

METROLOGY PROCEDURES



CALIBRATION INSTRUCTIONS

NOMENCLATURE: LINE IMPEDANCE STABILIZATION NETWORK
PART NUMBER: 7333-57-TS-50-N
MANUFACTURER: SOLAR ELECTRONICS COMPANY

1.0 SCOPE

- 1.1 This instruction outlines the procedure to follow when calibrating the above named instrument. A semi-automatic method using an HP-85 computer and an IEEE-488 bus is employed. However, an optional manual method is also included. Specifications are listed below.

15 KHz.....	≥ -22 dBm
20 KHz	≥ -18 dBm
30 KHz	≥ -10 dBm
40 KHz	≥ -8 dBm
50 KHz	≥ -6 dBm
60 KHz.....	≥ -4 dBm
70 - 90 KHz	≥ -2 dBm
100 - 4000 KHz	≥ -0.00 dBm

2.0 REFERENCES

- 2.1 7333-57-TS-50-N Data Sheets, Solar Electronics Co.

3.0 EQUIPMENT REQUIRED

PREPARED BY ROBERT CHASE	DATE	5-18-78																	
APPROVED BY 	ISSUE	ORIGINAL																	

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3.1 STANDARDS

3.1.1 Frequency Synthesizer, Hewlett-Packard Model 3325A.

3.1.2 RF Voltmeter, Boonton Model 9200B.

3.2 ACCESSORIES

3.2.1 Computer, Hewlett-Packard Model 85.

3.2.2 HP-IB Interface, Hewlett-Packard Model 82937A.

3.2.3 Cable, HP-IB, Hewlett-Packard Model 10833 or equivalent;
2 required.

3.2.4 Adapter, BNC (m) to Binding Posts, Pomona Model 1296 or
equivalent; 2 required.

3.2.5 Adapter, BNC (m) to N (m), Pomona Model 3535 or
equivalent.

3.2.6 Spade lug jumper, Pomona Model 1756-24 or equivalent.

3.2.7 Low Frequency RF probe, Boonton P/N 952016-3.

3.2.8 50Ω Adapter for RF Probe, Boonton P/N 952002.

3.2.9 Disk I1071 - Refer to Appendix B.

3.2.10 Disk Drive, Hewlett-Packard Model 9121A.

4.0 POWER REQUIRED

4.1 115VAC, 60 Hz, Single Phase.

5.0 CALIBRATION INSTRUCTIONS

5.1 ATTENUATION VS FREQUENCY TEST (SEMI - AUTOMATIC METHOD)

5.1.1 Connect the test circuit of Figure 1.

5.1.2 Turn on the HP3325A Frequency Synthesizer, Boonton Model
9200B RF Voltmeter, HP 9121D Disk Drive and HP-85
Computer.

5.1.3 Insert the I1071 disk into the left side drive
(subchannel 0) of the HP 9121D Disk Drive. Type the
following command.

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LOAD "I1071"

- 5.1.4 Press the **<END LINE>** key on the keyboard. (The quotes around I1071 must be included).
- 5.1.5 Wait for the Disk Drive LED to extinguish and then depress the **<RUN>** key.
- 5.1.6 Follow the directions presented on the HP-85 screen to perform the calibration.
- 5.1.7 When the program is complete, insure that the printout data (attenuation) is within the limits given. An asterisk indicates a failure.
- 5.1.8 If the readings are within the given limits, make a photocopy of the results portion of the printout and attach it to the UUT. (See sample in Figure 3).
- 5.1.9 If the unit readings are **NOT** within the given limits, notify the Lab Supervisor.
- 5.1.10 Disconnect the test setup. The calibration is complete.
- 5.2 ATTENUATION VS FREQUENCY TEST (MANUAL METHOD)
 - 5.2.1 Make a copy of the Data Sheet located at the end of this section. Enter UUT S/N, date and technician's name.
 - 5.2.2 Connect the test circuit of Figure 1 with the exception that the HP-85 computer, HP 9121D Disk Drive and the IEEE cables are not necessary.
 - 5.2.3 Turn on test equipment.
 - 5.2.4 Set the HP 3325A Synthesizer as follows:

FUNCTION.....SINE WAVE

AMPTD.....0 DB

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5.2.5 Depress the following buttons ((**BOLDFACE**) on the Boonton 9200B RF Voltmeter.

1.....**SELECT CHAN**

MODE.....**dBm**

5.2.6 Set the HP Synthesizer as follows:

FREQ.....15 KHz/test frequency.

5.2.7 Record the Boonton 9200B RF Voltmeter indication on the Data Sheet **REFERENCE** Column.

5.2.8 Repeat paragraphs 5.2.5 through 5.2.7 for all frequencies listed on the Data Sheet.

5.2.9 Connect the test circuit of Figure 2 with the exception that the HP-85 computer, HP 9121D Disk Drive and the IEEE cables are not necessary.

5.2.10 Set the HP Synthesizer to 15 KHz/test frequency.

5.2.11 Record the Boonton 9200B RF Voltmeter indication on the Data Sheet **OUTPUT** column.

5.2.12 Repeat paragraphs 5.2.10 and 5.2.11 for all frequencies listed on the Data Sheet.

5.2.13 Subtract the **REFERENCE** column indication from the **OUTPUT** column indication for each frequency on the Data Sheet. Enter the results in the **ATTENUATION** Column.

5.2.14 Refer to Table 5.2 and Appendix A. If the results are within the specification limits, make a copy of the completed Data Sheet Frequency and Attenuation Columns and attach them to the UUT.

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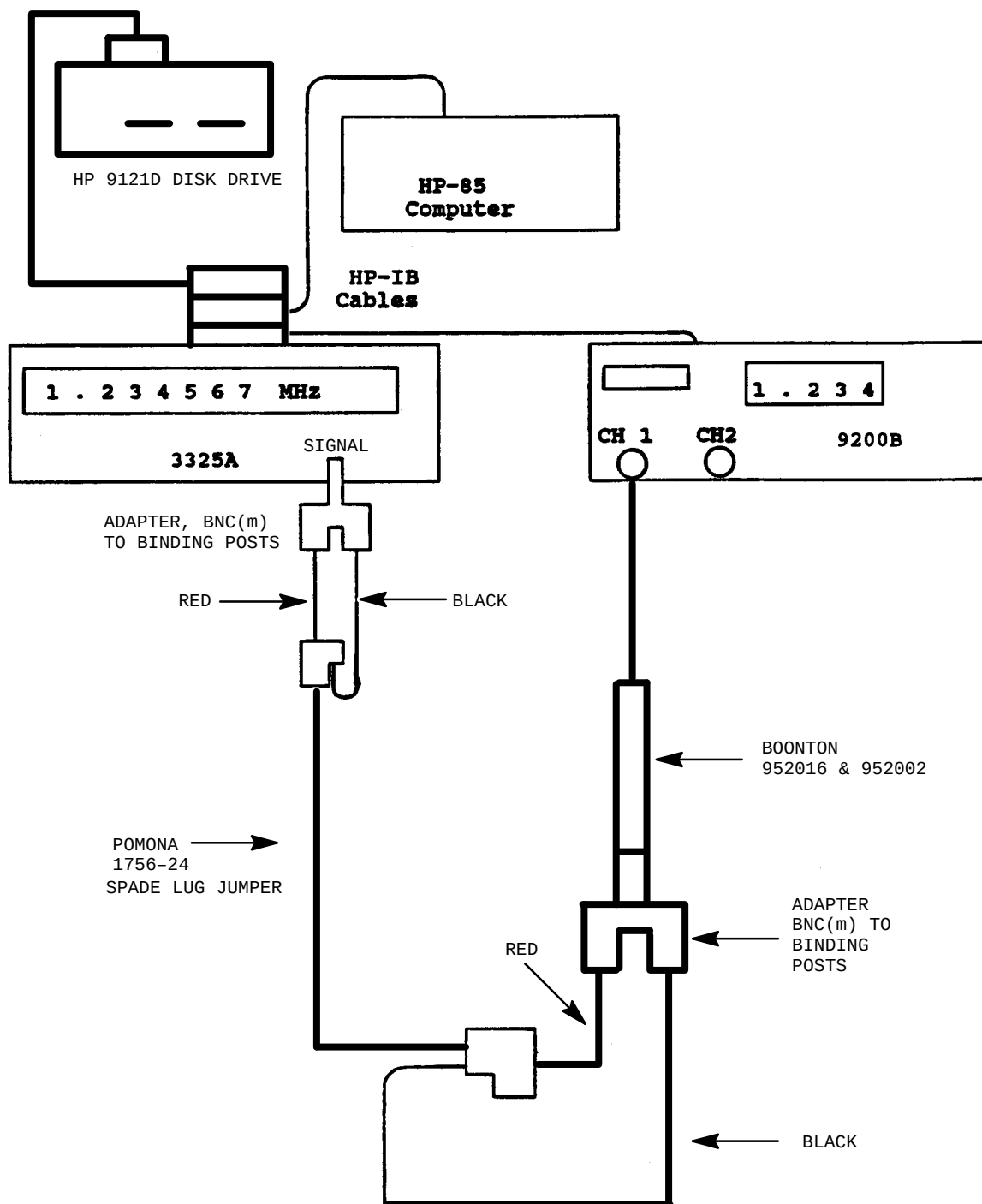


Test Frequency (KHz)	Limits (dBm)
15	≥ -22
20	≥ -18
30	≥ -10
40	≥ -8
50	≥ -6
60	≥ -4
70 - 90	≥ -2
100 - 1000	≥ -0.00

Table 5.2

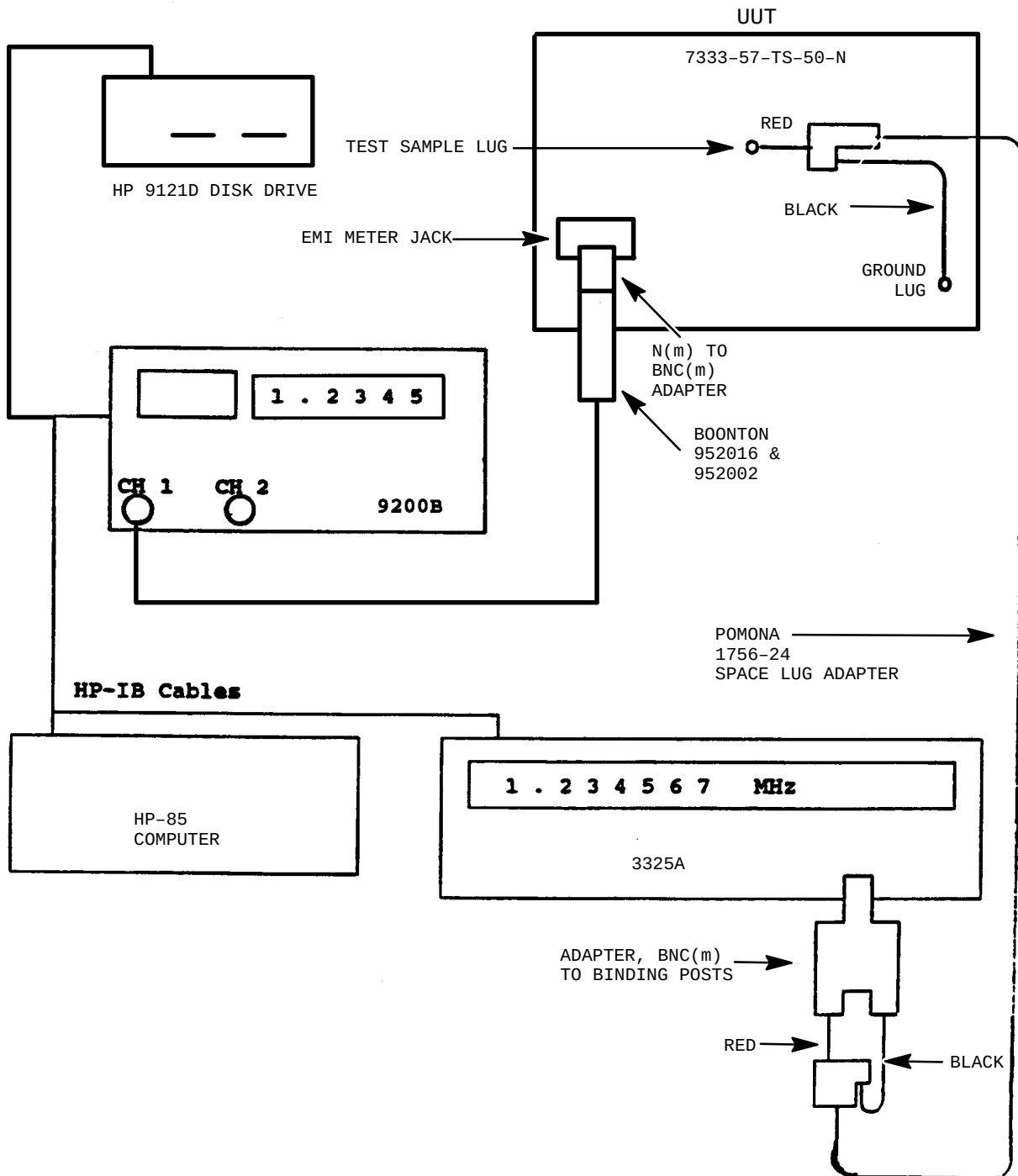
- 5.2.15 If any of the results is **NOT** within the specification limits notify the Lab Supervisor.
- 5.2.16 End of procedure.

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UUT REFERENCE MEASUREMENTS
Figure 1

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UUT OUTPUT MEASUREMENTS

FIGURE 2

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**** RESULTS ****

TEST NUMBER	ATTN dBm	TEST FREQ
# 1	-24.66 dBm @	15KHz
# 2	-19.02 dBm @	20KHz
# 3	-12.61 dBm @	30KHz
# 4	-8.99 dBm @	40KHz
# 5	-6.63 dBm @	50KHz
# 6	-5.09 dBm @	60KHz
# 7	-4.05 dBm @	70KHz
# 8	-3.33 dBm @	80KHz
# 9	-2.78 dBm @	90KHz
#10	-2.37 dBm @	100KHz
#11	-.85 dBm @	200KHz
#12	-.56 dBm @	300KHz
#13	-.43 dBm @	400KHz
#14	-.38 dBm @	500KHz
#15	-.32 dBm @	600KHz
#16	-.31 dBm @	700KHz
#17	-.32 dBm @	800KHz
#18	-.28 dBm @	900KHz
#19	-.29 dBm @	1000KHz
#20	-.27 dBm @	2000KHz
#21	-.26 dBm @	3000KHz
#22	-.27 dBm @	4000KHz

SOLAR ELECT. P/N 7333-57-TS-50N

I1071

DATE: 4/17/98

SERIAL NUMBER: 933350

TECH: BOB CHASE

SAMPLE RESULTS PRINTOUT

FIGURE 3

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DATA SHEET

SOLAR 7333-57-TS-50-N LISN

SN: _____ DATE: _____ TECHNICIAN: _____

Section 5.1 ATTENUATION VS FREQUENCY (attach computer printout)

Section 5.2 ATTENUATION VS FREQUENCY (Manual Method)

SPECIFICATIONS:

15 KHz..... $\geq$ -22 dBm
 20 KHz..... $\geq$ -18 dBm
 30 KHz..... $\geq$ -10 dBm
 40 KHz..... $\geq$ -8 dBm
 50 KHz..... $\geq$ -6 dBm
 60 KHz..... $\geq$ -4 dBm
 70 - 90 KHz..... $\geq$ -2 dBm
 100 - 4000 KHz..... $\geq$ -0.00 dBm

FREQUENCY (KHz)	ATTENUATION	REFERENCE	OUTPUT
15			
20			
30			
40			
50			
60			
70			
80			
90			
100			
200			
300			
400			

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DATA SHEET

SOLAR 7333-57-TS-50-N LISN

SN: _____ DATE: _____ TECHNICIAN: _____

Section 5.2 Cont'd

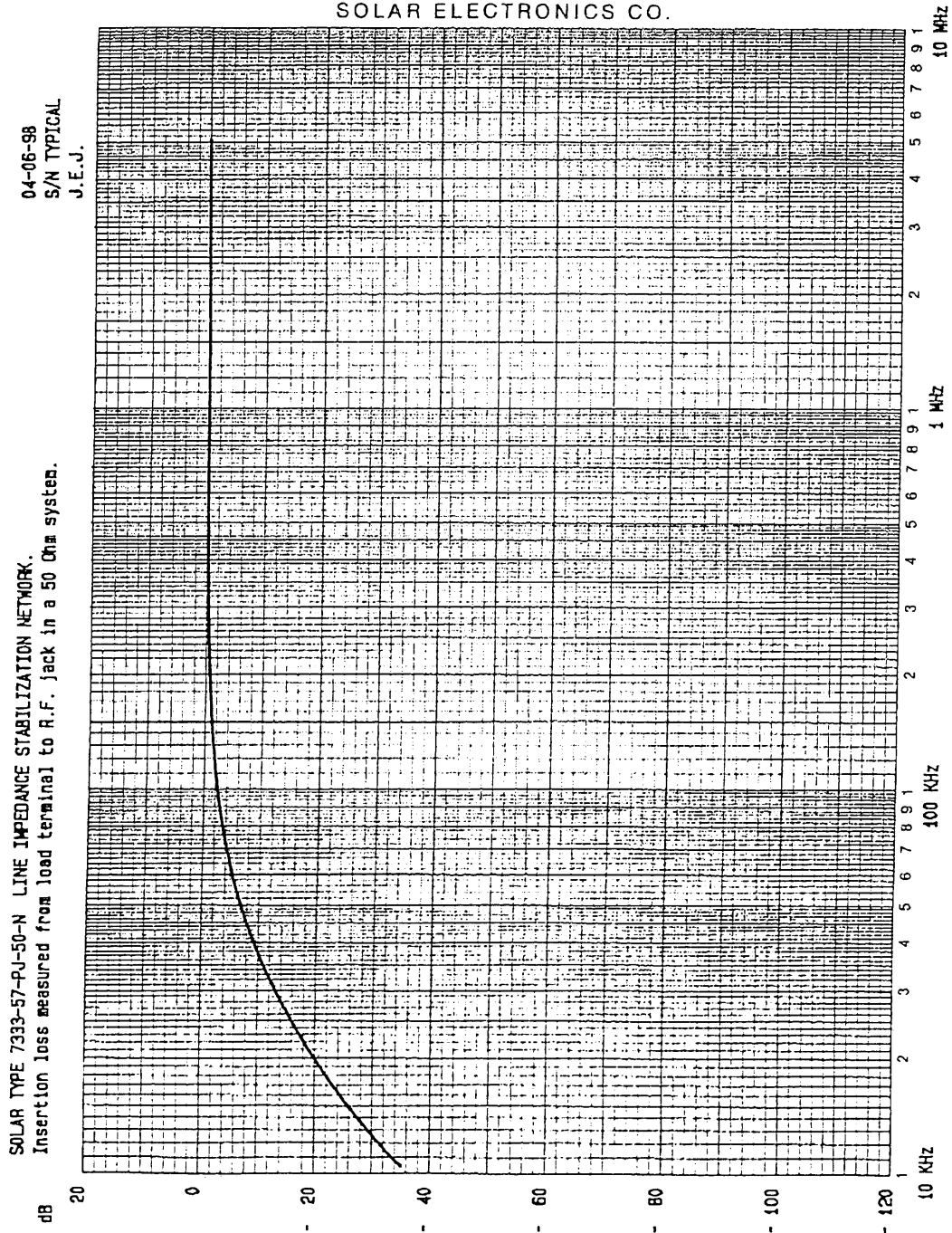
FREQUENCY (KHz)	ATTENUATION	REFERENCE	OUTPUT
500			
600			
700			
800			
900			
1000			
2000			
3000			
4000			

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APPENDIX A

SOLAR ELECTRONICS CO.



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APPENDIX B

Explanation of BASIC computer program I1071.

This computer program was written to perform automatic attenuation measurements utilizing the HP 3325A Frequency Synthesizer and the Boonton 9200B RF Voltmeter. An HP 82937A HP-IB Interface is utilized to allow bus operation of all instruments.

The beginning of the program displays a title page giving the program name, version and date. The operator is then asked to enter the date, UUT serial number, his/her name and the HP-IB address of all instruments.

The variable nature of the instrument addresses and the HP-IB Select Code was chosen to allow the use of different units without hardware switch settings having to be performed at each use.

The computer sets all instruments to remote mode after all information is entered. The HP 3325A is pre-set as follows:

IP - INSTRUMENT PRESET

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22 Reference measurements are taken and stored in an array A1(I) and then 22 directivity measurements are taken and stored in array B1(I) utilizing the following instrument commands.

C = HP 3325A Synthesizer

1980 OUTPUT C; FU1AM0DB ! 0 dBm Sinewave

2020 OUTPUT C; FR; F; KH ! Frequency in KHz

A = Boonton 9200B RF Voltmeter

2040 OUTPUT A; "D" ! Display measured dB

2060 ENTER A; A1(I) ! Read 9200 indication; Store in A1
ARRAY

The UUT specifications are checked as follows where I = the test number, an " *" indicates an out of specification result.

D = B1(I)-A1(I) ! OUTPUT - REFERENCE

IF I = 1 AND ABS (D) >= 22 THEN R\$ = "" ELSE R\$ = " *"

IF I = 2 AND ABS (D) >= 18 THEN R\$ = "" ELSE R\$ = " *"

IF I = 3 AND ABS (D) >= 10 THEN R\$ = "" ELSE R\$ = " *"

IF I = 4 AND ABS (D) >= 8 THEN R\$ = "" ELSE R\$ = " *"

IF I = 5 AND ABS (D) >= 6 THEN R\$ = "" ELSE R\$ = " *"

IF I = 6 AND ABS (D) >= 4 THEN R\$ = "" ELSE R\$ = " *"

IF I > 6 AND I < 10 AND ABS (D) >= 4 THEN R\$ = "" ELSE R\$ = " *"

IF I >= 9 AND ABS (D) >= 0 THEN R\$ = "" ELSE R\$ = " *"

At the end of the test results printout, the date, UUT serial number and the technician's name are printed.

A listing of the BASIC computer program follows.

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```

1000 ! PROGRAM NAME:I1071
1010 ! SOLAR ELECTRONICS CO.
1020 ! 7333-57-TS-50-N
1030 !
1040 !   LINE IMPEDANCE
1050 ! STABILIZATION NETWORK
1060 !
1070 !   J. KERSHAW
1080 !
1090 ! LAST UPDATE: 5-13-98 RFC
1100 !
1110 GOSUB 1200 ! DISPLAY TTLES I1070
1120 GOSUB 1430 ! USER INFO INPUT
1130 GOSUB 1570 ! SETUP HP-IB
1140 GOSUB 1820 ! INST. INT.
1150 GOSUB 1930 ! REFER. MEAS.
1160 GOSUB 2160 ! DIREC. MEAS.
1170 GOSUB 2510 ! CALCULATIONS
1180 GOSUB 2750 ! PRINTOUT END
1190 END
1200 CLEAR
1210 DISP "   SOLAR ELECTRONICS CO." @ DISP
1220 DISP "   LINE IMPEDANCE"
1230 DISP " STABILIZATION NETWORK"
1240 DISP "   7333-57-TS-50-N"
1250 DISP "   I1071"
1260 DISP " ATTENUATION VS FREQUENCY TEST" @ DISP
1270 PRINT
1280 DISP "   VER. 1.0" @ DISP
1290 DISP "   04-16-98"
1300 DISP
1310 DISP "   GEC-MARCONI HAZELTINE"
1320 DISP " DEPRESS <END LINE> TO CONTINUE"
1330 INPUT A$
1340 PRINT "   SOLAR ELECTRONICS CORP"
1350 DISP "   LINE IMPEDANCE"
1360 DISP " STABILIZATION NETWORK"
1370 PRINT "   7333-57-TS-50-N"
1380 PRINT "   I1071"
1390 PRINT
1400 PRINT " ATTENUATION VS FREQUENCY TEST"
1410 PRINT
1420 RETURN
1430 CLEAR
1440 DISP "ENTER THE DATE";
1450 BEEP
1460 INPUT D$
1470 CLEAR
1480 DISP "ENTER THE UUT SERIAL NO.";
1490 BEEP
1500 INPUT S$
1510 CLEAR
1520 DISP "ENTER YOUR NAME";
1530 BEEP
1540 INPUT N$
1550 CLEAR
1560 RETURN
1570 CLEAR
1580 DISP "ENTER THE HP 82937A HP-IB   INTERFACE SELECT CODE"
1590 DISP
1600 DISP "FACTORY SETTING IS 7."
1610 DISP
1620 INPUT H
1630 IF H<3 OR H>10 THEN GOTO 1570
1640 H=H*100
1650 CLEAR
1660 DISP "ENTER THE HP-IB ADDRESS FOR THE BOONTON 9200B RF VOLTMETER"

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1670 DISP
1680 DISP "FACTORY SETTING IS 10"
1690 INPUT A
1700 IF A<0 OR A>30 THEN GOTO 1650
1710 A=A+H
1720 CLEAR
1730 DISP "ENTER THE HP-IB ADDRESS FOR THE HP 3325A SYNTHESIZER/FUNCTION GENERATOR"
1740 DISP
1750 DISP "FACTORY SETTING IS 3"
1760 INPUT C
1770 IF C<0 OR C>30 THEN GOTO 1720
1780 C=C+H
1790 CLEAR
1800 !
1810 RETURN
1820 CLEAR
1830 ! PRESET TEST EQUIPMENT
1840 REMOTE C
1850 OUTPUT C ; "IP" ! PRESET
1860 WAIT 2000
1870 !
1880 !
1890 ! SET MULTIMETER
1900 REMOTE A
1910 OUTPUT A ; "D" ! DISPLAY MEASURED DB
1920 RETURN
1930 DISP "22 REFERENCE MEASUREMENTS WILL BE TAKEN"
1940 PRINT "REFERENCE MEASUREMENTS"
1950 PRINT
1960 DIM F1(28)
1970 DIM A1(28)
1980 OUTPUT C ; "F1AM0DB" ! 0 DBM SINEWAVE
1990 FOR I=1 TO 22
2000 READ F
2010 F1(I)=F
2020 OUTPUT C ; "FR";F;"KH" ! FREQUENCY IN KHZ
2030 WAIT 500
2040 OUTPUT A
2050 WAIT 1000
2060 ENTER A ; A1(I) ! READ 9200B INDICATION; STORE IN A1 ARRAY
2070 ! DISP "#";I;" " ;A1(I);" dBm @ " ;F1(I);"KHz"
2080 DISP USING 2960 ; "#";I,A1(I);" dBm @ " ;F1(I);"KHz"
2090 PRINT USING 2960 ; "#";I,A1(I);" dBm @ " ;F1(I);"KHz"
2100 NEXT I
2110 CLEAR
2120 DATA 15,20,30,40,50,60,70,80,90
2130 DATA 100,200,300,400,500,600,700,800,900
2140 DATA 1000,2000,3000,4000
2150 RETURN
2160 DISP "REMOVE THE RF VOLTMETER FROM THE"
2170 DISP "3325A OUTPUT AND CONNECT IT TO "
2180 DISP "THE EMI METER JACK OF THE UUT."
2190 DISP "(REFER TO FIGURE 2 OF I1071)"
2200 DISP @ DISP
2210 DISP "PRESS <END LINE> TO CONTINUE."
2220 INPUT A$
2230 DISP "CONNECT THE 3325A OUTPUT TO THE "
2240 DISP "TEST SAMPLE AND GROUND JACKS OF"
2250 DISP "THE UUT.(REFER TO FIGURE 2 OF I1071)" @ DISP
2260 DISP "CONNECT THE RF VOLTMETER TO THE"
2270 DISP "UUT EMI METER CONNECTOR."
2280 DISP
2290 DISP "DEPRESS <CONT> WHEN READY"
2300 PAUSE
2310 CLEAR
2320 DISP " 22 DIRECTIVITY MEASUREMENTS WILL BE TAKEN"
2330 RESTORE

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```

2340 PRINT
2350 PRINT
2360 PRINT "UUT OUTPUT MEASUREMENTS"
2370 PRINT
2380 FOR I=1 TO 22
2390 READ F
2400 F1(I)=F
2410 OUTPUT C: "FR".F."KH"
2420 WAIT 2500
2430 DIM B1(28)
2440 ENTER A: B1(I)
2450 PRINT USING 2960: "#".I,B1(I)," dBm @ ".F1(I),"KHz"
2460 DISP USING 2960: "#".I,B1(I)," dBm @ ".F1(I),"KHz"
2470 NEXT I
2480 PRINT
2490 PRINT
2500 RETURN
2510 PRINT "***** RESULTS *****"
2520 PRINT
2530 CLEAR
2540 RESTORE
2550 PRINT " TEST ATTN TEST "
2560 PRINT " NUMBER dBm FREQ"
2570 PRINT
2580 DISP " REF UUT OUT DELTA"
2590 FOR I=1 TO 22
2600 READ F: F1(I)=F
2610 F1(I)=F
2620 D=B1(I)-A1(I): OUTPUT - REF
2630 IF I=1 AND ABS(D)<=22 THEN R$="" ELSE R$=" *"
2640 IF I=2 AND ABS(D)<=18 THEN R$="" ELSE R$=" *"
2650 IF I=3 AND ABS(D)>=10 THEN R$="" ELSE R$=" *"
2660 IF I=4 AND ABS(D)>=8 THEN R$="" ELSE R$=" *"
2670 IF I=5 AND ABS(D)>=6 THEN R$="" ELSE R$=" *"
2680 IF I=6 AND ABS(D)>=4 THEN R$="" ELSE R$=" *"
2690 IF I>6 AND I<10 AND ABS(D)>=4 THEN R$="" ELSE R$=" *"
2700 IF I>9 AND ABS(D)>=0 THEN R$="" ELSE R$=" *"
2710 DISP USING 2960: "#".I,D," dBm @ ".F1(I),"KHz"
2720 PRINT USING 2960: "#".I,D," dBm @ ".F1(I),"KHz",R$
2730 NEXT I
2740 RETURN
2750 PRINT
2760 PRINT
2770 PRINT "SOLAR ELECT. P/N 7333-57-TS-50N" @ PRINT
2780 PRINT "I1071" @ PRINT
2790 PRINT "DATE: ".D$
2800 PRINT
2810 PRINT "SERIAL NUMBER: ".S$
2820 PRINT
2830 PRINT "TECH: ".N$
2840 PRINT
2850 FOR I=1 TO 5
2860 PRINT
2870 NEXT I
2880 RETURN
2890 LOCAL H/100
2900 LOCAL A
2910 CLEAR
2920 DISP "TESTS COMPLETE"
2930 DISP "DEPRESS <RUN> TO START AGAIN"
2940 RETURN
2950 IMAGE SDD.DD,5X,SDD.DD,5X,SDD.DD
2960 IMAGE A,DD,6X,SDD.DD,7A,DDDD,3A
2970 CLEAR
2980 END

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SPECIFICATIONS FOR CALIBRATION STANDARDS

[illegible]