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MEASUREMENT OF ADAPTER LOSS, MISMATCH, AND EFFICIENCY USING THE DUAL SIX-PORT

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MEASUREMENT OF ADAPTER LOSS, MISMATCH, AND EFFICIENCY USING THE DUAL SIX-PORT

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A noise measurement system is being developed for the U. S. Air Force which uses coaxial cryogenic and ambient noise temperature standards to determine the noise temperature of the device under test. When the device under test has a different connector than those on the noise standards, an adapter has to be used. Adapter loss and complex reflection coefficients must be compensated for or noise measurement accuracy is affected. A technique has been developed which uses a dual six-port measurment system to determine the mismatch, loss, and ultimately the efficiency of the adapter used. This enables correction of measurement results and allows measurements to be made with an adapter with no degradation of accuracy.

This report describes this method of evaluating adapters and provides instructions for its use.

I. INTRODUCTION

A noise measurement system is being developed at the Boulder Laboratories of the National Bureau of Standards for use by the Metrology Engineering Section at Newark Air Force Station. This system has accented the need for a reliable method of evaluating adapter input and output reflection coefficient, loss, and efficiency. A technique has been developed and tested which uses the dual six-port measurement system to ascertain these parameters. This technique requires calibrating the dual six-port system without adapters and then calibrating it again with adapters attached to the two measurement ports. Reflection coefficients and losses of the adapters on six-ports 1 and 2 are then calculated using the calibration results. After one further measurement which involves connecting the device under test to the adapter and determining the input reflection coefficient of this device, the efficiency of the combination can be calculated. If the device under test and adapter combination are left intact after this determination, an accurate correction for the the adapter can be made. In the following discussion, the adapter evaluation technique using the dual six-port measurement system is explained in simple terms. A detailed mathematical analysis of this technique is beyond the scope of this report. The main purpose of this report is to explain its function and use.

II. EQUIPMENT USED

The radiometer under developement is a complex multiband system. For simplicity, only the X-band front of this system is shown in Figure 1 which is a block diagram of this portion of the
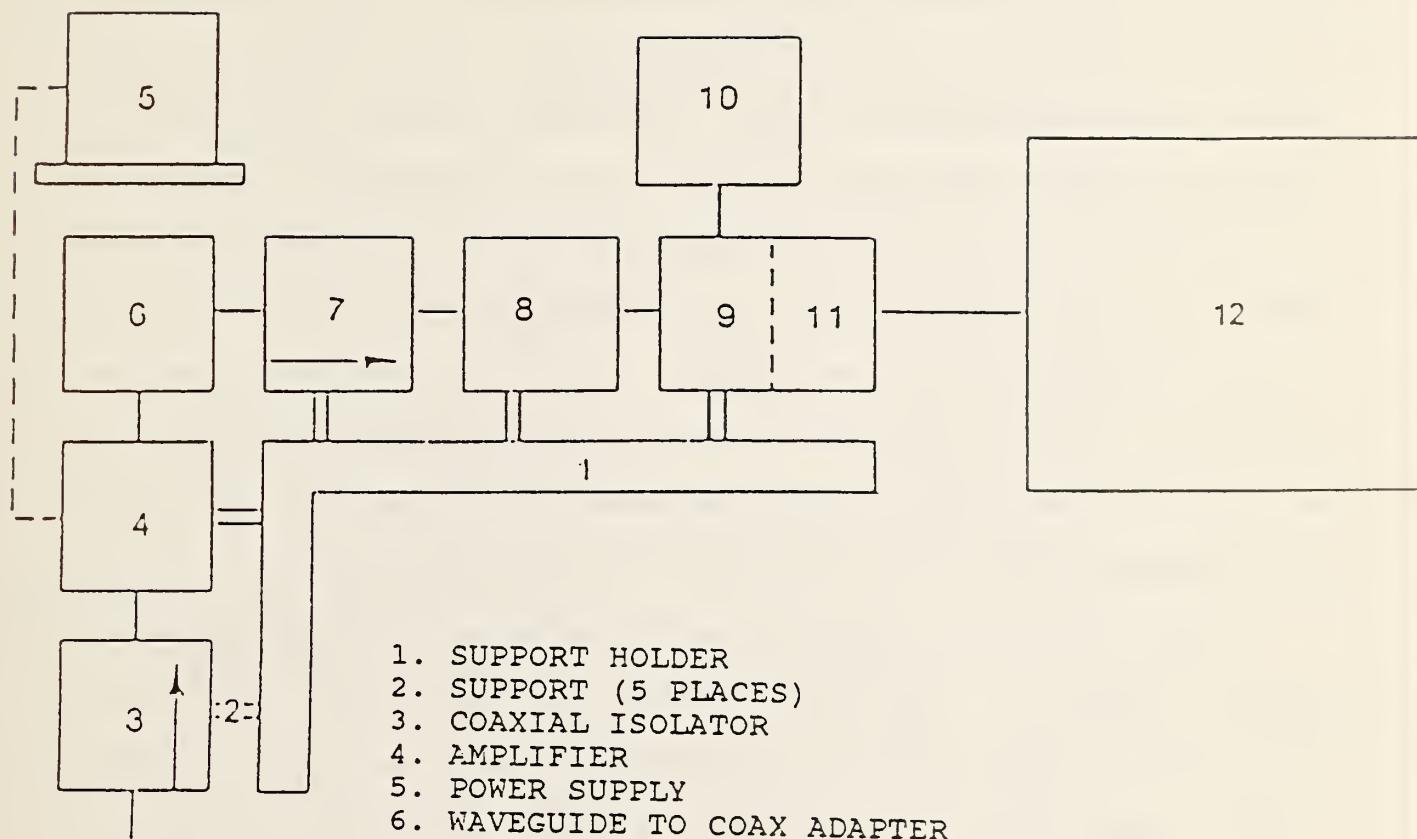
1. SUPPORT HOLDER
2. SUPPORT (5 PLACES)
3. COAXIAL ISOLATOR
4. AMPLIFIER
5. POWER SUPPLY
6. WAVEGUIDE TO COAX ADAPTER
7. ISOLATOR
8. HARMONIC FILTER
9. MIXER
10. LOCAL OSCILLATOR
11. AMPLIFIER
12. RADIOMETER

SIMPLIFIED BLOCK DIAGRAM

X BAND FRONT END AND RADIOMETER

FIGURE 1

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radiometer. The insertion point of this portion of the system is coaxial, but by using the evaluation technique described above, the loss, reflection coefficient, and efficiency of an X-band waveguide to coax adapter could be determined and the system then used to calibrate waveguide noise sources. See figure 2 for a typical noise measurement setup. Note that the two standards are coaxial and that the device under test is waveguide. Since the complex reflection coefficients and loss of the waveguide to coax adapter can be determined, the measurement can be made with very little degradation in accuracy. In a similar fashion, correction can be made for coaxial adapters used to connect a device under test with a different connector type than the one on the standards.

Figure 3 shows a typical setup for evaluating waveguide to coaxial adapters. The top portion of the figure shows the calibration system with no adapters while the bottom portion details the setup for measuring the loss and reflection coefficient of a waveguide to coax adapter. The two bends are used to eliminate any moding problems encountered when calibration standards are connected directly to the adapters. Short straight sections would do just as well but the bends were used to keep the insertion distance as short as possible and compensate for the right angle connections on the adapters.

The standards used to calibrate waveguide are the same as those used to calibrate coax except that in place of the open circuit calibration standards, quarter wave short circuits are used. These quarter wave short circuits need not be cut for the precise frequency of measurement. They should, however, be

COAXIAL CONNECTOR

RADIOMETER FRONT END

CRYO STD.

AMB. STD.

W.G. TO COAX ADPT.

WAVEGUIDE NOISE SOURCE
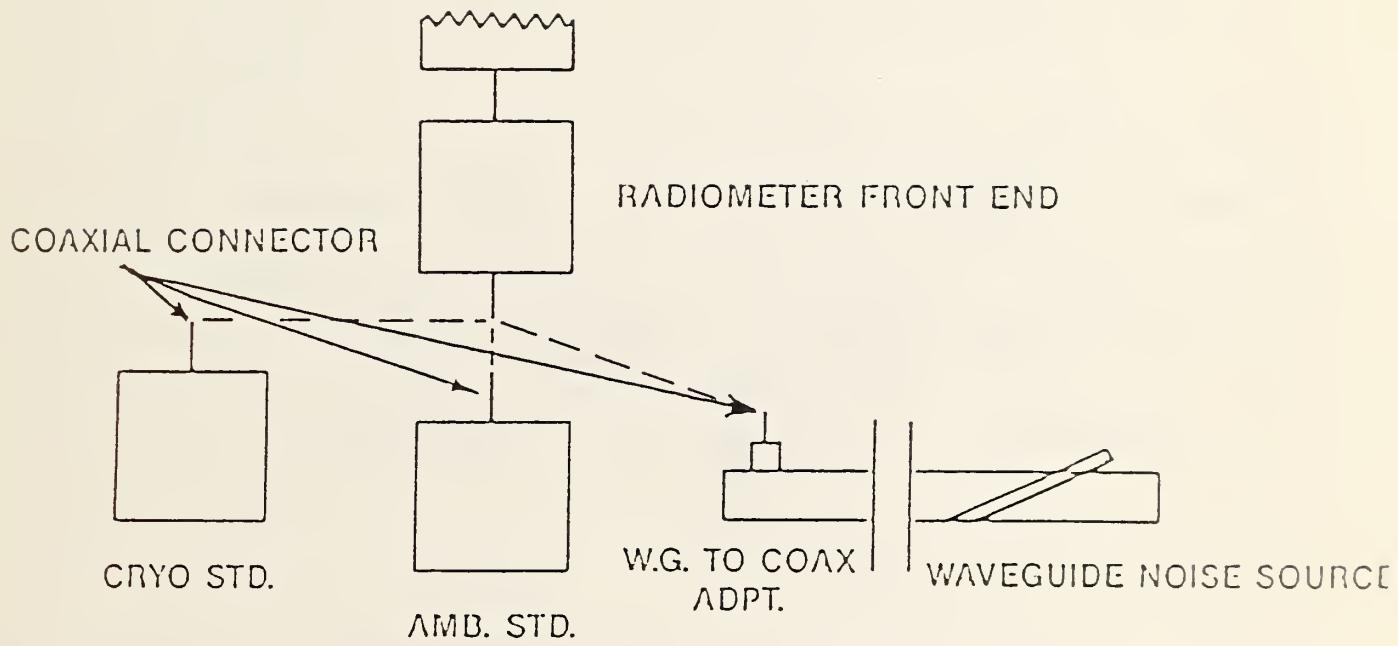
MEASUREMENT SETUP USING WAVEGUIDE TO COAX ADAPT.

FIGURE 2

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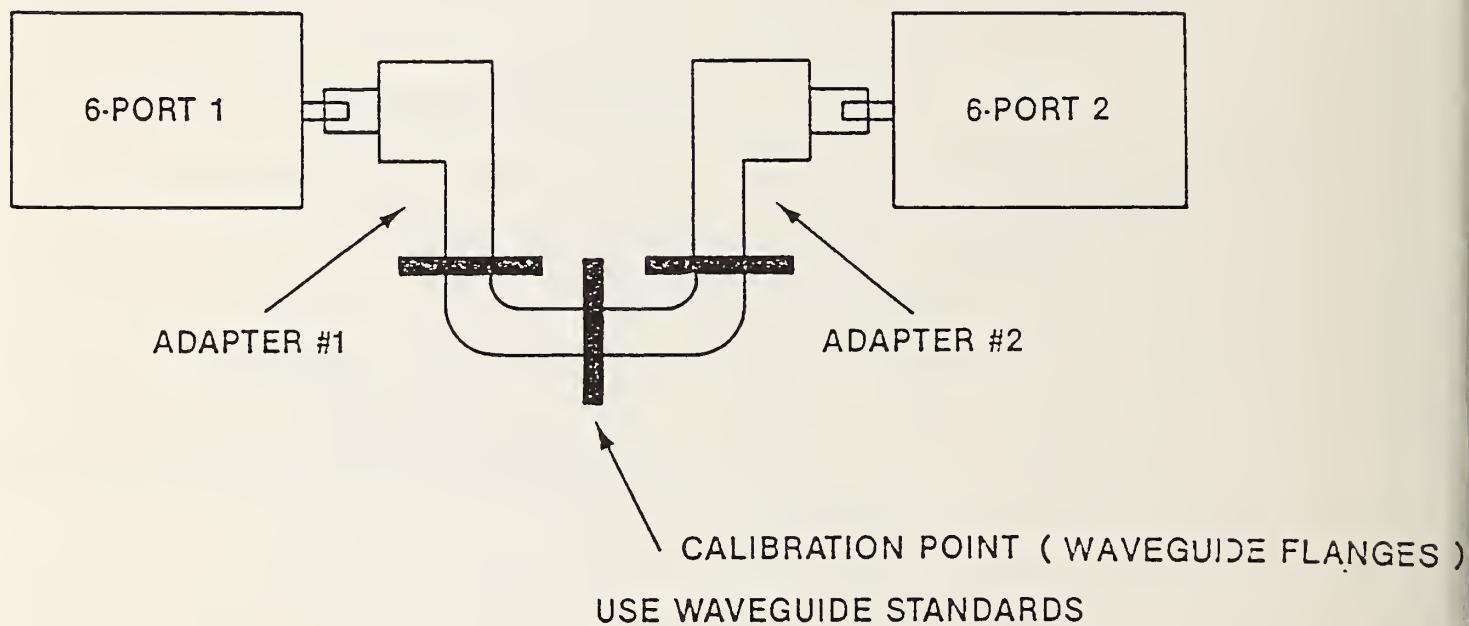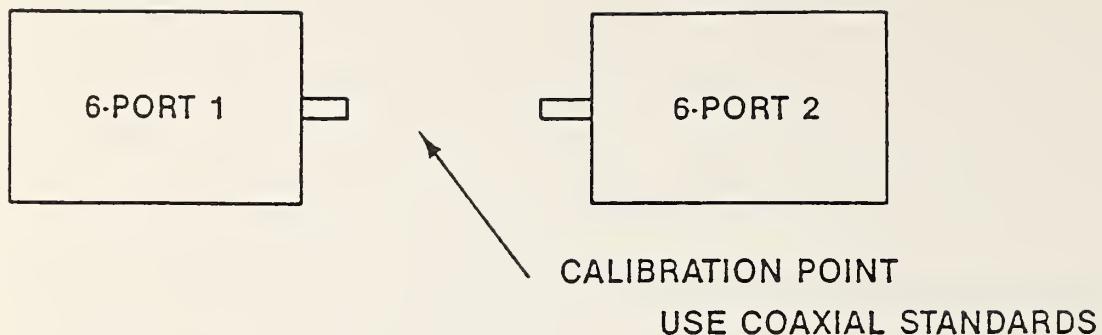
MEASUREMENT SETUP FOR WAVEGUIDE TO COAX ADAPTER

FIGURE 3

bolted in place when in use. Also the calibration airline is replaced by a waveguide straight section which ideally is of the length to cause a 90 degree phase shift. Table 1 (page 17) shows the ideal length for airlines at frequencies in the WR-284, WR-187, WR-137, and WR-90 waveguide sizes. The 90 degree column is the optimum length for a 90 degree airline.   However, especially at higher frequencies, this length is shorter than practical. A workable airline can be achieved by adding to the 90 degree length, a length equivalent to 180 degrees until the desired length is obtained. The 180 degree column shows the length to add.

III. SOFTWARE

The software developed for adapter evaluation is modeled from a technique described by Glenn F. Engen in 1974 [1] and implemented by Ramon Jesch using an automatic network analyzer and power measurement system in 1977 [2].

The technique uses the following:

$$S11=(b'-b)/(a-b'c) \qquad (1)$$

$$S22=(a'c-ac')/(a-b'c) \qquad (2)$$

$$S12^2=(a'-bc')/(a-b'c) + S11S22 \qquad (3)$$

where S11 and S22 are the complex reflection coefficients at each end of the adapter being measured and S12 is the transmission coefficient of the adapter from port 1 to port 2. The complex parameters a, b, and c are obtained by calibrating the six-ports without the adapters and   a', b', and c'are obtained by calibrating the six-ports with the adapters in place. Figure 3 is a block diagram showing the measurement of a waveguide to coax adapter pair. The loss and reflection coefficient   of each

adapter is obtained. a', b', and c' are not independent of a, b, and c.   Some variables are obtained and stored during the calibration without the adapters and used to compute a', b', and c' with the adapters.   These variables are computed in the "Iparab" and "Fparab" subprograms and are designated Zeta, Rho, W1, Re(W2), and IM(W2) in lines 5293 through 5298 of the adapter measurement program.   The adapter measurement program is a modified version of the calibration program "CALBR".   The modifications are mainly changes in program flow and include the addition of Subprograms "Gamma" and "FNAdp11".   These subprograms provide for the calculation of scattering coefficients and efficiency of the adapters on the two six-ports by using the following in addition to (1), (2), and (3):

$$\text{Alpha } 120 = S12m^2/(1-S11m^2) \tag{4}$$

$$\text{Alpha } 210 = S21m^2/(1-S22m^2) \tag{5}$$

where S11m, S22m, S12m, and S21m are scattering coefficient magnitudes for the adapter determined by using (1), (2), and (3). Alpha 120 and Alpha 210 are loss coefficients for the adapter from port 1 to 2 and port 2 to 1 respectively. Input power times the loss coefficient equals the output power.

$$G1 = S11 + (S12*S21*Gx)/(1-S22*Gx) \tag{6}$$

where G1 is the calculated complex reflection coefficient of the device under test and adapter combination, and Gx is the complex input reflection coefficient of the device under test as measured from the adapter.

$$\text{Alpha}12 = (1-Gxm^2)*S12m^2/((1-G1m^2)*[1-S22Gx]^2) \tag{7}$$

where Alpha 12 represents the efficiency of the device under test and adapter combination and Gxm, S12m, G1m, and [1-S22Gx] are

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magnitudes of previously determined quantities. The quantity Alpha 12 is the correction factor for the adapter. Divide the measured noise temperature by this factor if the adapter is on the device under test; Multiply by this factor if the adapter is on the standard.

For convenience, listings of these subprograms are included in APPENDIX I of this report. The current version of the complete adapter measurement program has been named "ADPM5"

IV. MAKING A MEASUREMENT

A. GENERAL OVERVIEW OF THE MEASUREMENT PROCESS

The operator will find little difference between using this program and the software (PROGRAM "CALBR") furnished with the six-port measurement system. Program flow has been modified so that two calibrations are performed instead of one and a measurement of the device under test attached to the selected adapter is made. An additional store and print segment has been added to print adapter parameters and save them for use later.

A flow diagram describing the operation of program "ADPM5" is shown in Figure 4. As can be seen in the figure, calibration frequencies and other calibration parameters are input. Then, calibration of the dual six-port measurement system is performed first without the adapters under test, and then with the adapters. Finally, after the two calibrations, the device under test is attached to the desired adapter and measured. The power data obtained from the three operations is processed and the losses, reflection coefficients, and efficiencies of the adapters on both six ports are calculated and stored.

A log of data collected from calibration of the six-ports
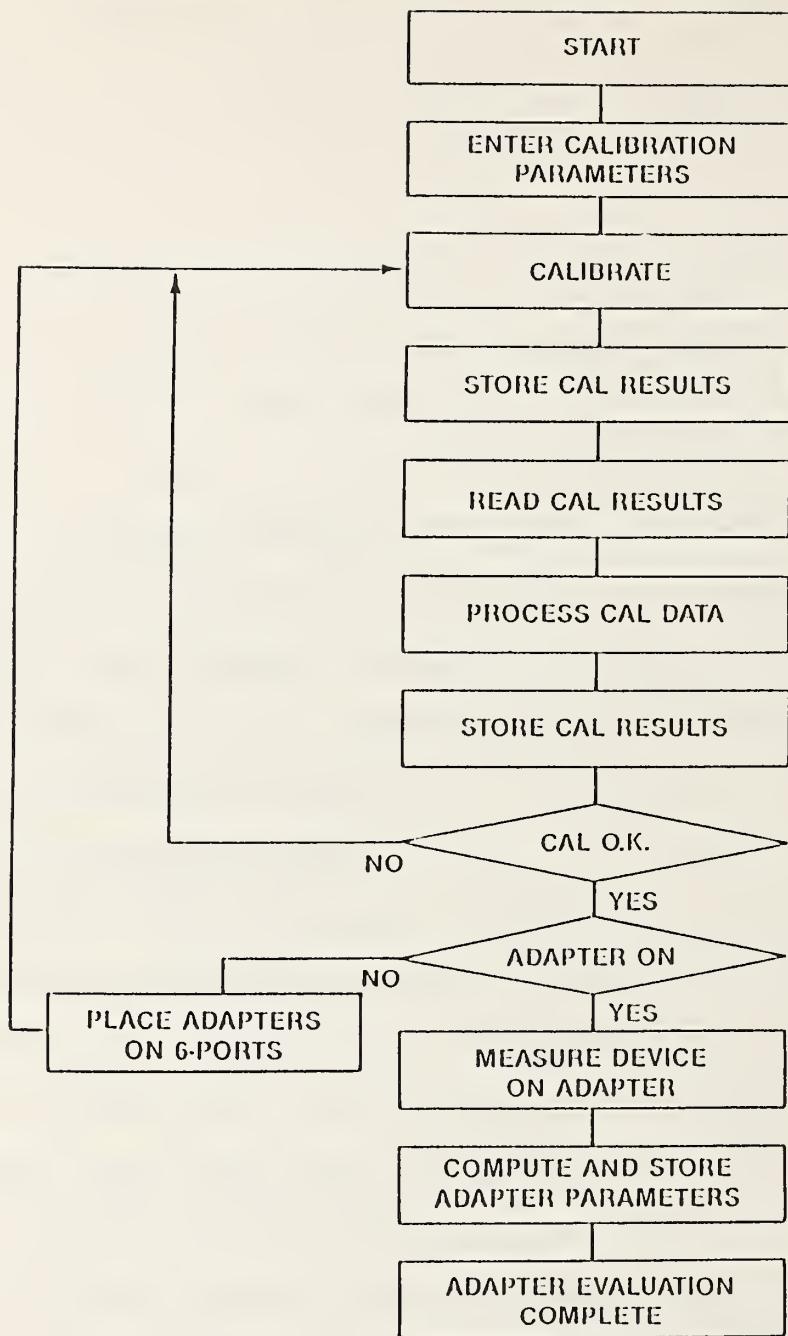
FUNCTIONAL FLOW CHART
FOR
ADAPTER MEASUREMENT
PROGRAM

FIGURE 4

hould be maintained.   Figure 5 is a sample data log showing the ata stored in one adapter evaluation.   The program storage is rranged so that the files shown are overwritten if a new valuation is made.   Permanent storage of calibration results is rovided in user named files if this is desired.   The prompt: "DO OU WANT TO SAVE SYSTEM PARAMETER DATA ON MASS STORAGE--Y/N" is isplayed at the end of each calibration sequence.   A yes answer s followed by prompts asking for file names desired and for a lisc to be placed in the correct disc drive.   A no answer exits :he routine and program execution continues.

3. DATA STORAGE AND USE

The first functions performed during program execution are :alibrations of the six-ports with and without adapter. The results of the calibrations are stored in the power matrix files lesignated with a prefix of PWRH and PWRD. A number is added to this prefix to provide identification for the file.   PWRH1 contains header information and describes the data file PWRD1 which contains the power data from the first calibration (without the adapters). After calibration, the power data is processed and file CRST1 is created.   This file contains the results of the first calibration.   The second calibration (with adapters) is now made and files PWRH2, PWRD2, and CRST2 are created and filled. After the calibrations, a device under test (usually a noise source with one output port is connected to the appropriate adapter and measured.   Power data from this measurement is stored in file 1PRD3 which is described by header file 1PRH3. After the measurement of the device under test, Subprogram "Gamma" automatically accesses the correct files and computes, displays,

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DATE	TIME	FREQ GHZ	DATA FILE NAMES	DESCRIPTION	CONN TYPE
850731	1722	3	PWRH1	SYSTEM CAL NO ADPT. HEADER INFO	N
			PWRD1	POWER MATRIX	
			CRST1	RESULT MATRIX	
				ADAPTER ON SIX-PORT	N
850731	1744	3	PWRH2	HEADER INFO	
			PWRD2	POWER MATRIX	
			CRST2	RESULT MATRIX	
				D.U.T. ON ADPT.	
			1PRH3	HEADER INFO(D.U.T.).	
			1PRD3	POWER MATRIX (D.U.T.)	
			CRST3	MODIFIED RESULT FOR ADPT.	
			AD-1	ALL ADAPTER SCATTERING PARAMETERS, LOSS, AND EFFICIENCY	

SAMPLE DATA LOG FOR USE WITH ADAPTER PROGRAM

FIGURE 5

and stores the reflection coefficients for the device under test--adapter combination. Subprogram "FNAdpt" then automatically retrieves data and calculates scattering coefficients, loss,and efficiency of the adapter. This data is stored in file AD-1 in the S matrix. A list of the contents of this matrix is found in Table 2 which is intended to be an aid in data retrieval. This data will be used to correct the noise temperature of the device under test for adapter error.

Figure 6 is a sample printout from the final phase of the program and details the loss and reflection coefficient of the adapters on both six-ports. The adapters used here were Type N male to female adapters.

C. RUNNING THE PROGRAM

Load "ADPM5" and press run.

As the program is run, prompts displayed on the screen lead the operator through required operations step by step.

1. The first prompt asks for the input option.

      1) Start, stop, and step list

      2) Type in list

      5) Exit

Answer with the appropriate response (usually 1)

2. The second prompt asks:

      Input six-port option

      1) <=2GHZ 6-port

      2) >=2ghz 6-port

Answer with the appropriate response.

3. The third prompt asks for frequency input as specified by options 1 or 2.

```
FILES PROCESSED=CRST5 AND CRST6

FREQUENCY= 7GHZ

ADAPTOR LOSS AT 6PORT NUMBER 1

SYSTEM CONSTANTS

A8,A9,B8,B9,C8,C9


A1,A2,B1,B2,C1,C2  .36931454192         .20671621467         .525670491353

-1.758488244E-02   -.250158691953    7.2367883E-02

ADAPTER CONSTANTS

A8,A9,B8,B9,C8,C9

-6.40256E-02       -.418296616          .53012308          4.721305E-02
-3.36437E-02       -.259555044

A1,A2,B1,B2,C1,C2 -6.402565E-02        -.41825661             .53012307
-4.721805E-02      -3.364376E-02       -.25955504

S12m,S12a,S12r,S12a

  .98546034012       -68.400123          .36277018            -.9162586

IMPEDANCE DATA FOR ADAPTER PM SIX-PORT #1

S11 MAGNITUDE      S11 ANGLE           S11 REAL         S11 IMAGINARY
-------------      ---------           --------         -------------
  .1030            -119.84             -.0513           -.0893

S22 MAGNITUDE      S22 ANGLE           S22 REAL         S22 IMAGINARY
-------------      ---------           --------         -------------
  .1017             162.6897           -.0971            .0303

LOSS DATA FOR ADAPTER ON SIX-PORT 1

ALPHA 12           LOSS DB             ALPHA 21         LOSS DB
--------           -------             --------         -------
  .9815             .0809               .9813            .0820
```

SAMPLE PRINTOUT OF ADAPTER PARAMETERS SIX-PORT 1

FIGURE 6

4. After the frequecies desired are entered, the fourth prompt asks:

Enter options for next operation

1) Input frequency

2) Determine system parameters without power standard

3) Measure 1-port on adapter

4) Evaluate Adapters

5) Exit

A response of 1 returns to the frequency input section of the program. A response of 2 is the normal input for a calibration sequence. A response of 3 is given only after both calibration have been performed . A response of 4 is given after both calibrations and the measurement of the one port device.

(This segment of the program is returned to after each task is accomplished and the program proceeds in response to the answers to the prompts).

5. The fifth prompt:

Turn on amplifiers   Press continue when ready

6. The sixth prompt:

Enter connector type option

1) 14mm, 7mm, or waveguide

2) Type N male adapter on 6-port 1

3) Type N Female adapter on 6-port 1

4) Other, not available at present

Enter the desired response.

7.   The   seventh prompt asks for connection of shorts, opens, a measurement with system ports connected, a 2-port, and

airline with measurements being made on each device   and the powers stored at the end of the sequence in a PWRD1 or PWRD2 file. After the first calibration, prompt 4 above is again displayed, and the program execution is repeated from that point until the two calibrations are completed.

When the second calibration is completed, prompt 4 is again displayed. This time answer with 3. This causes the program to access the measurement routines. Place the device under test on the appropriate adapter and continue program execution.

After the device under test is measured, prompt 4 is again displayed. This time answer the prompt with 4. This causes the program to automatically process the stored data and print and store the adapter evaluation data. When this has been accomplished, prompt 4 is again displayed. This time the correct response is 5. The beginning of the program is now accessed and measurements are complete. Press stop if no further measurements are desired.

The accuracy of the results obtained by this technique depends on a variety of factors. One way to evaluate systematic error is to perform the above tasks without inserting an adaptor. The varience of efficiency from unity is a measure of this error. This varience is usually less than .002.

TABLE 1

IDEAL LENGTH FOR AIRLINES TO CALIBRATE DUAL SIXPORT
WITH WAVEGUIDE INSERTION POINT

WR-284 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
2.6	7.55	1.89	3.78
2.7	6.85	1.71	3.43
2.8	6.29	1.57	3.15
2.9	5.83	1.46	2.92
3.0	5.45	1.36	2.73
3.1	5.13	1.28	2.57
3.2	4.85	1.21	2.43
3.3	4.60	1.15	2.30
3.4	4.39	1.10	2.20
3.5	4.19	1.05	2.10
3.6	4.02	1.00	2.01
3.7	3.85	0.96	1.93
3.8	3.71	0.93	1.86
3.9	3.57	0.89	1.79
3.95	3.51	0.88	1.76

WR187 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
4.0	4.79	1.20	2.40
4.1	4.50	1.13	2.25
4.2	4.25	1.06	2.13
4.3	4.04	1.01	2.02
4.4	3.84	0.96	1.92
4.5	3.68	0.92	1.84
4.6	3.52	0.88	1.76
4.7	3.39	0.85	1.70
4.8	3.26	0.82	1.63
4.9	3.15	0.79	1.58

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TABLE 1 (CONTINUED)

WR187 WAVEGUIDE (CONT)

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
5.0	3.04	0.76	1.52
5.1	2.94	0.74	1.47
5.2	2.85	0.71	1.43
5.3	2.77	0.69	1.39
5.4	2.69	0.67	1.35
5.5	2.62	0.65	1.31
5.6	2.55	0.64	1.28
5.7	2.49	0.62	1.25
5.8	2.42	0.61	1.21
5.85	2.39	0.60	1.20

WR137 WAVEGUIDE

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
5.9	2.92	0.73	1.46
6.0	2.82	0.71	1.41
6.1	2.73	0.68	1.36
6.2	2.64	0.66	1.32
6.3	2.56	0.64	1.28
6.4	2.49	0.62	1.25
6.5	2.42	0.61	1.21
6.6	2.36	0.59	1.18
6.7	2.30	0.57	1.15
6.8	2.24	0.56	1.12
6.9	2.19	0.55	1.09
7.0	2.14	0.53	1.07
7.1	2.09	0.52	1.04
7.2	2.04	0.51	1.02
7.3	2.00	0.50	1.00
7.4	1.96	0.49	0.98
7.5	1.92	0.48	0.96
7.6	1.88	0.47	0.94
7.7	1.85	0.46	0.92
7.8	1.81	0.45	0.91
7.9	1.78	0.45	0.89
8.0	1.75	0.44	0.87
8.1	1.72	0.43	0.86
8.2	1.69	0.42	0.85

TABLE 1 (CONTINUED)

WR90 WAVEGUIDE

| FREQUENCY GHZ | GUIDE WAVELENGTH INCHES | IDEAL AIRLINE INCHES | |
		90 DEG	180 DEG
8.2	2.40	0.60	1.20
8.3	2.32	0.58	1.16
8.4	2.25	0.56	1.12
8.5	2.18	0.55	1.09
8.6	2.12	0.53	1.06
8.7	2.06	0.52	1.03
8.8	2.01	0.50	1.01
8.9	1.96	0.49	0.98
9.0	1.91	0.48	0.96
9.1	1.87	0.47	0.94
9.2	1.83	0.46	0.91
9.3	1.79	0.45	0.89
9.4	1.75	0.44	0.88
9.5	1.72	0.43	0.86
9.6	1.68	0.42	0.84
9.7	1.65	0.41	0.83
9.8	1.62	0.41	0.81
9.9	1.59	0.40	0.80
10.0	1.56	0.39	0.78
10.1	1.54	0.38	0.77
10.2	1.51	0.38	0.76
10.3	1.49	0.37	0.74
10.4	1.46	0.37	0.73
10.5	1.44	0.36	0.72
10.6	1.42	0.35	0.71
10.7	1.40	0.35	0.70
10.8	1.38	0.34	0.69
10.9	1.36	0.34	0.68
11.0	1.34	0.33	0.67
11.1	1.32	0.33	0.66
11.2	1.30	0.32	0.65
11.3	1.28	0.32	0.64
11.4	1.27	0.32	0.63
11.5	1.25	0.31	0.62
11.6	1.23	0.31	0.62
11.7	1.22	0.30	0.61
11.8	1.20	0.30	0.60

TABLE 1 (CONTINUED)

```
----------------------------------------------------------------
WR90 WAVEGUIDE (CONT)
----------------------------------------------------------------
```

FREQUENCY GHZ	GUIDE WAVELENGTH INCHES	IDEAL AIRLINE INCHES	
		90 DEG	180 DEG
11.9	1.19	0.30	0.59
12.0	1.17	0.29	0.59
12.1	1.16	0.29	0.58
12.2	1.15	0.29	0.57
12.3	1.13	0.28	0.57
12.4	1.12	0.28	0.56

```
----------------------------------------------------------------
```

TABLE 2

CONTENTS OF S MATRIX USED TO STORE ADAPTER EVALUATION RESULTS

MATRIX ELEMENT	DESCRIPTION
-------------	-------------------------------
	ADAPTER ON SIX-PORT ONE
-----------	-------------------------------
S(F,1)	S11 MAGNITUDE
S(F,2)	S11 PHASE
S(F,3)	S11 REAL PART
S(F,4)	S11 IMAGINARY PART
S(F,5)	ALPHA 12
S(F,6)	S22 MAGNITUDE
S(F,7)	S22 PHASE
S(F,8)	S22 REAL PART
S(F,9)	S22 IMAGINARY PART
S(F,10)	ALPHA 21
S(F,11)	S12 MAGNITUDE
S(F,12)	S21 MAGNITUDE
S(F,13)	REFL. COEFF. OF D.U.T. AND ADAPT.
S(F,14)	REFL. COEFF. ANGLE OF D.U.T. AND ADPT.
S(F,15)	REAL PART OF S(F,14)
S(F,16)	IMAGINARY PART OF S(F,14)
S(F,17)	EFFICIENCY OF ADAPTER
------------	-----------------------------
	ADAPTER ON SIX-PORT TWO
------------	-----------------------------
S(F,18)	S11 MAGNITUDE
S(F,19)	S11 PHASE
S(F,20)	S11 REAL PART
S(F,21)	S11 IMAGINARY PART
S(F,22)	ALPHA 12
S(F,23)	S22 MAGNITUDE
S(F,24)	S22 PHASE
S(F,25)	S22 REAL PART
S(F,26)	S22 IMAGINARY PART
S(F,27)	ALPHA 21
S(F,28)	S12 MAGNITUDE
S(F,29)	S21 MAGNITUDE
S(F,30)	REFL. COEF. OF D.U.T. AND ADPT.
S(F,31)	REFL. COEF. PHASE OF D.U.T. AND ADPT.
S(F,32)	REAL PART OF S(F,30)
S(F,33)	IMAGINARY PART OF S(F,30)
S(F,34)	EFFICIENCY OF ADAPTER

NOTE: THE F IN THE MATRIX IDENTIFIER REFERS TO THE FREQUENCY
      NUMBER.

V. REFERENCES

[1] Engen, Glenn F. Calibration Techniques for Automatic Network Analyzers with Application to Adapter Evaluation; IEEE Transactions on Microwave Theory and Techniques; Vol MT-22, No. 12; December 1974.

[2] Jesch Ramon C. Evaluation of Low-Loss/Low Reflection Two-Port Devices or Adapters by Automated Measurement Techniques; NBSIR 78-870; 1977.

VI.   ACKNOWLEDGMENTS

LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "FNAdp"

```
6470 DEF FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,CA$)

6480 !Calc Parameters for Adapter from 6-Port Measurements 850805

6490 OPTION BASE 1

6500 Msus$=":F8,1"

6510 DIM Result(Nfreqs,60),Freqs(Nfreqs),Id_content$[80],S(Nfreqs,34)

6521 K=0

6570 !LINPUT "ENTER FILE NAME FOR DATA WITHOUT ADAPTER";N1$

6580 FIXED 0

6590!LINPUT"ENTER FILE NAME FOR DATA WITH ADAPTER";N2$

6620 N1$="CRST1"

6630 N2$="CRST3

6640 CALL Redhed(N1$,Msus$,Date$,Time$,Typ$,Nfreqs,Freqs(*),
     Repeats, Sp, Std_mnt,Id_contents$,Cnnct$)

6650 MASS STORAGE IS ":F8,1"

6660 PRINTER IS 16

6670 PRINT "START OF FNADPT"

6680 Nfreq=N=Nfreqs

6690 PRINT

6700 PRINT

6710$Sport=1

6720 PRINTER MS 0

6721 PRINT

6724 PRINT "ADAPTER EVALUATION"

6725 PRINT"------------------"
```

```
6727 PRINT

6730 PRINT "FILES PROCESSED=";N1$; " AND " ; N2$

6740 PRINT

6750 N1=INT(N1)

6760 N2=INT(N2)

6770 PRINTER IS 16

6780 FOR P=1 to Nfreqs

6790 FOR Prt=1 to 2

6800 PRINTER IS 16

6810 ON Prt GoTO 6820,6850

6820     CALL Redwrt(N2$,":F8,1"," ",Result(*),Nfreqs)

6830     Nfreq=1

6840 GOTO 6870

6850     CALL Redwrt(N2$,":F8,1"," ".Result(*),Nfreqs)

6860 NORMAL

6870 ON Sport GOTO 6880,6900

6880 Mc=0

6890 GoTo 6910

6900 Mc=12

6910 A8=Result(P,6+Mc)

6920 A9=Result(P,7+Mc)

6930 B8=Result(P,8+Mc)

6940 B9=Result(P,9+Mc)

6950 C8=Result(P,10+Mc)

6960 C9=Result(P,11+Mc)

6980 GOTO 6990

6990 A11(Prt)=A8

7000 A22 (Prt)=A9
```

24

```
7010 B11(Prt)=B8

7020 B22(Prt)=B9

7030 C11(Prt)=C8

7040 C22(Prt)=C9

7050 ON Prt GOTO 7060,7140

7060 FIXED 4

7061 PRINTER IS 16

7070 PRINT "FREQUENCY = ";Freqs(P);" GHZ"

7080 PRINT

7090 PRINT "ADAPTER LOSS AT 6PORT NUMBER ";Sport

7100 PRINT

7110 PRINT "SYSTEM CONSTANTS"

7120 PRINT

7130 GO TO 7180

7140 PRINT

7150 PRINTER IS 16

7160 PRINT "ADAPTER CONSTANTS"

7170 PRINT

7180 FIXED 4

7190 PRINT "A8,A9,B8,B9,C8,C9"

7200 PRINT A8,A9,B8,B9,C8,C9

7210 PRINT

7220 PRINT "A1,A2,B1,B2,C1,C1";A11(Prt),A22(Prt),B11(Prt),
     B22(Prt),C11(Prt),C22(Prt)

7230 PRINT

7240 NEXT Prt

7250 !
```

```
7260 ! S11=(b'-b)/(a-b'c)
7270 !
7280!_____
7290 Z1=B11(2)
7300 Z2=B22(2)
7310 Z3=B11(1)
7320 Z4=B22(1)
7330 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7340 Nr=Z9
7350 Ni=Z0
7360 Z3=C11(1)
7370 Z4=C22(1)
7380 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7390 Z3=Z9
7400 Z4=Z0
7410 Z1=A11(1)
7420 Z2=A22(1)
7430 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7440 Z1=Nr
7450 Z2=Ni
7460 Z3=Z9
7470 Z4=Z0
7480 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7490 S11r=Z9
7500 S11i=Z0
7510 X=Z9
7520 Y=Z0
7530 CALL CRPA(X,Y,R,T)
```

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```
7540 PRINT
7550 S11M=R
7560 S11a=T
7570!
7580! S22=(a'c-ac')/(a-b'c)
7590!
7600!_____
7610 Z1=A11(2)
7620 Z2=A22(2)
7630 Z3=C11(1)
7640 Z4=C22(1)
7650 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7660 Mr=Z9
7670 Mi=Z0
7680 Z1=A11(1)
7690 Z2=A22(1)
7700 Z3=C11(2)
7710 Z4=C22(2)
7720 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7730 Z1=Mr
7740 Z2=Mi
7750 Z3=Z9
7760 Z4=Z0
7770 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7780 Mr=Z9
7790 Mi=Z0
7800 Z1=B11(2)
```

```
7810 Z2=B22(2)

7820 Z3=C11(1)

7830 Z4=C22(1)

7840 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)

7850 Z3=Z9

7860 Z4=Z0

7870 Z1=A11(1)

7880 Z2=A22(1)

7890 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)

7900 Z3=Z9

7910 Z4=Z0

7920 Z1=Mr

7930 Z2=Mi

7940 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)

7950 S22r=Z9

7960 S22i=Z0

7970 X=Z9

7980 Y=Z0

7990 CALL Crpa(X,Y,R,T)

8000 S22M=R

8010 S22a=T

8020 !

8030 !S12^2=(a'-bc')/(a-b'c)+S11*S22

8040 !

8050 !_____

8060 Z3=C11(2)

8070 Z4=C22(2)

8080 Z1=B11(1)
```

```
8090 Z2=B22(1)

8100 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)

8110 Z1=A11(2)

8120 Z2=A22(2)

8130 Z3=Z9

8140 Z4=Z0

8150 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)

8160 Mr=Z9

8170 Mi=Z0

8180 Z1=B11(2)

8190 Z2=B22(2)

8200 Z3=C11(1)

8210 Z4=C22(1)

8220 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)

8230 Z1=A11(1)

8240 Z2=A22(1)

8250 Z3=Z9

8260 Z4=Z0

8270 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)

8280 Z1=Mr

8290 Z2=Mi

8300 Z3=Z9

8310 Z4=Z0

8320 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)

8330 Mr=Z9

8340 Mi=Z0

8350 Z1=S11r
```

```
8360 Z2=S11i
8370 Z3=S22r
8380 Z4=S22i
8390 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8400 Z1=Z9
8410 Z2=Z0
8420 Z3=Mr
8430 Z4=Mi
8440 CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
8450 Z1=Z9
8460 Z2=Z0
8470 CALL Csqra(Z1,Z2,Z9,Z0)
8480 S12r=Z9
8490 S12i=Z0
8500 S12m=SQR(Z9^2+Z0^2)
8510 S12a=ATN(S12i/S12r)*180/PI
8520 PRINT "S12m,S12a,S12r,S12i"
8530 PRINT S12m,S12a,S12r,S12i
8540 !
8550 !*****************************************************************
8560 !Alpha 210=(S21m)^2/(1-S22m^2)
8570 !Alpha 120=(S21m)^2/(1-S11m^2)
8580 !*****************************************************************
8590 A120=S12m^2/(1-S11m^2)
8600 A210=S12m^2/(1-S22m^2)
8610 Db120=10*LGT(A120)
8620 Db210=10*LGT(A210)
8630 PRINTER IS 16
```

```
8640 PRINT

8650 FIXED 0

8660 PRINTER IS 0

8680 PRINT

8690 PRINT "REFLECTION  COEFFICIENTS FOR  ADAPTER  ON  SIX-PORT #";Spor

8691 FIXED 2

8700 PRINT

8701 PRINT"FREQUENCY";Freqs(P);"GHZ"

8702 PRINT

8710 PRINT "S11 MAGNITUDE      S11 ANGLE      S11 REAL      S11
           IMAGINARY"

8720 PRINT "-------------      ----------     --------     -----
           ---------"

8730 FIXED 4

8740 PRINT S11m, S11a, S11r,S11i

8750 PRINT

8760 PRINT "S22 MAGNITUDE      S22 ANGLE      S22 REAL      S22
           IMAGINARY"

8770 PRINT "-------------      ----------     --------     -----
           ---------"

8780 PRINT S22m,S22a,S22r,S22i

8790 PRINT

8791 PRINT

8800 FIXED 0

8810 PRINT "LOSS DATA FOR ADAPTER ON SIX-PORT";SPORT

8820 PRINT "Alpha 12      LOSS DB      Alpha 21      LOSS DB"

8830 PRINT"---------      -------      --------      -------"
```

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```
8840 FIXED 4

8860 PRINT A120,Db120,A210,Db210

8870 K=0

8880 PRINT

8900 NORMAL

8920 IF Sport =2 THEN K=17

8921 IF Sport=1 THEN K=0

8930 S(P,K+1)=S11m

8940 S(p,K+2)=S11a

8950 S(P,K+3)=S11r

8960 S(P,K+4)=S11i

8970 S(P,K+5)=A120

8980 S(P,K+6)=S22m

8990 S(P,K+7)=S22a

9000 S(P,K+8)=S22r

9010 S(P,K+9)=S22i

9020 S(P,K+10)=A120

9030 S(P,K+11)=S12m

9040 S(P,K+12)=S21m

9050 !*************************************************

9060 PRINTER IS 16

9070 !  THE  FOLLOWING  CODE  EXISTS TO CALCULATE  EFFICIENCY  OF
        ADAPTER AND D.U.T.

9080 !_____

9090 !

9100 !G1=S11+(S12*S21*Gx)/(1-S22*Gx)

9110 !

9111 ON Sport GOTO 9120 9132
```

```
9120 R=Gxm(Sport)=M1
9130 T=Gxa(Sport)=P1
9140 CALL Cpra(R,T,X,Y)
9150 Gxr(Sport)=X
9160 Gxi(Sport)=Y
9210 Z1=Z3=S12r
9220 Z2=Z4=S12i
9230 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9240 Z1=Z9
9250 Z2=Z0
9260 Z3=Gxr
9270 Z4=Gxi
9280 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9290 Nur=Z9
9300 Nui=Z0
9310 PRINT Nur, Nui,Z9,Z0
9320 Z1=S22r
9330 Z2=S22i
9340 Z3=Gxm(Sport)
9350 Z4=0
9360 CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9370 PRINT "S22Gx"
9380 PRINT Z9,Z0
9390 Z1=1
9400 Z2=0
9410 Z3=Z9
9420 Z4=Z0
```

```
9430 CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)

9440 PRINT "1-S22GX",Z9,Z0

9450 Z1=Nur

9460 Z2=Nui

9470 Z3=Z9

9480 Z4=Z0

9490 Mag1=SQR(Z9^2+Z0^2)^2

9500 CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)

9510 Z1=S21r

9520 Z2=S21i

9530 PRINT "S11R, S11I"; S11r,S11i

9550 Z3=Z9

9560 Z4=Z0

9570 CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)

9580 G1r=Z9

9590 G1i=Z0

9600 !

9610 !!_____

9620 ! Alpha12=[(1-Gxm^2)*S12m^2]/[1-G1m^2*(1-S22Gx)m^2]

9630 !

9660 Magn=(1-Gxm^2)*S12m^2)

9670 G1m=SQR(G1r^2+G1i^2)^2

9680 X=G1r

9690 Y=G1i

9700 CALL Crpa(X,Y,R,T)

9710 G1a=T

9720 Magd=(1-G1m)*Mag1

9730 Alpha12=Magn/Magd
```

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```
9740 A12=Alpha12
9750 PRINTER IS 16
9760 PRINT "G1m, G1a, G1r, G1i"
9770 Print SQR(G1m),G1a,G1r,G1i
9780 PRINT "Gxm,Gxa,Gxr,Gxi"
9790 PRINT Gxm(Sport),Gxa(Sport),Gxr(Sport),Gxi(Sport)
9801 PRINTER IS 0
9805 PRINT "EFFICIENCY OF ADAPTER AND DEVICE COMBINATION";A12
9806 PRINT
9807 PRINT
9808 PRINTER IS 16
9810 IF Sport=1 then GOTO 9830
9920 GO TO 9900
9830 S(P,K+13)=Gxm(Sport)
9840 S(P,K+14)=Gxa(Sport)
9850 S(P,K+15)=Gxr(Sport)
9860 S(P,K+16)=Gxi(Sport)
9861 S(P,K+17)=A12
9890 GOTO 9940
9900 S(P,K+13)=Gxm(Sport)
9910 S(P,K+14)=Gxa(Sport)
9920 S(P,K+15)=Gxi(Sport)
9930 S(P,K+16)=Gxr(Sport)
9940 Sport=Sport+1
9950 if Sport=2 THEN GOTO 6790
9951 PRINT PAGE
9952 Sport=1
```

```
9955 NEXT P

9960 GOTO 9980

9970 PRINTER IS 16

9980 MASS STORAGE IS ":F8,1"

9990 FOR I=! TO 20

10000 NORMAL

10010 FIXED 0

10020 ASSIGN #1 TO "AD-"&VAL$(I),Check

10021 ASSIGN #1 TO *

10030 IF Check THEN Q$=VAL$(I)

10040 IF Check THEN 10060

10050 NEXT I

10060 CREATE "AD-"$Q$,2*Nfreqs

10070 ASSIGN #1 TO "AD-"&Q$

10080 PRINT #1;S(*)

10090 ASSIGN #1 TO *

10110 RETURN 0

10120 SUB Cmua(Z1,Z2,Z3,Z4,Z9,Z0)

10130 Z9=Z1*Z3-Z2*Z4

10140 Z0+Z1*Z4+Z2*Z3

10150 SUBEXIT

10160 SUBEND

10170 SUB Cdia(Z1,Z2,Z3,Z4,Z9,Z0)

10180 Z6=Z3^2+Z4^2

10190 Z9=(Z1*Z3+Z2*Z4)/Z6

10200 Z0=(Z2*Z3-Z1*Z4)/Z6

10210 SUBEXIT

10220 SUBEND
```

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```
10230 SUB Cinva(Z1,Z2,Z3,Z4,Z9,Z0)

10240 Z6=Z1^2+Z2^2

10250 Z9=Z1/Z6

10260 Z0=Z2/Z6

10270 SUBEXIT

10280 SUBEND

10290 SUB Csqa(Z1,Z2,Z3,Z4,Z9,Z0)

10300 Z9=Z1*Z1-Z2*Z2

10310 Z0=2*Z1*Z2

10320 SUBEXIT

10330 SUBEND

10340 SUB Cada(Z1,Z2,Z3,Z4,Z9,Z0)

10350 Z9=Z1+Z3

10360 Z0=Z2+Z4

10370 SUBEXIT

10380 SUBEND

10390 SUB Csua(Z1,Z2,Z3,Z4,Z9,Z0)

10400 Z9=Z1-Z3

10410 Z0=Z2-Z4

10420 SUBEXIT

10430 SUBEND

10440 SUB Caba(Z1,Z2,Z9)

10450 Z9=SQR(Z1*Z1=Z2*Z2)

10460 SUBEXIT

10470 SUBEND

10480 SUB Csqra(Z1,Z2,Z9,Z0)

10490 X=Z1
```

```
10500 Y=Z2

10510 CALL Crpa(X,Y,R,T)

10520 R=SQR(R)

10530 T=T/2

10540 Z9=R*COS(PI*T/180)

10550 Z0=R*SIN(PI*T/180)

10560 GOTO 12570

10570 SUBEXIT

10580 SUBEND

10590 SUB Crpa(X,Y,R,T)

10600 R=SQR(X^2+Y^)

10610 IF X=0 THEN GO TO 10640

10620 T=ATN(Y/X)

10630 GO TO 10650

10640 T=PI*SGN(Y)/2

10650 T=T*180/PI

10660 IF X>=0 THEN 10710

10670 IF Y>=0 THEN 10700

10680 T=T-180

10690 GO TO 10710

10700 T=T+180

10710 SUBEXIT

10720 SUBEND

10730 SUB cmuada(Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z0)

10740 Z9=Z1*Z3-Z2*Z4+Z5*Z7-Z6*Z8)

10750 Z0=Z1*Z4-Z2*Z3+Z5*Z8+Z6*Z7)

10760 SUBEXIT

10770 SUBEND
```

```
10780 SUB Cpra(R,T,X,Y)

10790 X=R8COS(PI*T/180)

10800 Y=R*SIN(PI*T/180)

10810 SUBEXIT

10820 SUBEND
```

LISTING OF ADAPTER PARAMETER CALCULATING SUBPROGRAM "Gamma"

```
11300 SUB Gamma(Nfreqs,Repeats,Ca$)

11310 OPTION BASE 1

11320 DIM Power(Nfreqs,Repeats,16,10),Po(1,8),Result(Nfreqs,60)
      Wrspt(2,12)

11330 FREAD "1PRD&"3"&":F8,1",Power(*)

11340 G=1

11350 PRINTER IS 16

11360 File$="CRST"&"2"

11370 FOR F=1 TO Nfreqs

11380 CALL Redwrt(File$,"F8,1"," ",Result(*),Nfreqs)

11390 FOR J=1 TO 2

11400 FOR N=1 TO 12

11410 PRINTER IS 0

11420 Wrspt(J,N)=Result(F,N+(J-1)*12)

11430 NEXT N

11440 NEXT J

11480 FOR Mnt=1 to 8

11490 Po(1,Mnt+Inc)=Power(F,1,1,Mnt+Inc)

11500 NEXT Mnt

11520 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R1)

11530 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R2)

11540 PRINTER IS 0

11550 PRINT "FREQ#",F

11552 PRINT
```

```
11554 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 1"

11555 PRINT

11560 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"

11561 PRINT "---------------","-----------"

11562 PRINT USING 11585;M1,P1

11563 PRINT

11564 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 2"

11565 PRINT

11567 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"

11568 PRINT "---------------","-----------"

11570 PRINT USING 11585;M2,P2

11585 IMAGE MD.DDDDD,12X,MDDD.DDDD

11590 NEXT F

11591 NORMAL

11592 PRINT

11593 PRINT

11594 PRINT

11595 PRINTER IS 16

11600 Q=FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)

11610 SUBEXIT

11620 SUBEND
```

COMPLETE LISTING OF MEASUREMENT PROGRAM "ADP5M"

880519
ADP5M

```
3  ! ****** ADP5M ******
4  ! RE-STORE "ADP5M:F8"   !AUGUST 28, 1985 1020
6  ! FILE NAME:    ADPTR5 !850828 0804 BCY-GJC
   ORIG VS IS CALBR40205-1000---BCY
7  ! ADP11 INSERTED AT LINE 9000 THIS VERSION
9    OPTION BASE 1
12   DIM F_list(11),Path(11),Amps(5),Line(11),Fstop_a(11),Famps(6)
13   DIM Typ$[6],Fil_nam$[6],Linput$[160],Mntno(10)
14 ! CALL Doc
22   PRINTER IS 16
23   DISP " "
24   Max_pts=11
27   Nfreqs=0
28   G1=0
30   Typ=1
31   Cal=1
33   ON ERROR GOTO Off
36   Tape$="14"
39   MASS STORAGE IS ":T"&Tape$
40   MASS STORAGE IS ":F8,1"
42   Print$="0"
45   OFF ERROR
48   GOTO Freq
51   Off: OFF ERROR
54   Print$="7,1"
57   GOTO Freq
60   Task:    PRINT  CHR$(12);LIN(5);TAB(10);CHR$(7);"ENTER  OPTION
            NUMBER FOR NEXT OPERATION:"
61   IF Proc<0 THEN INPUT "NUMBER OF FREQUENCIES TO PROCESS AND
     NUMBER OF Repeats",Nfreqs,Repeats
63   GOSUB Menu
66   Opt:   LINPUT "OPTION NUMBER ? ",Linput$
69         IF NOT FNNumi(Linput$) THEN Opt
72         Typ=VAL(Linput$)
75         IF (Typ<0) OR (Typ>5) THEN Opt
76         IF Typ>2 THEN Typ=Typ+1
78         IF Typ>5 THEN End
79         IF Proc=-1 THEN Proc=0
80         IF Typ=5 THEN CALL Gamma(Nfreqs,Repeats,Ca$)
81         IF Typ=5 THEN GOTO 22
83   Freq:IF Typ=1 THEN CALL Freqin(Max_pts,Nfreqs,Hi_lo_port,
            F_list(*),Path(*),Amps(*),Line(*),Lines,Fstop_a(*),
            Famps(*),Proc)
```

```
84          IF Typ>1 THEN Typ
87   GOTO Task
90   Typ:   PRINT CHR$(7);LIN(5);TAB(10);"TURN ON AMPLIFIER(S):"
93          FOR I=1 TO 5
96          IF Amps(I) THEN PRINT TAB(15);Famps(I);"-";Famps(I+1)
99          NEXT I
102         PRINT LIN(2);TAB(10);"PRESS 'CONT' WHEN READY"
105         PAUSE
108         Dim=16*(Typ<3)+4*(Typ=3)+(Typ>3)+(Typ=5)
111         IF Typ=1 THEN Typ$="FREQ"
114         IF Typ=2 THEN Typ$="PRTCAL"
115         IF Typ=4 THEN Typ$="1_PORT"
117    Cnnct:  PRINT CHR$(7);CHR$(12);LIN(5);TAB(10);"ENTER
               CONNECTOR TYPE OPTION:"
118   IF Cal=4 THEN Cal=VAL(Ca$)
119   PRINT
120   IF (Cal=2) AND (Typ=4) THEN PRINT "                    CONNECT
         ADAPTER AND 1 PORT DEVICE";CHR$(7)
121   IF (Cal=2) AND (Typ<4) THEN PRINT "            CONNECT ADAPTER "
         ;CHR$(7)
122   PRINT
123   GOSUB Menu1
124   LINPUT "ENTER OPTION NUMBER ",Linput$
126   IF NOT FNNumi(Linput$) THEN Cnnct
129   Cnnct=VAL(Linput$)
132   IF (Cnnct<1) OR (Cnnct>3) THEN Cnnct
135   IF Cnnct=1 THEN Cnnct$="NOT N"
138   IF Cnnct=2 THEN Cnnct$="TN_2L"
141   IF Cnnct=3 THEN Cnnct$="TN_2R"
144   IF Cnnct=4 THEN Cnnct$="WGN"
147   Rep2:   PRINT CHR$(12);CHR$(7)
150 ! LINPUT "ENTER # OF REPEAT MEASUREMENTS (SIDE-ARM SCANS)
         -- (1-10) ",Linput$
151   Linput$="1"
153   Tst:     IF NOT FNNumi(Linput$) THEN Rep2
156   Repeats=VAL(Linput$)
159   IF (Repeats<1) OR (Repeats>10) THEN Rep2
162   IF (Repeats>3) AND (Typ<3) THEN Rep2
163 !IF (Proc=1) AND (Typ=4) THEN GOTO Gamma1
164   IF Proc>0 THEN GOTO 171
165   Cal: DISP
168   CALL Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,
         F_list(*),Typ$,S_port,Std_mnt,Print$,Path(*),Line(*),
         Lines,Fstop_a(*),Cnnct$,Mounts,Mntno(*),Cal)
169   IF Typ=4 THEN GOTO 225
171   CALL Calres(Max_pts,Nfreqs,Repeats,Dim,Typ$,S_port,
         Std_mnt,Hi_lo_port,Print$,Cal,G1,Ca$)
174   DISP " "
177   DISP "DO YOU WANT TO SAVE SYSTEM PARAMETER DATA ON
            MASS STORAGE ?";CH$(7)
178   Flag=FNYorn
180   IF NOT Flag THEN GOTO Jump225
183   DISP " "
186   DISP "INSERT USER DISC INTO MASS STORAGE F8,0
            --- PRESS 'CONT' WHEN READY";CHR$(7)
```

```
189    PAUSE
192    File:  DISP " ";CHR$(7)
195    LINPUT "ENTER USER FILE NAME --- LESS THAN 7
               CHARACTERS",Fil_nam$
198    IF LEN(Fil_nam$)>6 THEN DISP "FILE NAME IS TOO
       LONG";CHR$(7);
201    IF LEN(Fil_nam$)>6 THEN File
204    ASSIGN #1 TO Fil_nam$&":F8,0",Check
207    ASSIGN * TO #1
210    IF Check THEN Disc
213    DISP " "
216    DISP "FILE NAME ";Fil_nam$;" IS IN USE.
           CONTINUE -- (Y/N) ?";CHR$(7);
219    IF FNYorn THEN Flag=1
220    IF Flag THEN PURGE Fil_nam$&":F8,0"
221    IF Flag THEN Disc
222    GOTO File
223    IF G1=1 THEN Ca$="3"
224    Disc:  CALL Disc_copy(Fil_nam$,Nfreqs,Typ$,Ca$)
225    Ca$=VAL$(Cal)
226    Jump225: IF Cal=4 THEN GOTO Cnnct
228    IF Cal=1 THEN GOTO 237    !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
230    IF Cal=3 THEN Task                !Gamma(Nfreqs,Repeats,Ca$)
231    GOTO 22
234    GOTO Task
235    Cal=1
236    GOTO Task
237    Cal=2
238    GOTO Cnnct
239    Menu: IF Proc<0 THEN CALL Gamma(Nfreqs,Repeats,Ca$)
240    IF Proc<0 THEN GOTO 48
243    PRINT USING Form1
244    PRINT USING Form2
245    RETURN
246    Menu1: PRINT USING Form3
249    PRINT USING Form4
252    RETURN
255    Form1: IMAGE /10X"1) INPUT FREQUENCIES"/10X"2)
               DETERMINE SYSTEM PARAMETERS WITHOUT POWER
               STANDARD"
258    Form2: IMAGE 10X"3) MEASURE 1-PORT ON ADAPTER"/10X"4)
               EVALUATE ADAPTERS"/10X"5) EXIT"
261    Form3: IMAGE /10X"1) 14mm, 7mm,OR WAVEGUIDE"/10X"2)
               TYPE N, MALE ADAPTER ON 6-PORT #1"/10X"3) TYPE N,
               MALE ADAPTER ON 6-PORT #2"
264    Form4: IMAGE 10X"4) OTHER, NOT AVAILABLE AT PRESENT"
267    End:   DISP "MEASUREMENT SESSION DONE"
268           PRINT CHR$(12)
270    Gamma1:PRINT "THIS IS Gamma"! THIS SEGMENT MUST CALL DATA
               FILES NEEDED
271    PAUSE
272    CALL Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,F_list(*),
           Typ$,S_port,Std_mnt,Print$,Path(*),Line(*),Lines,
           Fstop_a(*),Cnnct$,Mounts,Mntno(*),Cal)
273    CALL Gamma(Nfreqs)
```

44

```
274   Q=FNAdp(Nfreqs)
275   GOTO 235
276   END
279 ! FILE NAME:    FREQIN                      ! 800610-1615---BCY
```

MAIN

Amps(	12	83	96				
Ca$	80	118	171	223	224	225	239
Ca$:	0	223					
Cal	31	118	118	120	121	168	171
	225	226	228	230	235	237	272
Cal:	165						
Check	204	210					
Cnnct	129	132	132	135	138	141	144
Cnnct$	0	135	138	141	144	168	272
Cnnct$:	0	135	138	141	144		
Cnnct:	117	126	132	226	238		
Dim	108	168	171	272			
Disc:	224	210	221				
End:	267	78					
F_list(	12	83	168	272			
Famps(	12	83	96	96			
Fil_nam$	13	195	198	201	204	216	220
	224						
File:	192	201	222				
Flag	178	180	219	220	221		
Form1:	255						
Form2:	258						
Form3:	261						
Form4:	264						
Freq:	83	48	57				

Task:	60	87	230	234	236		
Tst:	153						
Typ	30	72	75	75	76	76	76
	78	80	81	83	84	108	108
	108	108	111	114	115	120	121
	162	169					
Typ$	13	111	114	115	168	171	224
	272						
Typ$:	0	111	114	115			
Typ:	90	84					

```
282   SUB Freqin(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),
         Amps(*),Line(*),Lines,Fstop_a(*),Famps(*),Proc)
285   OPTION BASE 1
288   PRINTER IS 16
291   PRINT CHR$(12)
294   DISP " "
297   Famps(1)=.25
300   Famps(2)=1
303   Famps(3)=2
306   Famps(4)=4
309   Famps(5)=8
312   Famps(6)=18
315   CALL Freq(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),Amps(*),
         Line(*),Lines,Fstop_a(*),Bail$,Proc)
318   PRINT CHR$(12)
321   DISP " "
324   SUBEND
327 ! *************** SUBPROGRAM FREQ ✴**********************
330 ! FILE NAME:   FREQ                    ! 811216-1715---BCY
```

S Freqin(

Amps(	282	315				
Bail$	315					
F_list(	282	315				
Famps(	282	297	300	303	306	309	312
Fstop_a(	282	315				
Hi_lo_port	282	315				
Line(	282	315				
Lines	282	315				
Max_pts	282	315				
Nfreqs	282	315				
Path(	282	315				
Proc	282	315				

```
333   SUB Freq(Max_pts,Nfreqs,Hi_lo_port,F_list(*),Path(*),Amps(*),
          Line(*),Lines,Fstop_a(*),Bail$,Proc)
336   OPTION BASE 1
339   DIM A$[32],Linput$[160]
342     A$="FREQUENCY INPUT/OUTPUT SECTION"
345     Center=(80-LEN(TRIM$(A$)))/2
348     PRINT TAB(Center),A$,LIN(2);CHR$(7)
351     PRINT "MAXIMUM # OF FREQUENCIES =";Max_pts
354   ! -------------- INPUT OPTIONS ---------------------------
357   P_opt1:    PRINT USING Form1;CHR$(7)
360              LINPUT "INPUT OPTION # ",Linput$
361              IF Linput$="5" THEN GOTO 428
363              IF NOT FNNumi(Linput$) THEN P_opt1
366              Opt=VAL(Linput$)
367              IF VAL(Linput$)=3 THEN Proc=1
368              IF VAL(Linput$)=4 THEN Proc=-1
369              IF Proc<0 THEN GOTO 431
370              Opt=1
371          IF (Opt<=0) OR (Opt>2) THEN P_opt1
373   P_opt2:    PRINT USING Form2;CHR$(7)
375              LINPUT "INPUT 6-PORT OPTION # ",Linput$
378              IF NOT FNNumi(Linput$) THEN P_opt2
381              S_opt=VAL(Linput$)
384          IF (S_opt<=0) OR (S_opt>2) THEN P_opt2
387              Hi_lo_port=S_opt-1
390              PRINT CHR$(12)
393   Opt:     Bail$="N"
396            Flag=0
399            ON Opt GOSUB Sss,Type
402          IF Bail$="Y" THEN GOSUB Restart
405          IF Flag THEN Opt
408          IF NOT Flag AND (Bail$="Y") THEN Exit
411   ! --------- PROCESS DATA, WHICH AIR LINE, AMPLIFIER -------
414   Round:    I=I+1
417              F_list(I)=PROUND(F_list(I),-6)
420              IF I<Nfreqs THEN Round
423              CALL Aline(Hi_lo_port,Nfreqs,F_list(*),Line(*),Lines,
                    Fstop_a(*))
426              CALL Path(Hi_lo_port,Nfreqs,F_list(*),Amps(*),Path(*))
427   GOTO 431
428   PRINT "END OF SESSION"
429   STOP
431   Exit: SUBEXIT
432   ! ---------------- START, STOP, STEP ---------------------
435   Sss:   CALL F_step(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),
                Bail$,Proc)
438   RETURN
441   ! ----------------- TYPE IN LIST --------------------------
444   Type:  CALL F_type(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),
                Bail$,Proc)
447   RETURN
450   ! ---------------- RESTART -------------------------------
453   Restart:   DISP "RESTART SAME OPTION ?--(Y/N)";CHR$(7);! retry
                      same option ?
456           IF FNYorn THEN Flag=1
```

49

```
459  RETURN
462  ! -------------- IMAGE FORMATS ---------------------------------
465  Form1:  IMAGE /"OPTIONS:"//"1. START,STOP,STEP LIST"/"2.
                   TYPE IN LIST",K!/"3. PROCESS DATA FOR ADAPT
                   LOSS"/" 4. CALCULATE ADAPTER LOSS"/"5. EXIT"
                   /,K
468  Form2:  IMAGE /"INPUT 6-PORT OPTION:"/"1) <=2GHz 6-PORT"/"2)
                   >=2 GHz 6-PORT"/,K
471  SUBEND
474  ! ************* SUBPROGRAM ALINE **********************
477  !  FILE NAME:   ALINE                    ! 811216-1600---BCY
```

S Freq(

A$	339	342	345	348			
Amps(	333	426					
Bail$	333	393	402	408	435	444	
Center	345	348					
Exit:	431	408					
F_list(	333	417	417	423	426	435	444
Flag	396	405	408	456			
Form1:	465						
Form2:	468						
Fstop_a(	333	423					
Hi_lo_port	333	387	423	426	435	444	
I	414	414	417	417	420		
Line(	333	423					
Lines	333	423					
Linput$	339	360	361	363	366	367	368
	375	378	381				
Max_pts	333	351	435	444			
Nfreqs	333	420	423	426	435	444	
Opt	366	370	371	371	399	435	444
Opt:	393	405					
P_opt1:	357	363	371				

50

P_opt2:	373	378	384			
Path(	333	426				
Proc	333	367	368	369	435	444
Restart:	453	402				
Round:	414	420				
S_opt	381	384	384	387		
Sss:	435	399				
Type:	444	399				

```
480   SUB Aline(Hi_lo_port,Nfreqs,F_list(*),Line(*),Lines,Fstop_a(*))
483   OPTION BASE 1
486   DIM F(7,Nfreqs)
489   Aline(1)=15     ! .25--<.75 GHz
492   Aline(2)=5      ! .75--2 GHz
495   Aline(3)=3      ! 2--3.75, 6.25--8.75, 11.25--13.75,
                        16.25--18 GHz
498   Aline(4)=5      ! >3.75--5.25, 9.75--<13.75 GHz
501   Aline(5)=6      ! 5.625--<6.25, >13.75--14.375,
                        15.625--<16.25 GHz
504   Aline(6)=7.5    !>8.75--9.375, 14.5--15.5 GHz
507   Aline(7)=10     !>5.25--<5.625, >9.375--<9.75, >15.5
                        --<15.625 GHz
510       Start=J=(Hi_lo_port=1)*2
513       Stop=2+(Hi_lo_port=1)*5
516       Hi_lo=Hi_lo_port+1
519   Inc_i:    I=I+1   !----------- BEGIN LINE SORT -------------
522             X=F_list(I)
525             K=0
528             ON Hi_lo GOSUB Lo,Hi
531             Cntr(K)=Cntr(K)+1
534             F(K,I)=X
537             IF I<Nfreqs THEN Inc_i
540   Inc_j:    J=J+1
543             IF J>Stop THEN SUBEXIT
546             IF Cntr(J)=0 THEN Inc_j
549             L=0
552   Inc_l:    L=L+1
555             IF L>Nfreqs THEN Inc_j
558             IF F(J,L)=0 THEN Inc_l
561             N=N+1
564             F_list(N)=F(J,L)
567             Fstop_a(N)=Cntr(J)
570             Cnt=Aline(J)
573             Line(N)=Cnt
576             IF Cnt<>Last_cnt THEN Lines=Lines+1
579             Last_cnt=Cnt
582   GOTO Inc_l
585   Lo:   K=1
588         IF X>=.75 THEN K=2
591   RETURN
594   Hi:  IF (X>=2) AND (X<=3.75) OR (X>=6.25) AND (X<=8.75) OR
           (X>=11.25) AND (X<=13.75) OR (X>=16.25) AND (X<=18) THEN
           K=3
597        IF K THEN RETURN
600        IF (X>3.75) AND (X<=5.25) OR (X>=9.75) AND (X<13.75) THEN K=4
603        IF K THEN RETURN
606        IF (X>=5.625) AND (X<6.25) OR (X>13.75) AND (X<=14.375)
           OR (X>=15.625) AND (X<16.25) THEN K=5
609        IF K THEN RETURN
612        IF (X>8.75) AND (X<=9.375) OR (X>=14.5) AND (X<=15.5)
           THEN K=6
615        IF K THEN RETURN
618        K=7
621   RETURN
```

```
624    SUBEND
627    ! ************* SUBPROGRAM F_STEP ***********************
630    ! FILE NAME: F_STEP                        ! 811216-0830---BCY
```

S Aline(

Aline(	489	492	495	498	501	504	507
	570						
Cnt	570	573	576	579			
Cntr(	531	531	546	567			
F(	486	534	558	564			
F_list(	480	522	564				
Fstop_a(	480	567					
Hi:	594	528					
Hi_lo	516	528					
Hi_lo_port	480	510	513	516			
I	519	519	522	534	537		
Inc_i:	519	537					
Inc_j:	540	546	555				
Inc_l:	552	558	582				
J	510	540	540	543	546	558	564
	567	570					
K	525	531	531	534	585	588	594
	597	600	603	606	609	612	
	615	618					
L	549	552	552	555	558	564	
Last_cnt	576	579					
Line(	480	573					
Lines	480	576	576				
Lo:	585	528					
N	561	561	564	567	573		
Nfreqs	480	486	537	555			

```
Start              510

Stop               513    543

X                  522    534    588    594    594    594    594
                   594    594    594    594    600    600    600
                   600    606    606    606    606    606    606
                   612    612    612    612
```

```
633    SUB F_step(Opt,Hi_lo_port,Max_pts,Nfreqs,F_list(*),Bail$,Proc)
636    OPTION BASE 1
639         Bail$="N"
642         MAT F_list=ZER
645    Start:  DISP "INPUT START,STOP,STEP(GHz) e.g., 2,.1 ";CHR$(7);
648            INPUT F1,F2,F3
651            PRINT LIN(2),"FREQUENCY INPUT IS FROM";F1;"TO";F2;"STEP"
                   ;F3;"GHz";CHR$(7)
654            CALL F_limt(F1,F2,F3,Opt,Hi_lo_port,Max_pts,Error)
657            IF Error THEN Err_test
660            IF F3=0 THEN Exit
663            Nfreqs=INT((F2-F1)/F3)+1
666    Incr:   Idx=Idx+1
669            IF Idx=Nfreqs THEN Exit
672            F_list(Idx+1)=F1+Idx*F3
675            IF Idx<Nfreqs THEN Incr
678    Exit:   F_list(1)=F1
681            IF F3=0 THEN Nfreqs=1
684            SUBEXIT
687    Err_test:    Times=Times+1
690            IF Times<=2 THEN Start
693            PRINT "DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7)
696            IF FNYorn THEN Start
699            Bail$="Y"
702    SUBEND
705    ! *************** SUBPROGRAM F_TYPE ********************
708    !   FILE NAME:  F_TYPE                     ! 811216-0900---BCY
```

S F_step(

Bail$	633	639	699				
Err_test:	687	657					
Error	654	657					
Exit:	678	660	669				
F1	648	651	654	663	672	678	
F2	648	651	654	663			
F3	648	651	654	660	663	672	681
F_list(	633	642	672	678			
Hi_lo_port	633	654					
Idx	666	666	669	672	672	675	
Incr:	666	675					
Max_pts	633	654					

Nfreqs	633	663	669	675	681
Opt	633	654			
Proc	633				
Start:	645	690	696		
Times	687	687	690		

```
711   SUB F_type(Opt,Hi_lo_port,Max_pts,Nfreqs,F(*),Bail$)
714    OPTION BASE 1
717    DIM Linput$[160]
720    Bail$="N"
723    MAT F=ZER
726   Start:  I=0
729          PRINT CHR$(12)
732          DISP " "
735          PRINT "INPUT FREQUENCY LIST -- ANY ORDER"
738          PRINT LIN(1);"TERMINATE FREQUENCY LIST WITH 0
                  IF LESS THAN ";Max_pts;" FREQUENCIES";CHR$(7)
741          PRINT LIN(1);"LIST TERMINATES WITH ";Max_pts;"
                  FREQUENCIES INPUT";CHR$(10);CHR$(7)
744   Incre:  I=I+1
747          DISP "INPUT F(";I;") GHz ";CHR$(7);
750          INPUT F(I)
753          IF NOT F(I) THEN Test1
756          PRINT "#";I;F(I);"GHz"
759          IF I<>Max_pts THEN Incre
762          I=I+1
765   Test1:  IF I=1 THEN Start
768             Nfreqs=I-1
771   Chng:   GOSUB Changes
774          DISP " "
777          CALL Order(F(*),Nfreqs)
780          CALL F_limt(F(1),F(Nfreqs),0,Opt,Hi_lo_port,Max_pts,Error
783          IF Error THEN GOSUB Err_test
786          IF Error THEN Chng
789   SUBEXIT
792   Changes:    DISP "CHANGES ?--(Y/N)";CHR$(7);
795               IF NOT FNYorn THEN RETURN
798               PRINT CHR$(12)
801               I=0
804   Inc:        I=I+1
807               PRINT "#";I;F(I);" GHZ"
810               IF I<>Nfreqs THEN Inc
813   List:       DISP "FREQUENCY LIST # ?";CHR$(7);
816               LINPUT " ",Linput$
819               IF NOT FNNumi(Linput$) THEN List
822               Digit=VAL(Linput$)
825               IF (Digit<=0) OR (Digit>Nfreqs) THEN List
828               DISP "CORRECTED # ";Digit;" ";CHR$(7);
831               INPUT F(Digit)
834               PRINT LIN(1);"CORRECTED #:"
837               PRINT SPA(5);"#";Digit;SPA(2);F(Digit);" GHz";CHR$(7)
840   GOTO Changes
843   Err_test:   Times=Times+1
846               IF Times<=2 THEN RETURN
849       PRINT LIN(2);"DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7)
852               IF FNYorn THEN RETURN
855               Bail$="Y"
858   SUBEND
861    !************* SUBPROGRAM PATH ********************
864    ! FILE NAME: PATH                        ! 811216-0930---BCY
```

57

S F_type(

Bail$	711	720	855				
Changes:	792	771	840				
Chng:	771	786					
Digit	822	825	825	828	831	837	837
Err_test:	843	783					
Error	780	783	786				
F(	711	723	750	753	756	777	780
	780	807	831	837			
Hi_lo_port	711	780					
I	726	744	744	747	750	753	756
	756	759	762	762	765	768	801
	804	804	807	807	810		
Inc:	804	810					
Incre:	744	759					
Linput$	717	816	819	822			
List:	813	819	825				
Max_pts	711	738	741	759	780		
Nfreqs	711	768	777	780	810	825	
Opt	711	780					
Start:	726	765					
Test1:	765	753					
Times	843	843	846				

```
867   SUB Path(Hi_lo_port,Nfreqs,F_list(*),Amps(*),Path(*))
870   OPTION BASE 1
873     Hi_lo=Hi_lo_port+1
876   Inc_i:      I=I+1
879             IF I>Nfreqs THEN SUBEXIT
882             X=F_list(I)
885             ON Hi_lo GOSUB Lo,Hi
888             ON Amp GOSUB Amp1,Amp2,Amp3,Amp4,Amp5
891             Path(I)=Path
894             IF Amp<=Last_amp THEN Inc_i
897             Amps(Amp)=Amp
900             Last_amp=Amp
903             IF I<Nfreqs THEN Inc_i
906   SUBEXIT
909   Lo:       Amp=1
912             IF X>1 THEN Amp=2
915   RETURN
918   Hi:       Amp=3
921             IF X>4 THEN Amp=4
924             IF X>7.8 THEN Amp=5
927     RETURN
930     Amp1:    Path=1
933              IF X>.35 THEN Path=2
936              IF X>.5 THEN Path=3
939              IF X>.7 THEN Path=4
942     RETURN
945     Amp2:    Path=5
948              IF X>1.3 THEN Path=6
951     RETURN
954     Amp3:    Path=7
957              IF X>2.5 THEN Path=8
960     RETURN
963     Amp4:    Path=9
966              IF X>5.4 THEN Path=10
969     RETURN
972     Amp5:    Path=11
975              IF X>10.5 THEN Path=12
978     RETURN
981     SUBEND
984   ! ************* SUBPROGRAM F_LIMT *********************
987   ! FILE NAME:  F_LIMT                    ! 811208-1600---BCY
```

S Path(

Amp	888	894	897	897	900	909	912
	918	921	924				
Amp1:	930	888					
Amp2:	945	888					
Amp3:	954	888					
Amp4:	963	888					

59

Amp5:	972	888				
Amps(	867	897				
F_list(	867	882				
Hi:	918	885				
Hi_lo	873	885				
Hi_lo_port	867	873				
I	876	876	879	882	891	903
Inc_i:	876	894	903			
Last_amp	894	900				
Lo:	909	885				
Nfreqs	867	879	903			
Path	891	930	933	936	939	945	948
	954	957	963	966	972	975	
Path(	867	891				
X	882	912	921	924	933	936	939
	948	957	966	975			

```
990   SUB F_limt(F1,F2,F3,Opt,Hi_lo_port,Max_pts,Error)
993   OPTION BASE 1
996    Error=0
997    PRINT "HILOPORT";Hi_lo_port
999    IF Opt>1 THEN Test
1002   IF F1>F2 THEN Msg1
1005   IF F1+F3>F2 THEN Msg2
1008   IF (F1<>F2) EXOR (F3<>0) THEN Msg6
101    Min_step=(F2-F1)/(Max_pts-1)
1014   IF Min_step>F3 THEN Msg3
1017   Test:  IF Hi_lo_port AND (F2>18) OR NOT Hi_lo_port AND
              (F2>2) THEN Msg4
1020           IF Hi_lo_port AND (F1<2) OR NOT Hi_lo_port AND
              (F1<.25) THEN Msg5
1023   SUBEXIT
1026   Msg1:  PRINT "START>STOP";CHR$(7)
1029   GOTO Exit
1032   Msg2:  PRINT "STEP TOO LARGE",CHR$(7)
1035   GOTO Exit
1038   Msg3:  IMAGE "MINIMUM STEP TO COVER RANGE REQUESTED IS ",
              Z.6D," GHZ",K
1041           PRINT USING Msg3;Min_step;CHR$(7)
1044   GOTO Exit
1047   Msg4:  PRINT "HIGH FREQUENCY OUT OF BOUNDS",CHR$(7)
1050   GOTO Exit
1053   Msg5:  PRINT "LOW FREQUENCY OUT OF BOUNDS",CHR$(7)
1056   GOTO Exit
1059   Msg6: PRINT "START,STOP,STEP FREQUENCIES ARE INCONSISTENT",
              ,CHR$(7)
1062   Exit:  Error=1
1065   SUBEND
1068 ! *************** SUBROUTINE CALDAT ********************
1071 ! FILE NAME :  CALDAT                    ! 810916-2120---BCY
1074 !
```

S F_limt(

Error	990	996	1062			
Exit:	1062	1029	1035	1044	1050	1056
F1	990	1002	1005	1008	1011	1020	1020
F2	990	1002	1005	1008	1011	1017	1017
F3	990	1005	1008	1014			
Hi_lo_port	990	997	1017	1017	1020	1020
Max_pts	990	1011				
Min_step	1011	1014	1041			
Msg1:	1026	1002				

Msg2:	1032	1005
Msg3:	1038	1014
Msg4:	1047	1017
Msg5:	1053	1020
Msg6:	1059	1008
Opt	990	999
Test:	1017	999

```
1077 SUB Caldat(Max_pts,Nfreqs,Repeats,Dim,Hi_lo_port,Freq_a(*),
        Typ$,Sp,Std_mnt,Print$,Path_a(*),Line(*),Lines,Fstop_a(*),
        Cnnct$,Mounts,Sn(*),Cal)
1080 OPTION BASE 1
1083 DIM Freq_o(Nfreqs),Path_o(Nfreqs),Fstop_o(1),Type$[7],
        Id_content$[80]
1086 DIM Map(Nfreqs),Power(Nfreqs,Repeats,Dim,10),Rvg1(2),
        Rvg2(2),Pi(Nfreqs,2,Repeats,Dim),Pmnt(Nfreqs,Repeats,Dim,2)
1089 REDIM Freq_a(Nfreqs),Path_a(Nfreqs),Fstop_a(Nfreqs)
1092 PRINTER IS 16
1093 Cal$=VAL$(Cal)
1095 CALL Fdata(Nfreqs,Freq_a(*),Freq_o(*),Path_a(*),Path_o(*),
                Fstop_o(*),Map(*))
1098    Typ_flag=POS(Typ$,"P")
1101    IF Typ_flag>1 THEN Meas_x!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1104 ! -------------- CALIBRATE ALL BUT LINES ----------------
1107    End=1
1110    Devices=6
1113    Type$="ORDERED"
1116 CALL Measre(Type$,Repeats,End,Freq_o(*),Path_o(*),Line(*),
                Fstop_o(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                Sn(*))
1119 ! ----------------- MEASURE AIR LINE(S) ----------------
1122    End=4
1125    Devices=Lines
1128    Type$="AIRLINE"
1131    CALL Measre(Type$,Repeats,End,Freq_a(*),Path_a(*),Line(*),
                Fstop_a(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                Sn(*))
1134    GOTO Index
1137 ! ------------ 1-PORT, 2-PORT, POWER MOUNT ------------
1140 Meas_x:   End=1+3*(Typ_flag=2)!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1143           Devices=1+Mounts
1146           Type$="ORDERED"
1149 CALL Measre(Type$,Repeats,End,Freq_o(*),Path_o(*),Line(*),
                Fstop_o(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
                Rvg2(*),Power(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
                Sn(*))
1152 !         IF Typ_flag=4 THEN Disc
1155 !         IF Typ_flag<>3 THEN Index
1158 !         IF (Typ_flag=3) AND (Sp=3) THEN Index
1159   GOTO Index !!!!!!!!!!!!!!!!!!!!!
1161 ! ------------ ZERO POWER ARRAY FOR ONE 1-PORT------------
1164         Col=6
1167         K=1
1170         IF Sp=2 THEN Col=1
1173 Inci:   I=I+1
1176        IF I>Nfreqs THEN Index
1179         J=0
1182 Incj:   J=J+1
1185         IF J>Repeats THEN Inci
1188         L=-1
1191 Incl:   L=L+1
```

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```
1194        IF L>3 THEN Incj
1197        Power(I,J,K,L+Col)=0
1200   GOTO Incl
1203 ! ---------------- RE-INDEX POWER MATRIX ----------------
1206   Index:   I=0
1209        Stopk=16*(Typ_flag<2)+4*(Typ_flag=2)+(Typ_flag>2)
                    +(Typ_flag=4)+Mounts
1212 !          Stopk=Dim !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
1215   Inc_i:   I=I+1
1218        IF I>Nfreqs THEN Disc
1221        J=0
1224   Inc_j:   J=J+1
1227        IF J>Repeats THEN Inc_i
1230        K=0
1233   Inc_k:   K=K+1
1236        IF K>Stopk THEN Inc_j
1239        L=0
1242   Inc_l:   L=L+1
1245        IF L>4 THEN Inc_k
1248        Power(I,J,K,L+4)=Power(I,J,K,L+5)
1251   GOTO Inc_l
1254 ! ------------ DISK WRITE TO SCATCH PADS ----------------
1257   Disc:    Dtg$=FNDtg$
1260             Date$=Dtg$[1,6]
1261             Time$=Dtg$[8,13]
1262             MASS STORAGE IS ":F8,1"
1263             Ca$=VAL$(Cal)
1264   !      FOR I=1 TO 50
1265   !      IF Typ$="1_port" THEN GOTO 1269
1266   !      ASSIGN #1 TO "PWRH"&VAL$(I)&":F8,1",Check
1267   !      GOTO 1270
1269   !      ASSIGN #1 TO "1PRH"&VAL$(I)&":F8,1",Check
1270   !      ASSIGN #1 TO *
1271   !      IF Check THEN Ca$=VAL$(I)
1272   !      IF Check THEN GOTO 1276
1274   !      NEXT I
1276   ON Typ_flag+1 GOSUB Typ01,Typ01,Typ2,Typ3,Typ4
1277 PRINT CHR$(7)
1278 LINPUT "ENTER ANY 80 CHARACTER STRING TO IDENTIFY DATA",
              Id_content$
1279        CALL Wrthed(Fileo$,":F8,1",0,Date$,Time$,Typ$,Nfreqs,
                    Freq_o(*),Repeats,Sp,Std_mnt,Id_content$,
                    Cnnct$)
1280        CALL Wrtbin(Filed$,":F8,1",Power(*),Records)
1281        MASS STORAGE IS ":F8,0"
1284 ! ------------------- PRINT OUT --------------------
1287        DISP "DO YOU WANT PRINT OUT OF POWER DATA ? -- (Y/N)";
              CHR$(7);
1290        IF NOT FNYorn THEN SUBEXIT
1293        CALL Prtpwr(Print$,Nfreqs,Repeats,Typ_flag,Rvg1(*),
                    Rvg2(*),Freq_o(*),Power(*),Date$,Time$,Pi(*),
                    Mounts,Dim)
1296   SUBEXIT
1299   Typ01:   Fileo$="PWR"&"H"&Ca$
1302             Filed$="PWR"&"D"&Ca$
```

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```
1305            Records=INT(Max_pts*3*16*10*8/256)+4
1308    RETURN
1311    Typ2:   Fileo$="2PORTH"
1314            Filed$="2PORTD"
1317            Records=INT(Max_pts*10*4*10*8/256)+4
1320    RETURN
1323    Typ3:   Fileo$="1PRH"&"3"
1326            Filed$="1PRD"&"3"
1329            Records=INT(Max_pts*10*1*10*8/256)+4
1332    RETURN
1335    Typ4:   Fileo$="PRMNTH"
1338            Filed$="PRMNTD"
1341            Records=INT(Max_pts*3*10*10*8/256)+4
1344    RETURN
1347    SUBEND
1350 ! ************* SUBPROGRAM PRTPWR ********************
1353 !   FILE NAME:  PRTPWR                    ! 811217-1630---BCY

S Caldat(
```

Ca$	1263	1299	1302			
Cal	1077	1093	1263			
Cal$	1093					
Cnnct$	1077	1279				
Col	1164	1170	1197			
Date$	1260	1279	1293			
Devices	1110	1116	1125	1131	1143	1149
Dim	1077	1086	1086	1086	1293	
Disc:	1257	1218				
Dtg$	1257	1260	1261			
End	1107	1116	1122	1131	1140	1149
Filed$	1280	1302	1314	1326	1338	
Fileo$	1279	1299	1311	1323	1335	
Freq_a(	1077	1089	1095	1131		
Freq_o(	1083	1095	1116	1149	1279	1293
Fstop_a(	1077	1089	1131			
Fstop_o(	1083	1095	1116	1149		

Hi_lo_port	1077	1116	1131	1149			
I	1173	1173	1176	1197	1206	1215	1215
	1218	1248	1248				
Id_content$	1083	1278	1279				
Inc_i:	1215	1227					
Inc_j:	1224	1236					
Inc_k:	1233	1245					
Inc_l:	1242	1251					
Inci:	1173	1185					
Incj:	1182	1194					
Incl:	1191	1200					
Index:	1206	1134	1159	1176			
J	1179	1182	1182	1185	1197	1221	1224
	1224	1227	1248	1248			
K	1167	1197	1230	1233	1233	1236	1248
	1248						
L	1188	1191	1191	1194	1197	1239	1242
	1242	1245	1248	1248			
Line(	1077	1116	1131	1149			
Lines	1077	1125					
Map(	1086	1095	1116	1131	1149		
Max_pts	1077	1305	1317	1329	1341		
Meas_x:	1140	1101					
Mounts	1077	1143	1209	1293			
Nfreqs	1077	1083	1083	1086	1086	1086	1086
	1089	1089	1089	1095	1116	1131	1149
	1176	1218	1279	1293			
Path_a(	1077	1089	1095	1131			
Path_o(	1083	1095	1116	1149			
Pi(	1086	1116	1131	1149	1293		
Pmnt(	1086	1116	1131	1149			

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Power(	1086	1116	1131	1149	1197	1248	1248
	1280	1293					
Print$	1077	1293					
Records	1280	1305	1317	1329	1341		
Repeats	077	1086	1086	1086	1116	1131	1149
	1185	1227	1279	1293			
Rvg1(	1086	1116	1131	1149	1293		
Rvg2(	1086	1116	1131	1149	1293		
Sn(	1077	1116	1131	1149			
Sp	1077	1116	1131	1149	1170	1279	
Std_mnt	1077	1279					
Stopk	1209	1236					
Time$	1261	1279	1293				
Typ$	1077	1098	1116	1131	1149	1279	
Typ01:	1299	1276	1276				
Typ2:	1311	1276					
Typ3:	1323	1276					
Typ4:	1335	1276					
Typ_flag	1098	1101	1140	1209	1209	1209	1209
	1276	1293					
Type$	1083	1113	1116	1128	1131	1146	1149

```
1356    SUB Prtpwr(Print$,Nfreqs,Repeats,Typ_flag,Rvgav1(*),
                  Rvgav2(*),Freq_o(*),Power(*),Date$,Time$,Pi(*),
                  Mounts,Dim)
1359    OPTION BASE 1
1362    DISP " "
1365    IF POS(Print$,",") THEN PRINTER IS 7,1
1368    IF POS(Print$,"0") THEN PRINTER IS 0
1371    PRINT TAB(10);"RVG1 (VOLTS)";TAB(44);"RVG2 (VOLTS)";TAB(67);
            Date$&"."&Time$
1374    PRINT USING Header0;Rvgav1(1);Rvgav1(2);Rvgav2(1);Rvgav2(2)
1375    PRINT LIN(2);TAB(29);"SIDE-ARM POWER DATA"
1380    PRINT TAB(33);"MILLIWATTS"
1383    Stopk=Dim
1386    Inci:   I=I+1
1389        IF I>Nfreqs THEN Exit
1392        PRINT USING Header1;"FREQUENCY";Freq_o(I);" GHz";Repeats;
                " REPEAT(S)"
1395        PRINT LIN(1);TAB(19);"6-PORT #1";TAB(43);CHR$(124);
                TAB(59);"6-PORT #2";LIN(1)
1398        PRINT USING Header2;"MNT1 ";"MNT2 ";"MNT3 ";"MNT4 ";
                "MNT1 ";"MNT2 ";"MNT3 ";"MNT4 "
1401        K=0
1404    Inck:   K=K+1
1407        IF K>Stopk THEN Inci
1410        Swc1=Swc2=Swp1=Swp2=0
1413        IF Typ_flag>2 THEN J_loop
1416        IF Typ_flag=2 THEN Two_p
1419        IF K=1 THEN PRINT "POWER MOUNT"
1422        IF K=3 THEN PRINT "SHORT"
1425        IF K=4 THEN PRINT "OPEN"
1428        IF K=5 THEN PRINT "THRU"
1431        IF K=9 THEN PRINT "LINE"
1434        IF K=13 THEN PRINT "TWO PORT"
1437        IF (K=5) OR (K=9) OR (K=13) THEN PRINT "0 DEGREES"
1440        IF (K=6) OR (K=10) OR (K=14) THEN PRINT "90 DEGREES"
1443        IF (K=7) OR (K=11) OR (K=15) THEN PRINT "180 DEGREES"
1446        IF (K=8) OR (K=12) OR (K=16) THEN PRINT "270 DEGREES"
1449        IF (K=7) OR (K=11) OR (K=15) THEN Swc1=1
1452        IF (K=8) OR (K=12) OR (K=16) THEN Swc2=1
1455        IF Swc1 THEN K=K+1
1458        IF Swc2 THEN K=K-1
1461      GOTO J_loop
1464      Two_p: IF K=1 THEN PRINT "0 DEGREES"
1467          IF K=2 THEN PRINT "90 DEGREES"
1470          IF K=3 THEN PRINT "180 DEGREES"
1473          IF K=3 THEN Swp1=1
1476          IF K=4 THEN PRINT "270 DEGREES"
1479          IF K=4 THEN Swp2=1
1482          IF Swp1 THEN K=K+1
1485          IF Swp2 THEN K=K-1
1488    J_loop: J=0
1491    FOR J=1 TO Repeats
1494            Pinc1=PROUND(Pi(I,1,J,K),-5)
1497            IF Pinc1=0 THEN Nextjj
150             Pinc2=PROUND(Pi(I,2,J,K),-5)
```

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```
1503          PRINT "Pinc1= ";Pinc1,"Pinc2= ";Pinc2,"Pratio=";
                  PROUND(Pinc2/Pinc1,-5)
1506  Nextjj: NEXT J
1509  J=0
1512  Incj:   J=J+1
1515          IF J<=Repeats THEN L_loop
1518          PRINT
1521          IF Swc1 OR Swp1 THEN K=K-1
1524          IF Swc2 OR Swp2 THEN K=K+1
1527  GOTO Inck
1530  L_loop: L=0
1533  Incl:   L=L+1
1536          IF L>8 THEN PRINT
1539          IF L>8 THEN Incj
1542          PRINT USING Form1;Power(I,J,K,L)
1545    GOTO Incl
1548  Header0:    IMAGE #,2X,D.7D,6X
1551  Header1:    IMAGE //9A,3D.6D,4A,5X,2D,10A/
1554  Header2:    IMAGE 8(5X,5A)/
1557  Form1:      IMAGE #,2X,2D.5D
1560  Exit:  PRINTER IS 16
1563          DISP " "
1566  SUBEND
1569 ! ********** SUBPROGRAM FDATA **************************
1572 !    FILE NAME:    FDATA                ! 811217-1400---BCY

S Prtpwr(
```

Date$	1356	1371					
Dim	1356	1383					
Exit:	1560	1389					
Form1:	1557						
Freq_o(	1356	1392					
Header0:	1548						
Header1:	1551						
Header2:	1554						
I	1386	1386	1389	1392	1494	1500	1542
Inci:	1386	1407					
Incj:	1512	1539					
Inck:	1404	1527					
Incl:	1533	1545					

J	1488	1491	1494	1500	1506	1509	1512
	1512	1515	1542				
J_loop:	1488	1413	1461				
K	1401	1404	1404	1407	1419	1422	1425
	1428	1431	1434	1437	1437	1437	1440
	1440	1440	1443	1443	1443	1446	1446
	1446	1449	1449	1449	1452	1452	1452
	1455	1455	1458	1458	1464	1467	1470
	1473	1476	1479	1482	1482	1485	1485
	1494	1500	1521	1521	1524	1524	1542
L	1530	1533	1533	1536	1539	1542	
L_loop:	1530	1515					
Mounts	1356						
Nextjj:	1506	1497					
Nfreqs	1356	1389					
Pi(	1356	1494	1500				
Pinc1	1494	1497	1503	1503			
Pinc2	1500	1503	1503				
Power(	1356	1542					
Print$	1356	1365	1368				
Repeats	1356	1392	1491	1515			
Rvgav1(	1356	1374	1374				
Rvgav2(	1356	1374	1374				
Stopk	1383	1407					
Swc1	1410	1449	1455	1521			
Swc2	1410	1452	1458	1524			
Swp1	1410	1473	1482	1521			
Swp2	1410	1479	1485	1524			
Time$	1356	1371					
Two_p:	1464	1416					
Typ_flag	1356	1413	1416				

```
1575 SUB Fdata(Nfreqs,Freq_a(*),Freq_o(*),Path_a(*),Path_o(*),
          Fstop_o(*),Map(*))
1578 OPTION BASE 1
1581    MAT Fstop_o=(Nfreqs)
1584    MAT Freq_o=Freq_a
1587    MAT Path_o=Path_a
1590    CALL Order(Freq_o(*),Nfreqs)
1593    CALL Order(Path_o(*),Nfreqs)
1596 Inc_i:    I=I+1
1599          IF I>Nfreqs THEN SUBEXIT
1602          Temp=Freq_o(I)
1605          J=0
1608 Inc_j:    J=J+1
1611          IF J>Nfreqs THEN Inc_i
1614          IF Freq_a(J)<>Temp THEN Inc_j
1617          Map(J)=I
1620    GOTO Inc_i
1623 SUBEND
1626 ! *********** SUBPROGRAM   MEASURE   **********************
1629 !   FILE NAME:   MEASRE                    ! 810916-2120---BCY
```

S Fdata(

Freq_a(	1575	1584	1614			
Freq_o(	1575	1584	1590	1602		
Fstop_o(	1575	1581				
I	1596	1596	1599	1602	1617	
Inc_i:	1596	1611	1620			
Inc_j:	1608	1614				
J	1605	1608	1608	1611	1614	1617
Map(	1575	1617				
Nfreqs	1575	1581	1590	1593	1599	1611
Path_a(	1575	1587				
Path_o(	1575	1587	1593			
Temp	1602	1614				

```
1632   SUB Measre(Type$,Repeats,End,Freq(*),Path(*),Aline(*),
               Fstop(*),Hi_lo_port,Nfreqs,Devices,Rvg1(*),
               Rvg2(*),Po_out(*),Map(*),Typ$,Sp,Pi(*),Pmnt(*),
               Sn(*))
1635   OPTION BASE 1
1638   DIM Von(Repeats,10),Vinc(Repeats,10)
1641   DIM Cont$[41],Clear$[12]
1644   DIM Voff1(1,10),Voff2(1,10),Vioff1(1,10),Vioff2(1,10),
         Clir$[12]
1647   DIM Wait$[24],Clr$[18],Edit$[20],Cler$[12],Ec$[1],Clar$[12],
         Cnt$[41]
1650    Ec$=CHR$(27)
1653    Wait$="                    -- WAIT"
1656    Cont$=Ec$&"&a3r34C"&" -- PRESS 'CONTINUE' WHEN READY"
1659    Cnt$=Ec$&"&a3r26C"&" -- PRESS 'CONTINUE' WHEN READY"
1662    Clear$=Ec$&"m"&Ec$&"&a3r34C"&Ec$&"J"
1665    Clr$=Ec$&"m"&Ec$&"&a3r0C"&Ec$&"J"&Ec$&"&a3r9C"
1668    Cler$=Ec$&"m"&Ec$&"&a3r34C"&Ec$&"K"
1671    Edit$=Ec$&"&a3r16C"&Ec$&"Q"&"ED"&Ec$&"R"&Ec$&"B"&Ec$&"B"
             &Ec$&"1"
1674    Clar$=Ec$&"m"&Ec$&"&a3r26C"&Ec$&"J"
1677    Clir$=Ec$&"m"&Ec$&"&a3r28C"&Ec$&"J"
1680    Typ_flag=POS(Typ$,"P")
1683    Rvg_reads=10
1686    Voff_rds=Pwr_reads=Dvm_rds=2
1689    Nphase=End
1692    T_device=Aline(1)
1695    Mode=0
1698    CALL Fase_shft(4,Hi_lo_port)
1701    IF (Type$<>"ORDERED") AND (Nfreqs<>1) THEN Rfout
1702    IF Type$<>"ORDERED" THEN Pause
1704    IF Typ_flag=1 THEN GOSUB Device3
1707    IF Typ_flag=2 THEN GOSUB Device6
1710    IF Typ_flag=3 THEN GOSUB Device8
1713    IF Typ_flag=4 THEN GOSUB Device9
1716    IF Hi_lo_port AND (Typ_flag<>4) THEN OUTPUT 710;"5354"
1719    IF NOT Hi_lo_port OR (Typ_flag=4) THEN OUTPUT 710;"52545556"
1722    Rfout:  CALL Rfout("INIT",Path(*),Freq(*),1,1,Hi_lo_port)
1725    IF Type$<>"ORDERED" THEN Pause
1728    IF (Typ_flag=4) OR NOT Hi_lo_port THEN CALL Rvgs(Rvg_reads,
         Hi_lo_port,Typ_flag,Rvg1(*),Rvg2(*))
1731    IF (Typ_flag<>4) AND Hi_lo_port THEN CALL Rvgs(Rvg_reads,
         Hi_lo_port,Typ_flag,Rvg1(*),Rvg2(*))
1734    PRINT USING "K";Ec$&"V"
1737    WAIT 3000
1740    IF Typ_flag<>4 THEN PRINT Clear$;Cont$;CHR$(7)
1743    IF Typ_flag=4 THEN PRINT Clear$;Cnt$;CHR$(7)
1746    DISP " "
1749    Pause:   PAUSE
1752            IF Type$="ORDERED" THEN PRINT Clar$;Edit$
1755            IF Type$="AIRLINE" THEN PRINT Clear$;Edit$
1758            Stop=0
1761            Freqs=1
1764 ! ----------------- START MEASUREMENTS -----------------
1765    IF Type$<>"AIRLINE" THEN OUTPUT 717,718;"F3VR1S4T0,"
```

```
1766        CALL Fase_shft(1,Hi_lo_port)
1767      FOR Device=1 TO Devices
1770          IF Device>4 THEN Nphase=4
1773          IF Typ_flag=2 THEN Nphase=4
1776          IF Type$<>"AIRLINE" THEN Order
1779          Start=Stop+1
1782          Stop=Fstop(Freqs)+Start-1
1785          Cntphi=8
1788      GOTO Begin
1791      Order:  Start=1
1794              Stop=Nfreqs
1797      Begin:  Path=Path(Start)
1800 !          OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1803 !          CALL Preads(Voff_rds,Hi_lo_port,1,Voff1(*),Vioff1(*))
1806 ! --------------------- PHASE LOOP ----------------------
1809          FOR Phase=1 TO Nphase
1812              Cntphi=Cntphi+1
1815              IF (Cntphi=1) AND (Typ_flag=1) THEN Dev
1818              IF (Cntphi=2) AND (Typ_flag=0) THEN Cnnct
1821              IF (Cntphi=2) AND (Typ_flag<=1) THEN Dev
1824              IF Typ_flag>1 THEN Freqs
1827              IF Cntphi<>9 THEN Freqs
1830              IF Type$<>"AIRLINE" THEN Cntphi=13
1833 ! ------------- FREQUENCY AND REPEAT LOOP ---------------
1836  Freqs:     FOR Freqs=Start TO Stop
1839  Voff:      OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1842             CALL Preads(Voff_rds,Hi_lo_port,1,Voff1(*),Vioff1(*))
1845  IF Typ_flag=4 THEN CALL Pwrmnt(Rvg1(*),Rvg2(*),Repeats,Freqs,
        Device,Pwr_reads,Pmnt(*))
1848  IF Type_flag<>4 THEN OUTPUT 710 USING "4(K/)";"71";"40";
        "4";"7"
1851  Repeat:           FOR Repeat=1 TO Repeats
1854   CALL Preads(Dvm_rds,Hi_lo_port,Repeat,Von(*),Vinc(*))
1857              NEXT Repeat
1860              OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
1863             CALL Preads(Voff_rds,Hi_lo_port,1,Voff2(*),Vioff2(*))
1866              IF Nfreqs=1 THEN Pcalc
1869              IF Freqs<>Stop THEN CALL Rfout("NEXT",Path(*),
                   Freq(*),Freqs,Start,Hi_lo_port)
1872              IF Freqs<>Stop THEN Pcalc
1875              IF (Freqs=Nfreqs) OR (Phase<>4) THEN CALL Rfout
                   ("FIRST",Path(*),Freq(*),Freqs,Start,Hi_lo_port)
1878              IF (Freqs=Nfreqs) OR (Phase<>4) THEN Pcalc
1881  CALL Rfout("NEXT",Path(*),Freq(*),Freqs,Start,Hi_lo_port)
1884 ! ---------------- CALCULATE POWER ----------------------
1887  Pcalc: !
1890  CALL Pcalc(Type$,Typ$,Hi_lo_port,Repeats,Cntphi,Freqs,Rvg1(*),
        Rvg2(*),Voff1(*),Voff2(*),Von(*),Vinc(*),Po_out(*),Map(*),
        Pi(*),Vioff1(*),Vioff2(*))
1893    NEXT Freqs
1896          IF (Device>4) OR (Type$="AIRLINE") OR (Typ$="2PORT")
                AND (Freqs-1=Stop) THEN CALL Fase_shft(Phase MOD
                4+1,Hi_lo_port)
1899 ! ------------ END FREQUENCY AND REPEAT LOOP -------------
1902  FOR I=Start TO Stop
```

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```
1905        FOR J=1 TO Repeats
1908            IF Type$<>"ORDERED" THEN Aline
1911            PRINT "Pinc1= ";PROUND(Pi(I,1,J,Cntphi),-5),"Pinc2= ";
                PROUND(Pi(I,2,J,Cntphi),-5),"Pratio= ";PROUND(Pi(I,2,J,
                    Cntphi)/Pi(I,1,J,Cntphi),-5)
1914            GOTO Nxxtj
1917 Aline:  Pinc1=Pi(Map(I),1,J,Cntphi)
1920            Pinc2=Pi(Map(I),2,J,Cntphi)
1923            PRINT "Pinc1= ";PROUND(Pinc1,-5),"Pinc2= ";PROUND(Pinc2,-5),
                    "Pratio= ";PROUND(Pinc2/Pinc1,-5)
1926  Nxxtj: NEXT J
1929        FOR J=1 TO Repeats
1932            FOR K=1 TO 10
1935                IF Type$<>"ORDERED" THEN Nxtprt
1938                PRINT USING Form;Po_out(I,J,Cntphi,K)
1941        GOTO Nxtk
1944  Nxtprt:    PRINT USING Form;Po_out(Map(I),J,Cntphi,K)
1947  Nxtk:  NEXT K
1950        NEXT J
1953        PRINT
1956        PRINT
1959  NEXT I
1962            NEXT Phase
1965 ! ----------------- END PHASE LOOP ----------------------
1968            IF Typ_flag=1 THEN Test
1971            IF (Typ_flag<>4) AND (Device=1) THEN Test
1974            IF Device=Devices THEN Dev
1977            GOSUB Device2
1980            PAUSE
1983            PRINT Clir$;Edit$
1986  Test:  IF Typ_flag>1 THEN Dev
1989            IF NOT Typ_flag AND (Device=1) THEN Dev
1992  Cnnct:IF Type$<>"AIRLINE" THEN GOSUB Connect
1995            PRINT
1998            IF Type$<>"AIRLINE" THEN GOTO Paws
2001            IF Stop=Nfreqs THEN Paws
2004            Nxt_device=Aline(Stop+1)
2007            IF T_device<>Nxt_device THEN GOSUB Connect
2010            PRINT
2013            T_device=Nxt_device
2016  Paws: IF Device=Devices THEN Dev
2019  IF Typ_flag<>4 THEN PRINT Clear$;Cont$;CHR$(7)
2022            IF Typ_flag=4 THEN PRINT Clear$;Cnt$;CHR$(7)
2025            PAUSE
2028            IF Typ_flag<>4 THEN PRINT Cler$;Edit$
2031            IF Typ_flag=4 THEN PRINT Clar$;Edit$
2034  Dev:NEXT Device
2037 ! --------------- END MEASUREMENT LOOP ------------------
2040  IF Type$<>"ORDERED" THEN Exit
2043  IF NOT ((Typ_flag=0) OR (Typ_flag=4)) THEN What
2046            FOR Freqs=1 TO Nfreqs
2049                FOR Reps=1 TO Repeats
2052                FOR Device=1 TO Devices
2055                FOR Mnt=1 TO 2
2058    Po_out(Freqs,Reps,Device,4+Mnt)=Pmnt(Freqs,Reps,Device,Mnt)


                                74
```

```
2061                    NEXT Mnt
2064                      FOR I=7 TO 10
2067                         Po_out(Freqs,Reps,Device,I)=0
2070                      NEXT I
2073                    NEXT Device
2076      GOTO Rep
2079      Sp2:              Po_out(Freqs,Reps,1,1)=Po_out(Freqs,Reps,1,6)
2082                        Po_out(Freqs,Reps,1,2)=Pmnt(Freqs,Reps)
2085                      FOR I=3 TO 5
2088                         Po_out(Freqs,Reps,1,I)=0
2091                      NEXT I
2094      Rep:             NEXT Reps
2097              NEXT Freqs
2100      What:   IF Typ_flag>1 THEN Exit
2103              IF Type$<>"AIRLINE" THEN SUBEXIT
2106      Exit:   PRINT Ec$&"m";CHR$(12)
2109              OUTPUT 710 USING "4(K/)";"71";"41";"4";"7"
2112      LOCAL 717,718
2115      RESET 717,718
2118      LOCAL 728
2121      OUTPUT 710;"C"
2124      PRINT CHR$(12)
2127      DISP " "
2130      SUBEXIT
2133 ! ------------- CONNECT DEVICES SUBROUTINES --------------
2136      Connect:  DISP "CONNECT NEXT DEVICE ? -- (Y/N)";CHR$(7)
2139           D0=FNYorn
2142              IF D0 THEN T_airlin
2145              IF NOT D0 THEN PRINT Ec$&"m";CHR$(12);LIN(10);TAB(10);"
                  PROGRAM HALT -- PRESS RUN TO RESTART"
2148      STOP
2151      T_airlin: IF Type$<>"AIRLINE" THEN Which
2154              PRINT USING "#,K";Clr$;"CONNECT ";Aline(Stop+1);
                          " CM AIR LINE";Cont$;CHR$(7)
2157      RETURN
2160      Which:      ON Device+1 GOTO Device1,Device2,Device3,Device4,
                  Device5,Device6,Device72163 Device1:  PRINT "NOTHING"

2166      Device2:PRINT CHR$(12);Clr$;CHR$(7);"CONNECT MOUNT";
                      Sn(Device+1);"TO B1 AND 6-PORT 1";CHR$(13)
                      &CHR$(10);TAB(10);"MOUNT";Sn(Device+2);"TO B2"
2169           PRINT LIN(1);TAB(10);"IF MOUNT = 0, USE ANY MOUNT";
                      LIN(2);TAB(10);"
PRESS 'CONT' WHEN READY";CHR$(7);
2172      RETURN
2175      Device3:  IF Typ_flag THEN PRINT CHR$(12);Clr$;CHR$(7);
          "CONNECT SHORTS";Wait$
2178        IF NOT Typ_flag THEN PRINT CHR$(12);Clr$;CHR$(7);
            "CONNECT SHORTS";Cont$
2181      RETURN
2184      Device4:  PRINT USING "#,K";Clr$;"CONNECT OPENS";Cont$;CHR$(7)
2187      RETURN
2190      Device5:  PRINT USING "#,K";Clr$;"CONNECT THRU";Cont$;CHR$(7)
2193      RETURN
2196      Device6:  PRINT USING "#,K";Clr$;CHR$(7)
```

```
2199           IF Typ_flag<2 THEN PRINT USING "#,K";"CONNECT
                                2-PORT";Cont$
2202           IF Typ_flag=2 THEN PRINT USING "#,K";"CONNECT
                                2-PORT";Wait$
2205   RETURN
2208   Device7: PRINT USING "#,K";Clr$;"CONNECT ";Aline(1);" CM
                         AIR LINE";Cont$;CHR$(7)
2211 RETURN
2214 Device8  PRINT USING "#,K";Clr$;"CONNECT 1-PORT(S)";Wait$;
                         HR$(7)
2217 RETURN
2220 Device9:PRINT CHR$(12);Clr$;CHR$(7);"CONNECT STD MOUNT";Sn(1);
             "TO B1 AND 6-PORT 1";CHR$(13)&CHR$(10);TAB(10);
             "MOUNT WITH SERIAL NUMBER";Sn(2);"TO B2";Wait$
2223 RETURN
2226 Form:   IMAGE #,10(D.5D,X)
2229 SUBEND
2232 ! ************** SUBPROGRAM RVGS *********************
2235 !    FILE NAME:  RVGS                ! 810526-1455---BCY
```

S Measre(

Aline(	1632	1692	2004	2154	2208	
Aline:	1917	1908				
Begin:	1797	1788				
Clar$	1647	1674	1752	2031		
Clear$	1641	1662	1740	1743	1755	2019	2022
Cler$	1647	1668	2028			
Clir$	1644	1677	1983			
Clr$	1647	1665	2154	2166	2175	2178	2184
	2190	2196	2208	2214	2220	
Cnnct:	1992	1818				
Cnt$	1647	1659	1743	2022		
Cntphi	1785	1812	1812	1815	1818	1821	1827
	1830	1890	1911	1911	1911	1911	1917
	1920	1938	1944			
Connect:	2136	1992	2007			
Cont$	1641	1656	1740	2019	2154	2178	2184
	2190	2199	2208			
DO	2139	2142	2145			
Dev:	2034	1815	1821	1974	1986	1989	2016

Device	1767	1770	1845	1896	1971	1974	1989
	2016	2034	2052	2058	2058	2067	2073
	2160	2166	2166				
Device1:	2163	2160					
Device2:	2166	1977	2160				
Device3:	2175	1704	2160				
Device4:	2184	2160					
Device5:	2190	2160					
Device6:	2196	1707	2160				
Device7:	2208	2160					
Device8:	2214	1710					
Device9:	2220	1713					
Devices	1632	1767	1974	2016	2052		
Dvm_rds	1686	1854					
Ec$	1647	1650	1656	1659	1662	1662	1662
	1665	1665	1665	1665	1668	1668	1668
	1671	1671	1671	1671	1671	1671	1674
	1674	1674	1677	1677	1677	1734	2106
	2145						
Edit$	1647	1671	1752	1755	1983	2028	2031
End	1632	1689					
Exit:	2106	2040	2100				
Form:	2226						
Freq(	1632	1722	1869	1875	1881		
Freqs	1761	1782	1836	1845	1869	1869	1872
	1875	1875	1878	1881	1890	1893	1896
	2046	2058	2058	2067	2079	2079	2082
	2082	2088	2097				
Freqs:	1836	1824	1827				
Fstop(	1632	1782					
Hi_lo_port	1632	1698	1716	1719	1722	1728	1728
	1731	1731	1766	1842	1854	1863	1869
	1875	1881	1890	1896			

I	1902	1911	1911	1911	1911	1917	1920
	1938	1944	1959	2064	2067	2070	2085
	2088	2091					
J	1905	1911	1911	1911	1911	1917	1920
	1926	1929	1938	1944	1950		
K	1932	1938	1944	1947			
Map(	1632	1890	1917	1920	1944		
Mnt	2055	2058	2058	2061			
Mode	1695						
Nfreqs	1632	1701	1794	1866	1875	1878	2001
	2046						
Nphase	1689	1770	1773	1809			
Nxt_device	2004	2007	2013				
Nxtk:	1947	1941					
Nxtprt:	1944	1935					
Nxxtj:	1926	1914					
Order:	1791	1776					
Path	1797						
Path(	1632	1722	1797	1869	1875	1881	
Pause:	1749	1702	1725				
Paws:	2016	1998	2001				
Pcalc:	1887	1866	1872	1878			
Phase	1809	1875	1878	1896	1962		
Pi(	1632	1890	1911	1911	1911	1911	1917
	1920						
Pinc1	1917	1923	1923				
Pinc2	1920	1923	1923				
Pmnt(	1632	1845	2058	2082			
Po_out(	1632	1890	1938	1944	2058	2067	2079
	2079	2082	2088				
Pwr_reads	1686	1845					

Rep:	2094	2076				
Repeat	1851	1854	1857			
Repeat:	1851					
Repeats	1632	1638	1638	1845	1851	1890	1905
	1929	2049	2049	2058	2058	2067	2079
	2079	2082	2082	2088	2094		
Rfout:	1722	1701				
Rvg1(	1632	1728	1731	1845	1890	
Rvg2(	1632	1728	1731	1845	1890	
Rvg_reads	1683	1728	1731			
Sn(	1632	2166	2166	2220	2220	
Sp	1632					
Sp2:	2079					
Start	1779	1782	1791	1797	1836	1869	1875
	1881	1902					
Stop	1758	1779	1782	1794	1836	1869	1872
	1896	1902	2001	2004	2154		
T_airlin:	2151	2142				
T_device	1692	2007	2013			
Test:	1986	1968	1971			
Typ$	1632	1680	1890	1896		
Typ_flag	1680	1704	1707	1710	1713	1716	1719
	1728	1728	1731	1731	1740	1743	1773
	1815	1818	1821	1824	1845	1968	1971
	1986	1989	2019	2022	2028	2031	2043
	2100	2175	2178	2199	2202		
Type$	1632	1701	1702	1725	1752	1755	1765
	1776	1830	1890	1896	1908	1935	1992
	1998	2040	2103	2151			
Type_flag	1848					
Vinc(	1638	1854	1890			
Vioffl(	1644	1842	1890			

Vioff2(	1644	1863	1890		
Voff1(	1644	1842	1890		
Voff2(	1644	1863	1890		
Voff:	1839				
Voff_rds	1686	1842	1863		
Von(	1638	1854	1890		
Wait$	1647	1653	2175	2202	2214	2220
What:	2100	2043			
Which:	2160	2151			

```
2238 SUB Rvgs(Reads,Hi_lo_port,Typ_flag,Rvgav1(*),Rvgav2(*))
2241 OPTION BASE 1
2244 DIM Rvg1$(Reads+1),Rvg2$(Reads+1),Temp1(Reads),Temp2(Reads)
2247 Start: Dvm1=717
2250        Dvm2=718
2253     Stopj=1
2256    IF NOT Hi_lo_port OR (Typ_flag=4) THEN OUTPUT 710;"5556"
2259    IF NOT Hi_lo_port OR (Typ_flag=4) THEN J=1
2262    IF NOT Hi_lo_port OR (Typ_flag=4) THEN Stopj=2
2265    IF NOT Hi_lo_port OR (Typ_flag=4) THEN Inc=1
2268    OUTPUT Dvm1,Dvm2 USING Initial
2271    OUTPUT 709;"0919"
2274 Incj:  J=J+1
2277        IF J>Stopj THEN Exit
2280        CALL Dvms(Reads,Rvg1$(*),Rvg2$(*))
2283        I=0
2286 Inci:  I=I+1
2289        IF I>Reads THEN Test
2292        Temp1(I)=-VAL(Rvg1$(I+1))
2295        Temp2(I)=-VAL(Rvg2$(I+1))
2298    GOTO Inci
2301 Test:  Rvgtest=Rvgav1(J)=SUM(Temp1)/Reads
2304     GOSUB Swtch
2307        Rvgtest=Rvgav2(J)=SUM(Temp2)/Reads
2310        IF NOT Hi_lo_port THEN GOSUB Swtch
2313    Maxs=Maxt=0
2316    Mins=Mint=9
2319    I=0
2322 Inc_i:  I=I+1
2325        IF I>Reads-1 THEN Var
2328        Max1=MAX(Temp1(I),Temp1(I+1))
2331        Min1=MIN(Temp1(I),Temp1(I+1))
2334        Max2=MAX(Temp2(I),Temp2(I+1))
2337        Min2=MIN(Temp2(I),Temp2(I+1))
2340        IF Max1>Maxs THEN Maxs=Max1
2343        IF Min1<Mins THEN Mins=Min1
2346        IF Max2>Maxt THEN Maxt=Max2
2349        IF Min2<Mint THEN Mint=Min2
2352    GOTO Inc_i
2355 Var:  Var1=Maxs-Mins
2358        Var2=Maxt-Mint
2361     PRINT USING "K";CHR$(27)&"&a15R"
2364     Secline:  PRINT "MAXIMUM VARIATION WITH ";Reads;
                  "READINGS ON RVG(";J+Inc;");"=";Var1;LIN(1);
                  TAB(41);"RVG(";J+Inc+1;") = ";Var2;" VOLTS"
2367          Inc=Inc+1
2370 !  IF NOT Hi_lo_port OR (Hi_lo_port=2) THEN OUTPUT 710;"5556"
2373  GOTO Incj
2376  Swtch:  IF Rvgtest<2 THEN DISP "RVG MECHANICAL SWITCH(ES)
              ARE IN THE WRONG POSITION OR SCANNER IS OFF -- PAUSE";
              CHR$(7)
2379          IF Rvgtest>2 THEN RETURN
2382          PAUSE
2385          LOCAL Dvm1,Dvm2
2388          RESET Dvm1,Dvm2
```

81

```
2391        WAIT 3000
2394        GOTO Start
2397 Exit:  OUTPUT 709;"C"
2400   LOCAL Dvm1,Dvm2
2403   RESET Dvm1,Dvm2
2406   IF Hi_lo_port AND (Typ_flag<>4) THEN OUTPUT 710;"5,5354"
2409 Initial:IMAGE "F3VR1S7T0,"
2412 SUBEND
2415 ! *************** SUBPROGRAM DVMS ********************
2418 !   FILE NAME:   DVMS                ! 810514-1805---BCY
```

S Rvgs(

Dvm1	2247	2268	2385	2388	2400	2403	
Dvm2	2250	2268	2385	2388	2400	2403	
Exit:	2397	2277					
Hi_lo_port	2238	2256	2259	2262	2265	2310	2406
I	2283	2286	2286	2289	2292	2292	2295
	2295	2319	2322	2322	2325	2328	2328
	2331	2331	2334	2334	2337	2337	
Inc	2265	2364	2364	2367	2367		
Inc_i:	2322	2352					
Inci:	2286	2298					
Incj:	2274	2373					
Initial:	2409						
J	2259	2274	2274	2277	2301	2307	2364
	2364						
Max1	2328	2340	2340				
Max2	2334	2346	2346				
Maxs	2313	2340	2340	2355			
Maxt	2313	2346	2346	2358			
Min1	2331	2343	2343				
Min2	2337	2349	2349				
Mins	2316	2343	2343	2355			
Mint	2316	2349	2349	2358			

Reads	2238	2244	2244	2244	2244	2280	2289
	2301	2307	2325	2364			
Rvg1$(	2244	2280	2292				
Rvg2$(	2244	2280	2295				
Rvgav1(	2238	2301					
Rvgav2(	2238	2307					
Rvgtest	2301	2307	2376	2379			
Secline:	2364						
Start:	2247	2394					
Stopj	2253	2262	2277				
Swtch:	2376	2304	2310				
Temp1(	2244	2292	2301	2328	2328	2331	2331
Temp2(	2244	2295	2307	2334	2334	2337	2337
Test:	2301	2289					
Typ_flag	2238	2256	2259	2262	2265	2406	
Var1	2355	2364					
Var2	2358	2364					
Var:	2355	2325					

```
2421 SUB Dvms(Reads,V1$(*),V2$(*))
2424 OPTION BASE 1
2427      Dvm1=717
2430      Dvm2=718
2433          ON INT #7,2 GOSUB Srq
2436          CONTROL MASK 7;128
2439          CARD ENABLE 7
2442          OUTPUT Dvm1,Dvm2;"@"
2445          I=1
2448          Reads1=Reads+1
2451 Idle: !
2454    GOTO Idle
2457 Srq:       ENTER Dvm1 BINT NOFORMAT;V1$(I)
2460          IF I=Reads1 THEN Dvm2
2463          OUTPUT Dvm1;"@"
2466 Dvm2:      ENTER Dvm2 BINT NOFORMAT;V2$(I)
2469          IF I=Reads1 THEN Exit
2472          OUTPUT Dvm2;"@"
2475          I=I+1
2478 RETURN
2481 Exit:  OUTPUT Dvm1,Dvm2;"%"
2484 SUBEND
2487 ! *************** READ POWER ***************************
2490 ! FILE NAME:  PREADS                    ! 810608-1110---BCY
```

S Dvms(

Dvm1	2427	2442	2457	2463	2481		
Dvm2	2430	2442	2466	2472	2481		
Dvm2:	2466	2460					
Exit:	2481	2469					
I	2445	2457	2460	2466	2469	2475	2475
Idle:	2451	2454					
Reads	2421	2448					
Reads1	2448	2460	2469				
Srq:	2457	2433					
V1$(	2421	2457					
V2$(	2421	2466					

```
2493 SUB Preads(Reads,Hi_lo_port,Repeat,Volts(*),Vinc(*))
2496 OPTION BASE 1
2499 DIM Decade$[4],V1$(Reads+1),V2$(Reads+1),Temp1(Reads),
         Temp2(Reads)
2502 !  IF Repeat=1 THEN OUTPUT 717,718 USING Initial
2505    Mnt=1
2508    Incr=1
2511    Incp$="00"
2514    Port$="3"     ! port #1
2517 !      IF NOT Hi_lo_port THEN OUTPUT 710;"5556"
2520 Incmnt: Mnt=Mnt+1
2523         IF Mnt>9 THEN Exit
2526         Mnt$=VAL$(Incr)
2529         OUTPUT 709;Incp$&Port$&Mnt$
2532         IF Mnt>5 THEN Mnt789
2535         CALL Dvms(Reads,V1$(*),V2$(*))
2538         FOR I=1 TO Reads
2541            Temp1(I)=VAL(V1$(I+1))     ! Mnt1
2544            Temp2(I)=VAL(V2$(I+1))     ! Mnt234
2547         NEXT I
2550    GOSUB Ave
2553    GOTO Incr
2556 Mnt789: CALL Dvms(Reads,V1$(*),V2$(*))
2559         FOR I=1 TO Reads
2562            Temp1(I)=VAL(V2$(I+1))     ! Mnt1
2565            Temp2(I)=VAL(V1$(I+1))     ! Mnt789
2568         NEXT I
2571    GOSUB Ave
2574 Incr:   Incr=Incr+1
2577         IF (Mnt<4) OR (Mnt>6) THEN GOTO Incmnt
2580          Mnt=Mnt+2
2583          Port$="2"
2586          Incp$="10"
2589          Incr=1
2592          OUTPUT 709;"C"
2595    GOTO Incmnt
2598 Exit: OUTPUT 709;"C"
2601 !     IF NOT Hi_lo_port THEN OUTPUT 710;"5,5254"
2604    SUBEXIT
2607 Ave: Vinc(Repeat,Mnt)=SUM(Temp1)/Reads
2610      Volts(Repeat,Mnt)=SUM(Temp2)/Reads
2613    RETURN
2616 Initial: IMAGE "F3VR1S4T0,"
2619 SUBEND
2622 ! ************** SUBPROGRAM PCALC **********************
2625 !    FILE NAME:   PCALC                  ! 810807-1800---BCY

S Preads(


Ave:              2607    2550    2571

Decade$           2499

Exit:             2598    2523
```

Hi_lo_port	2493						
I	2538	2541	2541	2544	2544	2547	2559
	2562	2562	2565	2565	2568		
Incmnt:	2520	2577	2595				
Incp$	2511	2529	2586				
Incr	2508	2526	2574	2574	2589		
Incr:	2574	2553					
Initial:	2616						
Mnt	2505	2520	2520	2523	2532	2577	2577
	2580	2580	2607	2610			
Mnt$	2526	2529					
Mnt789:	2556	2532					
Port$	2514	2529	2583				
Reads	2493	2499	2499	2499	2499	2535	2538
	2556	2559	2607	2610			
Repeat	2493	2607	2610				
Temp1(	2499	2541	2562	2607			
Temp2(	2499	2544	2565	2610			
V1$(	2499	2535	2541	2556	2565		
V2$(	2499	2535	2544	2556	2562		
Vinc(	2493	2607					
Volts(	2493	2610					

```
2628 SUB Pcalc(Type$,Typ$,Hi_lo_port,Repeats,Count,Freqs,Rvgl(*),
                Rvg2(*),Voffl(*),Voff2(*),Von(*),Vinc(*),P_out(*),
                Map(*),Pinc(*),Vioffl(*),Vioff2(*))
2631 OPTION BASE 1
2634 DIM Off_sum(1,10),Voff_ave(1,10)
2637 DIM Off_sumi(1,10),Voff_avei(1,10)
2640 DIM On(Repeats,10),Trvgl(2),Trvg2(2)
2643  Typ=POS(Typ$,"P")
2646  MAT Off_sum=Voffl+Voff2
2649  MAT Off_sumi=Vioffl+Vioff2
2652  MAT Voff_ave=Off_sum/(2)
2655  MAT Voff_avei=Off_sumi/(2)
2658  MAT On=Von
2661   GOTO Skprtl
2664   PRINTER IS 7,1      ! FOR PRINTOUT OF
2667   MAT PRINT Voffl     ! VOFFS AND VONS
2670   MAT PRINT Vioffl
2673   MAT PRINT Voff2
2676   MAT PRINT Vioff2
2679   MAT PRINT Von
2682   MAT PRINT Vinc
2685   PRINTER IS 16
2688 Skprtl: !
2691   MAT Trvgl=Rvgl*(2)
2694   MAT Trvg2=Rvg2*(2)
2697  F=Freqs
2700 Rep:  Rep=Rep+1
2703      IF Rep>Repeats THEN SUBEXIT
2706      Mnt=1
2709 Mnt:  Mnt=Mnt+1
2712      IF Mnt>4 THEN Rep
2715       Inc=NOT Hi_lo_port OR (Typ=4)
2718       Sum1=On(Rep,Mnt)+Voff_ave(1,Mnt)+Trvg2(1+Inc)
2721       Sum1i=Vinc(Rep,Mnt)+Voff_avei(1,Mnt)+Trvgl(1+Inc)
2724       Sum2=On(Rep,Mnt+5)+Voff_ave(1,Mnt+5)+Trvgl(1+Inc)
2727       Sum2i=Vinc(Rep,Mnt+5)+Voff_avei(1,Mnt+5)+Trvg2(1+Inc)
2730       Dell=Voff_ave(1,Mnt)-On(Rep,Mnt)
2733       Delli=Voff_avei(1,Mnt)-Vinc(Rep,Mnt)
2736       Del2=Voff_ave(1,Mnt+5)-On(Rep,Mnt+5)
2739       Del2i=Voff_avei(1,Mnt+5)-Vinc(Rep,Mnt+5)
2742       IF Type$="AIRLINE" THEN A_line
2745       IF Mnt>2 THEN Skip
2748       Pinc(F,1,Rep,Count)=5*Sum1i*Delli       !for display
2751       P_out(F,Rep,Count,2)=5*Sum1*Dell/(5*Sum1i*Delli)
2754       Pinc(F,2,Rep,Count)=5*Sum2i*Del2i       !for display
2757       P_out(F,Rep,Count,7)=5*Sum2*Del2/(5*Sum2i*Del2i)
2760       P_out(F,Rep,Count,1)=P_out(F,Rep,Count,6)=1
2763    GOTO Mnt
2766 Skip:  Pinc1=5*Sum1i*Delli
2769        P_out(F,Rep,Count,Mnt)=5*Sum1*Dell/Pinc1
2772        Pinc2=5*Sum2i*Del2i
2775        P_out(F,Rep,Count,Mnt+5)=5*Sum2*Del2/Pinc2
2778    GOTO Mnt
2781 A_line:    IF Mnt>2 THEN Skp
2784        Pinc(Map(F),1,Rep,Count)=5*Sum1i*Delli
```

```
2787          Pinc(Map(F),2,Rep,Count)=5*Sum2i*Del2i
2790          P_out(Map(F),Rep,Count,1)=P_out(Map(F),Rep,Count,6)=1
2793          P_out(Map(F),Rep,Count,2)=5*Sum1*Del1/(5*Sum1i*Del1i)
2796          P_out(Map(F),Rep,Count,7)=5*Sum2*Del2/(5*Sum2i*Del2i)
2799    GOTO Mnt
2802 Skp:  Pinc1=5*Sum1i*Del1i
2805          Pinc2=5*Sum2i*Del2i
2808            P_out(Map(F),Rep,Count,Mnt)=5*Sum1*Del1/Pinc1
2811            P_out(Map(F),Rep,Count,Mnt+5)=5*Sum2*Del2/Pinc2
2814    GOTO Mnt
2817    SUBEND
2820 ! ********** SUBROUTINE SYNTHESIZER *****************
2823 ! FILE NAME:   SYNTH              ! 811208-1700---DHR & BCY

S Pcalc(
```

A_line:	2781	2742					
Count	2628	2748	2751	2754	2757	2760	2760
	2769	2775	2784	2787	2790	2790	2793
	2796	2808	2811				
Del1	2730	2751	2769	2793	2808		
Del1i	2733	2748	2751	2766	2784	2793	2802
Del2	2736	2757	2775	2796	2811		
Del2i	2739	2754	2757	2772	2787	2796	2805
F	2697	2748	2751	2754	2757	2760	2760
	2769	2775	2784	2787	2790	2790	2793
	2796	2808	2811				
Freqs	2628	2697					
Hi_lo_port	2628	2715					
Inc	2715	2718	2721	2724	2727		
Map(	2628	2784	2787	2790	2790	2793	2796
	2808	2811					
Mnt	2706	2709	2709	2712	2718	2718	2721
	2721	2724	2724	2727	2727	2730	2730
	2733	2733	2736	2736	2739	2739	2745
	2769	2775	2781	2808	2811		
Mnt:	2709	2763	2778	2799	2814		
Off_sum(	2634	2646	2652				
Off_sumi(	2637	2649	2655				

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On(	2640	2658	2718	2724	2730	2736	
P_out(	2628	2751	2757	2760	2760	2769	2775
	2790	2790	2793	2796	2808	2811	
Pinc(	2628	2748	2754	2784	2787		
Pinc1	2766	2769	2802	2808			
Pinc2	2772	2775	2805	2811			
Rep	2700	2700	2703	2718	2721	2724	2727
	2730	2733	2736	2739	2748	2751	2754
	2757	2760	2760	2769	2775	2784	2787
	2790	2790	2793	2796	2808	2811	
Rep:	2700	2712					
Repeats	2628	2640	2703				
Rvg1(	2628	2691					
Rvg2(	2628	2694					
Skip:	2766	2745					
Skp:	2802	2781					
Skprt1:	2688	2661					
Sum1	2718	2751	2769	2793	2808		
Sum1i	2721	2748	2751	2766	2784	2793	2802
Sum2	2724	2757	2775	2796	2811		
Sum2i	2727	2754	2757	2772	2787	2796	2805
Trvg1(	2640	2691	2721	2724			
Trvg2(	2640	2694	2718	2727			
Typ	2643	2715					
Typ$	2628	2643					
Type$	2628	2742					
Vinc(	2628	2682	2721	2727	2733	2739	
Vioff1(	2628	2649	2670				
Vioff2(	2628	2649	2676				
Voff1(	2628	2646	2667				

```
Voff2(            2628    2646    2673

Voff_ave(         2634    2652    2718    2724    2730    2736

Voff_avei(        2637    2655    2721    2727    2733    2739

Von(              2628    2658    2679
```

```
2826 SUB Synth(Mode,Freq,Last_freq,Level)
2827 !INSERTED GO TO AND CALL STATEMENT AT 2830 AND 2928
     RESP. 850724 1443 GJC
2829   Addr=728
2832   IF Level>6 THEN DISP "TOO MUCH SYNTHESIZER LEVEL CONTROL -- PROGRAM HALT"
2835   IF Level>6 THEN STOP
2838   Lvl=Level
2841   Freq_mhz=Freq*1E6
2844   IF (Freq>=2) AND (Last_freq<2) OR (Freq<2) AND (Last_freq>
         =2) THEN Attn_flag=1
2847   IF Attn_flag THEN Attn=6
2850   IF Attn_flag THEN Lo_lvl
2853    Attn=INT(ABS(Lvl/10))+2
2856   Lo_lvl:   Lo_lvl=350
2859           OUTPUT Addr USING Lvlout;Attn,Lo_lvl
2862           OUTPUT Addr USING Mode;Mode
2865           OUTPUT Addr USING Freq;Freq_mhz
2868           IF Attn_flag THEN Attn=INT(ABS(Lvl/10))+2
2871           Lvlout=ABS(Lvl*10-240)-(Attn-1)*100-(Lvl>0)
2874           OUTPUT Addr USING Lvlout;Attn,Lvlout
2877           Status$=VAL$(4)
2880 Status:   ENTER Addr;Status$
2883           Temp=VAL(Status$)
2886           IF NOT Temp THEN SUBEXIT
2889           Cnt=Cnt+1
2892           IF Cnt<101 THEN Status
2895           IF Temp=1 THEN PRINT "UNLOCKED";CHR$(7)
2898           IF Temp=2 THEN PRINT "UNLEVELED";CHR$(7)
2901           IF Temp=3 THEN PRINT "UNLOCKED & UNLEVELED";CHR$(7)
2904           Countr=Countr+1
2907           IF Countr<51 THEN Status
2910           DISP "DO YOU WANT TO CONTINUE ? -- (Y/N)";CHR$(7);
2913           Cnt=Countr=0
2916           IF FNYorn THEN Status
2919 STOP
2922 Mode: IMAGE "O",D
2925 Freq: IMAGE "H",8Z
2928 Lvlout:  IMAGE "N",D,3Z
2933 SUBEND
2934 ! ********** SUBPROGRAM FILTER ***********************
2937 ! FILE NAME:   FILTER                  ! 810522-1630---BCY
```

S Synth(

Addr	2829	2859	2862	2865	2874	2880
Attn	2847	2853	2859	2868	2871	2874
Attn_flag	2844	2847	2850	2868		
Cnt	2889	2889	2892	2913		
Countr	2904	2904	2907	2913		

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Freq	2826	2841	2844	2844	
Freq:	2925				
Freq_mhz	2841	2865			
Last_freq	2826	2844	2844		
Level	2826	2832	2835	2838	
Lo_lvl	2856	2859			
Lo_lvl:	2856	2850			
Lvl	2838	2853	2868	2871	2871
Lvlout	2871	2874			
Lvlout:	2928				
Mode	2826	2862			
Mode:	2922				
Status$	2877	2880	2883		
Status:	2880	2892	2907	2916	
Temp	2883	2886	2895	2898	2901

```
2940 SUB Filter(Path)
2943 DIM Table$(12,2)[6],Data$[6],Pos$[2]
2946   Scanner=710
2949   Table$(1,1)="606162"
2952   Table$(1,2)=Null$
2955   Table$(2,1)="6061"
2958   Table$(2,2)="62"
2961   Table$(3,1)="6063"
2964   Table$(3,2)="61"
2967   Table$(4,1)="60"
2970   Table$(4,2)="6163"
2973   Table$(5,1)="64"
2976   Table$(5,2)="60"
2979   Table$(6,1)=Null$
2982   Table$(6,2)="6064"
2985   Table$(7,1)="656667"
2988   Table$(7,2)=Null$
2991   Table$(8,1)="6566"
2994   Table$(8,2)="67"
2997   Table$(9,1)="6568"
3000   Table$(9,2)="66"
3003   Table$(10,1)="65"
3006   Table$(10,2)="6668"
3009   Table$(11,1)="69"
3012   Table$(11,2)="65"
3015   Table$(12,1)=Null$
3018   Table$(12,2)="6569"
3021   Pos$=VAL$(40+(Path>6))
3024   OUTPUT Scanner USING "4(K/)";"70";Pos$;"4";"7"
3027   Pos: Pos=Pos+1
3030     IF Pos>2 THEN SUBEXIT
3033     Data$=Table$(Path,Pos)
3036     IF Data$=Null$ THEN Pos
3039     Pos$=VAL$(40+(Pos=2))
3042     OUTPUT Scanner USING "4(K/)";Data$;Pos$;"4";"6"
3045   GOTO Pos
3048 SUBEND
3051 ! ************* SUBPROGRAM FASE_SHFT ********************
3054 ! FILE NAME:   FASE                      ! 810522-1810---BCY
```

S Filter(

Data$	2943	3033	3036	3042	
Null$	2952	2979	2988	3015	3036
Path	2940	3021	3033		
Pos	3027	3027	3030	3033	3039
Pos$	2943	3021	3024	3039	3042
Pos:	3027	3036	3045		

Scanner	2946	3024	3042				
Table$(	2943	2949	2952	2955	2958	2961	2964
	2967	2970	2973	2976	2979	2982	2985
	2988	2991	2994	2997	3000	3003	3006
	3009	3012	3015	3018	3033		

```
3057 SUB Fase_shft(I,Hi_lo_port)
3060 DIM In$[2],Out$[2],Pos_in$[2],Pos_out$[2],Off_in$[4],Off_out$[4]
3063   Temp=4*Hi_lo_port
3066   In$=VAL$(43+Temp)
3069   Out$=VAL$(44+Temp)
3072   Pos_in$=VAL$(40+((I=1) OR (I=2)))
3075   Pos_out$=VAL$(40+((I=1) OR (I=4)))
3078   Off_in$="4,"&In$
3081   Off_out$="4,"&Out$
3084   OUTPUT 710 USING "8(K/)";In$;Pos_in$;Off_in$;"4";Out$;Pos_out$;Off_out$;"4
"
3087 SUBEND
3090 ! *************** SUBPROGRAM DAC ********************
3093 ! FILE NAME: DAC                        ! 810203-1830---BCY

S Fase_shft(
```

Hi_lo_port	3057	3063			
I	3057	3072	3072	3075	3075
In$	3060	3066	3078	3084	
Off_in$	3060	3078	3084		
Off_out$	3060	3081	3084		
Out$	3060	3069	3081	3084	
Pos_in$	3060	3072	3084		
Pos_out$	3060	3075	3084		
Temp	3063	3066	3069		

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```
3096  SUB Dac(Volts,Dac_err)
3099   Dac=706
3102   Dac_err=0
3105  IF (Volts<0) OR NOT (Volts<1) THEN Dac_err=1
3108  IF Dac_err THEN SUBEXIT
3111   Data$=VAL$(1000+INT(Volts/.001+.5))
3114   OUTPUT Dac USING "#,K";Data$
3117   SENDBUS Dac;191
3120 SUBEND
3123 ! ************* FUNCTION DTG-DATE TIME GROUP **************
3126 ! FILE NAME:  FNDTG$                          ! 80513-17300---BCY
```

S Dac(

Dac	3099	3114	3117	
Dac_err	3096	3102	3105	3108
Data$	3111	3114		
Volts	3096	3105	3105	3111

```
3129 DEF FNDtg$
3130  ! !!!!!CHANGED DATE FROM 84 TO 85 850724:GJC
3132  OUTPUT 9;"Read"
3135  ENTER 9;A$
3138  Dtg$="85"&A$[1,2]&A$[4,5]&"."&A$[7,8]&A$[10,11]&A$[13,14]
3141 RETURN Dtg$
3144 FNEND
3147 ! *************** FUNCTION FNYORN *******************
3150 ! FILE NAME:   FNYORN                 ! 810101-1600---BCY
```

FNDtg$

A$ 3135   3138   3138   3138   3138   3138

Dtg$ 3138   3141

```
3153 DEF FNYorn
3156 Key: Key=READBIN(0)
3159      N=Answer=NOT ((Key=78) OR (Key=110))
3162      Y=Answer=(Key=89) OR (Key=121)
3165      IF NOT Y AND N THEN Key
3168      DISP
3171 RETURN Answer
3174 FNEND
3177 ******************* FUNCTION FNNUMI *******************
3180 ! FILE NAME:  FNNUMI                    ! 810101-1600---BCY
```

FNYorn

Answer	3159	3162	3171		
Key	3156	3159	3159	3162	3162
Key:	3156	3165			
N	3159	3165			
Y	3162	3165			

```
3183 DEF FNNumi(Linput$)
3186    Length=LEN(TRIM$(Linput$))
3189    IF NOT Length THEN RETURN 0
3192 Inci: I=I+1
3195        IF I>Length THEN RETURN 1
3198        Num=NUM(Linput$[I])
3201        IF (Num<=47) OR (Num>=58) THEN RETURN 0
3204    GOTO Inci
3207 FNEND
3210 ! **************** FUNCTION FNNUMD *********************
3213 !   FILE NAME:  FNNUMD                 ! 820302-1700---BCY
```

FNNumi(

I	3192	3192	3195	3198
Inci:	3192	3204		
Length	3186	3189	3195	
Linput$	3183	3186	3198	
Num	3198	3201	3201	

```
3216 DEF FNNumd(Linput$)
3219    Dec=0
3222    Len=LEN(TRIM$(Linput$))                              ! length
3225    IF NOT Len=0 THEN RETURN 0                           ! non-ASCII
3228 Inci: I=I+1
3231        IF I>Len THEN RETURN 1                           ! passes ok
3234        Num=NUM(Linput$[I])                              ! decimal value
3237        IF Num=46 THEN Test                              ! test decimal point
3240        IF (Num<=47) OR (Num>=58) THEN RETURN 0  ! not a number
3243    GOTO Inci
3246 Test: IF Num=46 THEN Dec=Dec+1                          ! a period
3249        IF (Dec>1) OR (LEN(Linput$)=1) THEN RETURN 0 ! none or too many or
3252    GOTO Inci                                            ! no number following
3255    SUBEND
3258 ! ************** SUBPROGRAM ORDER *************************
3261 !    FILE NAME:  ORDER                        ! 820107-1530---BCY
```

FNNumd(

Dec	3219	3246	3246	3249	
I	3228	3228	3231	3234	
Inci:	3228	3243	3252		
Len	3222	3225	3231		
Linput$	3216	3222	3234	3249	
Num	3234	3237	3240	3240	3246
Test:	3246	3237			

```
3264 SUB Order(F(*),Nfreqs)
3267 OPTION BASE 1
3270   IF Nfreqs=1 THEN SUBEXIT
3273   Stop_i=INT(Nfreqs/2)
3276   Inc_i: I=J=I+1
3279        IF I>Stop_i THEN SUBEXIT
3282        Min=Max=F(I)
3285        L=K=0
3288        Stop_j=Nfreqs-I+1
3291   Inc_j: J=J+1
3294        IF J>Stop_j THEN Swtch
3297        Compare=F(J)
3300        IF Compare>Min THEN Max
3303        K=J
3306        Min=Compare
3309   Max:  IF Compare<Max THEN Inc_j
3312          L=J
3315          Max=Compare
3318   GOTO Inc_j
3321   Swtch:IF F(I)=Min THEN Skip
3324        F(K)=F(I)
3327        F(I)=Min
3330   Skip: IF F(Stop_j)=Max THEN Inc_i
3333        IF NOT L THEN L=K
3336        F(L)=F(Stop_j)
3339        F(Stop_j)=Max
3342   GOTO Inc_i
3345   SUBEND
3348 ! ***************************************************
```

S Order(

Compare	3297	3300	3306	3309	3315	
F(	3264	3282	3297	3321	3324	3324	3327
	3330	3336	3336	3339		
I	3276	3276	3279	3282	3288	3321	3324
	3327					
Inc_i:	3276	3330	3342			
Inc_j:	3291	3309	3318			
J	3276	3291	3291	3294	3297	3303	3312
K	3285	3303	3324	3333		
L	3285	3312	3333	3333	3336	
Max	3282	3309	3315	3330	3339	
Max:	3309	3300				

```
Min                3282    3300    3306    3321    3327

Nfreqs             3264    3270    3273    3288

Skip:              3330    3321

Stop_i             3273    3279

Stop_j             3288    3294    3330    3336    3339

Swtch:             3321    3294
```

```
3351 SUB Avg(Ave(*),Var(*),X(*),N)          ! 811108-0900---BCY
3354 OPTION BASE 1
3357 MAT Var-Var*(N-2)
3360 MAT X=X-Ave
3363 MAT X=X/(N)
3366 MAT Ave=X+Ave
3369 MAT X=X.X
3372 MAT X=X*((N-1)*N)
3375 MAT Var-Var+X
3378 MAT Var-Var/(N-1)
3381 SUBEND
3384 ! **************** SUBPROGRAM RFOUT *********************
3387 !   FILE NAME:  RFOUT                        ! 820130-1300---BCY
```

S Avg(

Ave(	3351	3360	3366	3366			
N	3351	3357	3363	3372	3372	3378	
Var(	3351	3357	3357	3375	3375	3378	3378
X(	3351	3360	3360	3363	3363	3366	3369

```
3390 SUB Rfout(Kind$,Path(*),Freq(*),Freqs,Start,Hilo)
3393 OPTION BASE 1
3396  Mode=0
3399  IF Kind$="NEXT" THEN Next
3402  IF Kind$="FIRST" THEN First
3405  N_freq=L_freq=Freq(1)
3408   Path=Path(1)
3411 GOTO Call
3414 First:N_freq=Freq(Start)
3417       L_freq=Freq(Freqs)
3420        Path=Path(Start)
3423 GOTO Call
3426 Next:N_freq=Freq(Freqs+1)
3429       L_freq=Freq(Freqs)
3432        Path=Path(Freqs+1)
3435 Call:CALL Filter(Path)
3438       CALL Pset(N_freq,Hilo,Dac_volt,Level)
3441       CALL Dac(Dac_volt,Err)
3444       CALL Synth(Mode,N_freq,L_freq,Level)
3447 SUBEND
3450 ! *************** SUBPROGRAM PSET *********************
3453 ! FILE NAME: PSET                    ! 820000-0000---BCY
3454 !******** RENAMED SUB PSET TO PSETDEL 850724:1446:GJC
```

S Rfout(

Call:	3435	3411	3423		
Dac_volt	3438	3441			
Err	3441				
First:	3414	3402			
Freq(	3390	3405	3414	3417	3426	3429
Freqs	3390	3417	3426	3429	3432
Hilo	3390	3438			
Kind$	3390	3399	3402		
L_freq	3405	3417	3429	3444	
Level	3438	3444			
Mode	3396	3444			
N_freq	3405	3414	3426	3438	3444
Next:	3426	3399			
Path	3408	3420	3432	3435	
Path(	3390	3408	3420	3432	
Start	3390	3414	3420		

```
3456 SUB Pset(Frq,Hi_lo,Dac_volt,Level)
3459          IF (Frq<=1) AND NOT Hi_lo THEN Range00
3462          IF (Frq<=2) AND NOT Hi_lo THEN Range0
3465          IF Frq<=4 THEN Flag=1
3468          IF (Frq>4) AND (Frq<=7.5) THEN Flag=2
3471          IF (Frq>7.5) AND (Frq<=7.8) THEN Flag=3
3472          IF (Frq>7.8) AND (Frq<8) THEN Flag=4
3477          IF (Frq>=8) AND (Frq<=10.5) THEN Flag=5
3480          IF (Frq>10.5) AND (Frq<=10.9) THEN Flag=6
3483          IF (Frq>10.9) AND (Frq<12) THEN Flag=7
3486          IF (Frq>=12) AND (Frq<14.0) THEN Flag=8
3489          IF (Frq>=14.0) AND (Frq<=15.9) THEN Flag=9
3492          IF (Frq>15.9) AND (Frq<=16.9) THEN Flag=10
3493          IF Frq>16.9 THEN Flag=11
3495          ON Flag GOTO Range1,Range2,Range3,Range4,Range5,
                         Range6,Range7,Range8,Range9,Range10,
                         Range11
3498 Range00: Dac_volt=.60
3501           Level=-5
3504    SUBEXIT
3507 Range0: Dac_volt=.55
3510           Level=-6
3513    SUBEXIT
3516 Range1: Dac_volt=.63
3519           Level=-5
3522    SUBEXIT
3525 Range2: Dac_volt=.59
3528           Level=-2
3531    SUBEXIT
3534 Range3: Dac_volt=.59
3537           Level=3
3540    SUBEXIT
3543 Range4: Dac_volt=.59
3546           Level=-18
3549    SUBEXIT
3552 Range5: Dac_volt=.59
3555           Level=-18
3558    SUBEXIT
3561 Range6: Dac_volt=.59
3564           Level=-19
3567    SUBEXIT
3570 Range7:   Dac_volt=.63
3573           Level=-15
3576    SUBEXIT
3579 Range8: Dac_volt=.63
3582           Level=-11
3585    SUBEXIT
3588 Range9: Dac_volt=.63
3591           Level=0
3594    SUBEXIT
3597 Range10: Dac_volt=.63
3598           Level=0
3600    SUBEXIT
3601 Range11: Dac_volt=.63
3602           Level=6
```

```
3603 SUBEND
3606 ! ***************** OVERLAY CALRES *********************
3609 !   FILE NAME: CALRES                    ! 810923-1330---BCY

S Pset(


Dac_volt           3456    3498    3507    3516    3525    3534    3543
                   3552    3561    3570    3579    3588    3597    3601

Flag               3465    3468    3471    3472    3477    3480    3483
                   3486    3489    3492    3493    3495

Frq                3456    3459    3462    3465    3468    3468    3471
                   3471    3472    3472    3477    3477    3480    3480
                   3483    3483    3486    3486    3489    3489    3492
                   3492    3493

Hi_lo              3456    3459    3462

Level              3456    3501    3510    3519    3528    3537    3546
                   3555    3564    3573    3582    3591    3598    3602

Range00:           3498    3459

Range0:            3507    3462

Range10:           3597    3495

Range11:           3601    3495

Range1:            3516    3495

Range2:            3525    3495

Range3:            3534    3495

Range4:            3543    3495

Range5:            3552    3495

Range6:            3561    3495

Range7:            3570    3495

Range8:            3579    3495

Range9:            3588    3495
```

```
3612 SUB Calres(Max_pts,Nfreqs,Repeats,Dim,Typ$,Sp,Std,Hi_lo_port,
              Prt$,Cal,Gl,Ca$)
3615 OPTION BASE 1
3618 DIM Date$[6],Time$[6],D(16,8),Id_cont$[80]
3621 DIM Freqs(Nfreqs),Power(Nfreqs,Repeats,Dim,10),File$[11],
        Dsk_nam$[11]
3624 DIM Result(Nfreqs,60),Omitf(Nfreqs),Aver(87),Var(87),
        Rd(Nfreqs,2,12)
3625   Ca$=VAL$(Cal)
3626   Freq=0
3627   DISP " "
3628    From_file$="PWR"&"D"&Ca$
3629    F_oh_file$="PWR"&"H"&Ca$
3630   PRINTER IS 16
3632   Typ=POS(Typ$,"P")
3633   Fl$=VAL$(Typ+1)
3636   IF Ca$="3" THEN From_file$="PWRD2"
3637   IF Ca$="3" THEN F_oh_file$="PWRH2"
3638   GOTO 3641
3639 ! From_file$="PWR"&"D"&Ca$
3640 ! F_oh_file$="PWR"&"H"&Ca$
3641   CALL Redhed(F_oh_file$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                  Freqs(*),Repeats,Sp,Std,Id_cont$,Cnnct$)
3642   FREAD From_file$&":F8,1",Power(*)
3643   IF Gl<>1 THEN GOTO 3659
3644   Fr_file$="CRST"&VAL$(VAL(Ca$)-2)
3645   PRINT Fr_file$
3646   CALL Redhed(Fr_file$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                  Freqs(*),Repeats,Sp,Std,Id_cont$,Cnnct$)
3647        CALL Redwrt(Fr_file$,":F8,1"," ",Result(*),Nfreqs)
3648    FOR Fr=1 TO Nfreqs
3649 FOR Sp=1 TO 2
3650 FOR P=1 TO 5
3652   ON Sp GOTO 3653,3655
3653   Rd(Fr,Sp,P)=Result(Fr,P)
3654   GOTO 3656
3655   Rd(Fr,Sp,P)=Result(Fr,P+12)
3656 NEXT P
3657 NEXT Sp
3658 NEXT Fr
3659    Dsk_nam$="SCRATCH"
3660    To_file$="CRST"&Ca$
3661    ON ERROR GOSUB Xerr
3662    ASSIGN #9 TO "T_RSLT:F8,1",Check
3663    ASSIGN * TO #9
3666    IF Check THEN CALL T_disc("T_RSLT:F8,1",4,696)
3669    OFF ERROR
3672 DISP "CALCULATING SYSTEM PARAMETERS"
3675 PRINT LIN(1);"SCRATCH DATA FILE NAME: ";From_file$
3678 PRINT LIN(1);"POWER DATA TAKEN: ";Date$&"."&Time$
3681 PRINT LIN(1);"FILE IDENTIFIER: ";Id_cont$;LIN(1)
3684 Incfrq: Freq=Freq+1
3687         IF Freq>Nfreqs THEN Done
3690            Repeat=0
3693 Incr: Repeat=Repeat+1
```

```
3696        IF Repeat>Repeats THEN Incfrq
3699            I=0
3702 Inci:  I=I+1
3705        IF I>16 THEN Subr
3708            Mnt=0
3711 Incm:  Mnt=Mnt+1
3714        IF Mnt>8 THEN Inci
3717            D(I,Mnt)=Power(Freq,Repeat,I,Mnt)
3720    GOTO Incm
3723 Subr: Fghz=Freqs(Freq)
3727 CALL Coeff(Freq,Fghz,Repeat,Repeats,Date$,Time$,Typ,Sp,
                From_file$,Dsk_nam$,Hi_lo_port,Prt$,Cnnct$,
                Errcnt,Error_flag,D(*),Result(*),Aver(*),Var(*),
                G1,Rd(*))
3729    GOTO Incr
3732 ! ----------------------------------------------------------
3735 Done: DISP " "
3738    IF NOT Error_flag THEN 3740
3740    IF G1=1 THEN To_file$="ADP"&Ca$
3741    IF G1=1 THEN GOTO Record
3742    IF Errcnt=Nfreqs THEN Exit_flag=1
3744    IF Exit_flag THEN PRINT LIN(2);CHR$(7);"NO RESULTS SAVED
           --- PAUSE IN EFFECT"
3747    IF Exit_flag THEN PAUSE
3750    IF Exit_flag THEN Exit
3753 ! Inck: K=K+1
3756 !     IF K>Nfreqs THEN Record
3759 !     IF Omitf(K) THEN PRINT Omitf(K)
3762 ! GOTO Inck
3763 Record: IF G1=1 THEN To_file$="CRST3"
3764            CALL Wrthed((To_file$),":F8,1",Max_pts,Date$,
                            Time$,Typ$,Nfreqs,Freqs(*),Repeats,
                            Sp,Std,Id_cont$,Cnnct$)
3765            CALL Redwrt(To_file$," ",":F8,1",Result(*),Nfreqs)
3766            IF Cal=3 THEN G1=0
3767            IF Cal=2 THEN G1=0
3768            IF Cal=1 THEN G1=0
3769            IF Cal=3 THEN GOTO 3777
3770            DISP "DO YOU WISH TO RECALIBRATE THIS SET--Y/N";CHR$(7)
3771            IF FNYorn THEN GOTO 3772
3772            GOTO 3777
3773            IF Cal=3 THEN G1=1
3774            Cal=4
3775            SUBEXIT
3777            IF Cal=2 THEN G1=1
3778            IF Cal=2 THEN Cal=3
3779            IF (Cal=3) AND (G1=1) THEN GOTO 3612
3780            PRINTER IS 16
3781 Exit:   PRINT LIN(1)
3782            PRINTER IS 16
3783            DISP " "
3784            DISP "THROUGH CALCULATING  --- ";
3785              SUBEXIT
3786 SUBEND
```

```
3789 ! ****************** SUBPROGRAM COEFF ********************
3792 !    FILE NAME: COEFF                          ! 810923-1330---BCY

S Calres(

Aver(              3624   3727

Ca$                3612   3625   3628   3629   3636   3637   3644
                   3660   3740

Cal                3612   3625   3766   3767   3768   3769   3773
                   3774   3777   3778   3778   3779

Check              3662   3666

Cnnct$             3641   3646   3727   3764

D(                 3618   3717   3727

Date$              3618   3641   3646   3678   3727   3764

Dim                3612   3621

Done:              3735   3687

Dsk_nam$           3621   3659   3727

Errcnt             3727   3742

Error_flag         3727   3738

Exit:              3781   3750

Exit_flag          3742   3744   3747   3750

F1$                3633

F_oh_file$         3629   3637   3641

F_oh_file$:           0   3637

Fghz               3723   3727

File$              3621

Fr                 3648   3653   3653   3655   3655   3658

Fr_file$           3644   3645   3646   3647

Freq               3626   3684   3684   3687   3717   3723   3727

Freqs(             3621   3641   3646   3723   3764

From_file$         3628   3636   3642   3675   3727
```

From_file$:	0	3636					
G1	3612	3643	3727	3740	3741	3763	3766
	3767	3768	3773	3777	3779		
Hi_lo_port	3612	3727					
I	3699	3702	3702	3705	3717	3717	
Id_cont$	3618	3641	3646	3681	3764		
Incfrq:	3684	3696					
Inci:	3702	3714					
Incm:	3711	3720					
Incr:	3693	3729					
Max_pts	3612	3764					
Mnt	3708	3711	3711	3714	3717	3717	
Nfreqs	3612	3621	3621	3624	3624	3624	3641
	3646	3647	3648	3687	3742	3764	3765
Omitf(	3624						
P	3650	3653	3653	3655	3655	3656	
Power(	3621	3642	3717				
Prt$	3612	3727					
Rd(	3624	3653	3655	3727			
Record:	3763	3741					
Repeat	3690	3693	3693	3696	3717	3727	
Repeats	3612	3621	3641	3646	3696	3727	3764
Result(	3624	3647	3653	3655	3727	3765	
Sp	3612	3641	3646	3649	3652	3653	3655
	3657	3727	3764				
Std	3612	3641	3646	3764			
Subr:	3723	3705					
Time$	3618	3641	3646	3678	3727	3764	
To_file$	3660	3740	3740	3763	3764	3765	

To_file$:	0	3763			
Typ	3632	3633	3727		
Typ$	3612	3632	3641	3646	3764
Var(	3624	3727			
Xerr:	0	3661			

```
3795 SUB Coeff(Freq,Fghz,Repeat,Repeats,Date$,Time$,Typ,Sp,
               From_file$,Dsk_nam$,Hiloport,P$,Cnnct$,Errcnt,
               Error_flag,D(*),Result(*),Aver(*),Var(*),G1,Rd(*))
3798 OPTION BASE 1
3801 DIM Wrspt(2,12),Stds(14,2),Rs(2,12),A(87),Sdev(87),S(6),
               C3(4,2),Pthru(4,8)
3804 DIM Pline(4,8),Ppad(4,8)
3807  ASSIGN #9 TO "T_RSLT:F8,1"
3810   IF Repeat=1 THEN MAT Aver=ZER
3813   IF Repeat=1 THEN MAT Var=ZER
3816   MAT Rs=ZER
3819   Date=VAL(Date$)
3822   Time=VAL(Time$)
3825   Opt$=VAL$(POS(Cnnct$,"N"))
3828   IF Opt$<>"2" THEN Calib
3831   Opt$=Opt$&Cnnct$[5]
3834 ! ------------------------------------------------------
3835 Calib:   IF G1=1 THEN Cal=1
3837           CALL Calib(D(*),Wrspt(*),Stds(*),Opt$,Error_flag,Rs(*),
                         Hiloport,G1,Rd(*),Freq)
3840          IF Error_flag THEN PRINT CHR$(7);"FATAL ERROR FOR ";
               Freqs(Freq);" GHz";LIN(1)
3843          IF Error_flag THEN Errcnt=Errcnt+1
3846          IF Error_flag THEN Omitf(Freq)=Fghz
3849          IF Error_flag THEN SUBEXIT
3852          FOR I=1 TO 4
3855          FOR J=1 TO 8
3858             Pthru(I,J)=D(I+4,J)
3861             Pline(I,J)=D(I+8,J)
3864             Ppad(I,J)=D(I+12,J)
3867          NEXT J
3870          NEXT I
3873          CALL Rhothu(Wrspt(*),Pthru(*),C3(*))
3876          FOR I=1 TO 3
3879          FOR J=1 TO 2
3882             S(2*I+J-2)=Stds(I+7,J)
3885          NEXT J
3888          NEXT I
3891          CALL Rho2pt(S(*),C3(*),Wrspt(*),Ppad(*))
3894          Stds(9,2)=S(4)
3897          MAT S=ZER
3900          S(3)=Stds(3,1)
3903          S(4)=Stds(3,2)
3906          CALL Rho2pt(S(*),C3(*),Wrspt(*),Pline(*))
3909          Stds(3,2)=S(4)
3912          Stds(3,1)=-20*LGT(Stds(3,1))
3915          Stds(9,1)=-20*LGT(Stds(9,1))
3918          Stds(11,1)=Sp
3921          Stds(11,2)=Pincid
3924          Stds(12,1)=Pstd
3927          Stds(12,2)=Pnet
3930          Stds(13,1)=Xmnt
3933          Stds(13,2)=Ymnt
3936          Many=(Repeats>1)*Repeat
3939         IF POS(P$,",") THEN PRINTER IS 7,1
```

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```
3942        IF POS(P$,"O") THEN PRINTER IS 0
3945     CALL Print(Fghz,Date$,Time$,From_file$,Dsk_nam$,Stds(*),
                   Wrspt(*),Rs(*),Many,Repeats)
3948        READ #9,Repeat
3951        PRINT #9;Wrspt(*),C3(*),Stds(*),Rs(*),Fghz,Date,Time
3954 ! -------------------------------------------------------
3957        READ #9,Repeat
3960        READ #9;A(*)
3963     IF Repeat=1 THEN MAT Aver=A
3966     IF Repeats=1 THEN Prnt
3969     IF Repeat<>1 THEN CALL Avg(Aver(*),Var(*),A(*),Repeat)
3972     IF Repeat<>Repeats THEN SUBEXIT
3975      MAT Sdev=SQR(Var)
3978      PRINT #9,Repeats+1;Aver(*)
3981      READ #9,Repeats+1
3984      READ #9;Wrspt(*),C3(*),Stds(*),Rs(*),Fghz,Date,Time
3987     CALL Print(Fghz,Date$,Time$,From_file$,Dsk_nam$,Stds(*),
                   Wrspt(*),Rs(*),-1,Repeats)
3990     CALL Prnt_sdev(Fghz,Date$,Time$,From_file$,Dsk_nam$,
                   Sdev(*),Sp)
3993 Prnt: PRINTER IS 16
3996        J=0
3999 Incj: J=J+1
4002       IF J>60 THEN SUBEXIT
4005        Result(Freq,J)=Aver(J)
4008    GOTO Incj
4011 SUBEND
4014 ! *************** SUBPROGRAM PRINT **********************
4017                                    ! 820103-1000---BCY&DHR

S Coeff(


A(                 3801    3960    3963    3969

Aver(              3795    3810    3963    3969    3978    4005

C3(                3801    3873    3891    3906    3951    3984

Cal                3835

Calib:             3835    3828

Cnnct$             3795    3825    3831

D(                 3795    3837    3858    3861    3864

Date               3819    3951    3984

Date$              3795    3819    3945    3987    3990

Dsk_nam$           3795    3945    3987    3990

Errcnt             3795    3843    3843
```

Error_flag	3795	3837	3840	3843	3846	3849	
Fghz	3795	3846	3945	3951	3984	3987	3990
Freq	3795	3837	3840	3846	4005		
Freqs(	3840						
From_file$	3795	3945	3987	3990			
G1	3795	3835	3837				
Hiloport	3795	3837					
I	3852	3858	3858	3861	3861	3864	3864
	3870	3876	3882	3882	3888	3999	4008
J	3855	3858	3858	3861	3861	3864	3864
	3867	3879	3882	3882	3885	3996	3999
	3999	4002	4005	4005			
Many	3936	3945					
Omitf(	3846						
Opt$	3825	3828	3831	3831	3837		
P$	3795	3939	3942				
Pincid	3921						
Pline(	3804	3861	3906				
Pnet	3927						
Ppad(	3804	3864	3891				
Prnt:	3993	3966					
Pstd	3924						
Pthru(	3801	3858	3873				
Rd(	3795	3837					
Repeat	3795	3810	3813	3936	3948	3957	3963
	3969	3969	3972				
Repeats	3795	3936	3945	3966	3972	3978	3981
	3987						
Result(	3795	4005					
Rs(	3801	3816	3837	3945	3951	3984	3987

S(	3801	3882	3891	3894	3897	3900	3903
	3906	3909					

Sdev(	3801	3975	3990

Sp	3795	3918	3990

Stds(	3801	3837	3882	3894	3900	3903	3909
	3912	3912	3915	3915	3918	3921	3924
	3927	3930	3933	3945	3951	3984	3987

Time	3822	3951	3984

Time$	3795	3822	3945	3987	3990

Typ	3795

Var(	3795	3813	3969	3975

Wrspt(	3801	3837	3873	3891	3906	3945	3951
	3984	3987					

Xmnt	3930

Ymnt	3933

```
4020 SUB Print(Fghz,Date$,Time$,File$,Dsk_nam$,Stds(*),Wrspt(*),
               Rs(*),Rpt_no,Repeat)
4023 OPTION BASE 1
4026 DIM Qpts(2,12)
4029 IF Rpt_no=0 THEN PRINT "                              SIX-PORT
                       PARAMETER RESULTS "
4032 IF Rpt_no>0 THEN PRINT "                    SIX-PORT PARAMETER
                       RESULTS          REPEAT # ";Rpt_no;
                       " OF ";Repeat
4035 IF Rpt_no<0 THEN PRINT "                    SIX-PORT PARAMETER
                       RESULTS      AVERAGE OF ";Repeat;
                       " REPEATS"
4038 PRINT LIN(1),"~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
     ~~~~~~~~~~~~~~~~~~"
4041 PRINT "YEAR  MONTH  DAY          TIME        FILE NAME    DISK
           IDENT    FREQ. IN GHz"
4044          PRINT USING Head20;Date$[1,2],Date$[3,4],Date$[5,6],
             Time$,File$,Dsk_nam$,Fghz
4047 Head20:  IMAGE X,2A,4X,2A,5X,2A,7X,6A,6X,6A,7X,7A,7X,DZ.6D
4050 PRINT LIN(1),"                         SCATTERING PARAMETERS OF
                   STANDARDS"
4053 PRINT
4056 PRINT "                    MAG--S11--ANG          dB--S12--ANG
           MAG--S22--ANG "
4059 Head51:IMAGE 11A,4X,Z.6D,2X,4D.3D,X,3D.6D,5D.3D,4X,Z.6D,2X,
           4D.3D
4062          PRINT USING Head51;"2-PORT   ",Stds(8,1),Stds(8,2),
                             Stds(9,1),Stds(9,2),Stds(10,1),
                             Stds(10,2)
4065 Head52:  IMAGE 11A,25X,Z.6D,5D.3D
4068          PRINT USING Head52;"LINE       ",Stds(3,1),Stds(3,2)
4071 Head60:  IMAGE 11A,4X,Z.6D,6D.3D
4074          PRINT USING Head60;"SHORT #1    ";Stds(4,1),Stds(4,2)
4077          PRINT USING Head60;"SHORT #2    ";Stds(5,1),Stds(5,2)
4080 Head70:  IMAGE 14A,X,Z.6D,6D.3D
4083          PRINT USING Head70;"OPEN 6-PORT #1",Stds(6,1),Stds(6,2)
4086          PRINT USING Head70;"OPEN 6-PORT #2",Stds(7,1),Stds(7,2)
4089 Head75:  IMAGE 11A,2X,3D.6D,5D.3D,18A,D,2A
4092 IF Stds(1,1)<>0 THEN PRINT USING Head75;"STD MOUNT",Stds(13,1),
     Stds(13,2),"( ON 6-PORT #",Stds(11,1)," )"
4095 Head76:  IMAGE /26A,2X,2D.4D,2X,11A
4098 Head77:  IMAGE 26A,2X,2D.4D,2X,39A
4101 IF Stds(11,1)<>0 THEN PRINT USING Head76;"STD MOUNT POWER:
                       ",Stds(12,1)," MILLIWATTS"
4104 IF Stds(11,1)<>0 THEN PRINT USING Head77;"STD MOUNT INCIDENT
     POWER: ",Stds(11,2)," MILLIWATTS"
4107 Head78: IMAGE /46A,X,Z.4D,20A,X,Z.4D
4110 IF Stds(11,1)=0 THEN PRINT USING Head78;"POWER RATIO CONSTANTS:
             6-PORT #1: (K1)=",Wrspt(1,12),"   6-PORT #2: (K2)=",
             Wrspt(2,12)
4113 IF Stds(11,1)<>0 THEN PRINT USING Head78;"POWER STANDARD CONSTANTS:  6-PORT
 #1: (K1)=",Wrspt(1,12),"    6-PORT #2: (K2)=",Wrspt(2,12)
4116          PRINT
4119          GOSUB Qprint
4122          PRINT "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
```

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```
4125   PRINT "RMS PARABOLOID RES*1E6 |   ***      CIRCLE RESIDUALS*1E6
                 *** |  2-PORT RES*1E6"
4128   PRINT "               INITIAL FINAL| SHORT  OPEN  THRU  LINE  2-
               PORT AVG | THRU  LINE 2-PORT"
4131   MAT Rs=Rs*(1E6)
4134 Head_res:   IMAGE 9A,X,2(6D),X,A,4(5D,X),2X,2(5D),2A,3(5D,X)
4137 Head_res1:   IMAGE 9A, X,2(6D),X,A,4(5D,X),2X,2(5D),2A
4140 PRINT USING Head_res;"6-PORT #1",Rs(1,1)*(Rs(1,2)/1E6),Rs(1,1),
          "|",Rs(1,3),Rs(1,4),Rs(1,5),Rs(1,6),Rs(1,7),Rs(1,8)," |",
          Rs(1,9),Rs(1,10),Rs(1,11)
4143 PRINT USING Head_res1;"6-PORT #2",Rs(2,1)*(Rs(2,2)/1E6),Rs(2,1),
          "|",Rs(2,3),Rs(2,4),Rs(2,5),Rs(2,6),Rs(2,7),Rs(2,8)," |"
4146          PRINT "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                    ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
4149   MAT Rs=Rs/(1E6)
4152 SUBEND
4155 Qprint: !
4158    CALL Wq(Wrspt(*),Qpts(*))             ! Calculate Q points
4161    PRINT "                   Q-POINT DESCRIPTION OF SIX-PORTS"
4164    PRINT
4167 PRINT USING Qpts1;"            MAG-1/Q1-ANG"
4170 Qpts1: IMAGE 25A,"     MAG--Q2--ANG       MAG--Q3--ANG
                    MAG--Q4--ANG"
4173 PRINT USING Qpts2;1,Qpts(1,1),Qpts(1,2),Qpts(1,3),Qpts(1,4),
               Qpts(1,5),Qpts(1,6),Qpts(1,7),Qpts(1,8)
4176 PRINT USING Qpts2;2,Qpts(2,1),Qpts(2,2),Qpts(2,3),Qpts(2,4),
               Qpts(2,5),Qpts(2,6),Qpts(2,7),Qpts(2,8)
4179 Qpts2:  IMAGE "6-PORT #"D,X,4(2X,Z.4D,X,4D.3D)
4182 PRINT
4185 RETURN
4188 ! ********** SUBROUTINE PRINT STD DEVIATIONS ****************
4191 !   820103-0900---BCY&DHR

S Print(


Date$              4020    4044    4044    4044

Dsk_nam$           4020    4044

Fghz               4020    4044

File$              4020    4044

Head20:            4047

Head51:            4059

Head52:            4065

Head60:            4071

Head70:            4080

Head75:            4089
```

Head76:	4095					
Head77:	4098					
Head78:	4107					
Head_res1:	4137					
Head_res:	4134					
Qprint:	4155	4119				
Qpts(	4026	4158	4173	4173	4173	4173	4173
	4173	4173	4173	4176	4176	4176	4176
	4176	4176	4176	4176			
Qpts1:	4170					
Qpts2:	4179					
Repeat	4020	4032	4035			
Rpt_no	4020	4029	4032	4032	4035	
Rs(	4020	4131	4131	4140	4140	4140	4140
	4140	4140	4140	4140	4140	4140	4140
	4140	4143	4143	4143	4143	4143	4143
	4143	4143	4143	4149	4149		
Stds(	4020	4062	4062	4062	4062	4062	4062
	4068	4068	4074	4074	4077	4077	4083
	4083	4086	4086	4092	4092	4092	4092
	4101	4101	4104	4104	4110	4113	
Time$	4020	4044				
Wrspt(	4020	4110	4110	4113	4113	4158	

```
4194 SUB Prnt_sdev(Fghz,Date$,Time$,File$,Dsk_nam$,Sdev(*),Sp)
4197 OPTION BASE 1
4200 PRINT LIN(2);"    STANDARD DEVIATIONS OF SELECTED PARAMETER
                RESULTS"
4203    PRINT LIN(1);"~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
                ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
4206 PRINT "YEAR  MONTH  DAY            TIME      FILE NAME    DISK
          IDENT     FREQ. IN GHz"
4209          PRINT USING Head2;Date$[1,2],Date$[3,4],Date$[5,6],
                          Time$,File$,Dsk_nam$,Fghz
4212 Head2:   IMAGE X,2A,4X,2A,5X,2A,7X,6A,6X,6A,7X,7A,7X,DZ.6D
4215 PRINT LIN(1),"                   SCATTERING PARAMETERS OF
                STANDARDS"
4218 PRINT
4221 PRINT "                   MAG--S11           dB--S12
                MAG--S22"
4224 Head3:   IMAGE 11A,7X,Z.6D,12X,Z.6D,14X,Z.6D
4227          PRINT USING Head3;"2-PORT      ",Sdev(37),Sdev(39),
                Sdev(41)
4230 Head4:   IMAGE 11A,27X,Z.6D
4233          PRINT USING Head4;"LINE        ",Sdev(29)
4236 Head5:   IMAGE 15A,3X,Z.6D
4239          PRINT USING Head5;"SHORT        ",Sdev(31)
4242          PRINT USING Head5;"OPEN 6-PORT #1 ",Sdev(33)
4245          PRINT USING Head5;"OPEN 6-PORT #2 ",Sdev(35)
4248 Head7:   IMAGE 11A,8X,.6D,8X,17A,D,2A
4251    IF Sp<>0 THEN PRINT USING Head7;"STD MOUNT   ",Sdev(49),
                    "     ( on 6-PORT #",Sp," )"
4254 Head8:   IMAGE /26A,4X,.4D,2X,11A
4257 Head9:   IMAGE 26A,4X,.4D,2X,39A
4260 IF Sp<>0 THEN PRINT USING Head8;"STD MOUNT POWER:         ",
                Sdev(37)," MILLIWATTS"
4263 IF Sp<>0 THEN PRINT USING Head9;"STD MOUNT INCIDENT POWER: ",
                Sdev(36)," MILIWATTS"
4266 Head10: IMAGE /46A,X,Z.4D,19A,X,Z.4D
4269 IF Sp=0 THEN PRINT USING Head10;"POWER RATIO CONSTANTS:
                    6-PORT #1: (K1)=",Sdev(12),"
                    6-PORT #2: (K2)=",Sdev(24)
4272 IF Sp<>0 THEN PRINT USING Head10;"POWER CALIBRATION
                CONSTANTS:  6-PORT #1: (K1)=",Sdev(12),"
                6-PORT #2: (K2)=",Sdev(24)
4275 PRINT CHR$(12)
4278 SUBEND
4281 ! ************ SUBROUTINE RHOTHU ***********************
4284 ! FILE NAME: RHOTHU                    ! 830310-1100---BCY

S Prnt_sdev(


Date$              4194   4209   4209   4209


Dsk_nam$           4194   4209


Fghz               4194   4209
```

File$	4194	4209					
Head10:	4266						
Head2:	4212						
Head3:	4224						
Head4:	4230						
Head5:	4236						
Head7:	4248						
Head8:	4254						
Head9:	4257						
Sdev(	4194	4227	4227	4227	4233	4239	4242
	4245	4251	4260	4263	4269	4269	4272
	4272						
Sp	4194	4251	4251	4260	4263	4269	4272
Time$	4194	4209					

```
4287 SUB Rhothu(Wrspt(*),Pthru(*),C3(*))
4290  OPTION BASE 1
4293  DIM W(4,8),Rthru(4,4)
4296  DEG
4299  FOR I=1 TO 4
4302     CALL W(Pthru(*),1,4,0,1,Wrspt(*),W(*))
4305     CALL Wg(Wrspt(*),1,0,W(I,1),W(I,2),Rthru(I,1),Rthru(I,2))
4308     C3(I,2)=Argth=ATN(Rthru(I,2)/(Rthru(I,1)+1E-20))+180*
         (Rthru(I,1)<0)*SGN(Rthru(I,2)+1E-20)
4311     C3(I,1)=Magth=SQR(Rthru(I,1)^2+Rthru(I,2)^2)
4314  NEXT I
4317  SUBEND
4320 ! ********** SUBROUTINE RHO2PT **************************
4323 ! FILE NAME: RHO2PT                    ! 830311-1130---BCY

S Rhothu(
```

Argth	4308						
C3(	4287	4308	4311				
I	4299	4305	4305	4305	4305	4308	4308
	4308	4308	4308	4311	4311	4311	4314
Magth	4311						
Pthru(	4287	4302					
Rthru(	4293	4305	4305	4308	4308	4308	4308
	4311	4311					
W(	4293	4302	4305	4305			
Wrspt(	4287	4302	4305				

```
4326 SUB Rho2pt(S(*),C3(*),Wrspt(*),P2pt(*))
4329  OPTION BASE 1
4332  DIM G(4,4),W(4,8)
4335  DEG
4338  I=1
4341     Argth=C3(I,2)
4344     CALL W(P2pt(*),1,4,0,1,Wrspt(*),W(*))
4347     CALL Wg(Wrspt(*),1,0,W(I,1),W(I,2),G(I,1),G(I,2))
4350     CALL Rect(S(1),S(2),X1,Y1)
4353     CALL Csub(G(I,1),G(I,2),X1,Y1,X,Y)
4356     Arg2p=ATN(Y/(X+1E-20))+180*(X<0)*SGN(Y+1E-20)
4359     Arg12=Arg2p-Argth
4362 Test:IF ABS(Arg12)<180 THEN Skp
4365        Arg12=Arg12-SGN(Arg12)*360
4368 GOTO Test
4371 Skp:  Args4=S(4)
4374        Sgn12=SGN(Arg12)*1
4377        Sgns4=SGN(Args4)*1
4380      IF Sgn12=Sgns4 THEN Subt
4383       Args4=Args4-SGN(Args4)*180
4386      IF ABS(Arg12-Args4)<90 THEN Switch
4389 Subt: IF ABS(Arg12-Args4)<90 THEN Exit
4392 Switch: S(4)=S(4)-SGN(S(4))*180
4395 Exit:SUBEND
4398 ! ********* SUBPROGRAM DISC COPY ****************
4401 !   FILE NAME:   DCOPY ! 820116-0110---BCY

S Rho2pt(
```

Arg12	4359	4362	4365	4365	4365	4374	4386
	4389						
Arg2p	4356	4359					
Args4	4371	4377	4383	4383	4383	4386	4389
Argth	4341	4359					
C3(	4326	4341					
Exit:	4395	4389					
G(	4332	4347	4347	4353	4353		
I	4338	4341	4347	4347	4347	4347	4353
	4353						
P2pt(	4326	4344					
S(	4326	4350	4350	4371	4392	4392	4392
Sgn12	4374	4380					
Sgns4	4377	4380					

Skp:	4371	4362		
Subt:	4389	4380		
Switch:	4392	4386		
Test:	4362	4368		
W(	4332	4344	4347	4347
Wrspt(	4326	4344	4347	
X	4353	4356	4356	
X1	4350	4353		
Y	4353	4356	4356	
Y1	4350	4353		

```
4404 SUB Disc_copy(Fil_nam$,Nfreqs,Typ$,Ca$)
4407 OPTION BASE 1
4410 DIM Date$[6],Time$[6]
4413 DIM Freqs(Nfreqs),Id_content$[80],Result(Nfreqs,52)
4416 Fl$=VAL$(POS(Typ$,"P")+1)
4419    CALL Redhed("CRST"&Ca$,":F8,1",Date$,Time$,Typ$,Nfreqs,
                 Freqs(*),Repeats,Sp,Std,Id_content$,Cnnct$)
4422    CALL Redwrt("CRST"&Ca$,":F8,1"," ",Result(*),Nfreqs)
4425    CALL Wrthed(Fil_nam$,":F8,0",Nfreqs,Date$,Time$,Typ$,
                 Nfreqs,Freqs(*),Repeats,Sp,Std,Id_content$,
                 Cnnct$)
4428    CALL Redwrt(Fil_nam$," ",":F8,0",Result(*),Nfreqs)
4431 SUBEND
4434 ! ************** SUBPROGRAM DISC TRANS *****************
4437 !   FILE NAME:   DTRANS                  !820116-0120---BCY
```

S Disc_copy(

Ca$	4404	4419	4422				
Cnnct$	4419	4425					
Date$	4410	4419	4425				
Fl$	4416						
Fil_nam$	4404	4425	4428				
Freqs(	4413	4419	4425				
Id_content$	4413	4419	4425				
Nfreqs	4404	4413	4413	4419	4422	4425	4425
	4428						
Repeats	4419	4425					
Result(	4413	4422	4428				
Sp	4419	4425					
Std	4419	4425					
Time$	4410	4419	4425				
Typ$	4404	4416	4419	4425			

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```
4440 SUB Disc_trans(Fil_nam$,Records,Nfreqs)
4443 OPTION BASE 1
4446 DIM Date$[6],Time$[6],Typ$[6]
4449 DIM Freqs(Nfreqs),Id_content$[80],Result(Nfreqs,52)
4452    CALL Redhed(Fil_nam$,":F8,0",Date$,Time$,Typ$,Nfreqs,
                     Freqs(*),Repeats,Sp,Std,Id_content$,Cnnct$)
4455    CALL Redwrt(Fil_nam$,":F8,0"," ",Result(*),Nfreqs)
4458  F1$=VAL$(POS(Typ$,"P")+1)
4461    CALL Wrthed("CRST"&Ca$,":F8,1",Records,Date$,Time$,Typ$,
                     Nfreqs,Freqs(*),Repeats,Sp,Std,Id_content$,
                     Cnnct$)
4464    CALL Redwrt("CRST"&Ca$," ",":F8,1",Result(*),Nfreqs)
4467    PRINT LIN(5);Fil_nam$;" CALIBRATION DATA TAKEN ON ";Date$
4470    PRINT LIN(2);"FREQUENCIES AT (GHZ)"
4473    PRINT
4476    FOR I=1 TO Nfreqs
4479       PRINT Freqs(I)
4482    NEXT I
4485 SUBEND
4488 ! *********** SUBPROGRAM WRTHED ************************
4491 ! FILE NAME:  WRTHED                     ! 820106-0800---BCY

S Disc_trans(

Ca$              4461    4464

Cnnct$           4452    4461

Date$            4446    4452    4461    4467

F1$              4458

Fil_nam$         4440    4452    4455    4467

Freqs(           4449    4452    4461    4479

I                4476    4479    4482

Id_content$      4449    4452    4461

Nfreqs           4440    4449    4449    4452    4455    4461    4464
                 4476

Records          4440    4461

Repeats          4452    4461

Result(          4449    4455    4464

Sp               4452    4461

Std              4452    4461
Time$            4446    4452    4461
Typ$             4446    4452    4458    4461
```

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```
4494 SUB Wrthed(File$,Msu$,Records,Date$,Time$,Typ$,Nfreqs,
                Freq_o(*),Repeats,Sp,Std_mnt,Id_content$,
                Cnnct$)
4497 OPTION BASE 1
4500 DIM Id$[19],Overhead$[80]
4503 MASS STORAGE IS Msu$
4504   PRINT File$
4505   WAIT 2500
4506 Overhead$="R2: 9 strings. R3: 4 strings, 4 real. R4:
                2 strings[80]. R5&R6: array(Nfreqs)"
4509 Id$="IDENTIFIER STRING: "
4512 Retry:  DISP " "
4515         PRINT CHR$(12)
4518 !       ON ERROR GOTO Trap
4521         ASSIGN #1 TO File$,Check
4524         ASSIGN * TO #1
4527        IF Check THEN CREATE File$,6+2*Records
4530          ASSIGN #1 TO File$
4533          PRINT #1,1;Overhead$
4536          PRINT #1,2;"DATE$","TIME$","TYP$","CNNCT","NFREQS",
                   "REPEATS","6-PORT","STD MNT","FREQUENCIES"
4539          PRINT #1,3;Date$,Time$,Typ$,Cnnct$,Nfreqs,Repeats,
                   Sp,Std_mnt
4542          PRINT #1,4;Id$,Id_content$
4545          READ #1,5
4548          PRINT #1;Freq_o(*)
4551          ASSIGN * TO #1
4554          OFF ERROR
4557   SUBEXIT
4560 Trap:    OFF ERROR
4563         IF FNDerr(ERRM$) THEN Retry
4566 SUBEND
4569 ! *********** SUBPROGRAM REDHED *************************
4572 ! FILE NAME:  REDHED                        ! 820106-0730---BCY

S Wrthed(


Check               4521    4527

Cnnct$              4494    4539

Date$               4494    4539

File$               4494    4504    4521    4527    4530

Freq_o(             4494    4548

Id$                 4500    4509    4542

Id_content$         4494    4542

Msu$                4494    4503

Nfreqs              4494    4539
```

Overhead$	4500	4506	4533
Records	4494	4527	
Repeats	4494	4539	
Retry:	4512	4563	
Sp	4494	4539	
Std_mnt	4494	4539	
Time$	4494	4539	
Trap:	4560		
Typ$	4494	4539	

```
4575 SUB Redhed(File$,Msu$,Date$,Time$,Typ$,Nfreqs,Freq_o(*),
                Repeats,Sp,Std_mnt,Id_content$,Cnnct$)
4578 OPTION BASE 1
4581 DIM Id$[19],Overhead$[80],Form$(8)[11]
4584 MASS STORAGE IS Msu$
4585   PRINT File$
4586   WAIT 2500
4587 Retry:   DISP " "
4590          PRINT CHR$(12)
4593   !      ON ERROR GOTO Trap
4596          ASSIGN #1 TO File$
4599          READ #1,1;Overhead$
4602          READ #1,2;Form$(*)
4605          READ #1,3;Date$,Time$,Typ$,Cnnct$,Nfreqs,Repeats,
                Sp,Std_mnt
4608          READ #1,4;Id$,Id_content$
4611          READ #1,5
4614          READ #1;Freq_o(*)
4617          ASSIGN * TO #1
4620          OFF ERROR
4623   SUBEXIT
4626 Trap:    OFF ERROR
4627   PRINT Files$
4629          IF FNDerr(ERRM$) THEN Retry
4632 SUBEND
4635 ! *********** SUBPROGRAM WRTBIN ******************
4638 ! FILE NAME:   WRTBIN             ! 811217-1500---BCY

S Redhed(


Cnnct$             4575    4605

Date$              4575    4605

File$              4575    4585    4596

Files$             4627

Form$(             4581    4602

Freq_o(            4575    4614

Id$                4581    4608

Id_content$        4575    4608

Msu$               4575    4584

Nfreqs             4575    4605

Overhead$          4581    4599

Repeats            4575    4605
```

Retry:	4587	4629
Sp	4575	4605
Std_mnt	4575	4605
Time$	4575	4605
Trap:	4626	
Typ$	4575	4605

-

```
4641 SUB Wrtbin(File$,Msu$,File(*),Records)
4644 OPTION BASE 1
4647 MASS STORAGE IS Msu$
4650 Retry:   DISP " "
4653          PRINT CHR$(12)
4656          ON ERROR GOTO Trap
4659          FCREATE File$,Records
4662 Fprint:  FPRINT File$,File(*)
4665          OFF ERROR
4668   SUBEXIT
4671 Trap:    OFF ERROR
4674          IF ERRN=54 THEN Fprint
4677          IF FNDerr(ERRM$) THEN Retry
4680 SUBEND
4683 ! **************** SUBPROGRAM REDWRT *********************
4686 !  FILE NAME:  REDWRT                     ! 820116-1230---BCY
```

S Wrtbin(

File$	4641	4659	4662
File(	4641	4662	
Fprint:	4662	4674	
Msu$	4641	4647	
Records	4641	4659	
Retry:	4650	4677	
Trap:	4671	4656	

```
4689 SUB Redwrt(File$,From$,To$,Data(*),Nfreqs)
4692 OPTION BASE 1
4695 Start:   PRINT CHR$(12)
4698          DISP " "
4701 !        ON ERROR GOTO Trap
4704          ASSIGN #1 TO File$
4707        IF To$=" " THEN Read
4710        MASS STORAGE IS To$
4713 Inci: I=I+1
4716      IF I>Nfreqs THEN Exit
4719         READ #1,5+2*I
4722         J=0
4725 Incj: J=J+1
4728      IF J>52 THEN Inci
4731         PRINT #1;Data(I,J)
4734    GOTO Incj
4737 Read: MASS STORAGE IS From$
4740 Inc_i: I=I+1
4743         IF I>Nfreqs THEN Exit
4746          READ #1,5+2*I
4749          J=0
4752 Inc_j: J=J+1
4755          IF J>52 THEN Inc_i
4758          READ #1;Data(I,J)
4761    GOTO Inc_j
4764 Exit: ASSIGN * TO #1
4767        OFF ERROR
4770   SUBEXIT
4773 Trap: OFF ERROR
4776      IF FNDerr(ERRM$) THEN Start
4779 SUBEND
4782 ! ********** FUNCTION FNDERR ****************
4785 !   FILE NAME:   FNDERR        ! 820127-1745---BCY

S Redwrt(


Data(            4689    4731    4758

Exit:            4764    4716    4743

File$            4689    4704

From$            4689    4737

I                4713    4713    4716    4719    4731    4740    4740
                 4743    4746    4758

Inc_i:           4740    4755

Inc_j:           4752    4761

Inci:            4713    4728

Incj:            4725    4734
```

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J	4722	4725	4725	4728	4731	4749	4752
	4752	4755	4758				
Nfreqs	4689	4716	4743				
Read:	4737	4707					
Start:	4695	4776					
To$	4689	4707	4710				
Trap:	4773						

```
4788   DEF FNDerr(Errm$)
4791   PRINT LIN(10);ERRM$
4794   DISP "DO YOU WANT TO RETRY ? -- (Y/N)";CHR$(7);
4797   IF FNYorn THEN RETURN 1
4800   PRINT CHR$(12);LIN(15);CHR$(7);"FATAL ERROR --- PROGRAM
             HALT"            '
4803    DISP " "
4806    STOP
4809   RETURN 0
4812   FNEND
4815 ! *************** SUBROUTINE T_DISC ********************
4818 !   FILE NAME: T_DISC                    ! 810818-1600---BCY

FNDerr(


Errm$              4788
```

```
4821 SUB T_disc(File$,Records,Length)
4824    ON ERROR GOTO Errml
4827    CREATE File$,Records,Length
4830    SUBEXIT
4833 Errml:   PRINT ERRM$
4836            PRINT "PAUSE IN EFFECT"
4839            PAUSE
4842            BEEP
4845    SUBEND
4848 ! ****************************************************
```

S T_disc(

Errml:	4833	4824
File$	4821	4827
Length	4821	4827
Records	4821	4827

```
4851 SUB Wrp(Wr(*),Wp(*)) ! Converts Wrspt to polar form
4854 MAT Wp=Wr
4857 FOR I=1 TO 2
4860 FOR J=4 TO 10 STEP 2
4863 CALL Polar(Wr(I,J),Wr(I,J+1),Wp(I,J),Wp(I,J+1))
4866 NEXT J
4869 NEXT I
4872 SUBEND
4875 ! **************** CALIB *********************************
```

S Wrp(

Calib:	4878					
I	4857	4863	4863	4863	4863	4869
J	4860	4863	4863	4863	4863	4866
Wp(	4851	4854	4863	4863		
Wr(	4851	4854	4863	4863		

```
4878 Calib: SUB Calib(Pwr(*),Wrspt(*),Stds(*),Opt$,Error_flag,
                      Resid(*),Hi_lo_port,G1,Rd(*),Freq)
                      !----(81/07/31)----GFE-GEC-------
4881 OPTION BASE 1
4884 DIM V(1:5),W(1:16,1:8),Res(2,12)
4887 MAT Resid=ZER                             ! Cres is NIOSH CR record 7   p. 5-10
4890 MAT Res=ZER                               ! Cres is NIOSH              p. 6-24
4893 Error_flag=0              ! Nonzero if calculation error, >0 if fatal error
4896 IF G1=1 THEN GOTO 4912
4897 FOR Sp=1 TO 2
4899    CALL Iparab(Pwr(*),Sp,V(*),Error_flag)
4902    IF Error_flag>0 THEN GOTO Calib_exit
4905    CALL Fparab(Pwr(*),Sp,V(*),Wrspt(*),Res(*),Error_flag,Hi_lo_port)
4908    IF Error_flag>0 THEN GOTO Calib_exit
4910 NEXT Sp
4911  GOTO 4921
4912  ! CONT
4916  FOR P=1 TO 5
4917  FOR Sp=1 TO 2
4918  Wrspt(Sp,P)=Rd(Freq,Sp,P)
4919  NEXT Sp
4920  NEXT P
4921  !
4923 ! PRINT Wrspt(1,1),Wrspt(1,2),Wrspt(1,3),Wrspt(1,4),
             Wrspt(1,5)
4924 CALL W(Pwr(*),1,16,16,1,Wrspt(*),W(*))
4925 FOR I=1 TO 2
4926    Res(I,3)=W(3,4*I)
4927    Res(I,4)=W(4,4*I)
4928    FOR J=5 TO 7
4929       FOR K=4*J-15 TO 4*J-12
4932          Res(I,J)=Res(I,J)+W(K,4*I)/4
4935       NEXT K
4938    NEXT J
4941 NEXT I
4944 CALL Tr15(W(*),Wrspt(*),Opt$,Stds(*),Res(*))
4947 CALL Stds2(W(*),Wrspt(*),Stds(*),Res(*))
4950 CALL Pratio(W(*),5,Wrspt(*),Wrspt(2,12))
4953    Wrspt(1,12)=1
4956    Res(1,8)=(Res(1,3)+Res(1,4)+4*Res(1,5)+4*Res(1,6)
                  +4*Res(1,7))/14
4959    Res(2,8)=(Res(2,3)+Res(2,4)+4*Res(2,5)+4*Res(2,6)
                  +4*Res(2,7))/14
4962    MAT Resid=Res
4965 Calib_exit: SUBEND
4968 ! ***********************************
```

S Calib(

Calib_exit:	4965	4902	4908			
Error_flag	4878	4893	4899	4902	4905	4908
Freq	4878	4918				

G1	4878	4896				
Hi_lo_port	4878	4905				
I	4925	4926	4926	4927	4927	4932	4932
	4932	4941				
J	4928	4929	4929	4932	4932	4938
K	4929	4932	4935			
Opt$	4878	4944				
P	4916	4918	4918	4920		
Pwr(	4878	4899	4905	4924		
Rd(	4878	4918				
Res(	4884	4890	4905	4926	4927	4932	4932
	4944	4947	4956	4956	4956	4956	4956
	4956	4959	4959	4959	4959	4959	4959
	4962					
Resid(	4878	4887	4962			
Sp	4897	4899	4905	4910	4917	4918	4918
	4919					
Stds(	4878	4944	4947			
V(	4884	4899	4905			
W(	4884	4924	4926	4927	4932	4944	4947
	4950					
Wrspt(	4878	4905	4918	4924	4944	4947	4950
	4950	4953				

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```
4971 SUB Iparab(P(*),Sp,V(*),Error_flag)   !--(81/07/30)-GFE-GEC-
4974 ON ERROR GOTO Error
4977 DIM B(1:16,1:9),X(1:9),Y(1:16)
4980 MAT Y=(-1)
4983 K=4*Sp-4     ! Adds 4 to column index when Sp=2
4986 N=0
4989 FOR J=1 TO 16  ! Iterate over rows in "P" matrix
4992 I=J-N             ! Index for "B" matrix
4995 P=P(J,K+1)
4998 IF P>0 THEN B       ! P=0 indicates no data in this row:
                            skip to next one
5001 N=N+1                ! & adjust row index for MAT "B" to lag
                            "P" by one unit
5004 GOTO Nextj
5007 B: B(I,7)=A=P(J,K+2)/P
5010    B(I,8)=B=P(J,K+3)/P
5013    B(I,9)=C=P(J,K+4)/P
5016    B(I,1)=A*A
5019    B(I,2)=B*B
5022    B(I,3)=C*C
5025    B(I,4)=A*B
5028    B(I,5)=A*C
5031    B(I,6)=B*C
5034 Nextj: NEXT J
5037 REDIM B(1:I,1:9),Y(1:I)   ! Drop last N rows in "B" and "Y",
                                 (no data here)
5040 CALL Msoln(B(*),Y(*),X(*))
5043 B=(2*X(4)-X(7)*X(8))/(2*X(1)*X(8)-X(4)*X(7))
5046 C=(2*X(5)-X(7)*X(9))/(2*X(1)*X(9)-X(5)*X(7))
5049 A=B+C+X(7)/X(1)
5052 V(1)=R1=SQR(X(2)*A*C)
5055 V(2)=R2=SQR(X(3)*A*B)
5058 V(3)=W1=SQR(C)
5061 V(4)=W2=(B+C-A)/2/W1
5064 V(5)=W3=B-W2*W2
5067 SUBEXIT
5070 Error: BEEP
5073 IF ERRN=30 THEN PRINT "Failure in Iparab, Poor set of power
                            data indicated.
    Sp= ";Sp
5076 IF ERRN<>30 THEN PRINT ERRM$
5079 Error_flag=10
5082 SUBEND
5085 ! ****************************************************************
```

S Iparab(

| A | | 5007 | 5016 | 5016 | 5025 | 5028 | 5049 | 5052 |
| | | 5055 | 5061 | | | | | |

| B | | 5010 | 5019 | 5019 | 5025 | 5031 | 5043 | 5049 |
| | | 5055 | 5061 | 5064 | | | | |

| B(| | 4977 | 5007 | 5010 | 5013 | 5016 | 5019 | 5022 |

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	5025	5028	5031	5037	5040		
B:	5007	4998					
C	5013	5022	5022	5028	5031	5046	5049
	5052	5058	5061				
Error:	5070	4974					
Error_flag	4971	5079					
Fparab:	5088						
I	4992	5007	5010	5013	5016	5019	5022
	5025	5028	5031	5037	5037	4989	4992
	4995	5007	5010	5013	5034	4983	4995
	5007	5010	5013				
N	4986	4992	5001	5001			
Nextj:	5034	5004					
P	4995	4998	5007	5010	5013		
P(	4971	4995	5007	5010	5013		
R1	5052						
R2	5055						
Sp	4971	4983	5073				
V(	4971	5052	5055	5058	5061	5064	
W1	5058	5061					
W2	5061	5064	5064				
W3	5064						
X(	4977	5040	5043	5043	5043	5043	5043
	5043	5043	5046	5046	5046	5046	5046
	5046	5046	5049	5049	5052	5055	
Y(	4977	4980	5037	5040			

```
5088 Fparab: SUB Fparab(P(*),Sp,V(*),W(*),Res(*),Error_flag,Hi_lo
                          _port)
     ! --(81/07/30)----------GFE-GEC-------
5091 ! V(1)...V(5)=R1,R2,W1,W2,W3
5094 DIM B(1:16,1:5),X(1:5),Y(1:16)
5097 K=4*Sp-4              ! Adds 4 to column index when Sp=2
5100 Ab=(V(4)*V(4)+V(5))*((V(4)-V(3))^2+V(5))   ! Normalize by ab
5103 FOR H=1 TO 10    ! 10 = upper limit to number of iterations
5106 N: N=0
5109 FOR J=1 TO 16        ! Iterates over rows in "P" matrix
5112 I=J-N                ! Index for "B" matrix
5115 P=P(J,K+1)
5118 IF P>0 THEN P        ! P=0 indicates no data in this row:
                            skip to next one
5121 N=N+1                ! & adjust row index in MAT "B" to lag "P"
                            by one unit
5124 GOTO Nextj
5127 P: P3=P(J,K+2)/P
5130    P5=P(J,K+3)/P
5133    P6=P(J,K+4)/P
5136    A=(V(1)*P5-P3)/V(3)-V(3)
5139    B=P3+V(4)*(V(4)+A)+V(5)-V(2)*P6
5142    C=A*A-4*P3
5145    P=2*(B*V(4)+A*V(5))
5148    Y(I)=-B*B-C*V(5)
5151 !  Parab_res(Sp,J)=Y(I)/Ab !Place normalized residual in
                                  approprate column
5154    B(I,1)=P*P5/V(3)
5157    B(I,2)=-2*B*P6
5160    B(I,3)=P*(-A/V(3)-2)
5163    B(I,4)=2*B*(2*V(4)+A)
5166    B(I,5)=2*B+C
5169 Nextj: NEXT J
5172 REDIM B(1:I,1:5),Y(1:I)    ! Drop bottom N rows (no data here)
5175 Q=DOT(Y,Y)
5178 IF H>1 THEN Qa
5181 Qi=Q                        ! Save initial residual
5184 GOTO T                      ! Initialize T
5187 Qa: IF Q<T*1.001 THEN Qb
5190 L=2*L
5193 IF L>70 THEN Error_flag=2
5196 IF L>70 THEN Error
5199 MAT X=X/(L)
5202 MAT V=V-X
5205 GOTO N
5208 Qb: IF (Q>T*.99) OR (Q<1E-16) THEN Res
                                ! "Normal" exit from "Fparab"
5211 T: T=Q
5214 L=1
5217 CALL Msoln(B(*),Y(*),X(*))
5220 MAT V=V+X
5223 NEXT H
5226 PRINT "Ten iterations performed by Fparab"
5229 Error_flag=1
5232 Error: BEEP
```

```
5235 PRINT "Abnormal exit from Fparab routine. Poor initial
              estimate implied"
5238 Res: Ab=(V(4)*V(4)+V(5))*((V(4)-V(3))^2+V(5))
                                  ! Normalize by  ab
5241       Res(Sp,1)=SQR(Q/(I-5))/Ab
5244       Res(Sp,2)=SQR(Qi/Q)
5247 IF V(5)>0 THEN Ex
5250 PRINT "Error in Fparab, (Im(W2))^2= ";V(5)
5253 V5=SQR(ABS(V(5)))
5256 Error_flag=Error_flag+2
5259 GOTO Err
5262 Ex: V(5)=SQR(V(5))    ! A plus or minus sign may be required
                            depending upon
5265 IF NOT Hi_lo_port THEN V(5)=-V(5)
5268 IF ABS(V(5)/V(4))>.05 THEN Exit
     !       how detector "numbers" are assigned
5271 BEEP
5274 PRINT "Poor initial parabolid estimate indicated"
5277 PRINT
5280 Err: BEEP
5283 PRINT "Six-port=";Sp
5286 PRINT "Zeta=      ";V(1)
5289 PRINT "Rho=       ";V(2)
5292 PRINT "W1=        ";V(3)
5295 PRINT "Re(W2)=   ";V(4)
5298 PRINT "Im(W2)=   ";V(5)
5301 PAUSE
5304 Exit: FOR I=1 TO 5
5307 W(Sp,I)=V(I)
5310 NEXT I
5313 SUBEND
5316 ! **************************
S Fparab(
```

A	5136	5139	5142	5142	5145	5160	5163
Ab	5100	5238	5241				
B	5139	5145	5148	5148	5157	5163	5166
B(	5094	5154	5157	5160	5163	5166	5172
	5217						
C	5142	5148	5166				
Err:	5280	5259					
Error:	5232	5196					
Error_flag	5088	5193	5229	5256	5256		
Ex:	5262	5247					
Exit:	5304	5268					

H	5103	5178	5223			
Hi_lo_port	5088	5265				
I	5112	5148	5154	5157	5160	5163	5166
	5172	5172	5241	5304	5307	5307	5310
J	5109	5112	5115	5127	5130	5133	5169
K	5097	5115	5127	5130	5133		
L	5190	5190	5193	5196	5199	5214	
N	5106	5112	5121	5121			
N:	5106	5205				
Nextj:	5169	5124				
P	5115	5118	5127	5130	5133	5145	5154
	5160					
P(	5088	5115	5127	5130	5133	
P3	5127	5136	5139	5142		
P5	5130	5136	5154			
P6	5133	5139	5157			
P:	5127	5118				
Q	5175	5181	5187	5208	5208	5211	5241
	5244					
Qa:	5187	5178				
Qb:	5208	5187				
Qi	5181	5244				
Res(	5088	5241	5244			
Res:	5238	5208				
Sp	5088	5097	5241	5244	5283	5307
T	5187	5208	5211			
T:	5211	5184				
V(	5088	5100	5100	5100	5100	5100	5100
	5136	5136	5136	5139	5139	5139	5139
	5145	5145	5148	5154	5160	5163	5202

	5202	5220	5220	5238	5238	5238	5238
	5238	5238	5247	5250	5253	5262	5262
	5265	5265	5268	5268	5286	5289	5292
	5295	5298	5307				
V5	5253						
W(	5088	5307					
X(	5094	5199	5199	5202	5217	5220	
Y	5175						
Y(	5094	5148	5172	5175	5217		

```
5319 SUB Pratio(W(*),Row,Wr(*),R) ! -(81/05/06)-GFE--
5322 DIM A(1:8)
5325 FOR I=1 TO 4
5328 J=Row+I-1
5331 CALL Cmpy(Wr(1,10),Wr(1,11),W(J,1),W(J,2),Ax,Ay)
5334 CALL Csub(Wr(1,6),Wr(1,7),Ax,Ay,Ax,Ay)
5337 CALL Csub(W(J,5),W(J,6),Wr(2,8),Wr(2,9),Bx,By)
5340 CALL Csub(W(J,1),W(J,2),Wr(1,8),Wr(1,9),Cx,Cy)
5343 CALL Cmpy(Wr(2,10),Wr(2,11),W(J,5),W(J,6),Dx,Dy)
5346 CALL Csub(Wr(2,6),Wr(2,7),Dx,Dy,Dx,Dy)
5349 A(2*I-1)=(Ax*Ax+Ay*Ay)/(Bx*Bx+By*By)*W(J,3)/W(J,7)
5352 A(2*I)=(Cx*Cx+Cy*Cy)/(Dx*Dx+Dy*Dy)*W(J,3)/W(J,7)
5355 NEXT I
5358 R=SUM(A)/8
5361 MAT A=A-(R)
5364 Res=SQR(DOT(A,A)/7)/R  !  (Std dev)/(mean)
5367 SUBEND
! ************************************************************
S Pratio(
```

A	5364						
A(	5322	5349	5352	5358	5361	5361	5364
Ax	5331	5334	5334	5349	5349		
Ay	5331	5334	5334	5349	5349		
Bx	5337	5349	5349				
By	5337	5349	5349				
Cx	5340	5352	5352				
Cy	5340	5352	5352				
Dx	5343	5346	5346	5352	5352		
Dy	5343	5346	5346	5352	5352		
I	5325	5328	5349	5352	5355		
J	5328	5331	5331	5337	5337	5340	5340
	5343	5343	5349	5349	5352	5352	
R	5319	5358	5361	5364			
Res	5364						
Row	5319	5328					
W(	5319	5331	5331	5337	5337	5340	5340
	5343	5343	5349	5349	5352	5352	
Wr(	5319	5331	5331	5334	5334	5337	5337
	5340	5340	5343	5343	5346	5346	

```
5373 SUB Stds2(W(*),Wr(*),S(*),Res(*))  !-(81/12/18)-GFE------
5376 ! Modification of "Stds" for use with Type N
        connector & "Tr13"
5379 DIM G(1:4,1:4),T(1:6)
5382 CALL Wg(Wr(*),1,1,W(3,1),W(3,2),S(4,1),S(4,2))
5385 CALL Wg(Wr(*),2,1,W(3,5),W(3,6),S(5,1),S(5,2))
5388 CALL Wg(Wr(*),1,1,W(4,1),W(4,2),S(6,1),S(6,2))
5391 CALL Wg(Wr(*),2,1,W(4,5),W(4,6),S(7,1),S(7,2))
5394 FOR I=1 TO 4
5397 FOR Sp=1 TO 2
5400 J=(Sp=1)+3*(Sp=2)
5403 K=J+2*(Sp=2)
5406 CALL Wg(Wr(*),Sp,0,W(I+12,K),W(I+12,K+1),G(I,J),G(I,J+1))
5409 NEXT Sp
5412 NEXT I
5415 CALL Rtpt(G(*),1,T(*),Res(1,11))
5418 CALL Polar(T(2),T(5),S(8,1),S(8,2))
5421 CALL Cmpy(T(2),T(5),T(3),T(6),X,Y)
5424 CALL Csub(T(1),T(4),X,Y,X,Y)
5427 CALL Polar(X,Y,R,T)
5430 S(9,1)=SQR(R)
5433 S(9,2)=T/2-180*(T>0)   !  Default value between -180 & 0
5436 CALL Polar(-T(3),-T(6),S(10,1),S(10,2))
5439 SUBEND
5442 ! ****************************************
S Stds2(
G(              5379    5406    5406    5415

I               5394    5406    5406    5406    5406    5412

J               5400    5403    5406    5406

K               5403    5406    5406

R               5427    5430

Res(            5373    5415

S(              5373    5382    5382    5385    5385    5388    5388
                5391    5391    5418    5418    5430    5433    5436
                5436

Sp              5397    5400    5400    5403    5406    5409

T               5427    5433    5433

T(              5379    5415    5418    5418    5421    5421    5421
                5421    5424    5424    5436    5436

Wr(             5373    5382    5385    5388    5391    5406

X               5421    5424    5424    5427

Y               5421    5424    5424    5427
```

```
5445 SUB Tr15(W(*),Wr(*),Opt$,Stds(*),Res(*))  !-(82/04/14)-GFE--
5448 ! Modification of "Trl" routine.  Gives three options
5451 ! Opt$=1          Standard TRL routine
5454 ! Opt$=2L,(2R)    For Type N connector, assumes equal mag
                       gamma for "opens"
5457 !                 & assigns phase of 180 to termination or
                       "short" on either Six-port#1 (left), or if
                       Opt$=2R to Six-port#2 (right)
5463 ! Option=3        Assumes equal mag gamma on "opens", equal
                       phase on "shorts"
5466 !                 Obtains Mag Gamma from opens, phase from
                       shorts
5469 IF (Opt$="1") OR (Opt$="2L") OR (Opt$="2R") OR (Opt$="3")
     THEN 5478
5472 PRINT "IMPROPER FORMAT FOR Option$"
5475 GOTO 5703
5478 DIM S(1:6)
5481 DEG
5484 CALL Rtpt(W(*),5,S(*),Res(1,9))
5487 CALL Ident(Tax,S(1),Tbx,S(2),Tcx,S(3),Tay,S(4),Tby,S(5),
               Tcy,S(6)) ! "Thru"5490 CALL Rtpt(W(*),9,S(*),
               Res(1,10))
5493 CALL Ident(Lax,S(1),Lbx,S(2),Lcx,S(3),Lay,S(4),Lby,S(5),
               Lcy,S(6)) ! "Line"
5496 CALL Cmpy(Lbx,Lby,Tcx,Tcy,Ax,Ay)
5499 CALL Csub(Lax,Lay,Ax,Ay,Max,May)
5502 CALL Cmpy(Tax,Tay,Lbx,Lby,Ax,Ay)
5505 CALL Cmpy(Lax,Lay,Tbx,Tby,Bx,By)
5508 CALL Csub(Ax,Ay,Bx,By,Mbx,Mby)
5511 CALL Csub(Lcx,Lcy,Tcx,Tcy,Mcx,Mcy)
5514 CALL Cmpy(Tbx,Tby,Lcx,Lcy,Ax,Ay)
5517 CALL Csub(Tax,Tay,Ax,Ay,Mdx,Mdy)
5520 CALL Csub(Mdx/2,Mdy/2,Max/2,May/2,Bx,By)
5523 CALL Cdiv(Mcx,Mcy,Bx,By,Ax,Ay)
5526 CALL Cdiv(-Mbx,-Mby,Bx,By,Cx,Cy)
5529 CALL Cmpy(Ax,Ay,Cx,Cy,Dx,Dy)
5532 CALL Csub(1,0,Dx,Dy,Dx,Dy)
5535 R=SQR(SQR(Dx*Dx+Dy*Dy))
5538 T=(ATN(Dy/(Dx+1E-20))+180*(Dx<0)*SGN(Dy+1E-20))/2   ! Root
     choice made here
5541 CALL Cadd(1,0,R*COS(T),R*SIN(T),Dx,Dy)
5544 CALL Cdiv(-Cx,-Cy,Dx,Dy,Abx,Aby)
5547 CALL Cdiv(-Ax,-Ay,Dx,Dy,Acx,Acy)
5550 CALL Cmpy(Mbx,Mby,Acx,Acy,Ax,Ay)        ! Compute Exp(-gammal)
                                             for line
5553 CALL Cadd(Ax,Ay,Max,May,Ax,Ay)
5556 CALL Cmpy(Mcx,Mcy,Abx,Aby,Bx,By)
5559 CALL Cadd(Bx,By,Mdx,Mdy,Bx,By)
5562 CALL Cdiv(Ax,Ay,Bx,By,X,Y)
5565 CALL Polar(X,Y,R,T)
5568 Stds(3,1)=SQR(R)
5571 Stds(3,2)=T/2-180*(T>0)    ! Default value of line length
                                between -180 & 0
5574 CALL Cmpy(Acx,Acy,Tbx,Tby,Dx,Dy)
5577 CALL Csub(1,0,Dx,Dy,Dx,Dy)
```

```
5580 CALL Cmpy(Acx,Acy,Tax,Tay,Ax,Ay)      ! Compute elements
                                              of Mat B
5583 CALL Csub(Tcx,Tcy,Ax,Ay,Ax,Ay)
5586 CALL Cdiv(Ax,Ay,Dx,Dy,Bcx,Bcy)
5589 CALL Cmpy(Abx,Aby,Tcx,Tcy,Ax,Ay)
5592 CALL Csub(Tax,Tay,Ax,Ay,Ax,Ay)
5595 CALL Cdiv(Ax,Ay,Dx,Dy,Px,Py)
5598 CALL Csub(Tbx,Tby,Abx,Aby,Bx,By)
5601 CALL Cdiv(Bx,By,Ax,Ay,Bbx,Bby)
5604 FOR K=3 TO 4
5607 IF (Opt$="2R") AND (K=3) THEN 5628
5610 CALL Cmpy(Acx,Acy,W(K,1),W(K,2),Ax,Ay)
5613 CALL Csub(1,0,Ax,Ay,Ax,Ay)
5616 CALL Csub(W(K,1),W(K,2),Abx,Aby,Bx,By)
5619 CALL Cdiv(Bx,By,Ax,Ay,Ax,Ay)
5622 IF K=3 THEN CALL Polar(-Ax,-Ay,R,T)
5625 IF (Opt$="2L") AND (K=3) THEN 5679
5628 CALL Cadd(W(K,5),W(K,6),Bcx,Bcy,Bx,By)
5631 CALL Cmpy(W(K,5),W(K,6),Bbx,Bby,Cx,Cy)
5634 CALL Cadd(1,0,Cx,Cy,Cx,Cy)
5637 CALL Cdiv(Cx,Cy,Bx,By,Bx,By)
5640   IF (Opt$<>"2R") OR (K=4) THEN 5652
5643   CALL Cmpy(Px,Py,Bx,By,Cx,Cy)
5646   CALL Polar(-Cx,-Cy,R,T)
5649   GOTO 5679
5652 CALL Cmpy(Ax,Ay,Bx,By,Qx,Qy)
5655 CALL Cmpy(Px,Py,Qx,Qy,Ax,Ay)
5658 IF K=4 THEN 5682
5661 H=T
5664 T=(ATN(Ay/(Ax+1E-20))+180*(Ax<0)*SGN(Ay+1E-20))/2
5667 Q=T-H   ! This assumes calibration with nominal short
5670 IF ABS(Q)>180 THEN Q=Q-360*SGN(Q)
5673 IF ABS(Q)>90 THEN T=T+180
5676 IF Opt$="1" THEN 5682
5679 NEXT K
5682 R=SQR(SQR(Ax*Ax+Ay*Ay))
5685 CALL Rect(R,T,Aax,Aay)
5688 CALL Cdiv(Px,Py,Aax,Aay,Bax,Bay)
5691 CALL Cmpy(Acx,Acy,Aax,Aay,Acx,Acy)
5694 CALL Cmpy(Bbx,Bby,Bax,Bay,Bbx,Bby)
5697 CALL Ident(Wr(1,6),Aax,Wr(1,7),Aay,Wr(1,8),Abx,Wr(1,9),Aby,
               Wr(1,10),Acx,Wr(1,11),Acy)
5700 CALL Ident(Wr(2,6),Bax,Wr(2,7),Bay,Wr(2,8),-Bcx,Wr(2,9),-Bcy,
               Wr(2,10),-Bbx,Wr(2,11),-Bby)
5703 SUBEND
5706 ! ****************************************
```

S Tr15(

Aax		5685	5688	5691	5697		
Aay		5685	5688	5691	5697		
Abx		5544	5556	5589	5598	5616	5697

Aby	5544	5556	5589	5598	5616	5697
Acx	5547	5550	5574	5580	5610	5691	5691
	5697					
acy	5547	5550	5574	5580	5610	5691	5691
	5697					
Ax	5496	5499	5502	5508	5514	5517	5523
	5529	5547	5550	5553	5553	5562	5580
	5583	5583	5586	5589	5592	5592	5595
	5601	5610	5613	5613	5619	5619	5622
	5652	5655	5664	5664	5682	5682	
Ay	5496	5499	5502	5508	5514	5517	5523
	5529	5547	5550	5553	5553	5562	5580
	5583	5583	5586	5589	5592	5592	5595
	5601	5610	5613	5613	5619	5619	5622
	5652	5655	5664	5664	5682	5682	
Bax	5688	5694	5700				
Bay	5688	5694	5700				
Bbx	5601	5631	5694	5694	5700		
Bby	5601	5631	5694	5694	5700		
Bcx	5586	5628	5700				
Bcy	5586	5628	5700				
Bx	5505	5508	5520	5523	5526	5556	5559
	5559	5562	5598	5601	5616	5619	5628
	5637	5637	5643	5652	5505	5508	5520
	5523	5526	5556	5559	5559	5562	5598
	5601	5616	5619	5628	5637	5637	5643
	5652						
Cx	5526	5529	5544	5631	5634	5634	5637
	5643	5646					
Cy	5526	5529	5544	5631	5634	5634	5637
	5643	5646					
Dx	5529	5532	5532	5535	5535	5538	5538
	5541	5544	5547	5574	5577	5577	5586
	5595						
Dy	5529	5532	5532	5535	5535	5538	5538
	5541	5544	5547	5574	5577	5577	5586
	5595						
H	5661	5667					

K	5604	5607	5610	5610	5616	5616	5622
	5625	5628	5628	5631	5631	5640	5658
	5679						
Lax	5493	5499	5505				
Lay	5493	5499	5505				
Lbx	5493	5496	5502				
Lby	5493	5496	5502				
Lcx	5493	5511	5514				
Lcy	5493	5511	5514				
Max	5499	5520	5553				
May	5499	5520	5553				
Mbx	5508	5526	5550				
Mby	5508	5526	5550				
Mcx	5511	5523	5556				
Mcy	5511	5523	5556				
Mdx	5517	5520	5559				
Mdy	5517	5520	5559				
Opt$	5445	5469	5469	5469	5469	5607	5625
	5640	5676					
Px	5595	5643	5655	5688			
Py	5595	5643	5655	5688			
Q	5667	5670	5670	5670	5670	5673	
Qx	5652	5655					
Qy	5652	5655					
R	5535	5541	5541	5565	5568	5622	5646
	5682	5685					
Res(	5445	5484	5490				
S(	5478	5484	5487	5487	5487	5487	5487
	5487	5490	5493	5493	5493	5493	5493
	5493						

Stds(	5445	5568	5571				
T	5538	5541	5541	5565	5571	5571	5622
	5646	5661	5664	5667	5673	5673	5685
Tax	5487	5502	5517	5580	5592		
Tay	5487	5502	5517	5580	5592		
Tbx	5487	5505	5514	5574	5598		
Tby	5487	5505	5514	5574	5598		
Tcx	5487	5496	5511	5583	5589		
Tcy	5487	5496	5511	5583	5589		
W(	5445	5484	5490	5610	5610	5616	5616
	5628	5628	5631	5631			
Wr(	5445	5697	5697	5697	5697	5697	5697
	5700	5700	5700	5700	5700	5700	
X	5562	5565					
Y	5562	5565					

```
5709 SUB W(P(*),Row,N1,N2,Stp,Wr(*),W(*))      !---81/07/16--GFE-
5712 FOR Sp=1+(N1=0) TO 1+(N2>0)
5715 CALL Ident(R1,Wr(Sp,1),R2,Wr(Sp,2),W1,Wr(Sp,3),W2,Wr(Sp,4),
               W3,Wr(Sp,5),L,L)
5718 FOR I=1 TO N1*(Sp=1)+N2*(Sp=2)           ! Iterate over either
                                                   N1 or N2
5721   Rw=Row+(I-1)*Stp
5724   L=4*(Sp-1)*(COL(P)=8)! Add 4 to column index as required
5727   P4=P(Rw,L+1)                    ! Read in Pwr values
5730   IF P4=0 THEN Nexti ! If P4=0 no data here, skip to next row
5733   P3=P(Rw,L+2)
5736   P1=R1*P(Rw,L+3)
5739   P2=R2*P(Rw,L+4)
5742   S=(P3+P4+P1/R1+P2/R2)/10        ! Calc weighting factors
5745   S3=(P3+S)^2
5748   S4=(P4+S)^2
5751   S1=(P1+S*R1)^2
5754   S2=(P2+S*R2)^2
5757   P=P1*P1/S1+P2*P2/S2+P3*P3/S3+P4*P4/S4
5760   Q=P1/S1+P2/S2+P3/S3
5763   Wx=(W1+(P3-P1)/P4/W1)/2              ! Initial values
5766   Wy=((W2*W2+W3*W3+(P3-P2)/P4)/2-Wx*W2)/W3 !
5769   GOSUB F                     ! Calc initial value of "F"
5772   R=1
5775   FOR K=1 TO 30             ! Begin Iteration
5778 Fa: Fa=Fb
5781    L=1
5784    Fs=E1/S1+E2/S2+E3/S3 ! Begin computation of derivatives
5787    Fx=Wx*Fs-W1*E1/S1-W2*E2/S2              ! =Fx/4
5790    Fy=Wy*Fs-W3*E2/S2                       ! =Fy/4
5793    D=Wx*Q-W1*P1/S1-W2*P2/S2
5796    E=Wy*Q-W3*P2/S2
5799    Ci=Fs+2*(Wx*Wx/S3+(Wx-W1)^2/S1+(Wx-W2)^2/S2-D*D/P)
                                           ! =Fxx/4
5802    Di=2*(Wx*Wy/S3+(Wx-W1)*Wy/S1+(Wx-W2)*(Wy-W3)/S2-D*E/P) !
                                           !  =Fxy/4
5805    Ei=Fs+2*(Wy*(Wy/S3+Wy/S1)+(Wy-W3)^2/S2-E*E/P)
                                           ! =Fyy/4
5808    Zi=Ci*Ei-Di*Di
5811    IF (Zi<0) OR (Ei<0) THEN Bkup
5814    X=(Fx*Ei-Fy*Di)/Zi           ! X,Y= correction as per Newton
                                             method
5817    Y=(Fy*Ci-Fx*Di)/Zi
5820    CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5823    GOSUB F
5826    IF Fb<Fa+1E-10 THEN ON 1+(L=1)*(X*X+Y*Y<1E-12)
          GOTO Nextk,Exit
5829    L=2*L                 ! Routine to reduce step size
5832    IF L=128 THEN Bkup2        ! Go to "backup routine"
5835    CALL Cadd(Wx,Wy,X/L,Y/L,Wx,Wy)! Restore a fraction of step
5838    GOTO 5823
5841 Nextk: NEXT K
5844 Error: PRINT "Abnormal exit from circle routine   ";"Sp= ";
                   Sp,"Row= ";Rw
5847         PRINT "Circle residual= ";Pi*SQR(Fb)/2
```

```
5850 Exit: L=4*(Sp-2)*(COL(W)=8)
5853        W(I,1+L)=Wx
5856        W(I,2+L)=Wy
5859        W(I,3+L)=Pi
5862        W(I,4+L)=Pi*SQR(Fb)/2
5865 Nexti: NEXT I
5868 NEXT Sp
5871 SUBEXIT
5874 ! -----------------------------------------------------
5877 Bkup2: CALL Cadd(Wx,Wy,X/64,Y/64,Wx,Wy)
5880 ! Backup algorithm based on Goldfeld, etal, Econometrica,
        July 1966, pg 541
5883 Bkup: Eg=(Ci+Ei-SQR((Ci-Ei)^2+4*Di*Di))/2        ! (Smallest
                                                         eigenvalue)/4
5886    IF Fx*Fx+Fy*Fy>1E-12 THEN Ka
5889    Ri=.1*SQR(P3*(P3<P1)*(P3<P2)+P1*(P1<P3)*(P1<P2)+P2*(P2<P1)
           *(P2<P3))
5892    X=-Ri*Di/SQR(Di*Di+(Ci-Eg)^2)
5895    Y=Ri*(Ci-Eg)/SQR(Di*Di+(Ci-Eg)^2)
5898    CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5901    GOSUB F
5904    GOTO Fa
5907 Ka: FOR Ka=1 TO 20
5910    A1=Eg-R*SQR(Fx*Fx+Fy*Fy)        ! Correction to Fxx & Fyy
5913    CALL Csub(Ci,Ei,A1,A1,Ca,Ea)
5916    Za=Ca*Ea-Di*Di
5919    X=(Fx*Ea-Fy*Di)/Za
5922    Y=(Fy*Ca-Fx*Di)/Za
5925    CALL Csub(Wx,Wy,X,Y,Wx,Wy)
5928    GOSUB F
5931    Zc=(Fb-Fa)/(2*(Ci*X*X+2*Di*X*Y+Ei*Y*Y)-4*(Fx*X+Fy*Y))-1
5934    IF Fb>Fa+1E-10 THEN Zc=-2 ! This insures a reduced step size
5937    R=R*(.4+3.6*(ABS(Zc)>.3)*(1-(ABS(Zc)<1)*(1-ABS(Zc))/.7))
5940    IF Zc>-1 THEN 5841
5943    CALL Cadd(Wx,Wy,X,Y,Wx,Wy)! Returns to original position and
5946    NEXT Ka                         ! repeats with smaller step size
5949    GOTO Error
5952 F: Wm=Wx*Wx+Wy*Wy              ! Compute value of "F"   (=Fb)
5955 W1m=Wm+W1*(W1-2*Wx)
5958 W2m=Wm+W2*(W2-2*Wx)+W3*(W3-2*Wy)
5961 Pi=P/(Wm*P3/S3+P4/S4+W1m*P1/S1+W2m*P2/S2)
5964 E3=Wm-P3/Pi
5967 E1=W1m-P1/Pi
5970 E2=W2m-P2/Pi
5973 Fb=E1*E1/S1+E2*E2/S2+E3*E3/S3+(1-P4/Pi)^2/S4
5976 RETURN
5979 SUBEND
5982 ! ****************************************

S W(


A1                5910   5913   5913

Bkup2:            5877   5832
```

Bkup:	5883	5811					
Ca	5913	5916	5922				
Ci	5799	5808	5817	5883	5883	5892	5895
	5895	5913	5931				
D	5793	5799	5799	5802			
Di	5802	5808	5808	5814	5817	5883	5883
	5892	5892	5892	5895	5895	5916	5916
	5919	5922	5931	5796	5802	5805	5805
E1	5784	5787	5967	5973	5973		
E2	5784	5787	5790	5970	5973	5973	
E3	5784	5964	5973	5973			
Ea	5913	5916	5919				
Eg	5883	5892	5895	5895	5910		
Ei	5805	5808	5811	5814	5883	5883	5913
	5931						
Error:	5844	5949					
Exit:	5850	5826					
F:	5952	5769	5823	5901	5928		
Fa	5778	5826	5931	5934			
Fa:	5778	5904					
Fb	5778	5826	5847	5862	5931	5934	5973
Fs	5784	5787	5790	5799	5805		
Fx	5787	5814	5817	5886	5886	5910	5910
	5919	5922	5931				
Fy	5790	5814	5817	5886	5886	5910	5910
	5919	5922	5931				
I	5718	5721	5853	5856	5859	5862	5865
K	5775	5841					
Ka	5907	5946					
Ka:	5907	5886					

L	5715	5715	5724	5727	5733	5736	5739
	5781	5826	5829	5829	5832	5835	5835
	5850	5853	5856	5859	5862		
N1	5709	5712	5718				
N2	5709	5712	5718				
Nexti:	5865	5730					
Nextk:	5841	5826					
P	5757	5799	5802	5805	5961		
P(	5709	5724	5727	5733	5736	5739	
P1	5736	5742	5751	5757	5757	5760	5763
	5793	5889	5889	5889	5889	5889	5961
	5967						
P2	5739	5742	5754	5757	5757	5760	5766
	5793	5796	5889	5889	5889	5889	5889
	5961	5970					
P3	5733	5742	5745	5757	5757	5760	5763
	5766	5889	5889	5889	5889	5889	5961
	5964						
P4	5727	5730	5742	5748	5757	5757	5763
	5766	5961	5973				
Pi	5847	5859	5862	5961	5964	5967	5970
	5973						
Q	5760	5793	5796				
R	5772	5910	5937	5937			
R1	5715	5736	5742	5751			
R2	5715	5739	5742	5754			
Ri	5889	5892	5895				
Row	5709	5721					
Rw	5721	5727	5733	5736	5739	5844	
S	5742	5745	5748	5751	5754		
S1	5751	5757	5760	5784	5787	5793	5799
	5802	5805	5961	5973			
S2	5754	5757	5760	5784	5787	5790	5793
	5796	5799	5802	5805	5961	5973	

S3	5745	5757	5760	5784	5799	5802	5805
	5961	5973				
S4	5748	5757	5961	5973		
Sp	5712	5715	5715	5715	5715	5715	5718
	5718	5724	5844	5850	5868		
Stp	5709	5721				
W(	5709	5850	5853	5856	5859	5862	
W1	5715	5763	5763	5787	5793	5799	5802
	5955	5955				
W1m	5955	5961	5967			
W2	5715	5766	5766	5766	5787	5793	5799
	5802	5958	5958			
W2m	5958	5961	5970			
W3	5715	5766	5766	5766	5790	5796	5802
	5805	5958	5958			
Wm	5952	5955	5958	5961	5964	
Wr(	5709	5715	5715	5715	5715	5715	
Wx	5763	5766	5787	5793	5799	5799	5799
	5799	5802	5802	5802	5820	5820	5835
	5835	5853	5877	5877	5898	5898	5925
	5925	5943	5943	5952	5952	5955	5958
Wy	5766	5790	5796	5802	5802	5802	5805
	5805	5805	5805	5820	5820	5835	5835
	5856	5877	5877	5898	5898	5925	5925
	5943	5943	5952	5952	5958	
X	5814	5820	5826	5826	5835	5877	5892
	5898	5919	5925	5931	5931	5931	5931
	5943					
Y	5817	5820	5826	5826	5835	5877	5895
	5898	5922	5925	5931	5931	5931	5931
	5943					
Za	5916	5919	5922			
Zc	5931	5934	5937	5937	5937	5940	
Zi	5808	5811	5814	5817		

```
5985 SUB Rtpt(G(*),Row,S(*),R)  !-(81/05/11)-GFE---
5988 ! Compute two-port cascading parameters (Ax,Bx,Cx,& Ay,By,Cy
      )=S(1)---S(6)
5991 DIM B(1:8,1:6),X(1:8),Y(1:8)
5994 L=2*(COL(G)>4) ! Adjustment for two different formats for "G"
5997 FOR I=1 TO 4
6000 J=I+4
6003 K=I+Row-1
6006 B(I,1)=B(J,4)=1
6009 B(I,2)=B(J,5)=C=G(K,3+L)
6012 B(I,3)=B(J,6)=A=-G(K,1)
6015 B(I,4)=B(J,1)=0
6018 B(I,5)=D=-G(K,4+L)
6021 B(I,6)=B=G(K,2)
6024 B(J,2)=-D
6027 B(J,3)=-B
6030 CALL Cmpy(-A,B,C,-D,Y(I),Y(J))
6033 NEXT I
6036 CALL Msoln(B(*),Y(*),S(*))
6039 MAT X=B*S
6042 MAT X=Y-X
6045 R=SQR(DOT(X,X)/DOT(S,S))
6048 SUBEND
6051 ! ********************************
```

S Rtpt(

A	6012	6030					
B	6021	6027	6030				
B(	5991	6006	6006	6009	6009	6012	6012
	6015	6015	6018	6021	6024	6027	6036
	6039						
C	6009	6030					
D	6018	6024	6030				
G(	5985	5994	6009	6012	6018	6021	
I	5997	6000	6003	6006	6009	6012	6015
	6018	6021	6030	6033			
J	6000	6006	6009	6012	6015	6024	6027
	6030						
K	6003	6009	6012	6018	6021		
L	5994	6009	6018				
R	5985	6045					
Row	5985	6003					

S	6045			
S(	5985	6036	6039	6045
X	6045			
X(	5991	6039	6042	6042	6045
Y(	5991	6030	6030	6036	6042

```
6054 SUB Msoln(B(*),Y(*),X(*)) !-(80/1/16)-------GFE-----------
6057 OPTION BASE 1
6060 DIM A(9,9),C(9,16),U(9)
6063 M=ROW(B)
6066 N=COL(B)
6069 REDIM A(N,N),C(N,M),U(N)
6072 MAT C=TRN(B)
6075 MAT A=C*B
6078 MAT A=INV(A)
6081 MAT U=C*Y
6084 MAT X=A*U
6087 SUBEND
6090 ! ********************************
```

S Msoln(

A(		6060	6069	6075	6078	6078	6084
B(		6054	6063	6066	6072	6075	
C(		6060	6069	6072	6075	6081	
M	6063	6069					
N		6066	6069	6069	6069	6069	
U(		6060	6069	6081	6084		
X(	6054	6084					
Y(	6054	6081					

```
6093 SUB Wg(Wr(*),I,F,Wx,Wy,X,Y)   !-(80/1/9)-GFE-------------
6096 CALL Csub(Wx,Wy,Wr(I,8),Wr(I,9),Nx,Ny)
6099 CALL Cmpy(Wr(I,10),Wr(I,11),Wx,Wy,X,Y)
6102 CALL Csub(Wr(I,6),Wr(I,7),X,Y,Dx,Dy)
6105 CALL Cdiv(Nx,Ny,Dx,Dy,X,Y)
6108 IF F-1 THEN CALL Polar(X,Y,X,Y)
6111 SUBEND
6114 ! *******************************
```

S Wg(

Dx	6102	6105					
Dy	6102	6105					
F	6093	6108					
I	6093	6096	6096	6099	6099	6102	6102
Nx	6096	6105					
Ny	6096	6105					
Wr(	6093	6096	6096	6099	6099	6102	6102
Wx	6093	6096	6099				
Wy	6093	6096	6099				
X	6093	6099	6102	6105	6108	6108	
Y	6093	6099	6102	6105	6108	6108	

```
6117 SUB Wq(W(*),Q(*))  !--80/04/03---GFE-----------------
6120 FOR I=1 TO ROW(W)
6123 CALL Ident(A,W(I,1),B,W(I,2),C,W(I,3),D,W(I,4),E,W(I,5),F,
               W(I,6))
6126 CALL Ident(G,W(I,7),H,W(I,8),P,W(I,9),Q,W(I,10),R,W(I,11),
               Q(I,12),W(I,12))
6129 CALL Polar(-Q,-R,Q(I,1),Q(I,2))
6132 Q(I,9)=S=SQR(F*F+G*G)
6135 CALL Polar((-F*H-G*P)/S/S,(G*H-F*P)/S/S,Q(I,3),Q(I,4))
6138 CALL Wg(W(*),I,1,C,0,Q(I,5),Q(I,6))
6141 CALL Wg(W(*),I,1,D,E,Q(I,7),Q(I,8))
6144 Q(I,10)=SQR(((F-C*Q)^2+(G-C*R)^2)/A)
6147 Q(I,11)=SQR(((F-D*Q+E*R)^2+(G-D*R-E*Q)^2)/B)
6150 NEXT I
6153 SUBEND
6156 ! ****************************
```

S Wq(

A	6123	6144					
B	6123	6147					
C	6123	6138	6144	6144			
D	6123	6141	6147	6147			
E	6123	6141	6147	6147			
F	6123	6132	6132	6135	6135	6144	6147
G	6126	6132	6132	6135	6135	6144	6147
H	6126	6135	6135				
I	6120	6123	6123	6123	6123	6123	6123
	6126	6126	6126	6126	6126	6126	6126
	6129	6129	6132	6135	6135	6138	6138
	6138	6141	6141	6141	6144	6147	6150
P	6126	6135	6135				
Q	6126	6129	6144	6147	6147		
Q(	6117	6126	6129	6129	6132	6135	6135
	6138	6138	6141	6141	6144	6147	
R	6126	6129	6144	6147	6147		
S	6132	6135	6135	6135	6135		
W(	6117	6120	6123	6123	6123	6123	6123
	6123	6126	6126	6126	6126	6126	6126
	6138	6141					

160

```
6159 SUB Mg(P(*),Row,Sp,Wr(*),F$,X,Y,Res)    !-(81/07/16)-GFE--
6162 DIM W(1:1,1:4)
6165 CALL W(P(*),Row,Sp-1,Sp-2,1,Wr(*),W(*))
6168 CALL Wg(Wr(*),Sp,P,W(1,1),W(1,2),X,Y)
6171 IF F$-"P" THEN CALL Polar(X,Y,X,Y)
6174 Res-W(1,4)
6177 SUBEND
6180 ! *******************************
```

S Mg(

F$	.	6159	6171		
P		6168			
P(		6159	6165		
Res		6159	6174		
Row		6159	6165		
Sp		6159	6165	6165	6168
W(		6162	6165	6168	6168	6174
Wr(		6159	6165	6168		
X		6159	6168	6171	6171
Y		6159	6168	6171	6171

```
6183 SUB Cadd(Ax,Ay,Bx,By,Cx,Cy)  !-(80/1/16)--GFE---
6186 Cx=Ax+Bx
6189 Cy=Ay+By
6192 SUBEND
6195 ! **********************************
```

S Cadd(

Ax	6183	6186
Ay	6183	6189
Bx	6183	6186
By	6183	6189
Cx	6183	6186
Cy	6183	6189

```
6198 SUB Csub(Ax,Ay,Bx,By,Cx,Cy) !-(80/1/16)--------GFE--
6201 Cx=Ax-Bx
6204 Cy=Ay-By
6207 SUBEND
6210 ! *****************************
```

S Csub(

Ax	6198	6201
Ay	6198	6204
Bx	6198	6201
By	6198	6204
Cx	6198	6201
Cy	6198	6204

```
6213 SUB Cmpy(Ax,Ay,Bx,By,Cx,Cy)  !-(80/1/16)-GFE----
6216 CALL Ident(X,Ax,Y,Ay,U,Bx,V,By,A,0,B,0)
6219 Cx=X*U-Y*V
6222 Cy=X*V+Y*U
6225 SUBEND
6228 ! ******************************
```

S Cmpy(

A	6216		
Ax	6213	6216	
Ay	6213	6216	
B	6216		
Bx	6213	6216	
By	6213	6216	
Cx	6213	6219	
Cy	6213	6222	
U	6216	6219	6222
V	6216	6219	6222
X	6216	6219	6222
Y	6216	6219	6222

```
6231 SUB Cdiv(Ax,Ay,Bx,By,Cx,Cy)  !-(80/1/16)--GFE-------------
6234 CALL Ident(X,Ax,Y,Ay,U,Bx,V,By,A,Bx*Bx+By*By,B,0)
6237 Cx=(X*U+Y*V)/A
6240 Cy=(Y*U-X*V)/A
6243 SUBEND
6246 !  *********************************
```

S Cdiv(

A	6234	6237	6240	
Ax	6231	6234		
Ay	6231	6234		
B	6234			
Bx	6231	6234	6234	6234
By	6231	6234	6234	6234
Cx	6231	6237		
Cy	6231	6240		
U	6234	6237	6240	
V	6234	6237	6240	
X	6234	6237	6240	
Y	6234	6237	6240	

```
6249 SUB Ident(A,B,C,D,E,F,G,H,I,J,K,L) !--(80/1/16)---GFE-----
6252 A=B
6255 C=D
6258 E=F
6261 G=H
6264 I=J
6267 K=L
6270 SUBEND
6273 ! **********************************
```

S Ident(

A   6249   6252

B   6249   6252

C   6249   6255

D   6249   6255

E   6249   6258

F   6249   6258

G   6249   6261

H   6249   6261

I   6249   6264

J   6249   6264

K   6249   6267

L   6249   6267

```
6276 SUB Polar(Xo,Y,R,T)  !--(80/1/16)--GFE-----
6279 DEG
6282 X=Xo
6285 R=SQR(X*X+Y*Y)
6288 T=ATN(Y/(X+1E-20))+180*(X<0)*SGN(Y+1E-20)
                                ! Range -180 to +180
6291 SUBEND
6294 ! ********************

S Polar(


R                 6276    6285

T                 6276    6288

X                 6282    6285    6285    6288    6288

Xo                6276    6282

Y                 6276    6285    6285    6288    6288
```

```
6297 SUB Rect(Ro,T,X,Y) !--(80/1/16)---------GFE-----
6300 DEG
6303 R=Ro
6306 X=R*COS(T)
6309 Y=R*SIN(T)
6312 SUBEND
6315 ! ************************

S Rect(


R                  6303    6306    6309

Ro                 6297    6303

T                  6297    6306    6309

X                  6297    6306

Y                  6297    6309
```

```
6318 SUB Cpwr(Pstd,Pwr(*),Row,Sp,Wr(*),Res)  !--(81/05/06)-GFE---
6321 CALL Mpwr(Pwr(*),Row,Sp,Wr(*),"N",X,Y,"Net",Pnet,Res)
6324 Wr(1,12)=Pstd/Pnet
6327 Wr(2,12)=Wr(2,12)*Wr(1,12)
6330 SUBEND
6333 ! ****************************
```

S Cpwr(

Pnet	6321	6324				
Pstd	6318	6324				
Pwr(	6318	6321				
Res	6318	6321				
Row	6318	6321				
Sp	6318	6321				
Wr(	6318	6321	6324	6327	6327	6327
X	6321					
Y	6321					

```
6336 SUB Mpwr(P(*),Row,Sp,Wr(*),G$,X,Y,P$,P,Res)  !-81/07/16)--GFE
6339 DIM W(1:1,1:4)
6342 CALL W(P(*),Row,Sp-1,Sp-2,1,Wr(*),W(*))
6345 CALL Cmpy(Wr(Sp,10),Wr(Sp,11),W(1,1),W(1,2),Ax,Ay)
6348 CALL Csub(Wr(Sp,6),Wr(Sp,7),Ax,Ay,Ax,Ay)
6351 P=Pinc=W(1,3)*Wr(Sp,12)*(Ax*Ax+Ay*Ay)
6354 IF (G$="R")+(G$="P")+(P$="Net")=0 THEN Exit
6357 CALL Wg(Wr(*),Sp,0,W(1,1),W(1,2),X,Y)
6360 IF P$="Net" THEN P=P*(1-X*X-Y*Y)
6363 IF G$="P" THEN CALL Polar(X,Y,X,Y)
6366 Exit: Res=W(1,4)
6369 SUBEND
```

S Mpwr(

Ax	6345	6348	6348	6351	6351	
Ay	6345	6348	6348	6351	6351	
Exit:	6366	6354				
G$	6336	6354	6354	6363		
P	6336	6351	6360	6360		
P$	6336	6354	6360			
P(	6336	6342				
Pinc	6351					
Res	6336	6366				
Row	6336	6342				
Sp	6336	6342	6342	6345	6345	6348	6348
	6351	6357					
W(	6339	6342	6345	6345	6351	6357	6357
	6366						
Wr(	6336	6342	6345	6345	6348	6348	6351
	6357						
X	6336	6357	6360	6360	6363	6363	
Y	6336	6357	6360	6360	6363	6363	

```
6372 SUB Mtpt(P(*),Row,Stp,Wr(*),F$,S(*),R(*))  !-(81/07/16)--GFE
6375 MAT R=ZER
6378 DIM W(1:4,1:8),C(1:6),G(1:4,1:4)
6381 CALL W(P(*),Row,4,4,Stp,Wr(*),W(*))
6384 FOR I=1 TO 4
6387 FOR Sp=1 TO 2
6390 J=(Sp=1)+5*(Sp=2)
6393 CALL Wg(Wr(*),Sp,0,W(I,J),W(I,J+1),G(I,2*Sp-1),G(I,2*Sp))
6396 R(Sp)=R(Sp)+W(I,4*Sp)
6399 NEXT Sp
6402 NEXT I
6405 MAT R=R/(4)
6408 CALL Rtpt(G(*),1,C(*),R(3))
6411 CALL Cmpy(C(2),C(5),C(3),C(6),Ax,Ay)
6414 CALL Csub(C(1),C(4),Ax,Ay,Ax,Ay)
6417 CALL Polar(Ax,Ay,R,T)
6420 T=T/2-180*(T>0)   ! -180<(Default value)<0
6423 IF F$="P" THEN P
6426 CALL Rect(SQR(R),T,X,Y)
6429 CALL Ident(S(1),C(2),S(2),C(5),S(5),-C(3),S(6),-C(6),S(3),X,
                S(4),Y)
6432 GOTO Exit
6435 P: CALL Polar(C(2),C(5),S(1),S(2))
6438    CALL Polar(-C(3),-C(6),S(5),S(6))
6441 S(3)=SQR(R)
6444 S(4)=T
6447  SUBEND
6450 Pset: ! PSET AT 3450
6460  RE-SAVE "ADP11",6460,11000  !850730
                                 CODED TO UTILIZE DUAL SIX-PORT

S Mtpt(


Ax                6411    6414    6414    6417

Ay                6411    6414    6414    6417

C(                6378    6408    6411    6411    6411    6411    6414
                  6414    6429    6429    6429    6429    6435    6435
                  6438    6438

Exit:                0    6432

F$                6372    6423

G(                6378    6393    6393    6408

I                 6384    6393    6393    6393    6393    6396    6402

J                 6390    6393    6393

P(                6372    6381

P:                6435    6423
```

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Pset:	6450						
R	6417	6426	6441				
R(	6372	6375	6396	6396	6405	6405	6408
Row	6372	6381					
S(	6372	6429	6429	6429	6429	6429	6429
	6435	6435	6438	6438	6441	6444	
Sp	6387	6390	6390	6393	6393	6393	6396
	6396	6396	6399				
Stp	6372	6381					
T	6417	6420	6420	6420	6426	6444	
W(	6378	6381	6393	393	6396		
Wr(	6372	6381	6393				
X	6426	6429					
Y	6426	6429					

```
6470   DEF FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)
6480   !    CALC         PARAMETERS    FOR ADAPTOR   FROM 6PORT MEAS
           JULY-AUG 1985
6490   OPTION BASE 1
6500   Msu$=":F8,1"
6510   DIM Result(Nfreqs,60),Freqs(Nfreqs),Id_content$[80],
           S(Nfreqs,34)
6521   K=0
6570   ! LINPUT "ENTER FILE NAME FOR DATA
           WITHOUT  ADAPTER",N1$
6580   FIXED 0
6590   ! LINPUT "ENTER FILE NAME FOR DATA WITH ADAPTER          ",N2$
6620   N1$="CRST1"
6630   N2$="CRST3"
6640    CALL Redhed(N1$,Msu$,Date$,Time$,Typ$,Nfreqs,Freqs(*),
                   Repeats,Sp,Std_mnt,Id_content$,Cnnct$)
6650   MASS STORAGE IS ":F8,1"
6660   PRINTER IS 16
6670   PRINT "START OF FNADPT"
6680   Nfreq=N=Nfreqs
6690   PRINT
6700   PRINT
6710    Sport=1
6720   PRINTER IS 0
6721   PRINT
6724   PRINT "ADAPTER EVALUATION"
6725   PRINT "------------------"
6727   PRINT
6730   PRINT "FILES PROCESSED =";N1$;" AND ";N2$
6740   PRINT
6750   N1=INT(N1)
6760   N2=INT(N2)
6770   PRINTER IS 16
6780   FOR P=1 TO Nfreqs
6790   FOR Prt=1 TO 2
6800   PRINTER IS 16
6810   ON Prt GOTO 6820,6850
6820         CALL Redwrt(N1$,":F8,1"," ",Result(*),Nfreqs)
6830         Nfreq=1
6840   GOTO 6870
6850         CALL Redwrt(N2$,":F8,1"," ",Result(*),Nfreqs)
6860         NORMAL
6870   ON Sport GOTO 6880,6900
6880   Mc=0
6890   GOTO 6910
6900   Mc=12
6910   A8=Result(P,6+Mc)
6920   A9=Result(P,7+Mc)
6930   B8=Result(P,8+Mc)
6940   B9=Result(P,9+Mc)
6950   C8=Result(P,10+Mc)
6960   C9=Result(P,11+Mc)
6980   GOTO 6990
6990   A11(Prt)=A8
7000 A22(Prt)=A9
```

```
7010    B11(Prt)=B8
7020    B22(Prt)=B9
7030   C11(Prt)=C8
7040   C22(Prt)=C9
7050   ON Prt GOTO 7060,7140
7060   FIXED 4
7061   PRINTER IS 16
7070   PRINT "FREQUENCY= ";Freqs(P);" GHZ"
7080   PRINT
7090   PRINT "ADAPTOR LOSS AT 6PORT NUMBER ";Sport
7100   PRINT
7110   PRINT "SYSTEM CONSTANTS"
7120   PRINT
7130   GOTO 7180
7140   PRINT
7150   PRINTER IS 16
7160   PRINT "ADAPTER CONSTANTS"
7170   PRINT
7180   FIXED 4
7190      PRINT "A8,A9,B8,B9,C8,C9"
7200      PRINT A8,A9,B8,B9,C8,C9
7210      PRINT
7220      PRINT "A1,A2,B1,B2,C1,C2";A11(Prt),A22(Prt),B11(Prt),
                   B22(Prt),C11(Prt),C22(Prt)
7230      PRINT
7240      NEXT Prt
7250      !
7260      ! S11=(b'-b)/(a-b'c)
7270      !
7280   ! _____

7290          Z1=B11(2)
7300          Z2=B22(2)
7310          Z3=B11(1)
7320          Z4=B22(1)
7330          CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7340          Nr=Z9
7350          Ni=Z0
7360          Z3=C11(1)
7370          Z4=C22(1)
7380          CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7390          Z3=Z9
7400          Z4=Z0
7410          Z1=A11(1)
7420          Z2=A22(1)
7430          CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7440          Z1=Nr
7450          Z2=Ni
7460          Z3=Z9
7470          Z4=Z0
7480          CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7490          S11r=Z9
7500          S11i=Z0
7510        X=Z9
7520        Y=Z0
```

```
7530        CALL Crpa(X,Y,R,T)
7540        PRINT
7550        S11m=R
7560        S11a=T
7570         !
7580   !    S22=(a'c-ac')/(a-b'c)
7590   !
7600   !   _____
7610          Z1=A11(2)
7620          Z2=A22(2)
7630          Z3=C11(1)
7640          Z4=C22(1)
7650          CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7660          Mr=Z9
7670          Mi=Z0
7680          Z1=A11(1)
7690          Z2=A22(1)
7700          Z3=C11(2)
7710          Z4=C22(2)
7720          CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7730          Z1=Mr
7740          Z2=Mi
7750          Z3=Z9
7760          Z4=Z0
7770          CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7780          Mr=Z9
7790          Mi=Z0
7800          Z1=B11(2)
7810          Z2=B22(2)
7820          Z3=C11(1)
7830          Z4=C22(1)
7840          CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
7850          Z3=Z9
7860          Z4=Z0
7870          Z1=A11(1)
7880          Z2=A22(1)
7890          CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
7900          Z3=Z9
7910          Z4=Z0
7920          Z1=Mr
7930          Z2=Mi
7940          CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
7950          S22r=Z9
7960          S22i=Z0
7970          X=Z9
7980          Y=Z0
7990          CALL Crpa(X,Y,R,T)
8000          S22m=R
8010          S22a=T
8020        !
8030        ! S12^2=(a'-bc')/(a-b'c)+S11*S22
8040        !
8050   !   _____
8060        Z3=C11(2)
8070        Z4=C22(2)
```

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```
8080        Z1=B11(1)
8090        Z2=B22(1)
8100        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8110        Z1=A11(2)
8120        Z2=A22(2)
8130        Z3=Z9
8140        Z4=Z0
8150        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
8160        Mr=Z9
8170        Mi=Z0
8180        Z1=B11(2)
8190        Z2=B22(2)
8200        Z3=C11(1)
8210        Z4=C22(1)
8220        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8230        Z1=A11(1)
8240        Z2=A22(1)
8250        Z3=Z9
8260        Z4=Z0
8270        CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
8280        Z1=Mr
8290        Z2=Mi
8300        Z3=Z9
8310        Z4=Z0
8320        CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
8330        Mr=Z9
8340        Mi=Z0
8350        Z1=S11r
8360        Z2=S11i
8370        Z3=S22r
8380        Z4=S22i
8390        CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
8400        Z1=Z9
8410        Z2=Z0
8420        Z3=Mr
8430        Z4=Mi
8440        CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
8450        Z1=Z9
8460        Z2=Z0
8470        CALL Csqra(Z1,Z2,Z9,Z0)
8480        S12r=Z9
8490        S12i=Z0
8500        S12m=SQR(Z9^2+Z0^2)
8510        S12a=ATN(S12i/S12r)*180/PI
8520        PRINT "S12m,S12a,S12r,S12i"
8530        PRINT S12m,S12a,S12r,S12i
8540        !
8550    ! ****************************************
8560    !  Alpha 210=|S21|^2/(1-|S22|^2)
8570    !  Alpha 120=|S21|^2/(1-|S11|^2)
8580    !  _____
8590        A120=S12m^2/(1-S11m^2)
8600        A210=S12m^2/(1-S22m^2)
8610        Db120=10*LGT(A120)
8620        Db210=10*LGT(A210)
```

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```
8630        PRINTER IS 16
8640        PRINT
8650     !  PRINT "S12m, S12a, S12r, S12i"
8660        PRINTER IS 0
8670        FIXED 0
8680        PRINT
8690        PRINT "REFLECTION COEFFICIENTS FOR ADAPTER ON 6-PORT
                 #";Sport
8691        FIXED 2
8700        PRINT
8701        PRINT "FREQUENCY:";Freqs(P);"GHZ"
8702        PRINT
8710        PRINT "S11 MAGNITUDE          S11 ANGLE              S11
                 REAL            S11  IMAGINARY"
8720        PRINT "--------------          ---------          ---------
                 ----------"
8730        FIXED 4
8740        PRINT S11m,S11a,S11r,S11i
8750     PRINT
8760        PRINT "S22 MAGNITUDE          S22 ANGLE              S22 REAL
                 S22  IMAGINARY"
8770        PRINT "--------------          ---------          ---------
                 ----------"
8780        PRINT S22m,S22a,S22r,S22i
8790        PRINT
8791        PRINT
8800        FIXED 0
8810        PRINT "LOSS DATA FOR ADAPTOR AN SIX-PORT";Sport
8820        PRINT "Alpha 12                LOSS DB                Alpha21
                          lOSS DB"
8830        PRINT "--------------          ---------          ---------
                 -----------"
8840        FIXED 4
8850     !  PRINT S12m,S12a,S12r,S12i
8860        PRINT A120,ABS(Db120),A210,ABS(Db210)
8870        K=0
8880        PRINT
8900        NORMAL
8920        IF Sport=2 THEN K=17
8921        IF Sport=1 THEN K=0
8930        S(P,K+1)=S11m
8940        S(P,K+2)=S11a
8950        S(P,K+3)=S11r
8960        S(P,K+4)=S11i
8970        S(P,K+5)=A120
8980        S(P,K+6)=S22m
8990        S(P,K+7)=S22a
9000        S(P,K+8)=S22r
9010        S(P,K+9)=S22i
9020        S(P,K+10)=A210
9030        S(P,K+11)=S12m
9040        S(P,K+12)=S21m
9050        ! ****************************************
9060        PRINTER IS 16
9070     ! THE FOLLOWING CODE EXISTS TO CALCULATE EFFICIENCY OF
```

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```
        ADAPTER AND DUT
9080    !  _____
9090    !
9100 !  G1=S11+(S12*S21*Gx)/(1-S22*Gx)
9110    !
9111    ON Sport GOTO 9120,9132
9120    R=Gxm(Sport)=M1
9130    T=Gxa(Sport)=P1
9131    GOTO 9140
9132    R=Gxm(Sport)=M2
9133    T=Gxa(Sport)=P2
9140    CALL Cpra(R,T,X,Y)
9150    Gxr(Sport)=X
9160    Gxi(Sport)=Y
9210    Z1=Z3=S12r
9220    Z2=Z4=S12i
9230    CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9240    Z1=Z9
9250    Z2=Z0
9260    Z3=Gxr1
9270    Z4=Gxi1
9280    CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9290    Nur=Z9
9300    Nui=Z0
9310    PRINT Nur,Nui,Z9,Z0
9320    Z1=S22r
9330    Z2=S22i
9340    Z3=Gxm(Sport)
9350    Z4=0
9360    CALL Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
9370   PRINT "S22GX"
9380   PRINT Z9,Z0
9390    Z1=1
9400    Z2=0
9410    Z3=Z9
9420    Z4=Z0
9430    CALL Csua(Z1,Z2,Z3,Z4,Z9,Z0)
9440   PRINT " 1-S22GX",Z9,Z0
9450    Z1=Nur
9460    Z2=Nui
9470    Z3=Z9
9480    Z4=Z0
9490    Mag1=SQR(Z9^2+Z0^2)^2
9500    CALL Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
9510    Z1=S11r
9520    Z2=S11i
9530    PRINT "S11R, S11I",S11r,S11i
9540    PRINT S11r,S11i
9550    Z3=Z9
9560    Z4=Z0
9570    CALL Cada(Z1,Z2,Z3,Z4,Z9,Z0)
9580    G1r=Z9
9590    G1i=Z0
9600    !
9610 !  _____
```

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```
9620   !
9630   ! Alpha12=[(1-|Gx|^2)*|S12|^2]/[(1-|Gl|^2*|1-S22Gx|^2]
9631   ! 1-Gxm(1)^2*S12m^2/(1-Glm^2
9640   !
9660   Magn=(1-Gxm(Sport)^2)*S12m^2
9670   Glm=SQR(Glr^2+Gli^2)^2
9680   X=Glr
9690   Y=Gli
9700   CALL Crpa(X,Y,R,T)
9710   Gla=T
9720   Magd=(1-Glm)*Magl
9730   Alpha12=Magn/Magd
9740   A12=Alpha12
9750   PRINTER IS 16
9760   PRINT "Glm,Gla, Glr,Gli"
9770   PRINT SQR(Glm),Gla,Glr,Gli
9780   PRINT "Gxm, Gxa, Gxr, Gxi"
9790   PRINT Gxm(Sport),Gxa(Sport),Gxr(Sport),Gxi(Sport)
9801   PRINTER IS 0
9805   PRINT "EFFICIENCY OF ADAPTER AND DEVICE COMBINATION:";A12
9806   PRINT
9807   PRINT
9808   PRINTER IS 16
9810   IF Sport=1 THEN GOTO 9830
9820   GOTO 9900
9830      S(P,K+13)=Gxm(Sport)
9840      S(P,K+14)=Gxa(Sport)
9850      S(P,K+15)=Gxi(Sport)
9860      S(P,K+16)=Gxr(Sport)
9861      S(P,K+17)=A12
9890     GOTO 9940
9900      S(P,K+13)=Gxm(Sport)
9910      S(P,K+14)=Gxa(Sport)
9920      S(P,K+15)=Gxi(Sport)
9930      S(P,K+16)=Gxr(Sport)
9931      S(P,K+17)=A12
9940   Sport=Sport+1
9950            IF Sport=2 THEN GOTO 6790
9951   PRINT PAGE
9952   Sport=1
9955   NEXT P
9960   GOTO 9980
9970      PRINTER IS 16
9980      MASS STORAGE IS ":F8,1"
9990      FOR I=1 TO 20
10000     NORMAL
10010  FIXED 0
10020     ASSIGN #1 TO "AD-"&VAL$(I),Check
10021    ASSIGN #1 TO *
10030     IF Check THEN Q$=VAL$(I)
10040     IF Check THEN 10060
10050     NEXT I
10060     CREATE "AD-"&Q$,2*Nfreqs
10070     ASSIGN #1 TO "AD-"&Q$
10080     PRINT #1;S(*)
```

```
10090    ASSIGN #1 TO *
10110     RETURN 0
```

FNAdp(

A11(	6990	7220	7410	7610	7680	7870	8110
	8230						
A12	9740	9805	9861	9931			
A120	8590	8610	8860	8970			
A210	8600	8620	8860	9020			
A22(	7000	7220	7420	7620	7690	7880	8120
	8240						
A8	6910	6990	7200				
A9	6920	7000	7200				
Alpha12	9730	9740					
B11(	7010	7220	7290	7310	7800	8080	8180
B22(	7020	7220	7300	7320	7810	8090	8190
B8	6930	7010	7200				
B9	6940	7020	7200				
C11(	7030	7220	7360	7630	7700	7820	8060
	8200						
C22(	040	7220	7370	7640	7710	7830	8070
	8210						
C8	6950	7030	7200				
C9	6960	7040	7200				
Ca$	6470						
Check	10020	10030	10040				
Cnnct$	6640						
Date$	6640						
Db120	8610	8860					
Db210	8620	8860					
Freqs(	6510	6640	7070	8701			

Gla	9710	9770					
Gli	9590	9670	9690	9770			
Glm	9670	9720	9770				
Glr	9580	9670	9680	9770			
Gxa(	9130	9133	9790	9840	9910		
Gxi(	9160	9790	9850	9920			
Gxil	9270						
Gxm(	9120	9132	9340	9660	9790	9830	9900
Gxr(	9150	9790	9860	9930			
Gxrl	9260						
I	9990	10020	10030	10050			
Id_content$	6510	6640					
K	6521	8870	8920	8921	8930	8940	8950
	8960	8970	8980	8990	9000	9010	9020
	9030	9040	9830	9840	9850	9860	9861
	9900	9910	9920	9930	9931		
M1	6470	9120					
M2	6470	9132					
Magl	9490	9720					
Magd	9720	9730					
Magn	9660	9730					
Mc	6880	6900	6910	6920	6930	6940	6950
	6960						
Mi	7670	7740	7790	7930	8170	8290	8340
	8430						
Mr	7660	7730	7780	7920	8160	8280	8330
	8420						
Msu$	6500	6640					
N	6680						
N1	6750	6750					

N1$	6620	6640	6730	6820		
N2	6760	6760				
N2$	6630	6730	6850			
Nfreq	6680	6830				
Nfreqs	6470	6510	6510	6510	6640	6680	6780
	6820	6850	10060				
Ni	7350	7450				
Nr	7340	7440				
Nui	9300	9310	9460			
Nur	9290	9310	9450			
O	10110					
P	6780	6910	6920	6930	6940	6950	6960
	7070	8701	8930	8940	8950	8960	8970
	8980	8990	9000	9010	9020	9030	9040
	9830	9840	9850	9860	9861	9900	9910
	9920	9930	9931	9955			
P1	6470	9130				
P2	6470	9133				
Prt	6790	6810	6990	7000	7010	7020	7030
	7040	7050	7220	7220	7220	7220	7220
	7220	7240					
Q$	0	10030	10030	10060	10070		
R	7530	7550	7990	8000	9120	9132	9140
	9700						
Repeats	6470	6640				
Result(	6510	6820	6850	6910	6920	6930	6940
	6950	6960					
S(	6510	8930	8940	8950	8960	8970	8980
	8990	9000	9010	9020	9030	9040	9830
	9840	9850	9860	9861	9900	9910	9920
	9930	9931	10080				
S11a	7560	8740	8940			
S11i	7500	8360	8740	8960	9520	9530	9540
S11m	7550	8590	8740	8930		

S11r	7490	8350	8740	8950	9510	9530	9540
S12a	8510	8530					
S12i	8490	8510	8530	9220			
S12m	8500	8530	8590	8600	9030	9660	
S12r	8480	8510	8530	9210			
S21m	9040						
S22a	8010	8780	8990				
S22i	7960	8380	8780	9010	9330		
S22m	8000	8600	8780	8980			
S22r	7950	8370	8780	9000	9320		
Sp	6640						
Sport	6710	6870	7090	8690	8810	8920	8921
	9111	9120	9130	9132	9133	9150	9160
	9340	9660	9790	9790	9790	9790	9810
	9830	9840	9850	9860	9900	9910	9920
	9930	9940	9940	9950	9952		
Std_mnt	6640						
T	7530	7560	7990	8010	9130	9133	9140
	9700	9710					
Time$	6640						
Typ$	6640						
X	7510	7530	7970	7990	9140	9150	9680
	9700						
Y	7520	7530	7980	7990	9140	9160	9690
	9700						
Z0	7330	7350	7380	7400	7430	7470	7480
	7500	7520	7650	7670	7720	7760	7770
	7790	7840	7860	7890	7910	7940	7960
	7980	8100	8140	8150	8170	8220	8260
	8270	8310	8320	8340	8390	8410	8440
	8460	8470	8490	8500	9230	9250	9280
	9300	9310	9360	9380	9420	9430	9440
	9480	9490	9500	9560	9570	9590	
Z1	7290	7330	7380	7410	7430	7440	7480
	7610	7650	7680	7720	7730	7770	7800

	7840	7870	7890	7920	7940	8080	8100
	8110	8150	8180	8220	8230	8270	8280
	8320	8350	8390	8400	8440	8450	8470
	9210	9230	9240	9280	9320	9360	9390
	9430	9450	9500	9510	9570		
Z2	7300	7330	7380	7420	7430	7450	7480
	7620	7650	7690	7720	7740	7770	7810
	7840	7880	7890	7930	7940	8090	8100
	8120	8150	8190	8220	8240	8270	8290
	8320	8360	8390	8410	8440	8460	8470
	9220	9230	9250	9280	9330	9360	9400
	9430	9460	9500	9520	9570		
Z3	7310	7330	7360	7380	7390	7430	7460
	7480	7630	7650	7700	7720	7750	7770
	7820	7840	7850	7890	7900	7940	8060
	8100	8130	8150	8200	8220	8250	8270
	8300	8320	8370	8390	8420	8440	9210
	9230	9260	9280	9340	9360	9410	9430
	9470	9500	9550	9570			
Z4	7320	7330	7370	7380	7400	7430	7470
	7480	7640	7650	7710	7720	7760	7770
	7830	7840	7860	7890	7910	7940	8070
	8100	8140	8150	8210	8220	8260	8270
	8310	8320	8380	8390	8430	8440	9220
	9230	9270	9280	9350	9360	9420	9430
	9480	9500	9560	9570			
Z9	7330	7340	7380	7390	7430	7460	7480
	7490	7510	7650	7660	7720	7750	7770
	7780	7840	7850	7890	7900	7940	7950
	7970	8100	8130	8150	8160	8220	8250
	8270	8300	8320	8330	8390	8400	8440
	8450	8470	8480	8500	9230	9240	9280
	9290	9310	9360	9380	9410	9430	9440
	9470	9490	9500	9550	9570	9580	

```
10120 SUB Cmua(Z1,Z2,Z3,Z4,Z9,Z0)
10130 Z9=Z1*Z3-Z2*Z4
10140 Z0=Z1*Z4+Z2*Z3
10150 SUBEXIT
10160 SUBEND
```

S Cmua(

Z0	10120	10140	
Z1	10120	10130	10140
Z2	10120	10130	10140
Z3	10120	10130	10140
Z4	10120	10130	10140
Z9	10120	10130	

```
10170 SUB Cdia(Z1,Z2,Z3,Z4,Z9,Z0)
10180 Z6=Z3*Z3+Z4*Z4
10190 Z9=(Z1*Z3+Z2*Z4)/Z6
10200 Z0=(Z2*Z3-Z1*Z4)/Z6
10210 SUBEXIT
10220 SUBEND
```

S Cdia(

Z0	10170	10200			
Z1	10170	10190	10200		
Z2	10170	10190	10200		
Z3	10170	10180	10180	10190	10200
Z4	10170	10180	10180	10190	10200
Z6	10180	10190	10200		
Z9	10170	10190			

```
10230 SUB Cinva(Z1,Z2,Z9,Z0)
10240 Z6=Z1*Z1+Z2*Z2
10250 Z9=Z1/Z6
10260 Z0=-Z2/Z6
10270 SUBEXIT
10280 SUBEND
```

S Cinva(

Z0	10230	10260		
Z1	10230	10240	10240	10250
Z2	10230	10240	10240	10260
Z6	10240	10250	10260	
Z9	10230	10250		

```
10290 SUB Csqa(Z1,Z2,Z9,Z0)
10300 Z9=Z1*Z1-Z2*Z2
10310 Z0=2*Z1*Z2
10320 SUBEXIT
10330 SUBEND

S Csqa(


Z0              10290  10310

Z1              10290  10300  10300  10310

Z2              10290  10300  10300  10310

Z9              10290  10300
```

```
10340 SUB Cada(Z1,Z2,Z3,Z4,Z9,Z0)
10350 Z9=Z1+Z3
10360 Z0=Z2+Z4
10370 SUBEXIT
10380 SUBEND

S Cada(


Z0              10340   10360

Z1              10340   10350

Z2              10340   10360

Z3              10340   10350

Z4              10340   10360

Z9              10340   10350
```

```
10390 SUB Csua(Z1,Z2,Z3,Z4,Z9,Z0)
10400 Z9=Z1-Z3
10410 Z0=Z2-Z4
10420 SUBEXIT
10430 SUBEND
```

S Csua(

Z0	10390	10410
Z1	10390	10400
Z2	10390	10410
Z3	10390	10400
Z4	10390	10410
Z9	10390	10400

```
10440 SUB Caba(Z1,Z2,Z9)
10450 Z9=SQR(Z1*Z1+Z2*Z2)
10460 SUBEXIT
10470 SUBEND
```

S Caba(

Z1   10440   10450   10450

Z2   10440   10450   10450

Z9   10440   10450

```
10480 SUB Csqra(Z1,Z2,Z9,Z0)
10490 X=Z1
10500 Y=Z2
10510 CALL Crpa(X,Y,R,T)
10520 R=SQR(R)
10530 T=T/2
10540 Z9=R*COS(PI*T/180)
10550 Z0=R*SIN(PI*T/180)
10560 GOTO 10570
10570 SUBEXIT
10580 SUBEND
```

S Csqra(

R	10510	10520	10520	10540	10550
T	10510	10530	10530	10540	10550
X	10490	10510			
Y	10500	10510			
Z0	10480	10550			
Z1	10480	10490			
Z2	10480	10500			
Z9	10480	10540			

```
10590 SUB Crpa(X,Y,R,T)
10600 R=SQR(X*X+Y*Y)
10610 IF X=0 THEN GOTO 10640
10620 T=ATN(Y/X)
10630 GOTO 10650
10640 T=PI*SGN(Y)/2
10650 T=T*180/PI
10660 IF X>=0 THEN 10710
10670 IF Y>=0 THEN 10700
10680 T=T-180
10690 GOTO 10710
10700 T=T+180
10710 SUBEXIT
10720 SUBEND
```

S Crpa(

R	10590	10600					
T	10590	10620	10640	10650	10650	10680	10680
	10700	10700					
X	10590	10600	10600	10610	10620	10660	
Y	10590	10600	10600	10620	10640	10670	

```
10730 SUB Cmuada(Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9,Z0)
10740 Z9=Z1*Z3-Z2*Z4+Z5*Z7-Z6*Z8
10750 Z0=Z1*Z4+Z2*Z3+Z5*Z8+Z6*Z7
10760 SUBEXIT
10770 SUBEND
```

S Cmuada(

Z0	10730	10750	
Z1	10730	10740	10750
Z2	10730	10740	10750
Z3	10730	10740	10750
Z4	10730	10740	10750
Z5	10730	10740	10750
Z6	10730	10740	10750
Z7	10730	10740	10750
Z8	10730	10740	10750
Z9	10730	10740	

```
10780 SUB Cpra(R,T,X,Y)
10790 X=R*COS(PI*T/180)
10800 Y=R*SIN(PI*T/180)
10810 SUBEXIT
10820 SUBEND
```

S Cpra(

R		10780	10790	10800
T		10780	10790	10800
X		10780	10790	
Y		10780	10800	

```
10830 SUB Doc
10840 LINPUT "Today'S Date--AS 850729",Doda$
10850 PRINTER IS 0
10860 PRINT PAGE
10870 PRINT "CHANGES LISTED ARE AS OF ";Doda$
10880 PRINT "CHANGE 1. RENAMED TO TST1-FINAL NAME TO BE ADPTR5"
10890 PRINT "CHANGE 2. CHANGED DATE IN FNDtgs$ FROM 84 TO 85"
10900 PRINT "CHANGE 3. RENAMED SUB Pset TO SUB psetdeL (LINE 3456)"
10910 PRINT "CHANGE 4. CHANGED SUB Synth TO CALL SUB Synth_900
              (LINES 2830 TO"
10920 PRINT "          2931)."
10930 PRINT "CHANGE 5. INSERTED SUB Synth_900 AT LINE 8000 AND SUB"
10940 PRINT "          Pset AT 8140 AND SUB Genlevel AT 8480"
10950 PRINT "CHANGE 6. ADDED Cal=1 AT LINE 31"
10960 PRINT "CHANGE 7. ENTER INPUT STATEMENT FOR Nfreqs
              WHEN ADAPTR CALC ONLY IS
"
10970 PRINT "CHANGE 8. CHANGED Typ LOGIC TO INCLUDE TYP>5 AT
              LINE 75"
10980 PRINT "CHANGE 9. CHANGE Typ LOGIC AT LINE 76"
10990 PRINT "CHANGE 10. CHANGED OR ADDED LOGIC IN STATEMENTS
              78-79"
11000 PRINT "CHANGE 11. CHANGED OR ADDED Typ LOGIC IN LINES
              115-116"
11010 PRINT "CHANGE 12. CHANGED OR ADDED LOGIC LINES 119 AND
              121"
11020 PRINT "CHANGE 13. ADDED STATEMENT 164 AND 180"
11030 PRINT "CHANGE 14. CHANGED OR ADDED STATEMENTS AT LINES 224,
              225,226,235,"
11040 PRINT "          236,237,238, AND 239"
11050 PRINT "CHANGE 15. CHANGED FORMAT LINE 261"
11060 PRINT "CHANGE 16. ADDED LINE 275                          "
11070 PRINT "CHANGE 17. ADDED VARIABLE Proc TO CALLING STATEMENT
              IN LINES
11080 PRINT "          282,315,AND 333."
11090 PRINT "CHANGE 18.  ADDED OR CHANGED LOGIC IN LINES 367-371."
11100 PRINT "CHANGE 19. CHANGED FORMAT STATEMENT IN LINE 465/"
11110 PRINT "CHANGE 20. ADDED Cal TO SUB Caldat IN LINE 1077"
11120 PRINT "CHANGE 21. DEFINED Cal$ IN LINE 1093"
11130 PRINT "CHANGE 22. ADDED OR CHANGED LOGIC IN LINES 1265-1272."
11140 PRINT "CHANGE 23. ADDED(&)Ca$ TO STRING IN LINES 1299 AND 1302"
11150 PRINT "CHANGE 24. ADDED(&)Ca$ TO STRING IN LINES 1323 AND 1326"
11160 PRINT "CHANGE 25. ADDED Cal TO SUB Calres CALL AND SUB Caldat
              CALLS "
11170 PRINT "          IN LINES 168, 171,1077,AND 3612"
11180 PRINT "CHANGE 26. DIMENSIONED MATRIX Rd(Nfreqs,2,12) IN LINE
"
11190 PRINT "          3624"
11200 PRINT "CHANGE 27. CHANGED VARIABLE LIST IN SUB Coeff--ADDED
              Cal AND Rd(*) "
11210 PRINT "          -DELETED Omitf(*) IN LINES 3727 AND 3795 "
11220 PRINT "CHANGE 28. ADDED  LINPUT STATEMENT AT LINE 3625."
11230 PRINT "CHANGE 29. ADDED &Ca$  TO FILE NAMES IN LINES 3639
              AND 3640"
11240 PRINT "CHANGE 30. ADDED LINES 3643 AND 3644."
```

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```
11250 PRINT "CHANGE 31. ADDED DO LOOP FROM 3648 TO 3658."
11260 PRINT "CHANGE 32. ADDED LINES 3767 AND 3772."
11270 PRINT "CHANGE 33. ADDED ADAPTER CALC SUB PRORAM FNAdpt AT
              LINE 9000."
11280 SUBEXIT
11290 SUBEND
```

S Doc

Doda$ 10840   10870

```
11300 SUB Gamma(Nfreqs,Repeats,Ca$)
11310   OPTION BASE 1
11320 DIM Power(Nfreqs,Repeats,16,10),Po(1,8),Result(Nfreqs,60),
                Wrspt(2,12)
11330 FREAD "1PRD"&"3"&":F8,1",Power(*)
11331 MASS STORAGE IS ": F8,1"
11332 PRINTER IS 0
11333   PRINT PAGE
11340 G=1
11350 PRINTER IS 16
11360 File$="CRST"&"2"
11370 FOR F=1 TO Nfreqs
11380 CALL Redwrt(File$,":F8,1"," ",Result(*),Nfreqs)
11390 FOR J=1 TO 2
11400 FOR N=1 TO 12
11410 PRINTER IS 0
11420 Wrspt(J,N)=Result(F,N+(J-1)*12)
11430 NEXT N
11440 NEXT J
11450 ! FOR I=1 TO 2
11460 ! Incr=(I=2)*5
11470 ! Inc=(I=2)*4
11480 FOR Mnt=1 TO 8
11490 Po(1,Mnt+Inc)=Power(F,1,1,Mnt+Incr)
11500 NEXT Mnt
11510 ! NEXT I
11520 CALL Mg(Po(*),1,1,Wrspt(*),"P",M1,P1,R1)
11530 CALL Mg(Po(*),1,2,Wrspt(*),"P",M2,P2,R2)
11540 PRINTER IS 0
11550 PRINT "FREQ #",F
11552 PRINT
11554 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 1"
11555 PRINT
11560 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11561 PRINT "--------------","----------"
11562 PRINT USING 11585;M1,P1
11563 PRINT
11564 PRINT "DEVICE PLUS ADAPTER ON 6-PORT 2"
11565 PRINT
11567 PRINT "GAMMA MAGNITUDE","GAMMA PHASE"
11568 PRINT "--------------","----------"
11570 PRINT USING 11585;M2,P2
11585 IMAGE MD.DDDDD,12X,MDDD.DDDD
11590 NEXT F
11591 NORMAL
11592 PRINT
11593 PRINT
11594 PRINT
11595 PRINTER IS 16
11600 Q=FNAdp(Nfreqs,Repeats,M1,P1,M2,P2,Ca$)
11610 SUBEXIT
11620 SUBEND

S Gamma(
```

Ca$	11300	11600			
F	11370	11420	11490	11550	11590
File$	11360	11380			
G	11340				
Inc	11490				
Incr	11490				
J	11390	11420	11420	11440	
M1	11520	11562	11600		
M2	11530	11570	11600		
Mnt	11480	11490	11490	11500	
N	11400	11420	11420	11430	
Nfreqs	11300	11320	11320	11370	11380	11600
P1	11520	11562	11600		
P2	11530	11570	11600		
Po(	11320	11490	11520	11530	
Power(	11320	11330	11490		
Q	11600				
R1	11520				
R2	11530				
Repeats	11300	11320	11600		
Result(	11320	11380	11420		
Wrspt(	11320	11420	11520	11530	

FNAdp(	6470	274	11600			
FNDerr(	4788	4563	4629	4677	4776	
FNDtg$	3129	1257				
FNNumd(	3216					
FNNumi(	3183	69	126	153	363	378	819
FNYorn	3153	178	219	456	696	795	852
	1290	2139	2916	3771	4797	
S Aline(	480	423				
S Avg(	3351	3969				
S Caba(	10440					
S Cada(	10340	8440	9570			
S Cadd(	6183	5541	5553	5559	5628	5634	5835
	5877	5943				
S Caldat(	1077	168	272			
S Calib(	4878	3837				
S Calres(	3612	171				
S Cdia(	10170	7480	7940	8320	9500	
S Cdiv(	6231	5523	5526	5544	5547	5562	5586
	5595	5601	5619	5637	5688	6105	
S Cinva(	10230					
S Cmpy(	6213	5331	5343	5421	5496	5502	5505
	5514	5529	5550	5556	5574	5580	5589
	5610	5631	5643	5652	5655	5691	5694
	6030	6099	6345	6411			
S Cmua(	10120	7380	7650	7720	7840	8100	8220
	8390	9230	9280	9360			
S Cmuada(	10730					
S Coeff(	3795	3727				
S Cpra(	10780	9140				

S Cpwr(	6318						
S Crpa(	10590	7530	7990	9700	10510		
S Csqa(	10290						
S Csqra(	10480	8470					
S Csua(	10390	7330	7430	7770	7890	8150	8270
	9430						
S Csub(	6198	4353	5334	5337	5340	5346	5424
	5499	5508	5511	5517	5520	5532	5577
	5583	5592	5598	5613	5616	5820	5898
	5913	5925	6096	6102	6348	6414	
S Dac(	3096	3441					
S Disc_copy(	4404	224					
S Disc_trans(	4440						
S Doc	10830						
S Dvms(	2421	2280	2535	2556			
S F_limt(	990	654	780				
S F_step(	633	435					
S F_type(	711	444					
S Fase_shft(	3057	1698	1766	1896			
S Fdata(	1575	1095					
S Filter(	2940	3435					
S Fparab(	5088	4905					
S Freq(	333	315					
S Freqin(	282	83					
S Gamma(	11300	80	239	273			
S Ident(	6249	5487	5493	5697	5700	5715	6123
	6126	6216	6234	6429			
RRS Iparab(	4971	4899					
S Measre(	1632	1116	1131	1149			
S Mg(	6159	11520	11530				

```
S Mpwr(        6336   6321

S Msoln(       6054   5040   5217   6036

S Mtpt(        6372

S Order(       3264    777   1590   1593

S Path(         867    426

S Pcalc(       2628   1890

S Polar(       6276   4863   5418   5427   5436   5565   5622
               5646   6108   6129   6135   6171   6363   6417
               6435   6438

S Pratio(      5319   4950

S Preads(      2493   1842   1854   1863

S Print(       4020   3945   3987

S Prnt_sdev(   4194   3990

S Prtpwr(      1356   1293

S Pset(        3456   3438

S Pwrmnt(         0   1845

S Rect(        6297   4350   5685   6426

S Redhed(      4575   3641   3646   4419   4452   6640

S Redwrt(      4689   3647   3765   4422   4428   4455   4464
               6820   6850  11380

S Rfout(       3390   1722   1869   1875   1881

S Rho2pt(      4326   3891   3906

S Rhothu(      4287   3873

S Rtpt(        5985   5415   5484   5490   6408

S Rvgs(        2238   1728   1731

S Stds2(       5373   4947

S Synth(       2826   3444

S T_disc(      4821   3666

S Tr15(        5445   4944
```

S W(	5709	4302	4344	4924	6165	6342	6381
S Wg(	6093	4305	4347	5382	5385	5388	5391
	5406	6138	6141	6168	6357	6393	
S Wq(	6117	4158					
S Wrp(	4851						
S Wrtbin(	4641	1280					
S Wrthed(	4494	1279	3764	4425	4461		

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4. TITLE AND SUBTITLE

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5. AUTHOR(S)

George J. Counas and Bill C. Yates

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

A noise measurement system is being developed for the U.S. Air Force which uses
coaxial cryogenic and ambient noise temperature standards to determine the
noise temperature of the device under test. When the device under test has
a different connector than those on the noise standards, an adapter has to
be used. Adapter loss and complex reflection coefficient must be compensated
for or noise measurement accuracy is affected. A technique has been developed
which uses a dual six-port measurement system to determine the mismatch,
loss, and ultimately the efficiency of the adapter used. This enables
correction of measurement results and allows measurements to be made with
an adapter with no degradation of accuracy.

This report describes this method of evaluating adapters and provides
instructions for its use.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

adapter parameters, dual six-port measurement system, efficiency, loss,
measurement technique, mismatch

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