state response as a function of frequency, transforming to low frequency, multiplying this transfer function by the Fourier Transform of a pulse and obtaining the inverse transform of the result.

Figure 1 is a schematic representation of the measurement scheme. A Scientific-Atlanta 2020 Antenna Analyzer System is used to make the measurements. The data gathering as well as the analysis is done by the computer-controlled 2020 system. The system software was designed in accordance with Scientific-Atlanta Protocol and is divided into three sections: 1) A test file generator section that obtains information from the operator about the parameters (that is, position, carrier frequency, time resolution, etc.) for the measurement and analysis (Figure 2 is a typical listing of a test file), 2) A data acquisition section that acquires data and stores it in a data file on disk, and, 3) A data analysis section that retrieves the information from the data file, does the Fourier Analysis, and displays the results.

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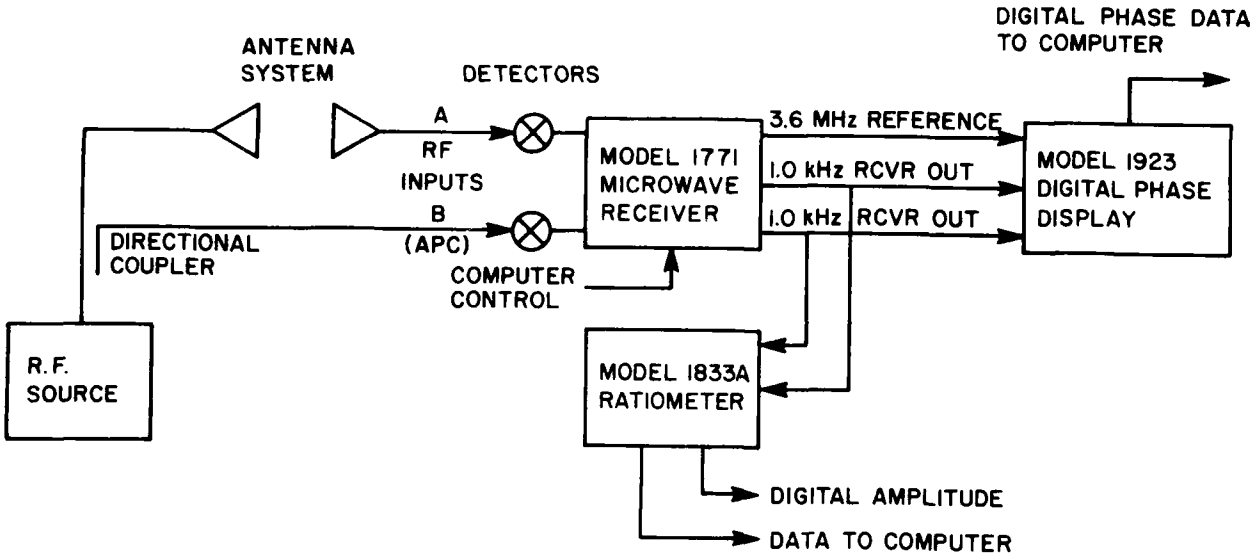



Figure 1. Schematic Representation of Measurement Technique

```
*PULSE RESPONSE      TEST FILE NR:10
    1. POSITION
       NO POSITION DATA
    2. FREQUENCY VALUES:
       CARRIER FREQ = 3000.00
       FREQ INC = 2.00
       NR FREQ = 512
       ACTUAL RESOLUTION TIME = .98 NANOSEC
       START FREQ = 2488.00
       END FREQ = 3510.00
    3. RECEIVER SETUP
          DUAL MODE
          CRYSTAL CURRENT IS PRESET
          WIDE SEARCH
    4. ANALYSIS
       ON LINE ANALYSIS WILL BE DONE
       FREQ DATA WILL NOT BE OUTPUT
       OUTPUT TO PRINTER
       SYSTEM VALUES WILL NOT BE SUBTRACTED
       NORMALIZE TO CARRIER
***END OF TEST FILE***
```

Figure 2. Typical Test File

## 2. FOURIER ANALYSIS

Consider an ideal pulse p(t) amplitude modulating a carrier at radian frequency $w_c$,

$$f(t) = p(t) \cos w_c t \ .$$

The Fourier transform is

$$F(w) = 1/2 \ \underline{P}(w + w_c) + 1/2 \ \underline{P}(w - w_c) \ ,$$

where $\underline{P}(w)$ is the Fourier transform of p(t). If this is input to any system where the transfer function is H(w), the resulting output is

$$G(w) = 1/2 \ H(w) \ [\underline{P}(w + w_c) + \underline{P}(w - w_c)] \ .$$

Hence, in the time domain

$$g(t) = 1/2 \int_{-\infty}^{\infty} H(w' - w_c)\, \underline{P}(w')\, e^{j(w' - w_c)t}\, dw'$$

$$+ 1/2 \int_{-\infty}^{\infty} H(w' + w_c)\, \underline{P}(w')\, e^{j(w' + w_c)t}\, dw' .$$

If we use the Hermetian properties

$$H(-w) = H^*(w)$$

$$\underline{P}(-w) = P^*(w) ,$$

we may write

$$g(t) = R_e \left[ e^{-jw_c t} \int_{\infty}^{\infty} H(w' - w_c)\, \underline{P}(w')\, e^{jw't}\, dw' \right] .$$

If we define

$$A(t) + jB(t) = \int_{-\infty}^{\infty} H(w' - w_c)\, \underline{P}(w')\, e^{jw't}\, dw' ,$$

then

$$g(t) = A(t) \cos w_c t + B(t) \sin w_c t$$

$$= C(t) \cos (w_c t + \Theta(t))$$

where,

$$C(t) = \sqrt{A^2(t) + B^2(t)} = \left| \int_{-\infty}^{\infty} H(w' - w_c)\, \underline{P}(w')\, e^{jw't}\, dw' \right|$$

and represents the desired pulse response. Based upon this analysis our procedure is:

1. Measure H(w)
2. Transform it to low frequency, that is, obtain $H(w' - w_c)$
3. Multiply by the transform of a pulse, that is, obtain $H(w' - w_c)\ \underline{P}(w')$
4. Take the inverse Fourier Transform and obtain its absolute value.

## 3. MEASUREMENTS ON A MICROWAVE SYSTEM

Figure 3 is a schematic of a microwave system used to test the pulse measurements and analysis technique. A $90^o$ hybrid is used to divide the signal into: $s_1$, a signal that travels through a small, variable and known time delay, $T_D$ and $s_2$, a signal that is time delayed by a 50 ft cable (time delay ≈ 70 nanosec). Also attenuated by the cable is $s_2$. The signals are recombined in a magic tee.

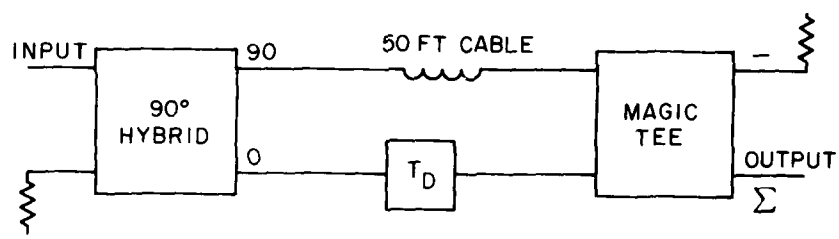



Figure 3. Schematic of Microwave System Used to Test Pulse Measurement System

Figure 4 shows a typical result using a carrier frequency of 3 GHz and using 512 frequency measurements. The onset of $s_1$ is clearly visible, followed (with a 70 nanosec delay) by a pulse whose height is the vector sum of $s_1$ and $s_2$. Finally, the trailing edge of $s_2$ alone is visible. In this case the time delay $T_D$ is set so that the two signals arrive at the magic tee in phase. Thus, the vector sum equals the scalar sum. The signal shown in Figure 4 varies considerably at times when smooth "flat top" pulses are expected. This is caused by the measurement system. Since the system uses detectors which are not ideal and transmission lines to carry the signals to and from the detectors the measurement includes the system response that we call s(w). Thus, the measured transfer function is

$$S(w)\ H(w)\ .$$

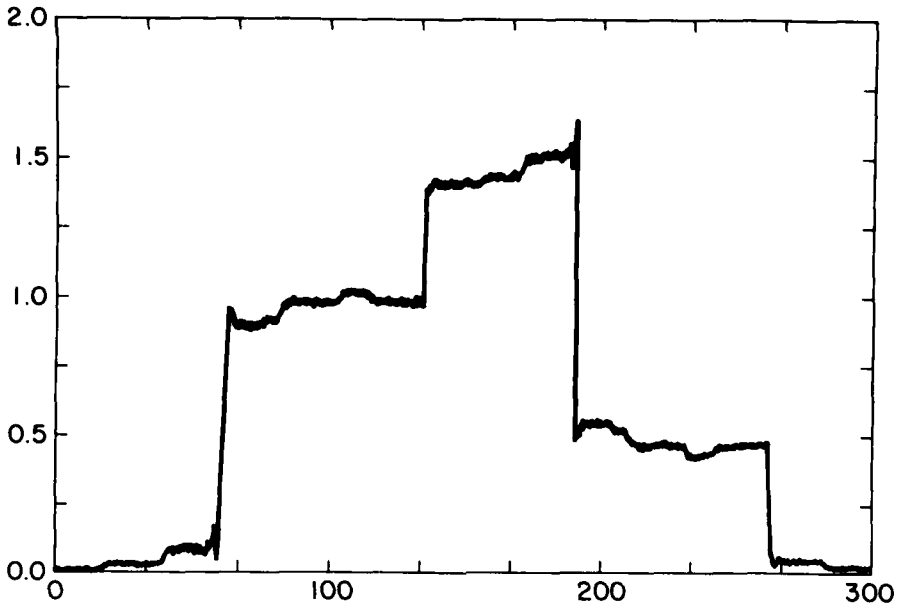



Figure 4. Pulse Response of Microwave System. Pulse width = 125 nanosec, carrier frequency = 3 GHz, $T_D = 0$

The system response S(w) was measured separately, stored in a data file, and used to divide out the system response. The result of using this procedure on the same measurement data that gave the result of Figure 4 is shown in Figure 5. The improvement is clear and the results are now as expected.

Figures 6 and 7 show results for values of $T_D$ which correspond to phase shifts of $60^o$ and $120^o$ respectively at the carrier frequency 3 GHz. The effects of the vector combination of the two pulses is clearly evident. Figure 8 shows a comparison of the expected and measured amplitude of the vector sum of the two pulses as a function of the time delay $T_D$. The agreement is excellent.

## 4. ANTENNA MEASUREMENTS

Measurements were also made to determine the pulse response of two narrow-band antennas:

1. A horn and narrow-band filter
2. A dipole and corner reflector.

Figure 9 shows the measured amplitude of the transfer function of the horn with narrow-band filter. It has a bandwidth of approximately 10 MHz and a center

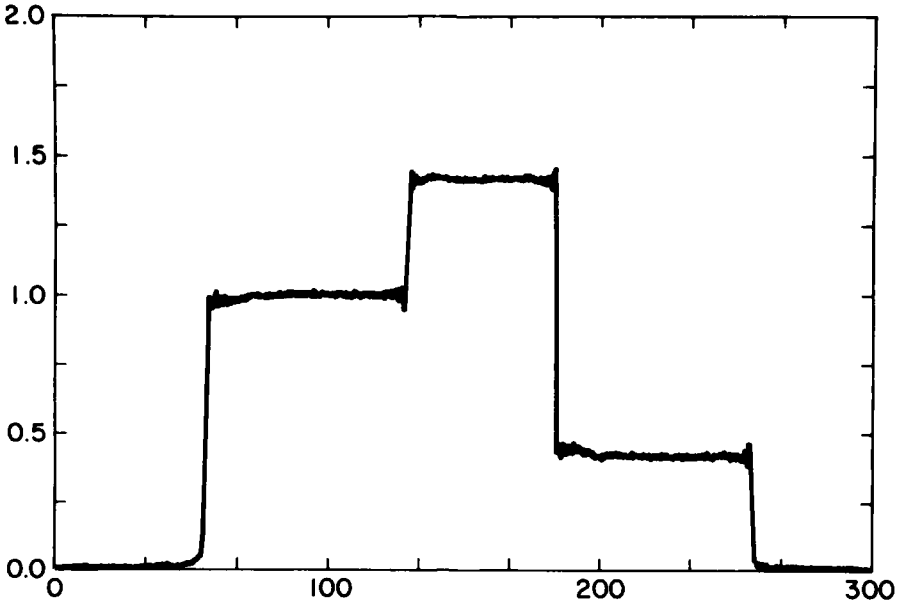



Figure 5. Pulse Response of Microwave System With the Elimination of Measurement System Error. Pulse width = 125 nanosec, carrier frequency = 3 GHz, $T_D = 0$

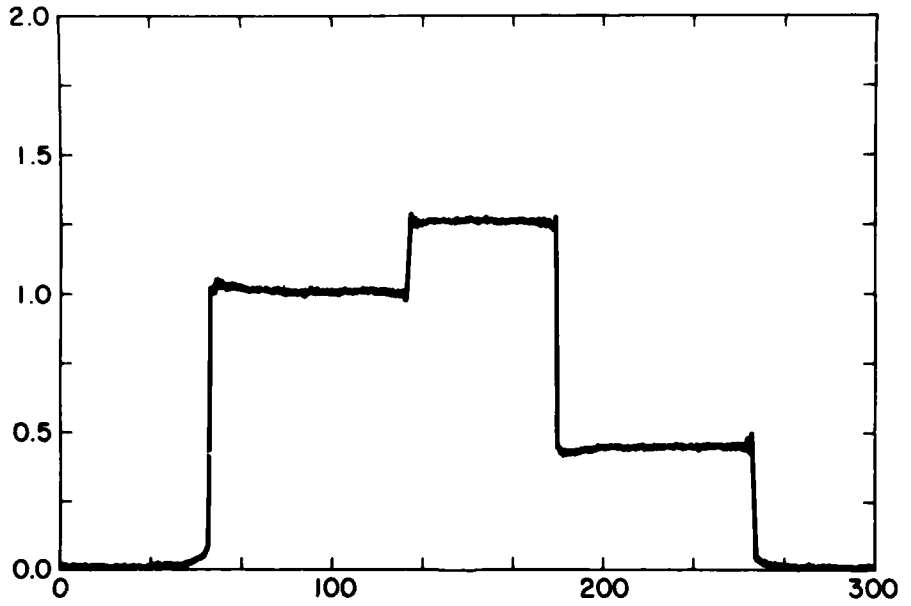



Figure 6. Pulse Response of Microwave System. $T_D = 1/18$ nanosec

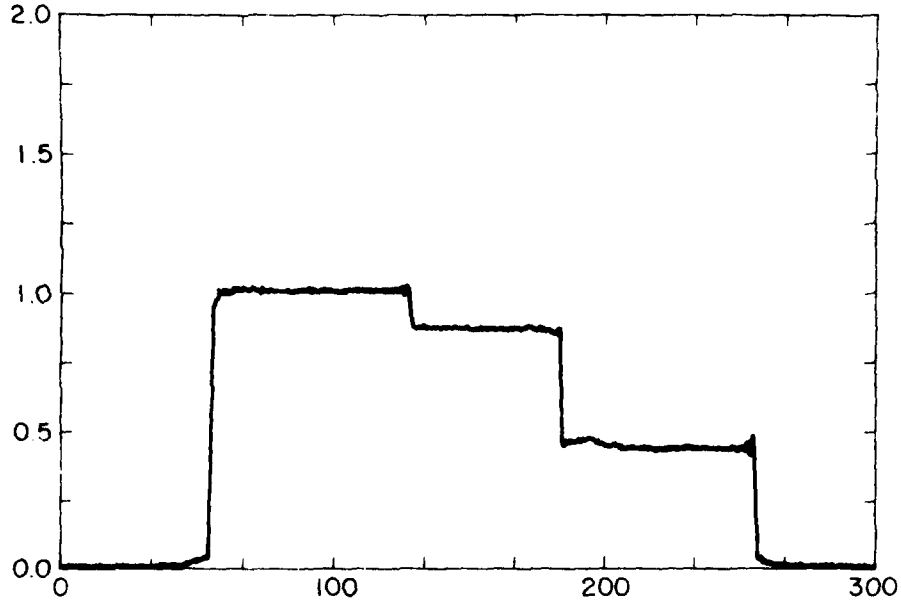



Figure 7. Pulse Response of Microwave System. $T_D$ = 1/9 nanosec

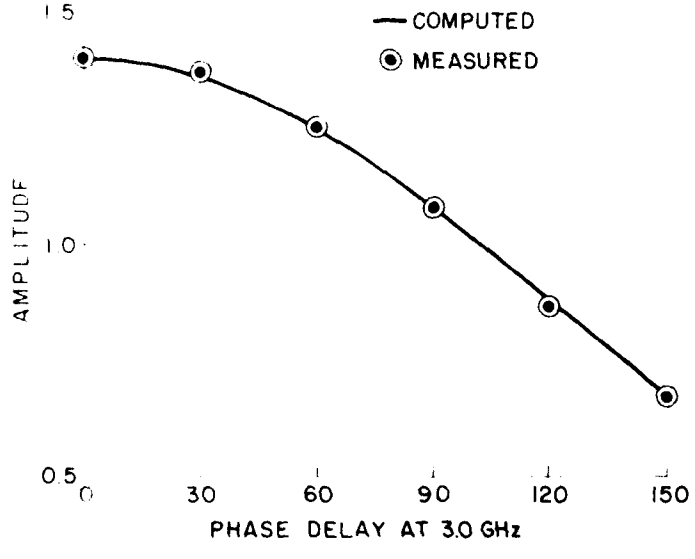



**Figure 8. Comparison of Computed and Measured Vector Sum of the Two Pulses Combined by the Magic Tree**

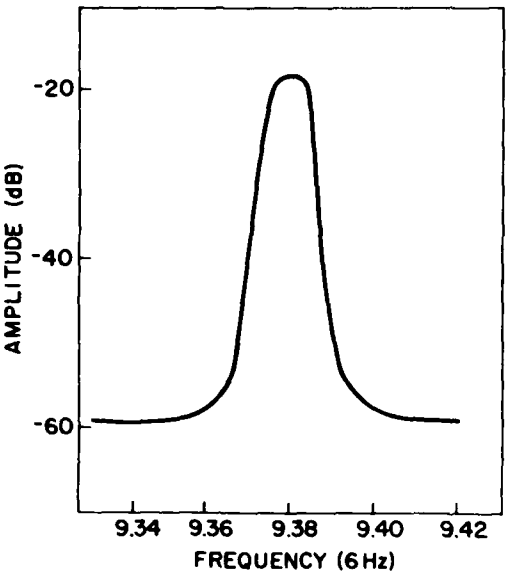



Figure 9. Transfer Function of Horn with Filter

frequency at 9.38 GHz. Figures 10 and 11 show the pulse response of this antenna for a carrier frequency of 9.38 GHz and for pulse widths of 125 and 250 nanosec respectively. The pulse rise time is seen to be approximately 100 nanosec, which is consistent with the bandwidth. Figures 12 through 19 show the pulse response for various values of carrier frequency. The display software is set up so that the pulse normalization and pulse width are variable. In the above cases both were held constant, the latter at 125 nanosec. Figure 20 is a result at a carrier frequency 9.386 GHz for a pulse width of 250 nanosec, but with an output normalization to give a better display of the pulse shape.

The measured transfer function of the dipole with corner reflector is shown in Figure 21. Figures 22 through 27 show the pulse response of this antenna for various carrier frequencies. The response for frequencies near the maximum in the frequency response curve show a rise time of about 10 nanosec and this is consistent with the bandwidth of this antenna.

Measurements were also made on a wideband antenna (a dipole-fed dish antenna) but these results are not presented for the following reasons:

1) At present the software only allows up to 512 data points and frequencies can only be set to a 1 MHz resolution. Both limit the resolution in time.

2) The measured response is actually the response of the transmitting and receiving antennas combined.

3) Difficulties were encountered in the technique for eliminating the measurement system response.

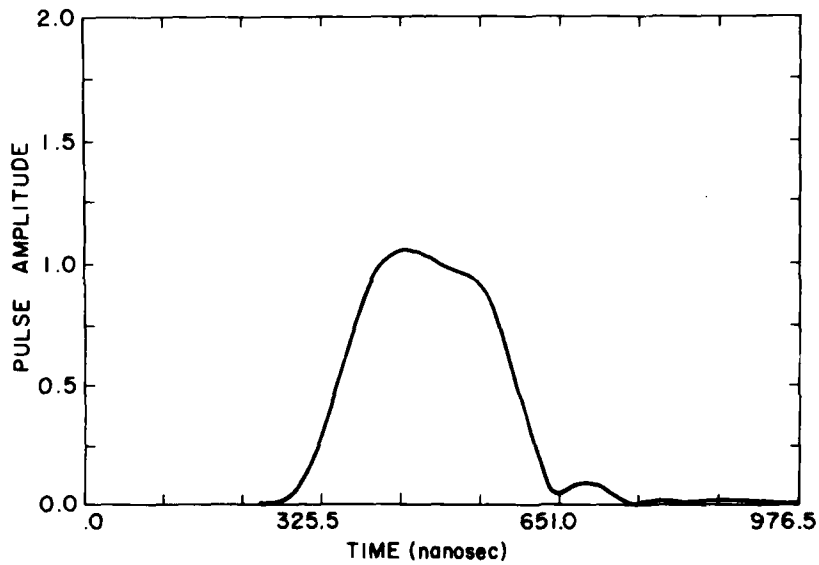



Figure 10. Pulse Response of Horn/Filter. Carrier frequency = 9.38 GHz, pulse width = 125 nanosec

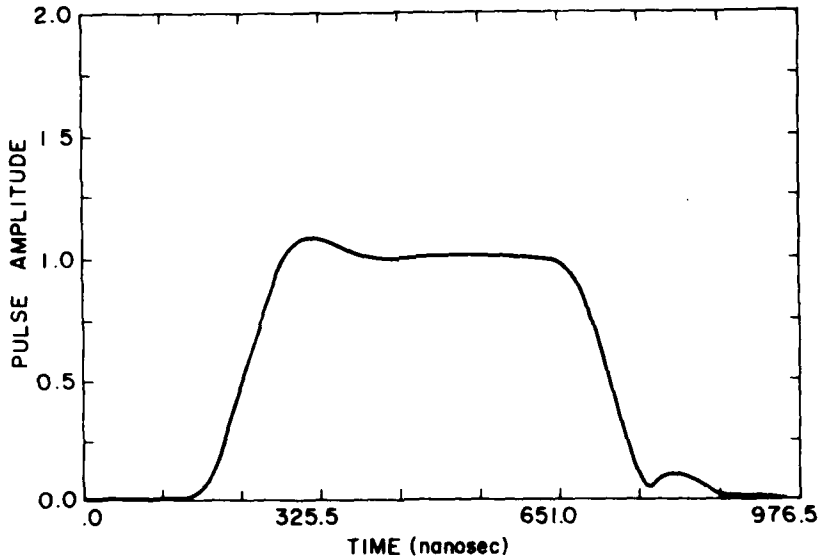



Figure 11. Pulse Response of Horn/Filter. Carrier frequency = 9.38 GHz, pulse width = 250 nanosec

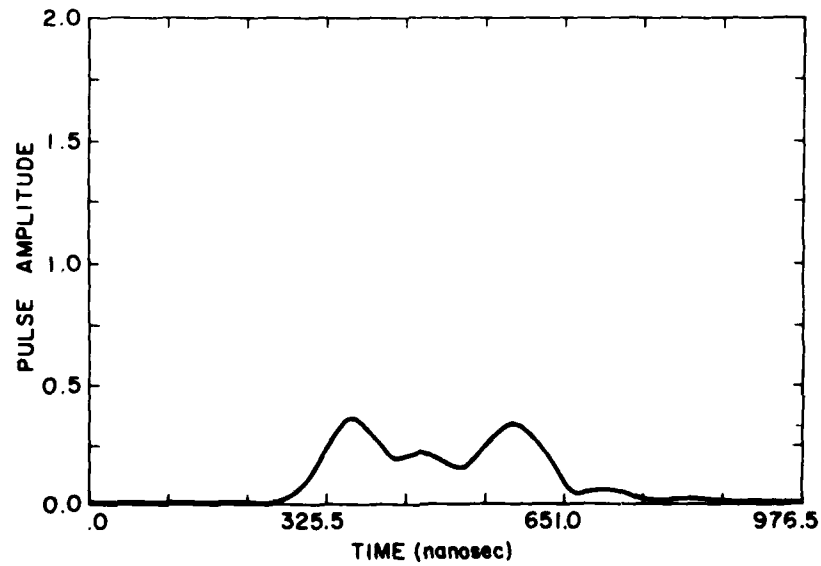



Figure 12. Pulse Response of Horn/Filter. Carrier frequency = 9.372 GHz, pulse width = 125 nanosec

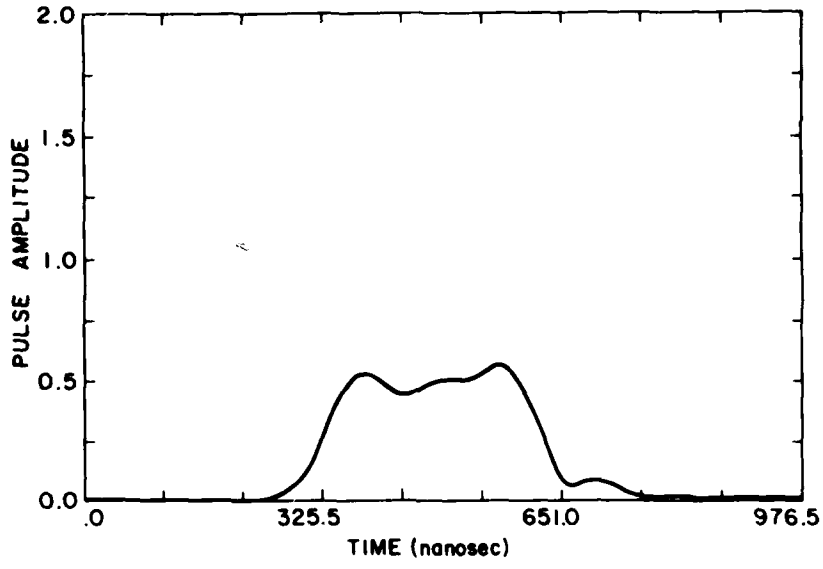



Figure 13. Pulse Response of Horn/Filter. Carrier frequency = 9.374 GHz, pulse width = 125 nanosec

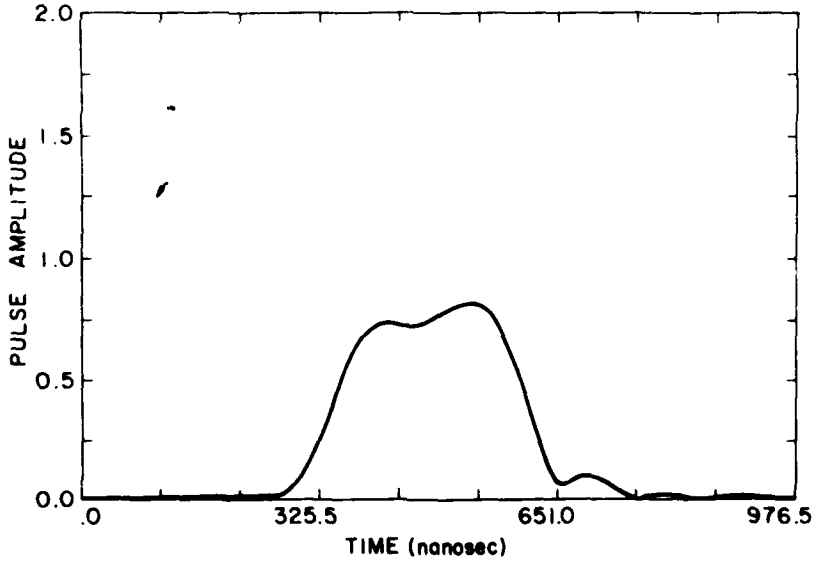



Figure 14. Pulse Response of Horn/Filter. Carrier frequency = 9.376 GHz, pulse width = 125 nanosec

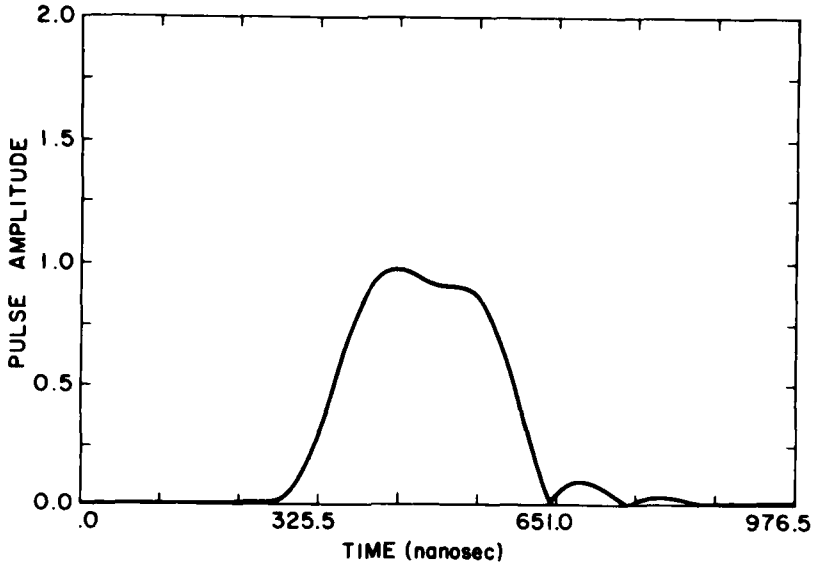



Figure 15. Pulse Response of Horn/Filter. Carrier frequency = 9.378 GHz, pulse width = 125 nanosec

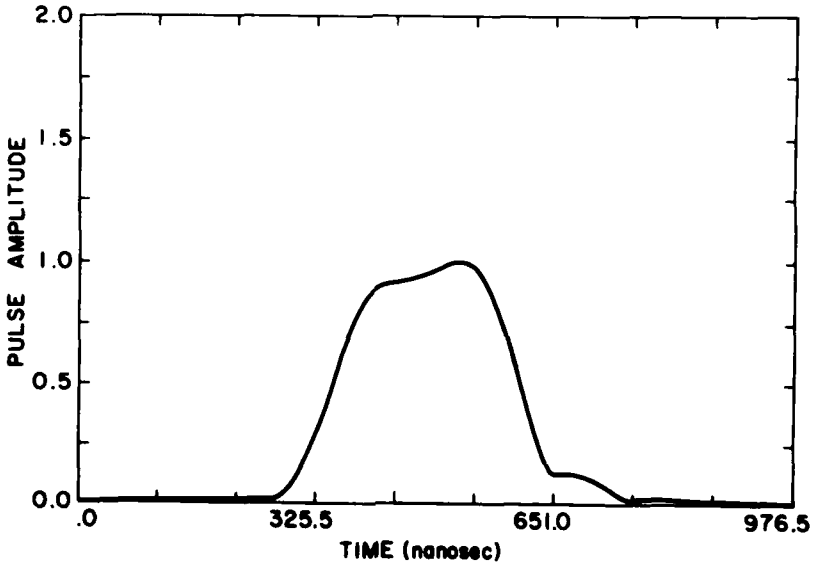



Figure 16. Pulse Response of Horn/Filter. Carrier frequency = 9.382 GHz, pulse width = 125 nanosec

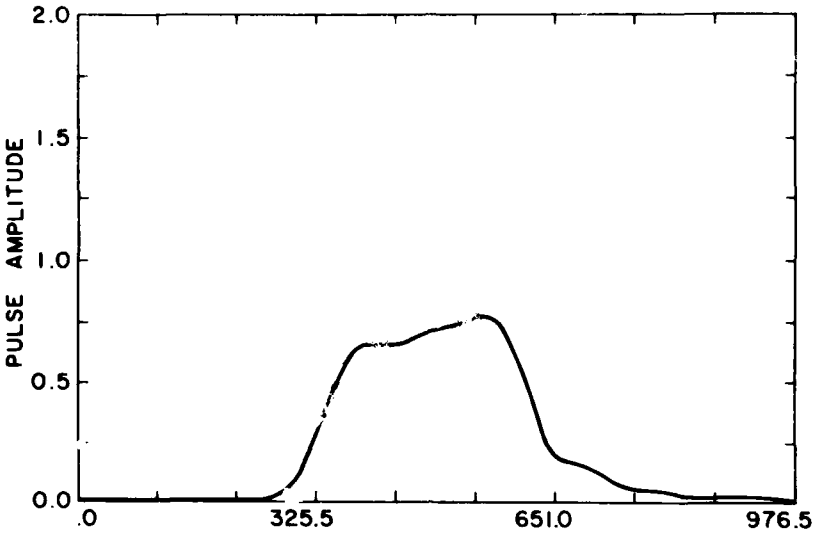



Figure 17. Pulse Response of Horn/Filter. Carrier frequency = 9.384 GHz, pulse width = 125 nanosec

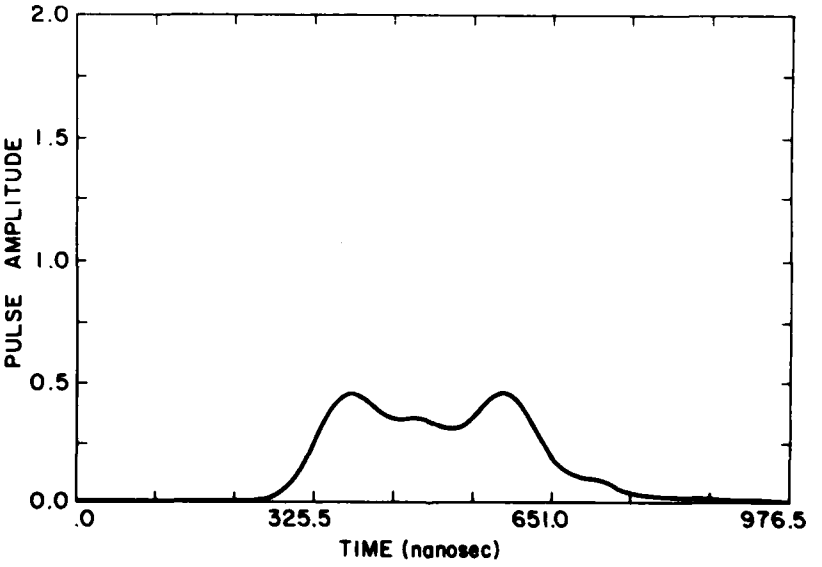



Figure 18. Pulse Response of Horn/Filter. Carrier frequency = 9.386 GHz, pulse width = 125 nanosec

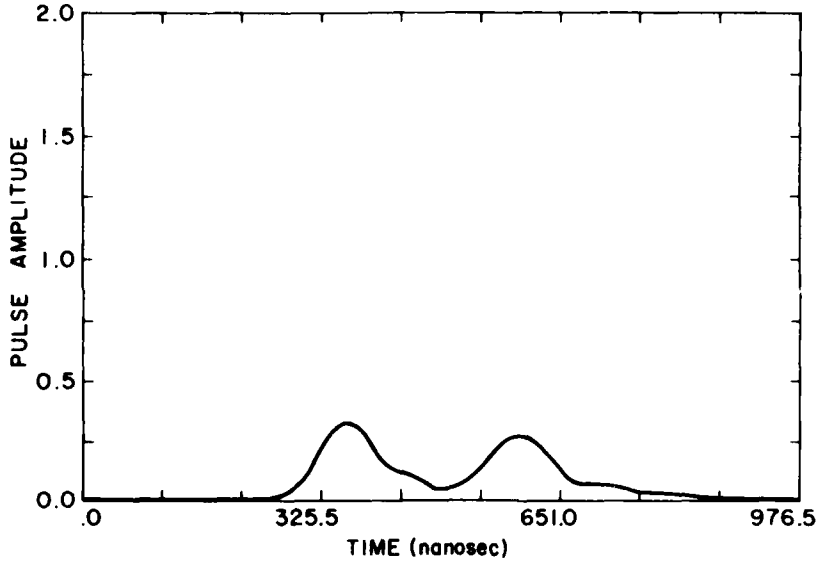



Figure 19. Pulse Response of Horn/Filter. Carrier frequency = 9.388 GHz, pulse width = 125 nanosec

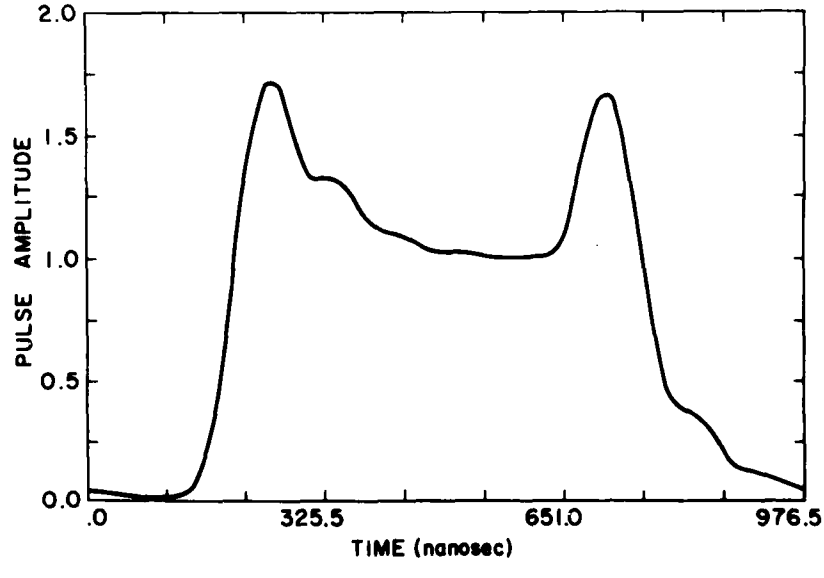



Figure 20. Pulse Response of Horn/Filter Showing Different Pulse Normalization

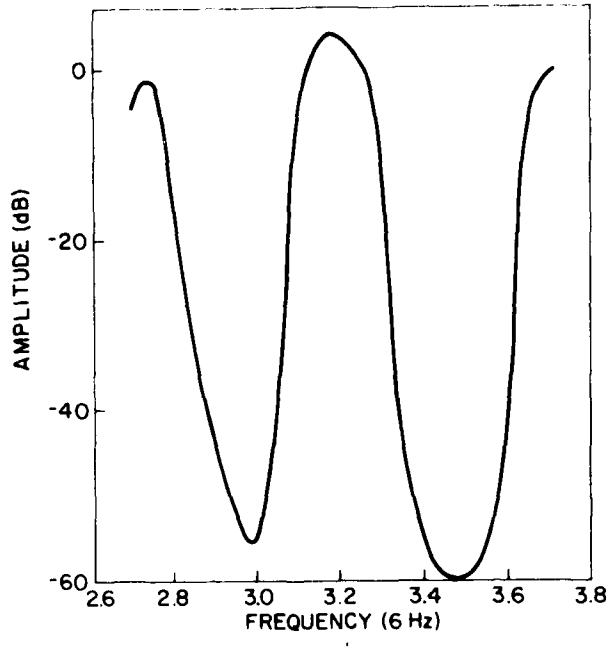



Figure 21. Transfer Function of Dipole with Corner Reflector

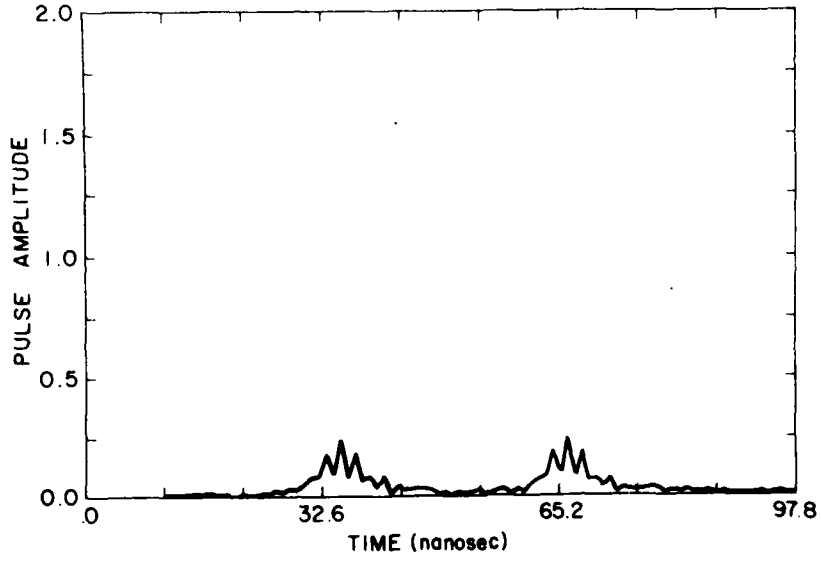



Figure 22. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.05 GHz

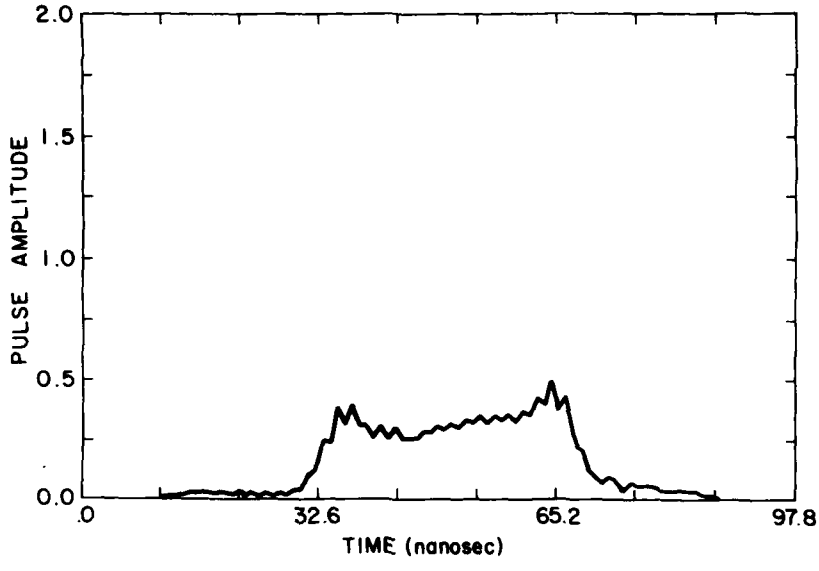



Figure 23. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.10 GHz

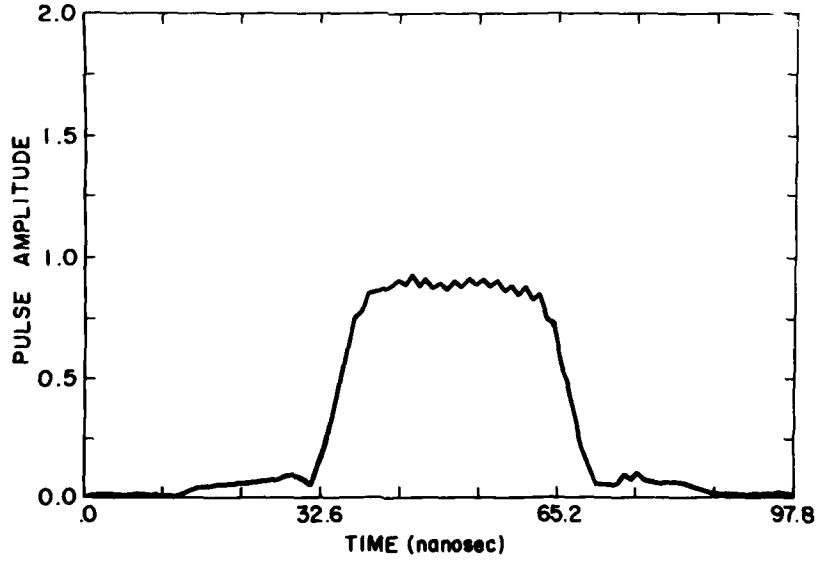



Figure 24. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.15 GHz

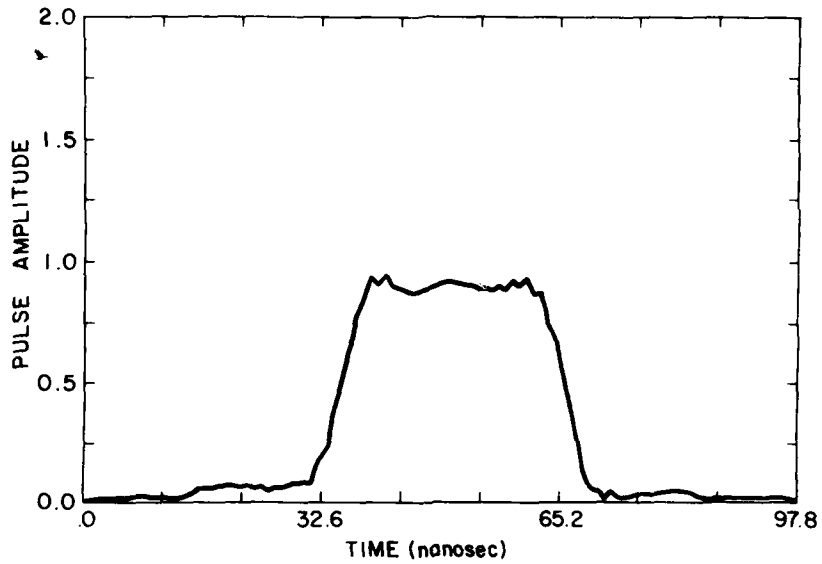



Figure 25. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.20 GHz

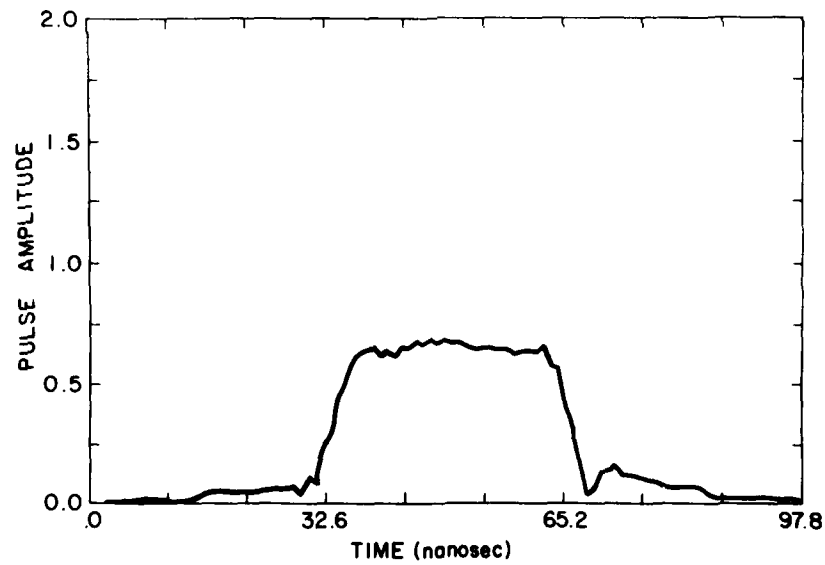



Figure 26. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.25 GHz

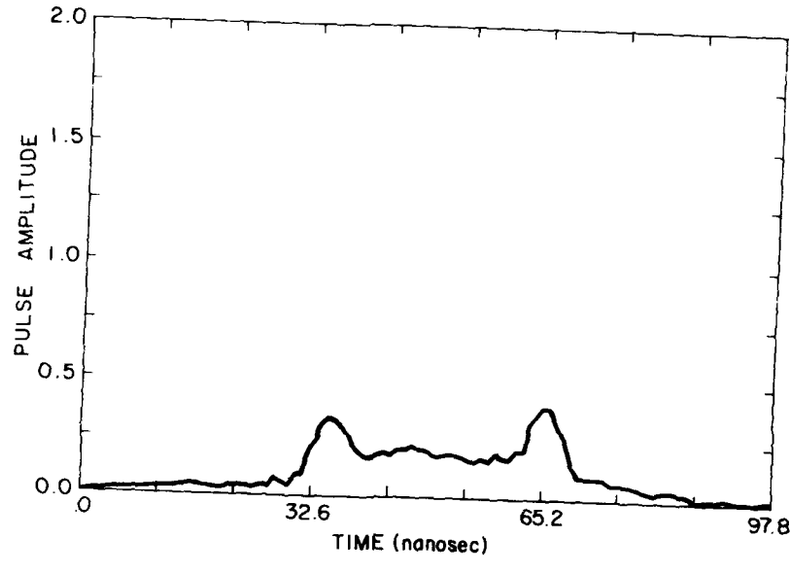



Figure 27. Pulse Response of Dipole With Corner Reflector. Carrier frequency = 3.30 GHz

# Appendix A

**Description of User Interface**

The system software is constructed to operate in accordance with Scientific-Atlanta protocol and is divided into three sections.

1. A test file generator section (File No. PUTG in Appendix B) which obtains parameters from the user (antenna position, carrier frequency, time resolution, etc.) to be used for measurement and analysis. Figure A1 shows a typical test file generation.

2. A Data Acquisition Section (File No. PUAQ in Appendix B) which acquires data and stores it in a data file on disk. This data file contains system parameters and the raw data – that is, amplitude and phase as a function of frequency.

3. A Data Analysis Section which retrieves the information from the data file, does the Fourier analysis, and displays the results. (Files No. PUAN, No. PUAN2, No. PUAN3, No. CFFT, No. CIFT and No. PUFT in Appendix B.) Due to limited memory, the Analysis Section is contained in two segments (second segment overlays the first in memory) with communication taking place via system common. If, in the Test File Generation Section, the user specifies on-line analysis then the Analysis Section is called in automatically. However, if no on-line analysis is specified, control passes back to the RTE Operating System after data acquisition. In this case analysis can still be done by running PUAN directly. Figure A2 shows a direct running of PUAN using Data File DF123 and Figure A3 shows the resulting output. Caution: In order to communicate large blocks of data between the segments of the analysis section it was necessary to write over system common used

```
TFM:WR,PUTG

 *PULSE RESPONSE      TEST FILE NR:
    1.  POSITION
        WANT TO INPUT POSITION VALUES?
YES
        TYPE AZIMUTH POSITION
0
        TYPE ELEVATION POSITION
30
        TYPE AUT PLZN POSITION
45
    2.  FREQUENCY VALUES:
        TYPE CARRIER FREQ
9500
        TYPE REQUIRED RESOLUTION TIME IN NANOSEC
5
        TYPE MIN & MAX FREQUENCIES
9000,10000
        ACTUAL RESOLUTION TIME = 1.95 NANOSEC
        CARRIER FREQ = 9500.00
        FREQ INC = 1.00
        NR FREQ = 512
        START FREQ = 9244.00
        END FREQ = 9755.00
    3.  RECEIVER SETUP
        RECEIVER IF MODE:
            A = A ONLY, B = B ONLY, D = DU;  S = SHARED:
D
        RECEIVER CRYSTAL CURRENT PRESET?:
YES


    WIDE (0) OR NARROW (1) SEARCH?
0
    4.  ANALYSIS
        ON LINE ANALYSIS?
YES
        WANT TO OUTPUT FREQ DATA?
NO
        RESULTS TO PRINTER?
YES
        TYPE PULSE WIDTH (EVEN NO. RES. TIMES)
64
        SUBTRACT SYSTEM VALUES?
NO
        TYPE 1, 2 OR 3 TO:
            1. TO NORMALIZE TO CARRIER FREQ
            2. TO NORMALIZE TO MAX AMPLITUDE
            3. FOR UNIT OUTPUT PULSE
2
            TYPE START & END TIMES TO VIEW (NO. RES. TIMES)
1,500
***END OF TEST FILE***

TFM:
```

**Figure A1. Typical Test File Generation**

```
RU,PUAN
     TYPE DATA FILE NAME
DF123
     TYPE LOGICAL UNIT NO. (1 = TE, 6 = PR):
6
     TYPE 1 TO LIST FREQ DATA, 0 TO NOT LIST
0
     POSITION DATA AVAILABLE IN FILE (1 = YES, 0 = NO)
0
     TYPE 1 TO SUBTRACT SYSTEM VALUES, 0 TO NOT SUBTRACT
0
     TYPE 1, 2 OR 3 TO--
       1. NORMALIZE TO CARRIER FREQ
       2. NORMALIZE TO MAX AMPLITUDE
       3. UNIT OUTPUT PULSE
3
     TYPE POSITION (NO. RES TIMES) TO NORMALIZE TO
256
     TYPE START & END VIEW TIMES (NO. RES TIMES)
1,500
     TYPE PULSE WIDTH (NO. RES TIMES)
64
```

Figure A2. Typical Direct Running of the Analysis Section

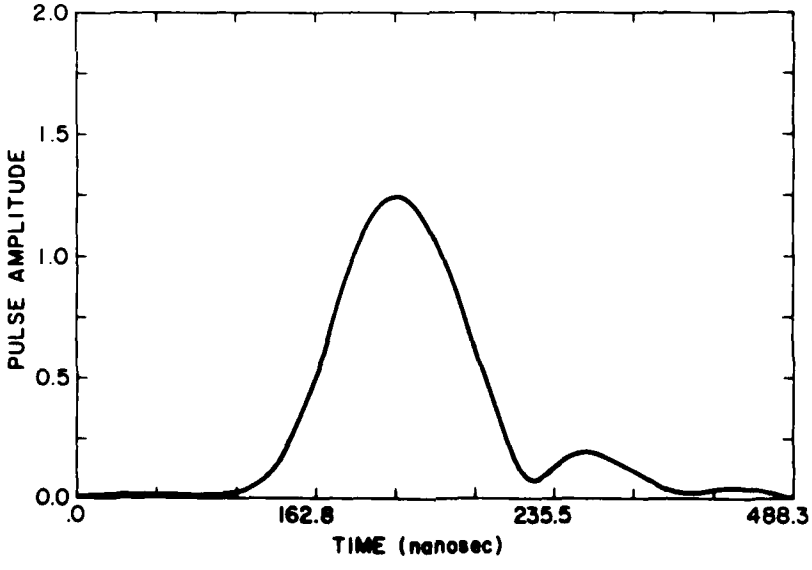



Figure A3. Output Resulting From Running the Analysis Section as Depicted in A2

by Scientific-Atlanta. At times this causes an error on the first call to PUAN; however, a second running of PUAN always gives correct analysis.

The command files shown at the end of Appendix B are used to conveniently integrate the software into the 2020 system. Once the Fourier programs have been compiled and the relocatable code stored in files % PUTG, % PUAQ, etc., the first three command files will load the pulse analysis system. The last two command files are used to back-up the system on magnetic tape.

# Appendix B

**Software Listings**

```
#PUTG  T=#####3 IS ON CR######2 USING ###21 BLKS R=####

###1  FTN4,L
###2        PROGRAM PUTG(5)
###3  C
###4  C    TEST FILE GENERATOR FOR ANTENNA PULSE RESPONSE
###5  C
###6         COMMON IVTEK(17#)
###7         COMMON IRTN(3),IFLG(1),LU(1),KFNR(1),IONLN(1),KDFPK(3),
###8        1KDFUP(3),KOMT(1),IPFAL(1),JPIA(1),IRCVR(1),KRCD(1),ICMPL(1),
###9        2IDUMA(6),JDISK(1),JBND(6),JBB(6),JBT(6),JITR(6),JTOL(6),
###1#       3JAZ(1),JEL(1),JAUT(1),JSRC(1),JAUX(1),JAUX2(1),JSAZ(6),
###11       4JXTAL(5),JDUM(27)
###12 C
###13        COMMON ITGN(3),IACQ(3),IRID(1),IUID(1),IIID(1),
###14       1I2ID(1),IAID(1),IEID(1),ITID(1),ISID(1),IUOF(1),IMODE(1),
###15       2IXTAL(1),IOND(1),ILIST(1),IPLOT(1),KRMAX(1),KUMAX(1),
###16       3K1MAX(1),K2MAX(1),KAMAX(1),KEMAX(1),NFRQ(1),
###17       4F(1#),NFR(1),IEBM(1),IDBP(1),IDUM(78)
###18 C
###19 C
###2#        DIMENSION NAMSY(3),KNAM(3),LNAM(3)
###21 C
###22        EQUIVALENCE (NAMSY(1),IDUM(3#))
###23 C
###24        DATA KNAM/2HPU,2HTG,2H  /
###25        DATA LNAM/2HPU,2HAQ,2H  /
###26        KKG=#
###27 C
###28 C    ENTRY-IFLAG COMES FROM TFM
###29 C      IFLG=1=LIST
###3# C      IFLG=2=EDIT
###31 C      IFLG=3=WRITE
###32 C
###33        IF(IFLG .NE. 3)GO TO 9#
###34 C    SET TEST AND DATA ACQUISITION FILES INTO SYSTEM COMMON
###35        DO 95 I=1,3
###36        ITGN(I)=KNAM(I)
###37  95    IACQ(I)=LNAM(I)
###38 C
###39  9#    KGO=#
###4# C    FOR FILE CREATION WRITE HEADING WITHOUT FILE NO.
###41  1##   IF(IFLG .EQ. 3)WRITE(1,1#1)
###42 C    FOR FILE EDIT OR LIST WRITE HEADING WITH FILE NO.
###43        IF(IFLG .EQ. 1 .OR. IFLG .EQ. 2)WRITE(1,1#1)KFNR
###44  1#1   FORMAT(1X,"*PULSE RESPONSE   TEST FILE NR:",I2)
###45 C    CODE FOR POSITION
###46        KNR=1
###47  99    WRITE(1,1#2)KNR
###48  1#2   FORMAT(1X,I3,".POSITION")
###49 C    IF LIST OR IF ENTRY INTO EDIT SIMPLY LIST
###5#        IF(IFLG .EQ. 1 .OR. (IFLG .EQ. 2 .AND. KGO .EQ. #))GO TO 12#
###51  11#   WRITE(1,1#22)
###52        CALL MOVES(JJDUM)
###53  1#22  FORMAT(5X,"WANT TO INPUT POSITION VALUES?")
###54        IDUM(15)=JJDUM
###55        IF(JJDUM .EQ. #)GO TO 1#53
###56        WRITE(1,1#5)
###57  1#5   FORMAT(5X,"TYPE AZIMUTH POSITION")
###58        READ(1,*)POSA
###59        KAMAX=POSA*1##.#
###6#        WRITE(1,1#5#)
###61  1#5#  FORMAT(5X,"TYPE ELEVATION POSITION")
###62        READ(1,*)POSE
```

```
0063        KEMAX=POSE*100.0
0064        WRITE(1,1051)
0065  1051  FORMAT(5X,"TYPE AUT PLZN POSITION")
0066        READ(1,*)POSP
0067        KUMAX=POSP*100.0
0068  1053  IF(KGO .NE. 0)GO TO 180
0069        GO TO 130
0070  120   IF(IDUM(15) .EQ. 0)GO TO 125
0071        POSA=KAMAX/100.0
0072        POSE=KEMAX/100.0
0073        POSP=KUMAX/100.0
0074        WRITE(1,103)POSA,POSE,POSP
0075  103   FORMAT(5X,"AZIMUTH=",F8.2/5X,"ELEVATION=",F8.2,
0076       1/5X,"AUT PLZN=",F8.2)
0077        GO TO 130
0078  125   WRITE(1,126)
0079  126   FORMAT(5X,"NO POSITION DATA")
0080  C    CODE FOR FREQUENCY VALUES
0081  130   KNR=KNR+1
0082  98    WRITE(1,104)KNR
0083  104   FORMAT(1X,I3,".FREQUENCY VALUES:")
0084        IF(IFLG .EQ. 1 .OR. (IFLG .EQ. 2 .AND. KGO .EQ. 0))GO TO 150
0085  140   WRITE(1,106)
0086  106   FORMAT(5X,"TYPE CARRIER FREQ")
0087        READ(1,*)FCC
0088        WRITE(1,1060)
0089  1060  FORMAT(5X,"TYPE REQUIRED RESOLUTION TIME IN NANOSEC")
0090        READ(1,*)RSEC
0091  1064  WRITE(1,1061)
0092  1061  FORMAT(5X,"TYPE MIN & MAX FREQUENCIES")
0093        READ(1,*)FMIN,FMAX
0094        NFRQ=1000./RSEC
0095        IDFRQ=1
0096        IRT=NFRQ
0097  1062  IF(IRT .LE. 512)GO TO 1063
0098        IDFRQ=IDFRQ+1
0099        IRT=NFRQ/IDFRQ
0100        GO TO 1062
0101  1063  NFRQ=IRT
0102        FDEL=FMAX-FCC
0103        IF(FCC-FMIN .LT. FDEL)FDEL=FCC-FMIN
0104        IFDEL=FDEL
0105        ICO=0
0106        ISIZ=NFRQ
0107  1069  ISIZ=ISIZ/2
0108        ICO=ICO+1
0109        IF(ISIZ .NE. 1)GO TO 1069
0110        NDF2=2**(ICO-1)
0111        IF(NDF2*IDFRQ .LT. IFDEL)GO TO 1066
0112        WRITE(1,1065)
0113  1065  FORMAT(1X,"RESOLUTION TIME TOO SMALL FOR ALLOWED FREQ RANGE")
0114        GO TO 140
0115  1066  NFRQ=2*NDF2
0116  1067  IF(NFRQ*IDFRQ .GT. IFDEL)GO TO 1068
0117        IF(NFRQ .GT. 256)GO TO 1052
0118        NFRQ=2*NFRQ
0119        GO TO 1067
0120  1052  IDFRQ=IDFRQ+1
0121        GO TO 1067
0122  1068  CONTINUE
0123        F(1)=FCC-IDFRQ*NFRQ/2
0124        F(2)=FCC+IDFRQ*(NFRQ/2-1)
0125        F(3)=IDFRQ
0126        RSEC=1000./F(3)/NFRQ
```

```
#127          WRITE(1,119)RSEC
#128   119    FORMAT(5X,"ACTUAL RESOLUTION TIME=",F7.2," NANOSEC")
#129          F(4)=RSEC
#130          F(5)=FCC
#131          F(6)=FMIN
#132          F(7)=FMAX
#133          KKG=1
#134          GO TO 15#
#135   1181   IF(KGO .NE. #)GO TO 18#
#136          GO TO 16#
#137   15#    NFRQ=(F(2)-F(1))/F(3)+1.5
#138          WRITE(1,1#7)F(5),F(3),NFRQ
#139   1#7    FORMAT(5X,"CARRIER FREQ=",F8.2/5X,"FREQ INC=",F8.2/5X,
#140         1"NR FREQ=",I5)
#141          FCC=F(5)
#142          WRITE(1,1#71)F(1),F(2)
#143   1#71   FORMAT(5X,"START FREQ=",F7.2/5X,"END FREQ=",F7.2)
#144          IF(KKG .EQ. 1)GO TO 1181
#145          KKF=#
#146   C    CODE FOR RECEIVER SETUP
#147   16#    KNR=KNR+1
#148          WRITE(1,162)KNR
#149   162    FORMAT(1X,I3,".RECEIVER SETUP")
#15#          IF(IFLG .EQ. 1 .OR. (IFLG .EQ. 2 .AND. KGO .EQ. #))GO TO 165
#151   166    WRITE(1,163)
#152   163    FORMAT(5X,"RECEIVER IF MODE."/
#153         17X,"A=A ONLY,B=B ONLY,D=DUAL,S=SHARED:")
#154          READ(1,164)IMODE
#155   164    FORMAT(R1)
#156          IF(IMODE .NE. 1#1B .AND. IMODE .NE. 1#2B .AND. IMODE .NE.
#157         11#4B .AND. IMODE .NE. 123B)166,167
#158   167    WRITE(1,168)
#159   168    FORMAT(5X,"RECEIVER CRYSTAL CURRENT PRESET?:")
#16#          CALL MOVES(IXTAL)
#161          WRITE(1,168#)
#162   168#   FORMAT(5X,"WIDE(#) OR NARROW(1) SEARCH?")
#163          READ(1,*)JXTAL(4)
#164          IF(KGO .NE. #)GO TO 18#
#165          GO TO 19#
#166   165    IF(IMODE .EQ. 1#1B)WRITE(1,1651)
#167          IF(IMODE .EQ. 1#2B)WRITE(1,1652)
#168          IF(IMODE .EQ. 1#4B)WRITE(1,1653)
#169          IF(IMODE .EQ. 123B)WRITE(1,1654)
#17#   1651   FORMAT(8X,"A-ONLY")
#171   1652   FORMAT(8X,"B-ONLY")
#172   1653   FORMAT(8X,"DUAL MODE")
#173   1654   FORMAT(8X,"SHARED MODE")
#174          IF(IXTAL .EQ. 1)WRITE(1,1655)
#175          IF(IXTAL .EQ. #)WRITE(1,1656)
#176   1655   FORMAT(8X,"CRYSTAL CURRENT IS PRESET")
#177   1656   FORMAT(8X,"CRYSTAL CURRENT NO PRESET")
#178          IF(JXTAL(4) .EQ. #)WRITE(1,1657)
#179          IF(JXTAL(4) .NE. #)WRITE(1,1658)
#18#   1657   FORMAT(8X,"WIDE SEARCH")
#181   1658   FORMAT(8X,"NARROW SEARCH")
#182   C    CODE FOR ANALYSIS SECTION
#183   19#    KNR=KNR+1
#184          WRITE(1,191)KNR
#185   191    FORMAT(1X,I3,".ANALYSIS")
#186          IF(IFLG .EQ. 1 .OR. (IFLG .EQ. 2 .AND. KGO .EQ. #))GO TO 195
#187   193    WRITE(1,194)
#188   194    FORMAT(5X,"ON LINE ANALYSIS?")
#189          CALL MOVES(IOND)
#19#          IANAL=IOND
```

```
#191          WRITE(1,1741)
#192    1741  FORMAT(5X,"WANT TO OUTPUT FREQ DATA?")
#193          CALL MOVES(JJDUM)
#194          IDUM(20)=JJDUM
#195          WRITE(1,1742)
#196    1742  FORMAT(5X,"RESULTS TO PRINTER?")
#197          CALL MOVES(JJDUM)
#198          IDUM(21)=JJDUM
#199          WRITE(1,1747)
#200    1747  FORMAT(5X,"TYPE PULSE WIDTH(EVEN # RES. TIMES)")
#201          READ(1,*)IPW
#202          IDUM(25)=IPW
#203          WRITE(1,1743)
#204    1743  FORMAT(5X,"SUBTRACT SYSTEM VALUES?")
#205          CALL MOVES(JJDUM)
#206          IDUM(23)=JJDUM
#207          IF(JJDUM .EQ. 0)GO TO 198
#208          WRITE(1,1745)
#209    1745  FORMAT(5X,"TYPE SYSTEM DATA FILE NAME")
#210          READ(1,1746)NAMSY
#211    1746  FORMAT(3A2)
#212    198   WRITE(1,1744)
#213    1744  FORMAT(5X,"TYPE 1,2 OR 3 TO:"/6X,"1.TO NORMALIZE TO CARRIER FREQ'
#214         16X,"2.TO NORMALIZE TO MAX AMPLITUDE"/6X,"3.FOR UNIT OUTPUT PULSE'
#215          READ(1,*)IDUM(24)
#216          IF(IDUM(24) .NE. 3)GO TO 1951
#217          WRITE(1,1952)
#218    1952  FORMAT(8X,"TYPE POSITION(# RES TIMES)TO NORMALIZE TO")
#219          READ(1,*)IDUM(26)
#220    1951  WRITE(1,1953)
#221    1953  FORMAT(8X,"TYPE START & END TIMES TO VIEW(# RES TIMES)")
#222          READ(1,*)IDUM(27),IDUM(28)
#223          GO TO 180
#224    195   IF(IOND .EQ. 0)WRITE(1,196)
#225          IF(IOND .NE. 0)WRITE(1,197)
#226    196   FORMAT(5X,"NO ON LINE ANALYSIS")
#227    197   FORMAT(5X,"ON LINE ANALYSIS WILL BE DONE")
#228          IF(IDUM(20) .EQ. 1)WRITE(1,1971)
#229          IF(IDUM(20) .EQ. 0)WRITE(1,1972)
#230    1971  FORMAT(5X,"FREQ DATA WILL BE OUTPUT")
#231    1972  FORMAT(5X,"FREQ DATA WILL NOT BE OUTPUT")
#232          IF(IDUM(21) .EQ. 1)WRITE(1,1973)
#233          IF(IDUM(21) .EQ. 0)WRITE(1,1974)
#234    1973  FORMAT(5X,"OUTPUT TO PRINTER")
#235    1974  FORMAT(5X,"OUTPUT TO TERMINAL")
#236          PUWD=IDUM(25)*RSEC
#237          WRITE(1,1872)PUWD
#238    1872  FORMAT(5X,"PULSE WIDTH=",F8.2," NANOSEC")
#239          IF(IDUM(23) .EQ. 1)WRITE(1,1975)
#240          IF(IDUM(23) .EQ. 0)WRITE(1,1976)
#241    1975  FORMAT(5X,"SYSTEM VALUES WILL BE SUBTRACTED")
#242    1976  FORMAT(5X,"SYSTEM VALUES WILL NOT BE SUBTRACTED")
#243          IF(IDUM(24) .EQ. 1)WRITE(1,1977)
#244          IF(IDUM(24) .EQ. 2)WRITE(1,1978)
#245          IF(IDUM(24) .EQ. 3)WRITE(1,1979)
#246    1977  FORMAT(5X,"NORMALIZE TO CARRIER")
#247    1978  FORMAT(5X,"NORMALIZE TO MAX AMPLITUDE")
#248    1979  FORMAT(5X,"UNIT OUTPUT PULSE")
#249          IF(IDUM(24) .NE. 3)GO TO 1881
#250          TNOR=RSEC*IDUM(26)
#251          WRITE(1,1882)TNOR
#252    1882  FORMAT(8X,"NORMALIZE TO OUTPUT AT",F8.2," NANOSEC")
#253    1881  STIM=RSEC*IDUM(27)
#254          ETIM=RSEC*IDUM(28)
```

```
#255          WRITE(1,18#3)STIM,ETIM
#256   18#3   FORMAT(8X,"VIEW START TIME=",F8.2,"NANOSEC"/
#257         18X,"VIEW END TIME=",F8.2," NANOSEC")
#258          GO TO 18#
#259   18#    WRITE(1,1##)
#26#   1##    FORMAT(1X,"***END OF TEST FILE***")
#261          GO TO(25#,17#,25#)IFLG
#262   17#    WRITE(1,1#9)
#263   1#9    FORMAT(1X,"TYPE LINE NO. TO EDIT (-1 TO END)")
#264          READ(1,*)ICC
#265          KGO=1
#266          ICC=ICC+1
#267          GO TO(25#,11#,14#,166,193,25#)ICC
#268   C    RETURN TO TFM
#269   25#    CALL EXEC(8,IRTN)
#27#          CALL MAIN
#271          END
#272          END$
```

```
0063  C
0064  C   BEGIN FREQ
0065  C
0066        MDFM(33)=2HBF
0067        MDFM(35)=32
0068  C
0069  C   END FREQ
0070  C
0071        MDFM(39)=2HEF
0072        MDFM(41)=32
0073  C
0074  C   STEP FREQ
0075  C
0076        MDFM(45)=2HSF
0077        MDFM(47)=32
0078  C
0079  C   DATA POINT MARKER
0080  C
0081        MDFM(49)=NFRQ
0082        MDFM(51)=2HDP
0083        MDFM(52)=0
0084  C
0085  C   FREQ
0086  C
0087        MDFM(54)=-2
0088        MDFM(56)=2HFR
0089        MDFM(58)=16
0090  C
0091  C   AMPLITUDE
0092  C
0093        MDFM(60)=-1
0094        MDFM(62)=2HAA
0095        MDFM(63)=3
0096        MDFM(64)=-14
0097  C
0098  C   PHASE
0099  C
0100        MDFM(68)=-1
0101        MDFM(70)=2HPA
0102        MDFM(71)=3
0103        MDFM(72)=-13
0104  C
0105  C   SET DISK
0106  C
0107        JDISK=1
0108  C
0109  C   TEMP SET FOR NO BMAX
0110  C
0111        MDFM(14)=0
0112  C
0113  C   SET TF FILE
0114  C
0115        ITGN(1)=2HPU
0116        ITGN(2)=2HTG
0117        ITGN(3)=2H
0118        ITGN(4)=2HPU
0119        ITGN(5)=2HAQ
0120        ITGN(6)=2H
0121  C
0122  C   OPEN FILE & TRANSFER FORMATS
0123  C
0124  10    CALL DFPK(1,1,1,LERR)
0125  C
0126  C   TRANSFER TF
```

```
#PUAQ  T=#####3 IS ON CR#####2 USING ###21 BLKS R=####

###1  FTN4,L
###2        PROGRAM PUAQ(5)
###3        COMMON IVTEK(17#)
###4        COMMON IRTN(3),IFLG(1),LU(1),KFNR(1),IONLN(1),KDFPK(3),
###5       1KDFUP(3),KOMT(1),IPFAL(1),JPIA(1),IRCVR(1),KRCD(1),ICMPL(1),
###6       2IDUMA(6),JDISK(1),JBND(6),JBB(6),JBT(6),JITR(6),JTOL(6),
###7       3JAZ(1),JEL(1),JAUT(1),JSRC(1),JAUX(1),JAUX2(1),JSAZ(6),
###8       4JXTAL(5),JDUM(27)
###9        COMMON ITGN(3),IACQ(3),IRID(1),IUID(1),IIID(1),
###1#      1I2ID(1),IAID(1),IEID(1),ITID(1),ISID(1),IUOF(1),IMODE(1),
##11       2IXTAL(1),IOND(1),ILIST(1),IPLOT(1),KRMAX(1),KUMAX(1),
##12       3K1MAX(1),K2MAX(1),KAMAX(1),KEMAX(1),NFRQ(1),
##13       4F(1#),NFR(1),IEBM(1),IDBP(1),IDUM(78)
##14        COMMON IEEE(128),MIAM(8),MDFM(12#)
##15        DIMENSION KDNAM(3),KTFM(3),KANAM(3)
##16        DIMENSION FF(3),ICC(128),IDAT(8),KKNAM(5),POS(3)
##17        EQUIVALENCE (IA,IDAT(3)),(IMA,IDAT(4)),(ISA,IDAT(5))
##18        EQUIVALENCE (IP,IDAT(6)),(IPR,IDAT(7)),(ILS,IDAT(8))
##19        DATA KKNAM/2HCO,2HMM,2HT  ,2HTF,#/
##2#        DATA KDNAM/2HDF,2HM  ,2H   /
##21        DATA KTFM/2HTF,2HM  ,2H   /
##22        DATA KANAM/2HPU,2HAN,2H   /
##23  C
##24  C    INITIALIZE FORMATS
##25  C
##26        DO 1 I=1,8
##27  1     MIAM(I)=#
##28        DO 2 I=1,12#
##29  2     MDFM(I)=#
##3#        DO 3 I=1,74
##31  3     MDFM(I)=1
##32  C
##33  C    TEST FILE
##34  C
##35        MDFM(2)=-128
##36        MDFM(4)=2HTF
##37        MDFM(6)=4#####B-15
##38  C
##39  C    COMMENTS
##4#  C
##41        MDFM(8)=-128
##42        MDFM(1#)=2HCO
##43        MDFM(12)=16
##44        IF(KOMT .EQ. #)MDFM(8)=#
##45  C
##46  C    BEAM MAX
##47  C
##48        MDFM(14)=-128
##49        MDFM(16)=2HBM
##5#        MDFM(18)=4#####B-15
##51  C
##52  C    POSITION MARKER
##53  C
##54        MDFM(22)=2HPM
##55        MDFM(23)=#
##56  C
##57  C    POSITION
##58  C
##59        MDFM(25)=-3
##6#        MDFM(27)=2HPO
##61        MDFM(29)=32
##62        IF(IDUM(15) .EQ. #)MDFM(25)=#
```

```
0127  C
0128        CALL DFPK(2,ITGN,128,LERR)
0129  C
0130  C   TRANSFER COMMENTS
0131  C
0132        IF(KOMT .EQ. 0)GO TO 45
0133        CALL DFPK(3,KKNAM,128,LERR)
0134  45    IF(IDUM(15) .EQ. 0)GO TO 46
0135  C
0136  C   TRANSFER POSITION
0137  C
0138        POS(1)=KAMAX/100.0
0139        POS(2)=KEMAX/100.0
0140        POS(3)=KUMAX/100.0
0141        DO 452 I=1,3
0142        ANG=POS(I)
0143        IAX=I
0144        CALL PSN(IAX,ANG,ISTAT)
0145        IF(ISTAT .NE. 0)WRITE(1,451)
0146        CALL SYN0(ANGM,IAST)
0147        CALL SYN1
0148        IF(IAST .NE. 0)WRITE(1,451)
0149        POS(I)=ANGM
0150  452   CONTINUE
0151  451   FORMAT(1X,"POSITION ERROR")
0152        CALL DFPK(2,POS,6,LERR)
0153  C
0154  C   TRANSFER BEG,END,STEP FREQ
0155  C
0156  46    DO 47 I=1,3
0157  47    FF(I)=F(I)
0158        CALL DFPK(2,FF,6,LERR)
0159  C   SET VARIABLES FOR LOWEST ATTENUATION
0160        IFA=0
0161        IFB=0
0162  C
0163  C   SET UP & TRANSFER FREQ,AMP,PHASE DATA
0164  C
0165  C   SET UP RECEIVER
0166  C   CHOOSE REMOTE TUNING
0167        ILR=1
0168  C   ENABLE APC SEARCH
0169        IAPC=1
0170  C   USE WIDE OR NARROW SEARCH DEPENDING ON JXTA(4)
0171  C   DISABLE REFERENCE CHECK
0172        IREF=0
0173  C   CHOOSE MODE
0174        IFF=-1
0175        IF(IMODE .EQ. 10)IFF=1
0176        IF(IMODE .EQ. 20)IFF=2
0177        IF(IMODE .EQ. 40)IFF=3
0178        IF(IMODE .EQ. 123)IFF=0
0179        CALL RMODE(ILR,IAPC,JXTAL(4),IXTAL,IREF,IFF)
0180  C   SET RECEIVER TO AUTO
0181        CALL RMAN(1)
0182        FZ=FF(1)
0183        CALL FREQ(0,FZ,FCNTR,ISTAT)
0184  C   SET DATA TO 1
0185        DO 11 I=1,8
0186  11    IDAT(I)=1
0187  C   INITIALIZE RATIOMETER
0188        CALL RAT0(IA,IMA,ISA,IB,IMB,ISB,ISTA)
0189  C   INITIALIZE PHASE DISPLAY
0190        CALL PHA0(IP,IPR,ILS,ISTP)
```

```
0191  C   DO MEASUREMENTS FOR EACH FREQUENCY
0192        PCTOL=F(4)
0193        DO 12 I=1,NFRQ
0194        FZ=FF(1)+(I-1)*FF(3)
0195  C   SET FREQUENCY AND MEASURE IT
0196        ITRY=0
0197  50    CALL FREQ(0,FZ,FCNTR,ISTAT)
0198        IFZ=FZ
0199        IFCN=FCNTR+.5
0200        IF(IFZ .EQ. IFCN)GO TO 53
0201        ITRY=ITRY+1
0202        IF(ITRY .LT. 100)GO TO 50
0203  53    CONTINUE
0204  C   RECORD MEASURED VALUE
0205        IDAT(1)=FCNTR
0206        IDAT(2)=32767*(FCNTR-IDAT(1))
0207  C   SET ATTENUATION
0208        CALL RATN(IFA,IFB)
0209        CALL DLAY(100)
0210  C   CHECK RECEIVER STATUS
0211        CALL RSTAT(ILOK,IORNG)
0212        IJU=ILOK+1
0213        GO TO(100,200)IJU
0214  100   WRITE(1,15)
0215  15    FORMAT(1X,"NO PHASE LOCK")
0216  200   CONTINUE
0217  C   TRIGGER RATIOMETER
0218  290   CALL RAT1
0219  C   GET DATA
0220        ITRY=0
0221  C   CHECK STATUS OF RATIOMETER
0222  300   CALL RAT2
0223        IF(ISTA .EQ. 0)GO TO 550
0224        IF(ITRY .EQ. 101)GO TO 540
0225        CALL DLAY(10)
0226        ITRY=ITRY+1
0227        GO TO 300
0228  540   WRITE(1,5000)
0229  5000  FORMAT(1X,"RATIO TIMEOUT")
0230        GO TO 1000
0231  C   DB VALUES MUST BE NEGATIVE
0232  550   IF(IB .GE. 0)IFB=IFB+1
0233        IF(IA .GE. 0)IFA=IFA+1
0234        IF(IA .LT. 0 .AND. IB .LT. 0)GO TO 580
0235        IF(IFA .EQ. 7 .OR. IFB .EQ. 7)GO TO 590
0236        CALL RATN(IFA,IFB)
0237        CALL DLAY(100)
0238        GO TO 290
0239  590   WRITE(1,5500)
0240  5500  FORMAT(1X,"AMPLITUDE TOO HIGH")
0241        GO TO 1000
0242  580   CONTINUE
0243        IATE=IA
0244        IBTE=IB
0245        IA=IA+50*IFA
0246        IB=IB+50*IFB
0247        IF(IATE .LT. -300)IFA=0
0248        IF(IBTE .LT. -300)IFB=0
0249  C   TRIGGER PHASE DISPLAY
0250        CALL PHA1
0251  C   GET DATA
0252        ITRY=0
0253  C   CHECK STATUS OF PHASE METER
0254  450   CALL PHA2
```

```
#255          IF(ISTP .EQ. #)GO TO 48#
#256          IF(ITRY .GE. 1#1)GO TO 47#
#257          CALL DLAY(1#)
#258          ITRY=ITRY+1
#259          GO TO 45#
#260  47#     WRITE(1,45##)
#261  45##    FORMAT(1X,"PHASE TIMEOUT")
#262          GO TO 1###
#263  48#     CONTINUE
#264  C     TRANSFER DATA
#265           CALL DFPK(2,IDAT,8,LERR)
#266  12      CONTINUE
#267  C     CLOSE DATA FILE
#268           CALL DFPK(8,1,1,LERR)
#269           ICMPL=1
#270           IF(IOND .NE. #)4##,5##
#271  1###    WRITE(1,1##1)
#272  1##1    FORMAT(1X,"DATA FILE ABORTED")
#273           CALL DFPK(7,IDUMY,IDUMY,LERR)
#274           WRITE(1,1##2)
#275  1##2    FORMAT(1X,"TRY AGAIN?")
#276           CALL NOYES(ITRY)
#277           IF(ITRY .NE. #)GO TO 1#
#278  5##     CALL EXEC(8,KTFM)
#279           CALL MAIN
#280  4##     KDFUP(1)=KDFPK(1)
#281           KDFUP(2)=KDFPK(2)
#282           KDFUP(3)=KDFPK(3)
#283           M=#
#284  1##5    ICODE=1#####B+9
#285           CALL EXEC(ICODE,KANAM)
#286           M=1
#287           IF(M .EQ. 1)GO TO 4#5
#288           GO TO 5##
#289  4#5     WRITE(1,4#1)
#290  4#1     FORMAT(1X,"ERROR IN SCHEDULING ANALYSIS PROGRAM",
#291         1/2X,"TRY AGAIN?")
#292           CALL NOYES(ITRY)
#293           IF(ITRY .NE. #)GO TO 1##5
#294           GO TO 5##
#295           END
#296           END$
```

```
@PUAN  T=@@@@3 IS ON CR@@@@2 USING @@@21 BLKS R=@@@@

@@@1  FTN4,L
@@@2        PROGRAM PUAN(3)
@@@3        COMMON IVTEK(17@)
@@@4        COMMON IRTN(3),IFLG(1),LU(1),KFNR(1),IONLN(1),KDFPK(3),
@@@5       1KDFUP(3),KOMT(1),IPFAL(1),JPIA(1),IRCVR(1),KRCD(1),ICMPL(1),
@@@6       2IDUMA(6),JDISK(1),JBND(6),JBB(6),JBT(6),JITR(6),JTOL(6),
@@@7       3JAZ(1),JEL(1),JAUT(1),JSRC(1),JAUX(1),JAUXZ(1),JSAZ(6),
@@@8       4JXTAL(5),JDUM(27)
@@@9        COMMON ITGN(3),IACQ(3),IRID(1),IUID(1),IIID(1),
@@1@       1I2ID(1),IAID(1),IEID(1),ITID(1),ISID(1),IUOF(1),IMODE(1),
@@11       2IXTAL(1),IOND(1),ILIST(1),IPLOT(1),KRMAX(1),KUMAX(1),
@@12       3K1MAX(1),K2MAX(1),KAMAX(1),KEMAX(1),NFRQ(1),
@@13       4F(1@),NFR(1),IEBM(1),IDBP(1),IDUM(78)
@@14        COMMON IEEE(128),MIAM(8),MDFM(12@)
@@15        DIMENSION DB(512),DEG(512)
@@16        DIMENSION ICC(128),FFA(3),IDAT(8),POS(3)
@@17        DIMENSION KANAM(3)
@@18        COMPLEX X(512)
@@19        EQUIVALENCE (ICC(1),MIAM(1))
@@2@        DATA KANAM/2HPU,2HAN,2H1 /
@@21        PI=3.1415926
@@22        JSKIP=@
@@23        IF(IOND .NE. @)4,3
@@24  C   OBTAIN DATA FILE NAME
@@25  3     WRITE(1,6@)
@@26  6@    FORMAT(1X,"TYPE DATA FILE NAME")
@@27        READ(1,7@)KDFUP
@@28  7@    FORMAT(3A2)
@@29  C   OUTPUT TO TERMINAL OR PRINTER?
@@3@        WRITE(1,5)
@@31  5     FORMAT(1X,"TYPE LOGICAL UNIT NO.(1=TE,6=PR):")
@@32        READ(1,*)LUA
@@33        IDUM(22)=LUA
@@34        WRITE(1,71)
@@35  71    FORMAT(1X,"TYPE 1 TO LIST FREQ DATA,@ TO NOT LIST")
@@36        READ(1,*)JD2@
@@37        WRITE(1,72)
@@38  72    FORMAT(1X,"POSITION DATA AVAILABLE IN FILE(1=YES,@=NO)")
@@39        READ(1,*)JD15
@@4@        WRITE(1,73)
@@41  73    FORMAT(1X,"TYPE 1 TO SUBTRACT SYSTEM VALUES,@ TO NOT SUBTRACT")
@@42        READ(1,*)JD23
@@43        IF(JD23 .EQ. @)GO TO 75
@@44        WRITE(1,76)
@@45  76    FORMAT(1X,"TYPE SYSTEM DATA FILE NAME")
@@46        READ(1,77)IDUM(3@),IDUM(31),IDUM(32)
@@47  77    FORMAT(3A2)
@@48  75    WRITE(1,74)
@@49  74    FORMAT(1X,"TYPE 1,2 OR 3 TO-"/3X,"1.NORMALIZE TO CARRIER FREQ"/
@@5@       13X,"2.NORMALIZE TO MAX AMPLITUDE"/3X,"3.UNIT OUTPUT PULSE")
@@51        READ(1,*)JD24
@@52        IDUM(24)=JD24
@@53        IF(JD24 .NE. 3)GO TO 78
@@54        WRITE(1,79)
@@55  79    FORMAT(1X,"TYPE POSITION(# RES TIMES)TO NORMALIZE TO")
@@56        READ(1,*)IDUM(26)
@@57  78    WRITE(1,791)
@@58  791   FORMAT(1X,"TYPE START & END VIEW TIMES(# RES TIMES)")
@@59        READ(1,*)IDUM(27),IDUM(28)
@@6@        WRITE(1,792)
@@61  792   FORMAT(1X,"TYPE PULSE WIDTH(# RES TIMES)")
@@62        READ(1,*)IDUM(25)
```

```
0063          GO TO 6
0064    4     IOND=0
0065          JD15=IDUM(15)
0066          JD20=IDUM(20)
0067          JD23=IDUM(23)
0068          JD24=IDUM(24)
0069          LUA=1
0070          IF(IDUM(21) .EQ. 1)LUA=6
0071          IDUM(22)=LUA
0072    6     CONTINUE
0073    C   OPEN FILE & GET FORMATS
0074          CALL DFUP(1,LERR)
0075          KERR=1
0076          IF(LERR .NE. 0)GO TO 101
0077    C   READ & OUTPUT TEST FILE
0078          CALL DFUP(4,LERR,ICC,128)
0079          WRITE(LUA,10)ICC
0080    10    FORMAT(1X,32A2)
0081          KERR=2
0082          IF(LERR .NE. 0)GO TO 101
0083    C   READ & OUTPUT COMMENTS
0084          IF(KOMT .EQ. 0)GO TO 35
0085          CALL DFUP(4,LERR,ICC,128)
0086          WRITE(LUA,10)ICC
0087          KERR=3
0088          IF(LERR .NE. 0)GO TO 101
0089    35    IF(JD15 .EQ. 0)GO TO 25
0090    C   READ & OUTPUT POSITION
0091          CALL DFUP(4,LERR,POS,6)
0092          WRITE(LUA,20)POS
0093    20    FORMAT(10X,F8.2)
0094          KERR=4
0095          IF(LERR .NE. 0)GO TO 101
0096    C   READ START,END & FREQ INC & OUTPUT
0097    25    CALL DFUP(4,LERR,FFA,6)
0098          WRITE(LUA,20)FFA
0099          KERR=5
0100          IF(LERR .NE. 0)GO TO 101
0101          NFRQ=(FFA(2)-FFA(1))/FFA(3)+1.5
0102          N=NFRQ
0103          NCO=0
0104    100   M=N
0105          N=N/2
0106          NCO=NCO+1
0107          IF(N*2 .NE. M)GO TO 105
0108          IF(N .NE. 1)GO TO 100
0109          IF(JSKIP .EQ. 1)GO TO 202
0110    C   FOR EACH FREQ READ & OUTPUT:
0111    C     (1)FREQ > IDAT(1),IDAT(2)
0112    C     (2)AMP  > IDAT(3-5)
0113    C     (3)PHASE> IDAT(6-8)
0114          IF(JD20 .EQ. 1)WRITE(LUA,45)
0115    45    FORMAT(10X,"FREQ",14X,"AMP(DB)",10X,"DEG")
0116    202   DBMAX=-100
0117          DO 12 I=1,NFRQ
0118          CALL DFUP(4,LERR,IDAT,9)
0119          AMULT=1.0
0120          IF(IDAT(4) .EQ. 1)AMULT=.1
0121          IF(IDAT(4) .EQ. 0)AMULT=.01
0122          IF(AMULT .EQ. 1.0)GO TO 101
0123          DBSYS=IDAT(3)*AMULT
0124          DGSYS=0.1*IDAT(6)
0125          IF(JSKIP .EQ. 1)GO TO 61
0126          DB(I)=DBSYS
```

```
#127          DEG(I)=DGSYS
#128          GO TO 62
#129    61    DB(I)=DB(I)-DBSYS
#130          DEG(I)=DEG(I)-DGSYS
#131    62    IF(DB(I) .GT. DBMAX)DBMAX=DB(I)
#132          FCC=IDAT(1)+IDAT(2)/32767.0
#133          IF(JD20 .EQ. 1)WRITE(LUA,40)FCC,DB(I),DEG(I)
#134    40    FORMAT(3(10X,F8.2))
#135    12    CONTINUE
#136          KERR=6
#137          IF(LERR .NE. 0)GO TO 101
#138          CALL DFUP(6,LERR)
#139          IF(JD23 .NE. 1)GO TO 230
#140          IF(JSKIP .EQ. 1)GO TO 230
#141          DO 201 I=1,3
#142    201   KDFUP(I)=IDUM(29+I)
#143          JSKIP=1
#144          GO TO 6
#145    230   CONTINUE
#146          NFRQ2=NFRQ/2
#147          IF(JD24 .EQ. 1)DBMAX=DB(NFRQ2+1)
#148          DO 14 I=1,NFRQ
#149          DB(I)=DB(I)-DBMAX
#150    14    CONTINUE
#151          DEG1=DEG(NFRQ2+1)
#152          DO 15 I=1,NFRQ
#153          DEG(I)=DEG(I)-DEG1
#154    21    IF(DEG(I) .LE. -180.)DEG(I)=DEG(I)+360.
#155          IF(DEG(I) .GT. 180.)DEG(I)=DEG(I)-360.
#156          IF(DEG(I) .LE. -180. .OR. DEG(I) .GT. 180.)GO TO 21
#157    15    CONTINUE
#158          IWP=IDUM(25)
#159          CALL PUFT(X,NCO,IWP)
#160          DO 19 I=1,NFRQ
#161          RAD=DEG(I)*PI/180.
#162          AMP=10.0**(DB(I)/20.0)
#163          IF(I.LE.NFRQ2)X(I+NFRQ2)=AMP*CMPLX(COS(RAD),-SIN(RAD))*X(I+NFRQ2)
#164          IF(I.GT.NFRQ2)X(I-NFRQ2)=AMP*CMPLX(COS(RAD),-SIN(RAD))*X(I-NFRQ2)
#165    19    CONTINUE
#166          GO TO 107
#167    105   WRITE(1,102)
#168    102   FORMAT(1X,"NO. OF FREQ NOT A POWER OF TWO")
#169          GO TO 99
#170    101   WRITE(1,30)KERR,LERR
#171    30    FORMAT(1X,"ERROR IN DFUP # ",I2,"  LERR=",I5)
#172    99    CALL DFUP(6,LERR)
#173    108   CALL EXEC(6)
#174    107   IDUM(1)=ICO
#175          IDUM(2)=NCO
#176          IDUM(3)=LUA
#177          F(3)=FFA(3)
#178          CALL PUAN2(X)
#179          GO TO 108
#180          END
#181          END$
```

```
@PUAN2 T=@@@@3 IS ON CR@@@@2 USING @@@@@ BLKS R=@@@@

@@@1   FTN4,L
@@@2         SUBROUTINE PUAN2(X)
@@@3         COMMON IVTEK(17@)
@@@4         COMMON IRTN(3),IFLG(1),LU(1),KFNR(1),IONLN(1),KDFPK(3),
@@@5        1KDFUP(3),KOMT(1),IPFAL(1),JPIA(1),IRCVR(1),KRCD(1),ICMPL(1),
@@@6        2IDUMA(6),JDISK(1),JBND(6),JBB(6),JBT(6),JITR(6),JTOL'6),
@@@7        3JAZ(1),JEL(1),JAUT(1),JSRC(1),JAUX(1),JAUX2(1),JSAZ(6),
@@@8        4JXTAL(5),JDUM(27)
@@@9   C
@@1@         COMMON ITGN(3),IACQ(3),IRID(1),IUID(1),IIID(1),
@@11        1I2ID(1),IAID(1),IEID(1),ITID(1),ISID(1),IUOF(1),IMODE(1),
@@12        2IXTAL(1),IOND(1),ILIST(1),IPLOT(1),KRMAX(1),KUMAX(1),
@@13        3K1MAX(1),K2MAX(1),KAMAX(1),KEMAX(1),NFRQ(1),
@@14        4F(1@),NFR(1),IEBM(1),IDBP(1),IDUM(78)
@@15         COMMON IEEE(128),MIAM(8),MDFM(12@)
@@16         DIMENSION IDAT(512),KANAM(3)
@@17         COMPLEX X(512)
@@18         EQUIVALENCE (RSEC,JDUM(25))
@@19         EQUIVALENCE (ITGN(1),IDAT(1))
@@2@         DATA KANAM/2HPU,2HAN,2H3 /
@@21         RSEC=1@@@./(NFRQ-1)/F(3)
@@22         JDUM(27)=IDUM(28)-IDUM(27)
@@23         ICO=IDUM(1)
@@24         NCO=IDUM(2)
@@25         LUA=IDUM(22)
@@26         JD24=IDUM(24)
@@27         NFRQ2=NFRQ/2
@@28         CALL CIFT(X,NCO)
@@29         XR=REAL(X(NFRQ2))
@@3@         XI=AIMAG(X(NFRQ2))
@@31         XNOR=SQRT(XR*XR+XI*XI)
@@32         IF(JD24 .NE. 3)XNOR=1.
@@33         IS=IDUM(27)
@@34         IE=IDUM(28)
@@35         DO 1 I=IS,IE
@@36         XR=REAL(X(I))
@@37         XI=AIMAG(X(I))
@@38         XR=SQRT(XR*XR+XI*XI)/XNOR
@@39         IDAT(I-IS+1)=3@@.*XR
@@4@   1     CONTINUE
@@41         ICODE=1@@@@@B+9
@@42         CALL EXEC(ICODE,KANAM)
@@43         RETURN
@@44         END
@@45         END$
```

```
#PUAN3 T=####3 IS ON CR####2 USING #####8 BLKS R=####

###1  FTN4,L
###2        PROGRAM PUAN3(3)
###3        COMMON IVTEK(17#)
###4        COMMON IRTN(3),IFLG(1),LU(1),KFNR(1),IONLN(1),KDFPK(3),
###5       1KDFUP(3),KOMT(1),IPFAL(1),JPIA(1),IRCVR(1),KRCD(1),ICMPL(1),
###6       2IDUMA(6),JDISK(1),JBND(6),JBB(6),JBT(6),JITR(6),JTOL(6),
###7       3JAZ(1),JEL(1),JAUT(1),JSRC(1),JAUX(1),JAUX2(1),JSAZ(6),
###8       4JXTAL(5),JDUM(27)
###9  C
###1#        COMMON ITGN(3),IACQ(3),IRID(1),IUID(1),I1ID(1),
###11       1I2ID(1),IAID(1),IEID(1),ITID(1),ISID(1),IUOF(1),IMODE(1),
###12       2IXTAL(1),IOND(1),ILIST(1),IPLOT(1),KRMAX(1),KUMAX(1),
###13       3K1MAX(1),K2MAX(1),KAMAX(1),KEMAX(1),NFRQ(1),
###14       4F(1#),NFR(1),IEBM(1),IDBP(1),IDUM(78)
###15        COMMON IEEE(12#),MIAM(8),MDFM(12#)
###16        DIMENSION IYL(1#),IXA(7),IYA(15),IL(2),IDAT(512)
###17        EQUIVALENCE (ITGN(1),IDAT(1))
###18        EQUIVALENCE (RSEC,JDUM(25))
###19        DATA IYA/2H P,2H U,2H L,2H S,2H E,2H  ,2H A,2H M,2H P,2H L,
###2#       12H I,2h T,2H U,2H D,2H E/
###21        DATA IXA/2HTI,2HME,2H(N,2HAN,2HOS,2HEC,2H) /
###22        DATA IYL/2H#.,2H# ,2H#.,2H5 ,2H1.,2H# ,2H1.,2H5 ,2H2.,2H# /
###23        ID=JDUM(27)
###24        IX#=1##
###25        IY#=1##.
###26        CALL QPLOT(5)
###27        ZZ=#
###28        DZ=ID*RSEC/3.
###29        IY1=8#
###3#        IX1=5#
###31        DO 5 I=1,4
###32        CALL QPLOT(#,IX1,IY1)
###33        WRITE(1,1##)ZZ
###34        IX1=IX1+3##
###35  5     ZZ=ZZ+DZ
###36  1##   FORMAT(F6.1)
###37        IX1=IX#
###38        IY1=IY#
###39        DO 2 I=1,1#
###4#        CALL QPLOT(1,IX1,IY1)
###41        IY2=IY1+6##
###42        CALL QPLOT(3,IX1,IY2)
###43  2     IX1=IX1+1##
###44        IX1=IX#
###45        DO 3 J=1,9
###46        CALL QPLOT(1,IX1,IY1)
###47        IX2=IX1+9##
###48        CALL QPLOT(3,IX2,IY1)
###49  3     IY1=IY1+75
###5#        CALL QPLOT(6)
###51        IX1=#
###52        IY1=5##
###53        DO 2# I=1,15
###54        IYAT=IYA(I)
###55        CALL QPLOT(2,IX1,IY1,IYAT,2)
###56  2#    IY1=IY1-2#
###57        IX1=4##
###58        IY1=4#
###59        CALL QPLOT(2,IX1,IY1,IXA,14)
###6#        IX1=5#
###61        IY1=IY#
###62        DO 6 I=1,5
```

```
##63          DO 7 J=1,2
##64          IZ=2*(I-1)+J
##65     7    IL(J)=IYL(IZ)
##66          CALL QPLOT(2,IX1,IY1,IL,4)
##67     6    IY1=IY1+15#
##68          CALL QPLOT(1,IX#,IY#)
##69          DO 1 I=1,ID
##7#          IY=IY#+IDAT(I)
##71          IX=I*9##./ID+1##
##72          CALL QPLOT(3,IX,IY)
##73     1    CONTINUE
##74          END
##75          END$
```

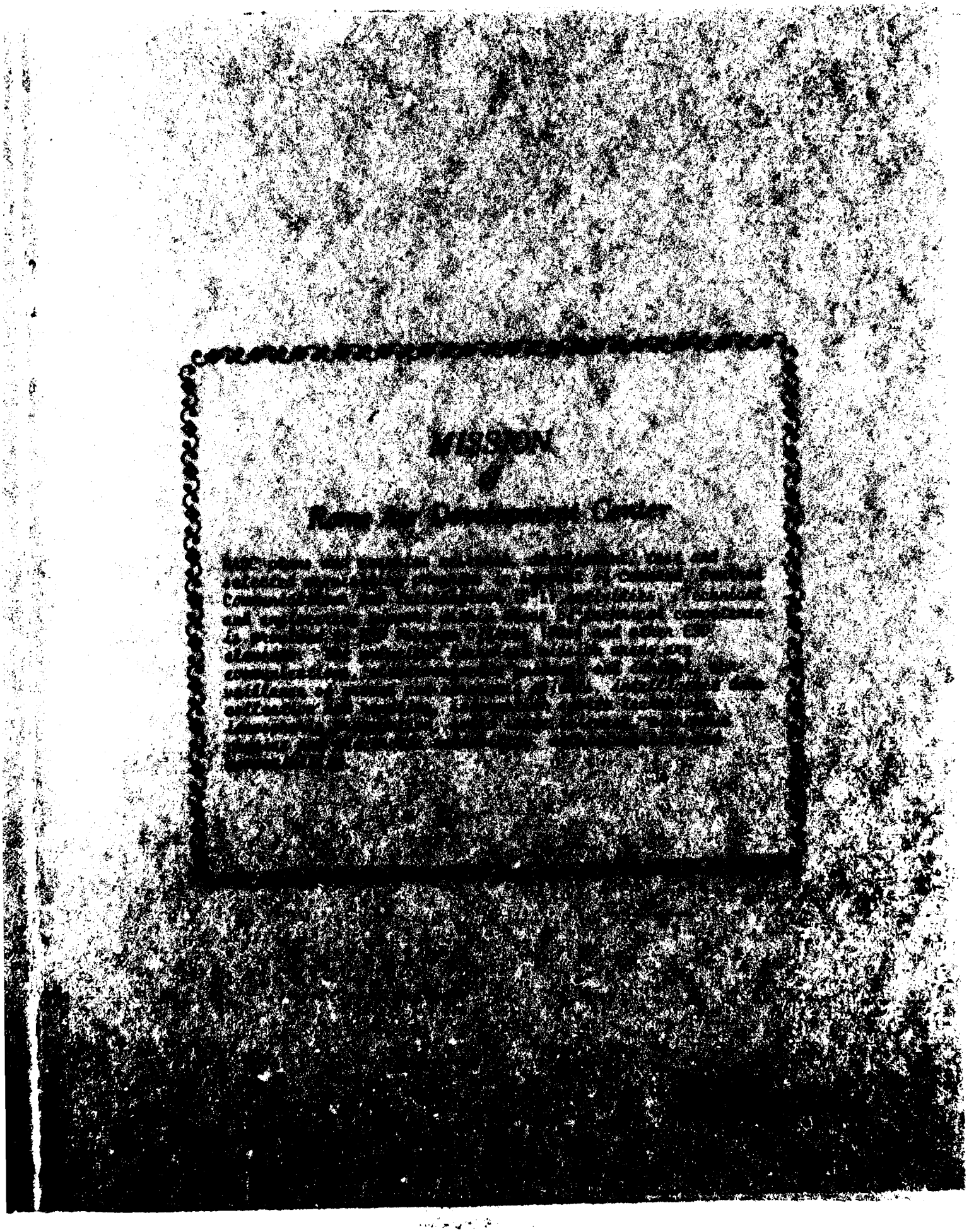
```
#CFFT  T=#####3 IS ON CR#####2 USING #####4 BLKS R=####

###1  FTN4,L
###2          SUBROUTINE CFFT(X,M)
###3  C    WILL OBTAIN COMPLEX FFT OF ARRAY Y.
###4  C    M IS POWER OF TWO WHICH GIVES ORDER OF ARRAY
###5  C
###6          COMPLEX X(1),U,W,T
###7          N=2**M
###8          N2=N/2
###9          N1=N-1
##1#          J=1
##11          DO 3 I=1,N1
##12          IF(I .GE. J)GO TO 1
##13          T=X(J)
##14          X(J)=X(I)
##15          X(I)=T
##16     1    K=N2
##17     2    IF(K .GE. J)GO TO 3
##18          J=J-K
##19          K=K/2
##2#          GO TO 2
##21     3    J=J+K
##22          PI=3.1415926
##23          DO 5 L=1,M
##24          LE=2**L
##25          LE1=LE/2
##26          U=(1.#,#.#)
##27          W=CMPLX(COS(PI/LE1),SIN(PI/LE1))
##28          DO 5 J=1,LE1
##29          DO 4 I=J,N,LE
##3#          ID=I+LE1
##31          T=X(ID)*U
##32          X(ID)=X(I)-T
##33     4    X(I)=X(I)+T
##34     5    U=U*W
##35          RETURN
##36          END
##37          END$
```

```
@PUFT  T=@@@@3 IS ON CR@@@@2 USING @@@@2 BLKS R=@@@@

@@@1  FTN4,L
@@@2        SUBROUTINE PUFT(Y,M,IWP)
@@@3        COMPLEX Y(512)
@@@4        N=2**M
@@@5        DO 1 I=1,N
@@@6  1     Y(I)=(@.@,@.@)
@@@7        IS=N/2-IWP/2+1
@@@8        IH=N/2+IWP/2
@@@9        DO 2 I=IS,IH
@@1@  2     Y(I)=(1.@,@.@)
@@11        CALL CFFT(Y,M)
@@12        RETURN
@@13        END
@@14        ENDS
```

```
@CIFT  T=@@@@3 IS ON CR@@@@2 USING @@@@3 BLKS R=@@@@

@@@1  FTN4,L
@@@2        SUBROUTINE CIFT(X,M)
@@@3        COMPLEX X(1),U,W,T
@@@4        N=2**M
@@@5        B=1.@/N
@@@6        DO 6 J=1,N
@@@7  6     X(J)=B*X(J)
@@@8        N2=N/2
@@@9        N1=N-1
@@1@        J=1
@@11        DO 3 I=1,N1
@@12        IF(I .GE. J)GO TO 1
@@13        T=X(J)
@@14        X(J)=X(I)
@@15        X(I)=T
@@16  1     K=N2
@@17  2     IF(K .GE. J)GO TO 3
@@18        J=J-K
@@19        K=K/2
@@2@        GO TO 2
@@21  3     J=J+K
@@22        PI=3.1415926
@@23        DO 5 L=1,M
@@24        LE=2**L
@@25        LE1=LE/2
@@26        U=(1.@,@.@)
@@27        W=CMPLX(COS(PI/LE1),-SIN(PI/LE1))
@@28        DO 5 J=1,LE1
@@29        DO 4 I=J,N,LE
@@3@        ID=I+LE1
@@31        T=X(ID)*U
@@32        X(ID)=X(I)-T
@@33  4     X(I)=X(I)+T
@@34  5     U=U*W
@@35        RETURN
@@36        END
@@37        ENDS
```

```
#PU    T=00003 IS ON CR00002 USING 00002 BLKS R=0000

0001  :TR,#RT
0002  :LG,15
0003  :MR,%MAIN
0004  :MR,%ERINN
0005  :MR,%DUM
0006  :MR,%PUTG
0007  :MR,%NOYES
0008  :MR,%PUAQ
0009  :MR,%DFPK
0010  :MR,%PSN
0011  :MR,%PINT
0012  :MR,%PSNA
0013  :MR,%SYN0
0014  :MR,%RCVR
0015  :MR,%FREQ
0016  :MR,%RAT0
0017  :MR,%PHA0
0018  :MR,%CNT0
0019  :MR,%FRQ0
0020  :MR,%DLAY
0021  :RU,LOADR,99,1,18,1,2
0022  :RT,LOADR



#PUA   T=00003 IS ON CR00002 USING 00001 BLKS R=0000

0001  :TR,#RT
0002  :LG,10
0003  :MR,%PUAN
0004  :MR,%PUAN2
0005  :MR,%DFUP
0006  :MR,%PUFT
0007  :MR,%CIFT
0008  :MR,%CFFT
0009  :RU,LOADR,99,1,18,0,2
0010  :RT,LOADR


#PUA3  T=00003 IS ON CR00002 USING 00001 BLKS R=0000

0001  :TR,#RT
0002  :LG,5
0003  :MR,%PUAN3
0004  :MR,%QPLOT
0005  :MR,%ERAS
0006  :RU,LOADR,99,1,18
0007  :TR,#RT


0020  :ST,8,%DFPK::-3:5
0021  :ST,8,%PSN::-3:5
0022  :ST,8,%PINT::-3:5
0023  :ST,8,%PSNA::-3:5
0024  :ST,8,%SYN0::-3:5
0025  :ST,8,%RCVR::-3:5
0026  :ST,8,%FREQ::-3:5
0027  :ST,8,%RAT0::-3:5
0028  :ST,8,%PHA0::-3:5
0029  :ST,8,%CNT0::-3:5
0030  :ST,8,%FRQ0::-3:5
0031  :ST,8,%DLAY::-3:5
0032  :ST,8,%PUAN::-3:5
0033  :ST,8,%PUAN1::-3:5
0034  :ST,8,%DFUP::-3:5
0035  :ST,8,%PUFT::-3:5
0036  :ST,8,%CIFT::-3:5
0037  :ST,8,%CFFT::-3:5
0038  :ST,8,%QPLOT::-3:5
0039  :ST,8,%ERAS::-3:5
```

```
@DTOT  T=@@@@3 IS ON CR@@@@@2 USING @@@@2 BLKS R=@@@@

@@@1  :ST,@PUTG,8
@@@2  :ST,@PUAQ,8
@@@3  :ST,@PUAN,8
@@@4  :ST,@PUAN1,8
@@@5  :ST,@PUAN2,8
@@@6  :ST,@PUAN3,8
@@@7  :ST,@PUFT,8
@@@8  :ST,@CFFT,8
@@@9  :ST,@CIFT,8
@@1@  :ST,@PU,8
@@11  :ST,@PUA,8
@@12  :ST,@PUA3,8
@@13  :ST,@RT,8
@@14  :ST,%MAIN,8
@@15  :ST,%ERTNN,8
@@16  :ST,%DUM,8
@@17  :ST,%PUTG,8
@@18  :ST,%NOYES,8
@@19  :ST,%PUAQ,8
@@2@  :ST,%DFPK,8
@@21  :ST,%PSN,8
@@22  :ST,%PINT,8
@@23  :ST,%PSNA,8
@@24  :ST,%SYN@,8
@@25  :ST,%RCVR,8
@@26  :ST,%FREQ,8
@@27  :ST,%RAT@,8
@@28  :ST,%PHA@,8
@@29  :ST,%CNT@,8
@@3@  :ST,%FRQ@,8
@@31  :ST,%DLAY,8
@@32  :ST,%PUAN,8
@@33  :ST,%PUAN1,8
@@34  :ST,%DFUP,8
@@35  :ST,%PUFT,,8
@@36  :ST,%CIFT,8
@@37  :ST,%CFFT,8
@@38  :ST,%QPLOT,8
@@39  :ST,%ERAS,8

@TTOD  T=@@@@3 IS ON CR@@@@@2 USING @@@@2 BLKS R=@@@@

@@@1  :ST,8,@PUTG::-3
@@@2  :ST,8,@PUAQ::-3
@@@3  :ST,8,@PUAN::-3
@@@4  :ST,8,@PUAN1::-3
@@@5  :ST,8,@PUAN2::-3
@@@6  :ST,8,@PUAN3::-3
@@@7  :ST,8,@PUFT::-3
@@@8  :ST,8,@CFFT::-3
@@@9  :ST,8,@CIFT::-3
@@1@  :ST,8,@PU::-3
@@11  :ST,8,@PUA::-3
@@12  :ST,8,@PUA3::-3
@@13  :ST,8,@RT::-3
@@14  :ST,8,%MAIN::-3:5
@@15  :ST,8,%ERTNN::-3:5
@@16  :ST,8,%DUM::-3:5
@@17  :ST,8,%PUTG::-3:6
@@18  :ST,8,%NOYES::-3:5
@@19  :ST,8,%PUAQ::-3:5
```


MISSION

END

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