FINAL REPORT
ACCEPTANCE OF BIG RALLY II COMMUNICATIONS SYSTEM
TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-451

ITT service FEDERAL ELECTRIC CORPORATION

an associate of

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

ESD-TDR-64-451
Vol. I

FINAL REPORT
ACCEPTANCE OF BIG RALLY II COMMUNICATIONS SYSTEM
TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-451

PREPARED FOR
486L SYSTEM PROGRAM OFFICE
DEPUTY FOR COMMUNICATIONS
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
U.S. AIR FORCE

THIS REPORT IS PREPARED UNDER CONTRACT PROVISION, PARAGRAPH 3.7 OF USAF CONTRACT NO. 19(628)-510
JULY 1964

HEADQUARTERS
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
LAURENCE G. HANSCOM FIELD BEDFORD, MASSACHUSETTS

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14 Jul 64

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REPORT SUMMARY

VOLUME I	Test Report System Test Procedures
VOLUME II	Test Procedures
VOLUME III	Test Procedures
VOLUME IV	Test Data, Phase I
VOLUME V	Test Data, Phase II
VOLUME VI	Test Data, Phase II

REFERENCES

1. CONTRACT: US Air Force Administrative Contract
   AF19(628)-510 25 April 1962
   ESD L. G. Hanscom Field
   Bedford, Mass.

2. LETTER: Hq. Electronic Systems Division
   Air Force Systems Command
   L. G. Hanscom Field
   Bedford, Mass.
   Sub: BRII System Test Procedures, 6 June 1963

3. MESSAGE: Unclas EFTO SPACECOMLO, Rome
   ESUHD-1-7-1314
   From: Test Director BRII
   To: EurGEEIA Rgn Wiesbaden AB Germany
   EAME Commarea Lindsey AB Germany

4. BIG RALLY II: DD Form 250's

5. Design Report for Big Rally Communications System

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1. INTRODUCTION

1.1 The Big Rally II tests as planned by Federal Electric Corporation and approved by Headquarters Electronic Systems Division, Air Force Systems Command, see reference No. 2, was designed to test the BRII system and determine whether the requirements of U.S. Air Force Administrative Contract AF19(628)-510, as ammended, (reference 1), had been met.

1.2 The tests were divided into two phases: 1) Main line sites ID through GPA and tributaries GAB & GEL, 2) Main line sites GPA, TID and TKG and the remaining tributaries, see figure 1-1.

1.3 Testing was divided into two basic categories in each phase: 1) Individual equipment or station testing and, 2) System testing involving all links assigned to a particular circuit or group of circuits under test. Station testing was effected at all sites and thus tested all items of operational equipment on an individual or single link basis. System tests were planned for circuits or links as set forth in the System Design Report to present data indicative of the system performance as a whole.

1.4 Since the BRII system is a part of a greater network and designed to connect military installations in Italy, Greece and Turkey with command control installations in central Europe, the BRII interface at site ID was selected as the focal point for system testing. The plan was to take circuits interfaced at ID and running through the system to certain terminal stations, the performance of which would be a yardstick of the system performance.

1.5 The BRII System Design Report, paragraph 4, reference No. 5, sets forth certain circuits and gives design data therefor. In the systems testing, it was planned to test these same circuits so that a comparison could be made with design. However, different circuits, except in one instance, were selected by the Test Director, therefore a direct comparison between system test results and design is not possible except in the case of the ID-GEL circuit. This circuit met the design objectives where a direct comparison can be made.

2. TEST APPARATUS

2.1 All apparatus and equipment required for each test is given preceding the detailed procedures. The test apparatus is of standard commercial design for the type tests involved and generally is the apparatus furnished for site maintenance.

3. TEST CRITERIA AND PROCEDURES

3.1 Test criteria developed by Federal Electric Corp. and approved by Electronic Systems Division, Air Force Systems Command is the basis for all tests, station and system. This criteria was issued in booklet form, for all major equipments and the system tests, under the title Test Procedures. These procedures include, complete instructions for conducting the tests, specifications to be met, and forms for recording results. The specifications are indicated in the test data sheets or the test procedures as appropriate.

4. RESULTS OF TESTS

4.1 The results of tests were recorded on data sheet forms furnished as part of the test procedure booklets. These forms list the data to be recorded and the specification to be met. Volumes IV, V and VI of this report are a reproduction of the data accumulated during the tests. A summary of this data as it pertains to the systems performance is given below.

4.2 Amplitude vs Frequency Response. Maximum variation with respect to 1000 cycle reference signal: (See table 1.).

4.3 Envelope Delay Distortion. Delay in microseconds with respect to the delay of a 1000 cycle signal. (See table 2.).

4.4 Harmonic Distortion. See System Test, Phase I, page 6 of Section II of this volume. (See table 3.).

4.5 Channel Noise. The channel noise data is derived from a F1A weighted circuit at zero transmission level. (See table 4.).

4.6 Net Loss Variation. Loss variation in db for the percent of time indicated of a 7 day period. Data based on continuous 7 day recordings. (See table 5.)

5. DEFICIENCIES. Deficiencies have been listed on DD Form 250's and have been or are being corrected by the contractor. The deficiencies have included mechanical functions in equipment as well as electronic factors. Among those affecting the system operation are listed below.

5.1 Defective modulator transfer on exciters of the AN/MRC-85. These have been corrected.

5.2 Order wire override at sites IC, GK and GA. These have been corrected.

5.3 Intermittent hum and distortion on orderwire at sites IC and GPA. It was found that excessive ground loop lengths existed at certain sites in the orderwire distribution facilities due to separation of the East and West terminals. This resulted in excessive noise and hum pickup, cross talk, and distortions which were fed into the radio system. Insertion of isolation transformers in these loops has corrected this trouble.

5.4 Spurious tones on radio carrier at site IC, GA, and GPA. At some sites the 60KC pilot was spilling over into adjacent links causing spurious tones and modulation products to be generated. This was corrected by the insertion of a 60KC rejection filter at the trouble points.

5.5 High idle noise in low group of MC-50 on GPA-GA link. Corrected as indicated in paragraph 5.3 above.

5.6 Excessive cross talk between orderwire, technical control and MC-50 channels on GPA-GAB and GPA-GA links. Corrected as indicated in paragraph 5.3 above.

5.7 Intermodulation on AN/MRC-85 equipment at sites IR-W and GA-W. This has been corrected by the readjustment of exciters and receivers at these sites.

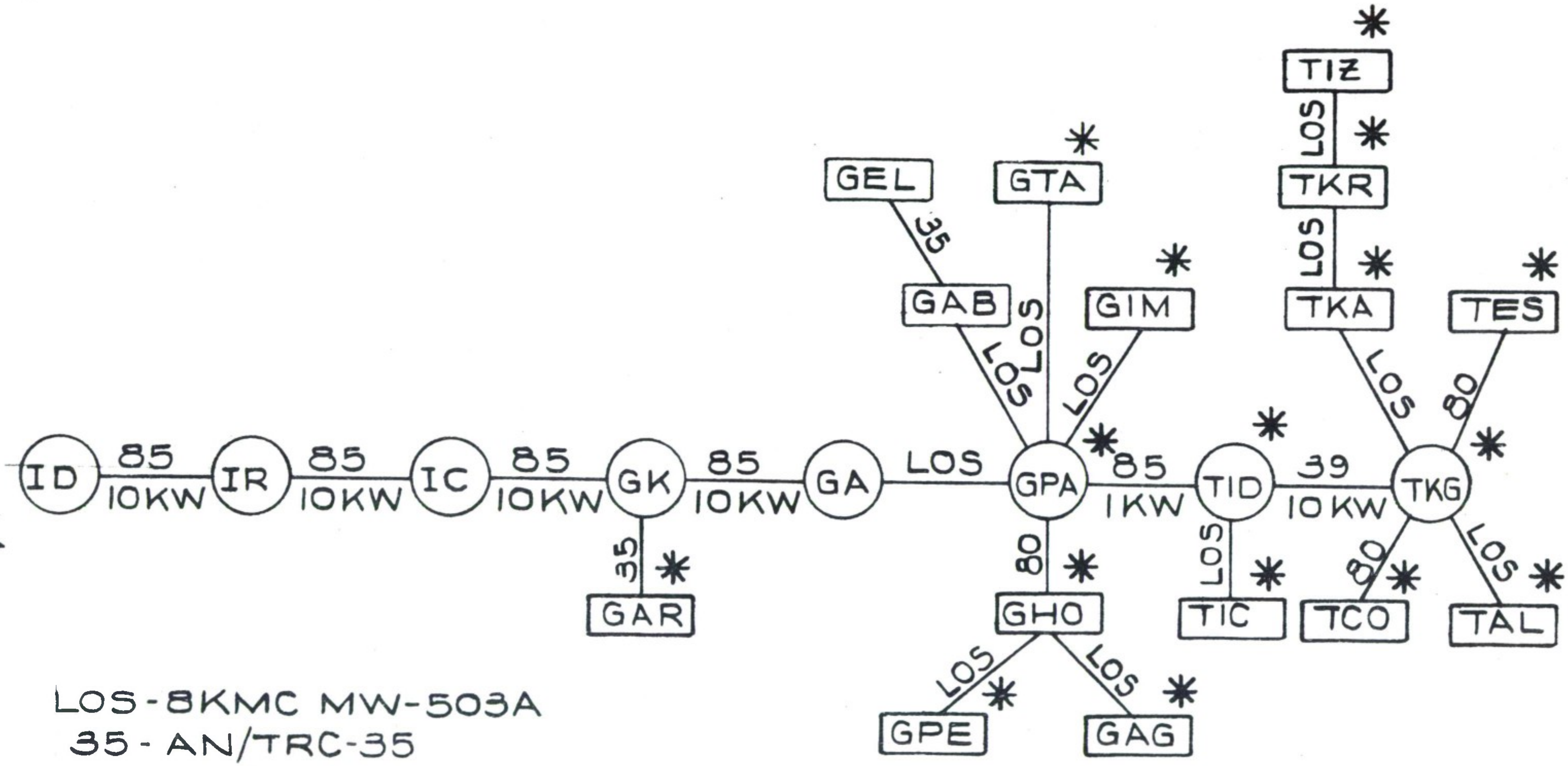
5.8 Defective channel filter at site ID. This filter has been replaced.

5.9 Out of tolerance transmit frequencies and AFC control of MW-503A microwave equipment at sites GA, GPA and GAB. These have been corrected by the readjustment of the reference cavities and the realignment of this equipment where found necessary.

5.10 Fault indicator panel operation at site IC unsatisfactory. The unsatisfactory operation of this panel has been corrected.

5.11 Defects or unsatisfactory items on individual equipments or other station items not affecting the system operation are not indicated herein but have been listed on the DD Form 250's and are required to be corrected by the contractor.

6. SUMMARY. The BRII system was designed and built as a temporary communication system to fulfill the immediate needs of the U.S. Air Force. This immediate requirement had imposed a very rigid time schedule on the engineering design and the selection of equipments. This schedule precluded the manufacture of equipments which would meet the required performance standards, and also precluded path testing between proposed sites. It was, therefore, necessary to select equipments which were immediately available or could be fabricated to meet the schedule. Path propagation performance was based solely on calculations. Much of the early engineering by necessity had to be on an estimate basis with a detailed confirmation followup. The factors described in the System Design Report, Reference No. 5, add up to a system which might not be expected to meet DCS standards. However, the actual performance of the system as shown by the test results, after correction of initial descrepancies, and more conclusively by its actual performance in service over a period of approximately two years, show that it meets the reliability, quality and dependability requirements of the Air Force as set forth in contract AF19(628)-510 and more nearly approaches the DCS standard that might be expected.



LOS-8KMC MW-503A
35-AN/TRC-35
39-AN/FRC-39
80-AN/MRC-80
85-AN/MRC-85

FIG 1-1

ALL MULTIPLEX IS MC-50
EXCEPT GK-GAR & GAB-GEL
WHICH IS AN/TCC-3

* PHASE II

FREQ. CPS	ID - GPA	ID - GEL	TID-TCO-TID (Looped at TCO)
300-3400	+1.5 to -3.1db	+4.5 to -6db	+1.5 to -1.25
400-3000	+1.4 to -2.2db	+3.5 to -1db	+1.5 to -1.0
600-2400	+1.2 to -2.0db	+3.0 to +1db	+1.5 to -0.5

TABLE 1

FREQ. CPS	ID - GPA Low Group	ID - GPA High Group	ID - GEL	TID-GPA-TID (Looped at GPA) Low Group	TID-TKG-TID (Looped at TKG)		TID-GIM	TID-TCO
					High Group	Base Group		
900	+65 to +540	+165 to -25	+400 to +310	+100 to +30	+95 to +35	+100 to +40	+130 to +110	+100 to +100
1200	-70 to -170	-40 to -285	-350 to -430	0 to -65	+10 to -50	+50 to -50	+45 to -70	-25 to -70
1400	+270 to -125	+140 to -250	-445 to -500	+30 to -50	+50 to -40	+50 to -40	+30 to +10	+20 to -100
1600	+530 to -50	+125 to -200	-380 to -480	+80 to -50	+60 to -10	+100 to -05	+70 to +60	+90 to -60
1800	+465 to -80	+175 to -275	-490 to -495	+80 to -110	+15 to -50	+40 to -60	0 to -30	+300 to +30
2000	+390 to -80	+250 to -340	-435 to -500	+150 to -120	+50 to -50	+60 to -60	+20 to -50	0 to -25
2200	+600 to -165	+350 to -370	-420 to -785	+175 to -140	+50 to -60	+50 to -75	0 to -70	-10 to -55
2400	+900 to -165	+580 to -400	-460 to -785	+250 to -190	+40 to -70	+70 to -70	+120 to +30	0 to -65
2600	+1100 to -250	+810 to -485	-255 to -785	+400 to -195	+95 to -70	+100 to -60		-60 to -05

TABLE 2

6277832

Ch.	1D-GPA		ID-GEL	TID-GPA-TID (Looped at GPA)	TID-TKG-TID (Looped at TKG)		TID-GIM-TID (Looped at GIM)	TID-TCO-TID (Looped at TCO)
	High Group	Low Group		Low Group	Group 1	Base Group		
1	1.79%	3.73%		1.9	1.4	1.5		
2	2.00	3.18		1.5	2.6	1.6		
3	1.44	3.23		2.0	2.5	2.7		
4	3.25	2.90		1.2	2.3	1.7		
5	2.67	4.20		2.8	2.0	3.5		
6	1.74	2.82		2.2	2.1	2.3		
7	1.93	3.70	4.05%	3.3	2.2	2.0		2.2 (High Group)
8	1.98	4.35		3.0	2.0	1.6	3.3	2.0 (Low Group)
9	1.74	3.98	5.24	2.1	1.26	1.9	3.0	
10	2.06	5.00-		2.5	1.7	2.0		
11	2.48	Bad Filter		1.9	1.3	2.19		
12	2.07	5.00-		2.0	1.6	3.0		

TABLE 3

62:7S32

Ch	ID - GPA		ID - GEL	TID-GPA-TID (Looped at GPA)	TID-GTA -TID	TID-TIC -TID	TID-GIM -TID	TID-TKG -TID	TID-TES -TID	TID-TAL -TID	TID-TCO -TID
	High Group	Low Group									
1	+25 dbaØ	+25dbaØ									
2	25	26									
3	24	25									
4	24	25.5									
5	25	IC Term.									
6	25	IC Term.									
7	23.5	32	33dbaØ	19.8dbaØ		20dbaØ	23.6dbaØ		27dbaØ		27 dbaØ
8	24	31.5			26.5dbaØ			21dbaØ		24dbaØ	
9	25	28.5	31.5								
10	22	27									
11	22.5	ID Bad Filter									
12	23.5	IC Term									

Talk through test - All channels good except #11 from ID which had a bad filter.

TABLE 4

VARIATION = TO OR LESS THAN	PERCENT OF TIME		
	ID-GPA		TID-GPA-GIM-GPA-TID-TKG-TCO-TKG-TID
	Ch 3 Hi Gr.	Ch 4 Low Gr.	
0db	21.3	11.5	3.5
0.5db	55.3	40.7	87.2
1.0db	87.3	80.0	97.4
1.5db	97.0	93.0	99.6
2.0db	100	100	100

TABLE 5

G NO. 6272927 ERN157

A ORIGINAL ISSUE

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED

GROUP	NEXT ASSEMBLY	FIRST USED ON
G		
G		
G		
G		
G		
G1		

APPLICATION

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

COML. TOL. APPLY TO STOCK SIZES

APPROVALS	SIGNATURE & DATE
DRAWN	
CHECKED	AR 3/23/64
MECH	
ELECT	
STDS	D. Roberts 3/23/64
FEC	H. Elliott 4-2-64
FEC SOURCE	
OTHER	

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VOLUME I
TEST PROCEDURES
BIG RALLY II COMMUNICATIONS SYSTEM

CODE IDENT. NO.	DWG. SIZE	
14842	A	6272927
SCALE	FEC NO.	SHEET 1 OF 2

A

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. REPROVEL NO. 400M

LIST OF MATERIALS

ITEM NO.	QTY REQD	U OF M	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.
1			SYSTEM TESTS PHASE I	6272916
2			SYSTEM TESTS PHASE II	6272915
3			LOS MICROWAVE MW503A, PHASE II	6272926
			Errata sheets applicable to original editions have been incorporated herein.	

VOLUME I
TEST PROCEDURES

ITT SERVICE FEDERAL ELECTRIC CORPORATION
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PREPARED BY [signature] DATE 3/29/64
CHECKED BY [signature] DATE 4/2/64

CODE IDENT. NO. 14842 | DWG SIZE A | LM 6272927 | A

FEC NO. | SHEET 2

DWG NO. 6272916 ERN157

A ORIGINAL ISSUE

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED

GROUP	NEXT ASSEMBLY	FIRST USED ON
G		
G		
G		
G		
G		
G1	6272927	

APPLICATION

APPROVALS	SIGNATURE & DATE
DRAWN	
CHECKED	[signature] 3/23/64
MECH	
ELECT	
STDS	[signature] 3/23/64
FEC	H. Elliott 4-8-64
FEC SOURCE	
OTHER	

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

COML. TOL. APPLY TO STOCK SIZES

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FEDERAL ELECTRIC CORPORATION

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SYSTEM TESTS
PHASE I
BIG RALLY II COMMUNICATIONS SYSTEM

CODE IDENT. NO.	DWG. SIZE	
14842	A	6272916

A

SCALE	FEC NO.	SHEET 1 OF 11

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. REPROVEL NO. 400M

1. SCOPE

1.1 This test plan outlines the testing procedures and performance criteria for the Big Rally II Communications System. This test plan will apply to the Phase I System.

2. TEST EQUIPMENT

2.1 Test equipment required is indicated with each test procedure.

3. TEST CONDITIONS

3.1 The equipment must be properly installed and have been placed into operation prior to the performance of the test procedures.

3.2 All equipment and link tests should have been completed prior to the performance of the System Test. All multiplex link levels should be checked in accordance with the multiplex link test procedures just prior to performing these tests.

3.3 In Phase I system testing, ID will act as the system control site. Stations which will be included by Phase I testing are ID, IR, IC, GK, GA, GPA, GAB and GEL. Stations which will be included by Phase II testing are GPA, GTA, GIM, GHO, GPE, GAG, TID, TIC, TKG, TES, TCO, TAL, TKH, TKA, TKR, and TIZ.

4. PROCEDURE

4.1 The procedure for performing each test is included within these specifications.

4.2 The system tests will be conducted on all channels which terminate at the System Control Site and a terminal site on a link.

4.3 Recordings will be made on one channel as indicated in the procedures.

4.4 The testing procedures shall be completed in the order presented.

4.5 All data recording will be done at the System Control Site.

5. REQUIREMENTS

5.1 One Time Measurements

5.1.1 Insertion Loss vs. Frequency

5.1.2 Envelope Delay Distortion

5.1.3 Harmonic Distortion

5.1.4 Circuit Monitor and Alarm

5.2 Test Recordings

5.2.1 Median Noise Level

5.2.2 Net Loss Variation

5.2.3 Master Oscillator Stability (ID only)

6. RECORDING RESULTS

6.1 Test results shall be recorded in triplicate on the forms attached.

7. ONE TIME MEASUREMENTS

7.1 Insertion Loss vs. Frequency, Form BRII/91.

7.1.1 Test Equipment

A. Audio Oscillator, HP 200 CD or HP-650A

B. AC VTVM, HP 400 H

C. Line Matching Transformer, HP AC-60B

D. 23 db Pads

7.1.2 Test Conditions

A. This test will be performed on all voice frequency channels terminating at the system control site and a distant link terminating station. The control site will transmit a signal which will be looped back at the distant station. The control site will then measure the level of the received signal.

7.1.3 Procedure

A. Connect the audio oscillator to a voice frequency modulator input. This connection must be made with the use of the line matching transformer.

B. Ensure that the voice frequency channel under test is looped back at the distant station with a 23 db pad. If an unmodified AN/TCC-3 or AN/TCC-7 is being used, adjust the channel output to -4 dbm so that the proper level can be looped back to the channel input.

C. The audio oscillator will feed signal frequencies from 300 cps to 3400 cps into the selected channel modulator. The oscillator output level will be -16 dbm across the entire frequency band.

D. Connect the ACVTVM to the channel demodulator output of the channel under test at the control site. This can be accomplished by use of a line matching transformer set to 600 ohms. Record the voltmeter reading.

E. Repeat steps A through D for all voice frequency channels terminating at the control site and at distant link terminating stations.

7.2 Envelope Delay Distortion, Form BR11/92

7.2.1 Test Equipment

A. Delay measuring set - Acton 453A.

B. 23 db pads.

7.2.2 Test Condition

The test will be conducted by means of looping back the voice channels at a distant terminating site. The envelope delay measurements will be recorded at the control site.

7.2.3 Procedure

A. Connect the delay measuring set transmitter to the voice frequency channel modulator of the selected circuit to be tested.

B. Insure that the voice frequency channel under test is properly looped back at the distant terminating station with a 23 db pad. Loop back can be accomplished at stations with unmodified multiplex by adjusting the channel output to -4 dbm.

C. Connect the delay measuring set receiver to the voice frequency channel demodulator of the selected circuit under test.

D. Synchronize the delay measuring set transmitter and receiver. Adjust the receiver to read zero delay at 1000 cps.

E. Using 0.6 rpm sweep rate, observe rapid delay changes occurring in the frequency range from 300 cps to 3500 cps. Note the frequencies at which rapid delay change occurs.

F. Measure and record the delays for the following frequencies: 300, 500, 700, 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600, 2800, 3000, 3200, 3400 cps.

G. Repeat steps A through F on all voice frequency channels which terminate at the control site and a distant terminating station.

7.3 Harmonic Distortion, Form BRII/93

7.3.1 Test Equipment

A. Performance Monitor

B. Audio Oscillator, HP 650A.

C. 4-Wire/4-Way Junction Network, Kellogg KMT4440

D. Matching Transformer, HP-AC60B (2 each)

E. Wave Analyser, GR736-A

7.3.2 Procedure

A. Connect the performance monitor oscillator 14A12 to a pair of input jacks on the 4 way/4 wire bridge.

B. Using a matching transformer, connect the HP 650A oscillator to another pair of input jacks on the 4 way/4 wire bridge.

C. Connect the output of the 4 way bridge to a channel input on the MC-50 multiplex.

D. Terminate the unused jacks of the 4 way bridge with 600 ohm resistors.

E. Set one oscillator to a frequency of 400 cps and the other to a frequency of 1000 cps.

F. Record the output levels of both oscillators which will be the same and will provide a combined level of -16 dbm at the 4 way bridge output.

G. Loop back at the distant station with a 23 db pad. Loop back can be accomplished at stations with unmodified multiplex by adjusting the channel output to -4 dbm.

H. Connect the wave analyser to the multiplex demodulator output via an AC-60B Matching Transformer in the terminate position.

I. Sweep the frequency band from 300 cps to 3500 cps and record the level of the voltage peaks which appear on the meter.

J. Using the voltage levels recorded in step 1, calculate and record the per cent distortion using the following formula:

$$\% \text{ Distortion} \quad \frac{\sqrt{V_3^2 \qquad V_4^2 \qquad V_n^2}}{\sqrt{V_1^2 \qquad V_2^2}} \quad X \ 100$$

where V_1 , V_2 RMS voltage of the fundamental frequencies.

V_3 . . . . . V_n RMS voltage of the harmonics.

K. Repeat above procedure for all channels terminating at the control site and at distant link terminating stations.

7.4 Circuit Monitor and Alarm, Form BRII/93

7.4.1 Test equipment is not required for this test.

7.4.2 Test Condition

This test determines that the circuit monitor and alarm functions properly at each site when activated by the control station.

7.4.3 Procedure

A. Notify the required main line sites that the test is to be performed and ascertain the condition of indicator lamps at each.

B. The green indicator lamps, on the monitor and alarm panel, at each site should be activated.

C. Momentarily release the group carrier/signaling unit.

D. The red warning indicator lamp should glow and the audible alarm should be activated. (Note: The audible alarm will not be connected until the final BRII site configuration is complete.)

E. Ascertain that the red warning lamp and audible alarms are activated at each required site.

F. Insert the group carrier/signaling supply and lock.

G. Ascertain that the condition of step B exists.

H. Repeat the above steps for all groups existing at the control station.

I. Initial Data Sheet.

8. TEST RECORDINGS

8.1 Median Noise Level

8.1.1 Test Equipment

A. Noise Measuring Set, WECO3A

B. Graphic Level Recorder, GR5121A

C. Oscillator, HP 650A

D. 600 ohm termination

8.1.2 Test Conditions

A. This test will consist of continuous noise measurement with the graphic level recorder. The noise recordings will be made on the highest frequency voice channel between sites ID and GPA. Recordings will be taken for a continuous period on one channel. Recordings will be made for at least 24 hours and if the circuit is available should be made for one week. Recordings will will be made at the control site. The batteries in the 3A test set will be changed every 48 hours.

8.1.3 Procedure

A. Connect a 600 ohm termination to the voice channel output under test. Ensure that the voice frequency channel under test is properly looped back at the distant station with a 23 db pad. Loop back can be accomplished at stations with unmodified multiplex by adjusting the channel output to -4 dbm.

B. Using the Noise Measuring Set (NMS) with C message weighting network measure the noise appearing in a voice frequency channel output.

C. Interconnect graphic recorder with noise measuring set and calibrate as follows:

1. Set FUNCTION switch of NMS to 600 and DBRN switch to 45.

2. Connect 600 ohm output of oscillator HP 650A to IN connectors of NMS 3A.

3. Connect GRD connectors of NMS to station ground.

4. Adjust oscillator output level for DBRN meter reading of ±9 on the NMS at a frequency of 2000 cps.

5. Connect recorder to MON AC out jacks of the NMS.

6. Adjust the output of the oscillator for a level of 50 dbrn.

7. Adjust the gain control on the recorder so that the pen rests at mid-scale of the chart. Record the signal level on the chart.

8. Increase the signal in 5 db steps, marking each 5 db change at the new pen position on the chart.

D. Recorder Measuring Procedure - When recording noise measurements, mark the recorder paper to show the type of measurement, weighting, DBRN switch setting, and the date and hour the measurement commences. In addition, keep a log of any altered control settings and mark the record accordingly when it is removed. To record the noise measurements, proceed as follows:

DRAWING NUMBER 6272916 | 8

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System Tests Phase I
PREPARED BY [signature] DATE 3/27/64
CHECKED BY [signature] DATE 4/7/64
CODE IDENT. NO. 14842
DWG. SIZE A
6272916
A
FEC NO.
SHEET 8

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1. Select C - weighting network and insert plug-in unit containing the network receptacle.

2. After calibrating the chart as described in step C, connect the NMS to the output of the channel under test.

3. Chart speed will be set at 100 Divisions per hour.

4. Recordings will be made continuously for a 24 hour minimum period.

5. Recorder chart calibration will be verified once every 24 hours.

8.2 Net Loss Variation

8.2.1 Test Equipment

A. Audio Oscillator HP 200CD or HP650A

B. Graphic Level Recorder GR1521-AM (2 each)

C. Matching Transformer HP AC-60B (2 each)

8.2.2 Test Condition

The test will be conducted by means of looping back a voice channel between stations ID and GPA. The net loss stability will be recorded continuously at least 24 hours on the channel. If possible recordings should be taken for one week. The recordings will be made at the system control site.

8.2.3 Procedures

A. Connect audio oscillator through 600 ohm matching transformer to a selected voice channel modulator.

B. Connect graphic level recorder input in parallel with audio oscillator output (on the oscillator side of the matching transformer).

C. Adjust audio oscillator output to provide -16 dbm, 1000 cps signal at the voice channel modulator input.

D. At the channel terminating station loop back the voice channel demodulator output to the channel modulator input utilizing a 23 db attenuation pad.

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E. Connect the graphic recorder input to the channel demodulator output through a matching transformer. Insure that the matching transformer provides a 600 ohm load to the channel demodulator.

F. Insure that both graphic recorders are calibrated for 5 db in one db step above and below graph's center axis. Check the calibration every 24 hours.

G. Continuously record 1000 cps input and output utilizing graphic recorders. The channel input shall be -16 dbm and the channel output should be ± 7 dbm ± 10 db.

8.3 Master Oscillator Stability, Form BRII/93

8.3.1 Test Equipment

A. Frequency Counter, HP524D

B. Receiver, Hallicrafters, SX62A

8.3.2 Test Conditions

The frequency of the master oscillator will be measured at the beginning and end of a continuous 30 day operating period. The frequency counter must be calibrated against the signal transmitted by standard frequency stations at Rugby, England or Torino, Italy.

8.3.3 Procedure

A. To calibrate the frequency counter, the following procedure should be used:

1. The 524 counter has a provision for standardizing with station WWV or any standard frequency station.

2. Connect the counter to the antenna input of the SX62A -7 with an antenna also connected.

3. Tune the receiver to the standard frequency station using the BFO.

4. During a period of unmodulated transmission, detune the receiver BFO to obtain a convenient beat frequency tone of approximately 1,000 cps. Use a pair of headphones or a scope for this indication.

5. Adjust the counter oscillator harmonic to synchronize with the standard frequency station signal. The difference between the standard frequency signal and the counter harmonic will be evident by a side tone modulation or pulsation which will decrease to a very slow pulsation as the difference frequency approaches zero.

6. After the counter oscillator is set to the zero difference frequency, verify that the pulsation, or side tone does not reappear or vary as receiver BFO is varied. BFO tone will vary but zero difference between the two signals will not.

NOTE: If a variation in difference frequency is noted, the counter is set to the opposite side band of the transmitting station. This procedure is necessary as it is difficult to obtain a precise zero beat with the BFO off in view of noise and poor low frequency response of the receiver.

B. Connect the calibrated counter to TP1 on the master oscillator drawer. Set the oscillator frequency as closely as possible to 64 kc. Record the frequency indicated on the counter.

C. After 30 days of system operation, recalibrate the counter as in step A and record the frequency of the master oscillator as indicated on the counter.

DWG NO. 62[redacted]15 [redacted] 1 [redacted]RW157

A ORIGINAL ISSUE

REVISIONS

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GROUP	NEXT ASSEMBLY	FIRST USED ON
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APPLICATION

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

COML. TOL. APPLY TO STOCK SIZES

APPROVALS	SIGNATURE & DATE
DRAWN	
CHECKED	JR 3/23/64
MECH	
ELECT	
STDS	D. P. [illegible] 3/23/64
FEC	H. Elliott 4-8-64
FEC SOURCE	
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SYSTEM TESTS
PHASE II
BIG RALLY II COMMUNICATIONS SYSTEM

CODE IDENT. NO.	DWG. SIZE	
14842	A	6272915

A

SCALE	FEC NO.	SHEET 1 OF 20

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FEE-2A (P)

1. All references to Phase II in the System Tests Procedures dated 10 April 1963 are hereby cancelled.

2. The attached booklet, dated 25 November 1963, has been revised and contains all information necessary for System Tests Phase II. No reference to the 10 April 1963 booklet will be necessary.

3. The System Test booklet, dated 10 April 1963, and errata sheets will be retained for purposes of record and also is valid for System Tests Phase I.

DRAWING NUMBER 6272915 | 2

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System Tests Phase II	CODE IDENT. NO.	DWG. SIZE	
PREPARED BY [signature] DATE 3/29/64	14842	A	6272915
CHECKED BY [signature] DATE 4/7/64		FEC NO.	SHEET 2

A

1. SCOPE

1.1 This test plan outlines the testing procedures and perforance criteria for the Big Rally II communications system. This test plan will apply only to the Phase II Systems.

2. TEST EQUIPMENT

2.1 Test equipment required is indicated with each test procedure.

3. TEST CONDITIONS

3.1 The equipment must be properly installed and have been placed into operation prior to the performance of the test procedures.

3.2 All equipment and link tests should have been completed prior to the performance of the System Test. All multiplex link and radio levels should be checked in accordance with the multiplex and radio link test procedures just prior to performing these tests.

All level readings will be recorded in the individual site logs; notation shall also be made in the log sheets stating whether prime or stand-by equipment was used. Every attempt shall be made to balance tests between prime and stand-by equipment.

3.3 In Phase II System Testing, TID will act as the System Control Site.

Phase II System Tests will involve the following terminals: GPA, GIM, GTA, TID, TIC, TKG, TES, TCO, TAL.

System Tests will be conducted as follows:

3.3.1 One Time Measurements

(a) Harmonic Distortion (Form BRII/93, Revised) Sht. 1

Because of the test equipment complement, no straight-away test of harmonic distortion is possible. Loop tests as indicated below will be arranged for this test.

I. All channels from TID to GPA on loop basis.

II. All channels from TID to TKG on both LG and HG on loop basis.

III.	From TID to GIM (all L.G.)	From TID to GPA ch. 7, 8 or 9 From GPA to GIM ch. 2 From GIM to GPA ch. 2 From GPA to TID ch. 7, 8 or 9
IV.	From TID to GIM (all L.G.)	From TID to GPA ch. 7, 8 or 9 From GPA to GIM ch. 3 From GIM to GPA ch. 3 From GPA to TID ch. 7, 8 or 9
V.	From TID to TCO (all L. G.)	From TID to TKG ch. 7, 8 or 9 From TKG to TCO ch. 4 From TCO to TKG ch. 4 From TKG to TID ch. 7, 8 or 9
VI.	From TID to TCO (High Group between TID & TKG)	From TID to TKG ch. 7, 8 or 9 From TKG to TCO ch. 4 From TCO to TKG ch. 4 From TKG to TID ch. 7, 8 or 9

(b) Insertion Loss vs. Frequency (BRII/95 Revised)

These tests will be performed on a straight-away basis with the following configurations:

I.	TID to GIM	TID to GPA ch. 7, 8 or 9 GPA to GIM ch. 2
II.	GIM to TID	GIM to GPA ch. 2 GPA to TID ch. 7, 8 or 9
III.	TID to GIM	TID to GPA ch. 7, 8 or 9 GPA to GIM ch. 3
IV.	GIM to TID	GIM to GPA ch. 3 GPA to TID ch. 7, 8 or 9
V.	TID to TCO	TID to TKG ch. 7, 8 or 9 TKG to TCO, ch. 3
VI.	TCO to TID	TCO to TKG ch. 3 TKG to TID ch. 7, 8 or 9
VII.	TID to TCO	TID to TKG ch. 7, 8 or 9 TKG to TCO ch. 4
VIII	TCO to TID	TCO to TKG ch. 4 TKG to TID ch. 7, 8 or 9

IX. TID to TCO — TID to TKG ch. 7, 8 or 9 HG; TKG to TCO ch. 4

X. TCO to TID — TCO to TKG ch. 4; TKG to TID ch. 7, 8 or 9 HG

(c) Envelope Delay Distortion (Form BRII/96 Revised)

This test will be made first by looping all channels from TID to GPA (1 group) and all channels from TID to TKG (2 groups - one high and 1 low).

Following this measurement te sts will be made to TCO and to GIM from TID as listed below:

I.	a.	At TID to TKG	ch. 7, 8 or 9 LG
	b.	TKG to TCO	ch. 3
	c.	TCO to TKG	ch. 3
	d.	TKG to TID	ch. 7, 8 or 9 LG
II.	a.	At TID to TKG	ch. 7, 8 or 9 HG
	b.	TKG to TCO	ch. 3
	c.	TCO to TKG	ch. 3
	d.	TKG to TID	ch. 7, 8 or 9 HG
III.	a.	At TID to GPA	ch. 7, 8 or 9 LG
	b.	GPA to GIM	ch. 3
	c.	GIM to GPA	ch. 3
	d.	GPA to TID	ch. 7, 8 or 9 LG

(d) Channel Monitor and Alarm (Form BRII/93) Revised Sh. 2

This test will be performed as described under 6.4 of this booklet and will be completed by applicable main line sites.

(e) Overall System Test (From BRII/94) Revised Sh. 1 & 2

This test will be directed and performed by TI D and will consist of the following parts:

(1) 1,000 cycle measurements - both straight-away and loop.

(2) Noise measurements - both straight-away and loop.

(3) Talking Tests where possible and practicable.

(4) All of the above tests will be performed on the following channel assignments:

TID to and from GPA	ch. 7, 8 or 9 ***
TID to and from GTA	TID-GPA ch. 7, 8 or 9 *** GPA-GTA ***
TID to and from TIC	***
TID to and from GIM	TID-GPA ch. 7, 8 or 9 *** GPA-GIM ***
TID to and from TKG	ch. 7, 8 or 9 ***
TID to and from TES	TID-TKG ch. 7, 8 or 9 *** TKG-TES ***
TID to and from TAL	TID-TKG ch. 7, 8 or 9 ***
TID to and from TCO	TID-TKG ch. 7, 8 or 9 *** TKG-TCO ***

*** The specific channel assignment shall be at the discretion of the Test Team Director.

(5) It is the purpose of this "Overall System Test" to show the performance of several links in tandem. One channel to each of the above points will be tested.

In order that all of the above noise measurements may be correlated and evaluated accurately, all noise measurements shall be made with the TSS-559 measuring set. This test should not be made with unlike measuring equipment at opposite ends of the section being tested.

(6) Except where telephone terminating equipment and telephone test instruments may be provided, parts F and G, section 6.5.2 will not be applicable.

3.3.2 Test Recording

(a) Median Noise Level (Form BRII/97, revised)

Test recordings will be made of F1A message noise as read on a loop from TID to GPA to GIM, back to TID, through TKG, looped at TCO, back to TKG, and returned to TID.

A companion loop, using the same routing above will be patched up for determining the stability of the loop under test.

In the channelization listed below, proper patching pads are assumed for all connections:

LOOP #1

a.	TID to GPA	ch. 12 LG
b.	GPA to GIM	ch. 2
c.	GIM to GPA	ch. 2
d.	GPA to TID	ch. 12 LG
e.	TID to TKG	ch. 1 HG
f.	TKG to TCO	ch. 3
g.	TCO to TKG	ch. 3
h.	TKG to TID	ch. 1 HG

LOOP #2

a.	TID to GPA	ch. 11 LG
b.	GPA to GIM	ch. 3
c.	GIM to GPA	ch. 3
d.	GPA to TID	ch. 11 LG
e.	TID to TKG	ch. 2 HG
f.	TKG to TCO	ch. 4
g.	TCO to TKG	ch. 4
h.	TKG to TID	ch. 2 HG

The assignment of one of the two loops above for either the Median Noise Level test or the Net Loss Variation Test shall be at the discretion of the Test Team Director.

This selection shall be shown on the test form.

During the Median Noise Level test, once every hour, the loop shall be terminated for six minutes or more as requested by the Test Team Director. The point at which the loop will be terminated will be at the discretion of the Director.

The point of termination shall be shown on the test form.

(b) Noise Recording on GPA-TID-TKG test loop. (Form BRII/99)

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In addition to the two loops above which are assigned to the Median Noise Level Test and/or the Net Loss Variation Test, an additional test loop will be arranged between TID to and through GPA, back to TID, to and through TKG, and back to the testing point TID.

Various points of termination will be assigned by the Test Team Director. The channel assignment below assumes that proper pads are provided on all patches.

(Loop #3 TID-GPA-TKG Test Loop)

TID to GPA	ch. 10 LG
GPA to TID	ch. 10 LG
TID to TKG	ch. 3 HG
TKG to TID	ch. 3 HG

(c) Net Loss Variation (Form BRII/98)

A test recording shall be made of either Loop #1 or Loop #2 as selected by the Test Team Director.

4. PROCEDURE

4.1 The detailed procedure for performing each test is included within these specifications.

4.2 All channels will be tested between all adjacent stations by 1,000 cycle net loss measurements.

4.3 Channels outlined in paragraph 3.3.1, parts (a), (b) and (c) will be tested as respectively indicated. All channels between all sections will not necessarily have all tests performed.

4.4 Recordings will be made as indicated in the procedures.

4.5 All data shall be recorded at the System Control Site, TID.

5. RECORDING RESULTS

5.1 Test results shall be recorded in triplicate on the forms provided. Samples of the various forms are attached to this booklet.

6. ONE TIME MEASUREMENTS

6.1 Insertion Loss vs. Frequency

6.1.1 Test Equipment

A. Audio Oscillator, HP 200 CD or HP-650A

B. AC VTVM, HP 400 H

C. Line Matching Transformer, HP AC-60B

6.1.2 Test Conditions

A. This test will be performed on those channels indicated in 3.3.1 (b).

B. This test will be made in both directions for each test as outlined in 3.3.1 (b).

C. This test will not be made on a loop basis.

6.1.3 Procedure

A. Connect the audio oscillator to a voice frequency modulator input. This connection must be made with the use of the line matching transformer.

B. The audio oscillator will feed signal frequencies from 300 cps to 3400 cps into the selected channel modulator. The oscillator output level will be -16 dbm across the entire frequency band.

C. Connect the AC VTVM to the channel demodulator output of the channel under test at the control site. This can be accomplished by use of a line matching transformer set to 600 ohms. Record the voltmeter reading.

D. Repeat Steps A through D for all channels assigned under 3.3.1 (b).

6.2 Envelope Delay Distortion (Form BRII/96 Revised for Phase II)

6.2.1 Test Equipment

A. Delay Measuring Set - Acton 453 A.

B. 23 db pads

6.2.2 Test Condition

The test will be conducted by means of looping back the voice channels at a distant terminating site. The envelope delay measurements will be recorded at the control site.

6.2.3 Procedure

A. Connect the delay measuring set transmitter to the voice frequency channel modulator of the selected circuit to be tested.

B. Insure that the voice frequency channel under test is properly looped back at the distant terminating station with a 23 db pad.

C. Connect the delay measuring set receiver to the voice frequency channel demodulator of the slected circuit under test.

D. Synchronize the delay measuring set transmitter and receiver. Adjust the receiver to read zero delay at 1000 cps.

E. Using 0.6 rpm sweep rate, observe rapid delay changes occuring in the frequency range from 900 cps to 2600 cps. Note the frequencies at which rapid delay change occurs.

F. Measure and record the delays for the following frequencies: 900, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600 cps.

G. Repeat steps A through F on all voice frequency channels which are shown under 3.3.1 (c).

6.3 Harmonic Distortion (Form BRII/93 Revised)

6.3.1 Test Equipment

A. Performance Monitor

B. Audio Oscillator, HP 650A

C. 4-Wire/4 Way Junction Network, Kellogg KMT4440.

D. Matching Transformer, HP-AC60B (2 each).

E. Wave Analyser, GR736-A

6.3.2 Procedure

A. Connect the performance monitor oscillator 14A12 to a pair of input jacks on the 4 way/ 4 wire bridge.

B. Using a matching transformer, connect the HP 650A oscillator to another pair of input jacks on the 4 way/4 wire bridge.

C. Connect the output of the 4 way bridge to a channel input on the MC-50 multiplex.

D. Terminate the unused jacks of the 4 way bridge with 600 ohm resistors.

E. Set one oscillator to a frequency of 400 cps and the other to a frequency of 1000 cps.

F. Record the output levels of both oscillators which will be the same and will provide a combined level of -16 dbm at the 4 way bridge output.

G. Loop back at the distant station with a 23 db pad.

H. Connect the wave analyzer to the multiplex demodulator output via an AC-60B Matching Transformer in the terminate position.

I. Sweep the frequency band from 300 cps to 3500 cps and record the level of the voltage peaks which appear on the meter.

J. Using the voltage levels recorded in Step I, calculate and record the per cent distortion using the following formula:

$$\% \text{ Distortion} = \frac{\sqrt{V_3^2 + V_4^2 + \ldots V_n^2}}{\sqrt{V_1^2 + V_2^2}} \times 100$$

where V_1 V_2 RMS Voltage of the fundamental frequencies.

$V_3 \ldots V_n$ RMS Voltage of the harmonics.

K. Repeat Steps A through J for all loops shown under 3.3.1 (a).

6.4 Circuit Monitor and Alarm (Form BRII/93 Revised) Sheet 2

6.4.1 Test equipment is not required for this test.

6.4.2 Test Condition

This test determines that the circuit monitor and alarm functions properly at each site when activated by the control station.

6.4.3 Procedure

A. Notify the required main line sites that the test is to be performed and ascertain the condition of indicator lamps at each.

B. The green indicator lamps, on the monitor and alarm panel, at each site should be activated.

C. Activate the RESET-TEST switch of the specified channel, on the Monitor and Alarm Panel, to the TEST position.

D. The red warning indicator lamp should glow and the audible alarm should be activated.

E. Ascertain that the red warning lamp and audible alarms are activated at each required site.

F. Reset the alarm circuit.

G. Ascertain that the condition of Step B exists.

H. Repeat the above steps for all voice frequency channels applicable for this test.

I. Initial Data Sheet.

6.5 Overall System Test (Phase II Testing Only) BR/94, Sheet 1

6.5.1 Test Equipment

A. Audio Oscillator, HP-650A.

B. ACVTVM HP 400 H

C. Matching Transformer, HP-AC 60B

6.5.2 Procedure

A. Connect the audio oscillator to the selected channel modulator input at TID. This connection must be made with the line matching transformer.

B. Adjust the oscillator to a frequency of 1000 cps with an output level of -16 dbm at the output of the line matching transformer.

C. At the terminating station of the circuit under test, connect the VTVM to the channel demodulator by use of a line matching transformer set in the 600 ohm terminating position.

D. Record the output level indicated on the meter.

E. The transmitting and receiving stations should now reverse their functions and repeat steps A through D.

F. Each channel will now be tested for conversational intelligibility by normal talking and listening at the channel terminations. (See 3.3.1 (e)).

G. Initial data sheet if normal conversation is intelligible. (See 3.3.1 (e)).

6.6 Overall System Test Part (2)

6.6.1 Test Equipment

A. Noise Measuring Set Type TSS-559

B. 600 ohm termination.

6.6.2 Procedure

A. Calibrate the Noise Measuring Set, Type TSS-559 according to the manufacturer's specifications.

B. Terminate the circuit either at the distant end or at the testing end if the test is being made on a loop basis.

C. Read the noise and record it on the forms provided.

7. TEST RECORDINGS

7.1 Median Noise Level

7.1.1 Test Equipment

A. Noise Measuring Set, Daven 12-B.

B. Graphic Level Recorder, GR5121A.

C. Oscillator, HP 650A.

D. 600 ohm termination.

7.1.2 Test Conditions

A. One test will consist of a continuous noise recording taken on a loop circuit from TID to GPA, GPA to GIM, through GIM back to GPA, from GPA to TID, from TID to TKG, from TKG to TCO through TCO back to TKG and from TKG to TID.

The detailed channel assignments are shown under 3.3.2 (a).

B. Ensure that the voice frequency channel under test is properly looped back at the distant station with a 23 db pad. All channels shall have been adjusted for the normal plus 7.0 dbm 0.5 db before any noise measurements are made.

C. After calibrating the noise measuring set for F1A observe the noise readings for several minutes to determine in what range the uncorrected noise level is running.

D. Make the following corrections to what has been determined to be the average reading:

Example: average reading found to be -45 dbm (-40 dbm RECEIVE-DBM setting and -5 on the indicating meter)

-45 dbm
- (+7) db correction (plus 7 dbm point)
-52 dbm

-85 dbm (zero dba point)
-(-52 dbm (converting to dba)
33 dba

In the above example the noise reading has been observed to average 33 dba.

E. Disconnect the measuring set from the channel under test.

F. After adjusting the output of the HP650A oscillator to a level of -45 dbm, connect the output to the 600 ohm input of the noise measuring set.

G. Observe that the noise measuring set now reads -45 dbm ± 0.5 db. If the reading is off by more than 0.5 db, check the output of the oscillator and/or the calibration of the noise measuring set. Also, if it is necessary to re-calibrate, Step (C) should be repeated.

H. Connect the recorder to the noise measuring set.

I. Adjust the gain of the recorder so that the pen rests on the mid-scale of the chart. Record this mid-scale point on the chart as 40 dba.

J. From this center point of calibration on the recording paper, increase and decrease the output of the 1,000 cycle oscillator in 5 db steps until the full range of the graphic recorder now falls within the noise range of 20 dba to 60 dba.

K. Disconnect the test oscillator and connect the noise measuring set to the channel previously tested under Step (C).

L. Adjust the chart speed for 100 divisions per hour with a writing speed of 3" per second.

M. Record the noise for a period of at least 10 minutes.

N. Observe the graphic recording of noise and determine its average value.

O. Correct the reading as follows:
Example: Average reading found to be 40 dba

	40 dba
Less	7 db
	33 dba corrected for zero dbm

P. Recorder Measuring Procedure - When recording noise measurements, mark the recorder paper to show the type of measurement, weighting and the date and hour the measurement commences. In addition, keep a log of any altered control settings and mark the record accordingly when it is removed. To record the noise measurements, proceed as follows:

1. The chart speed will set for 100 divisions per hour with a writing speed of 3" per second.

2. Recordings will be made continuously for a 24 hour minimum period.

3. Recorder chart calibration will be verified once every 24 hours.

7.2 Net Loss Variation

7.2.1 Test Equipment

A. Audio Oscillator HP 200 CD or HP 650A.

B. Graphic Level Recorder GR1521-AM (2 each).

C. Matching Transformer HP AC-60B (2 each).

7.2.2 Test Conditions

The test will be conducted by means of looping a channel between TID and GPA, GPA to GIM, GIM to GPA, GPA to TKG, TKG to TCO, TCO to TKG, and TKG to TID.

Please refer to 3.3.2 (a). It shall be at the discretion of the Test Team Director to select either Loop #1 or Loop #2 for the Net Loss Variation Test. The recordings will be made at the System Control Site.

NOTE: Recorder writing and chart speed to be same as noise recording settings.

7.2.3 Procedures

A. Connect audio oscillator through 600 ohm matching transformer to a selected voice channel modulator.

B. Connect graphic level recorder input in parallel with audio oscillator output (on the oscillator side of the matching transformer).

C. Adjust audio oscillator output to provide -16 dbm, 1000 cps signal at the voice channel modulator input.

D. At the channel terminating station, loop back the voice channel demodulator output to the channel modulator input, utilizing a 23 db attenuation pad.

E. Connect the graphic recorder input to the channel demodulator output through a matching transformer. Insure that the matching transformer provides a 600 ohm load to the channel demodulator.

F. Insure that both graphic recorders are calibrated for 5 db in one db step above and below graph's center axis. Check the calibration every 24 hours.

G. Continuously record 1000 cps input and output utilizing graphic recorders. The channel input shall be -16 dbm and the channel output should be 7 dbm at the start of the test.

DATA SHEET

1. MEDIAN NOISE RECORDING

The figures below are the median values of noise as determined from a plot of all samples collected during the test run. Short period measurements may exceed the figures below.

Measured at TID, Looped at GIM, and Terminated at TID	31.6 dba
Measured at TID, Terminated at GIM	28.6 dba
Measured at TID, Looped at GIM, Returned to TID, Looped at TCO, and Returned to TID. Terminated at the beginning of the Loop at TID.	34.6 dba
Measured at TID, Looped at TCO and Terminated at TID.	31.6 dba
Measured at TID, Terminated at TCO.	28.6 dba

System Tests Phase II	CODE IDENT. NO.	DWG. SIZE	
PREPARED BY [signature] DATE 3/29/64	14842	A	6272915
CHECKED BY [signature] DATE 4/2/64		FEC NO.	SHEET 18

A

DATA SHEET

1. NET LOSS VARIATION

Expected Level Changes:

On the loop between TID, TCO, TID, GIM and returned to TID, the 1,000 cycle value should not change more than 10 db in a consecutive 168 hour test run.

On any loop between TID and TCO and on any loop between TID and GIM, the 1,000 cycle value should not change more than 5 db in a consecutive 168 hour period.

DATA SHEET

1. NOISE RECORDING ON GPA-TID-TKG TEST LOOP (Form BRII/99)

The figures below are the median values of noise as determined from a plot of all samples collected during the test run. Short period measurements may exceed the limits shown below:

Recorder at TID

#1 Recorder connected to Channel 3, HG from TKG.
Termination at TKG. Expected Value: 26.4 dba

#2 Recorder connected to Channel 3, HG from TKG.
Termination at TID (Loop Reading)
Expected Value: 29.4 dba

#3 Recorder connected to Channel 3, HG from TKG.
Termination at GPA on Channel 10 LG.
(GPA-TID-TKG-TID) Expected Value: 31.2 dba

#4 Recorder connected to Channel 3, HG from TKG.
Termination at TID on Channel 10 LG.
(TID-GPA-TID-TKG-TID) Expected Value: 32.4 dba

Since the expected noise levels are the same between TID and GPA, and between TID and TKG, other combinations in the same ascension will have the same values as those above.

System Tests Phase II	CODE IDENT. NO.	DWG. SIZE	
PREPARED BY P. [signature] DATE 3/29/64	14842	A	6272915
CHECKED BY [signature] DATE 4/7/64		FEC NO.	SHEET 20

DWG NO. 6272926 ERN157

A ORIGINAL ISSUE

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED

SHEET NO.	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
ISSUE LTR	A	A	A	A	A	A	A	A	A	A															
SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
ISSUE LTR	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

GROUP	NEXT ASSEMBLY	FIRST USED ON
G		
G		
G		
G		
G		
G1	6272927	

APPLICATION

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

COML. TOL. APPLY TO STOCK SIZES

APPROVALS	SIGNATURE & DATE
DRAWN	
CHECKED	[signature] 3/23/64
MECH	
ELECT	
STDS	[signature] 3/23/64
FEC	H. Elliott 4-8-64
FEC SOURCE	
OTHER	

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LOS MICROWAVE MW 503A
PHASE II
BIG RALLY II COMMUNICATION SYSTEM

CODE IDENT. NO.	DWG. SIZE	
14842	A	6272926
SCALE	FEC NO.	SHEET 1 OF 35

A

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FEE-2A (F)

1. SCOPE

1.1 This section outlines the testing procedures for the LOS microwave MW-503A.

2. TEST EQUIPMENT

2.1 Test equipment required is indicated with each test procedure.

3. TEST CONDITIONS

3.1 The MICROWAVE Equipment must be properly installed and have been placed into operation prior to the performance of the test procedure in accordance with manufacturer's manual.

3.2 Testing procedures will be performed on equipment properly installed with all signal and power connections complete.

4. PROCEDURE

4.1 The procedure for performing each test is included within this section.

4.2 The testing procedures shall be completed in the order presented.

5. REQUIREMENTS

5.1 Transmitter, 52F4-MW

5.1.1 Klystron Beam Current - RF Power Output

5.1.2 RF Frequency and AFC

5.2 Receiver, 551F-6

5.2.1 Klystron Beam Current

5.2.2 IF Amplifier Noise Level-Receiver Sensitivity

5.2.3 IF Amplifier Deviation Sensitivity

5.3 Transmission Line

5.3.1 Waveguide VSWR

5.4 Alarm Tests

5.5 LOS Microwave, MW-503A, Link Tests

5.5.1 Diversity Equipment (Frequency or Space Diversity System Only) - Pilot Tone Level and Deviation

5.5.2 Diversity - Switchover Equipment (Hot-Standby System Only) - Pilot Tone Level and Deviation

5.5.3 Baseband Level and Frequency Response

5.5.4 Order Wire Level and Frequency Response

5.5.5 Intermodulation Distortion

5.5.6 Net Path Loss

5.5.7 Signal-to-Noise Ratio

6. RECORDING RESULTS

6.1 Test results shall be recorded in triplicate on the attached Data Sheets.

6.2 Most of the test levels that are to be recorded on the Data Sheets are measured on 75 ohm circuits. The VTVM is calibrated to read in dbm across 600 ohm circuits. Thus while using this VTVM to determine 75 ohm circuit levels, a correction factor of 9 db must be added to the actual meter reading to obtain dbm. IN ALL such cases in this procedure, record the uncorrected ACTUAL meter indication as read on the VTVM. The EXPECTED levels on the Data Sheets are given as the actual meter reading.

7. TRANSMITTER, 52F4-MW (DATA SHEET BRII/81)

7.1 RF Power Output

7.1.1 Test Equipment

A. Microwave Power Meter, HP-431A

B. Thermistor Mount, HP-478A

C. Adapter, Waveguide - N Female, HP-H281A

D. Attenuator, Variable Waveguide, HP-H375A

7.1.2 Procedure

A. Place the TX ON-OFF Switches of both Transmitters (A and B) in the OFF position. (Frequency Diversity only)

B. Connect the test equipment as shown in Figure 1 according to the type of diversity employed.

C. Set the Variable Attenuator, HP-H375A, for 10 db of attenuation.

D. Place the Power Meter, HP-431A, controls the following position:

1. Input Z - As marked on Thermistor Mount, HP-478A.

2. Range - as required.

3. Zero Adjust - As required.

E. Place the TX ON-OFF Switch of Transmitter A on the ON position.

F. Place the Power Selector Switch, located on the Transmitter A Metering Panel, in the TXI position. Record the TX Klystrom Beam Current reading of Meter M102 (right-hand meter) on the Data Sheet.

G. Note the Power Meter, HP-431A, indication. Calculate the Transmitter Power in the following manner:

Add the Power Meter indication, the loss of the directional coupler (obtained from the decal on the coupler nameplate by interpolation), and the attenuation of the Variable Attenuator.

EXAMPLE:	Power Meter Indication -	-1 dbm
	Direction Couplers Loss -	20 db
	Attenuator Setting -	10 db
	TX Power Output -	29 dbm

H. Place the TX ON-OFF Switch of Transmitter A in the OFF position.

I. Repeat Steps E through H for Transmitter B for a Hot Standby or Frequency Diversity configuration. A different test equipment set-up is required for a Space Diversity configuration, thus repeat Steps B through H for Transmitter B of a Space Diversity System

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7.2 RF Frequency and AFC

7.2.1 Test Equipment

A. Frequency Counter, HP-524D or equivalent

B. Transfer Oscillator, HP-540B

C. Adapter, HP-H281A

D. Cable (for use above 4GC), HP-AC16Q

7.2.2 Procedure

A. Record the assigned operating frequency code of Transmitter A as it appears on the Transmitter nameplate.

B. Place the TX ON-OFF Switches of both Transmitters (A and B) in the OFF position. (Frequency Diversity only)

C. Connect the test equipment as shown in Figure 2 according to the type of diversity employed.

D. Place the TX ON-OFF Switch of Transmitter A in the ON position.

E. Adjust the LEVEL Control (located inside the unit) on the Transmitter A 78A1-MW AFC Alarm Unit for an indication of 10 on Meter M-1 and set the adjustable contact on M-1 to 0.

F. With Transmitter A and associated AFC equipment properly aligned and with the AFC "ON", measure and record on the Data Sheet the transmitter operating frequency.

NOTE: 1. All modulation except pilot signal must be removed from the modulator while making frequency measurements.

2. The reference cavity must have been set within $\pm 0.002\%$ when the transmitter was swept.

G. Place the AFC ON-OFF Switch in the "OFF" position and detune the Klystron mechanical frequency adjustment in the CW direction for an indication of 5 on the Transmitter A 78A1-MW Alarm Unit Meter.

H. Place the AFC Switch in the ON position. After allowing sufficient time (at least 1 minute) for stabilization, record the reading of Meter M-1 of Transmitter A 78A1-MW AFC Alarm Unit on the Data Sheet.

I. Turn the AFC Switch OFF and detune the Klystron mechanical frequency adjustment in a CCW direction for a reading of 5 on the Transmitter A 78A1-MW Alarm Unit Meter.

J. Place the AFC Switch in the ON position. After allowing sufficient time (at least 1 minute) for stabilization, record the reading of Meter M-1 of Transmitter A 78A1-MW AFC Alarm Unit on the Data Sheet.

K. Tune Transmitter A back to operating frequency. Set the 78A1-MW AFC Unit Meter to 10 by use of Level Control, if necessary. Set the adjustable alarm contact to 5.

L. Place the TX ON-OFF Switch of Transmitter A in the OFF position.

M. Repeat Steps A, D, through J for Transmitter B for a Hot Standby or Frequency Diversity Configuration. A different test equipment set-up is required for a Space Diversity Configuration, thus repeat Steps A, C, through J for Transmitter B of a Space Diversity System.

8. RECEIVER, 55IF-6 (DATA SHEET BRII/82)

8.1 Klystron Beam Control

8.1.1 Test Equipment - None Required

8.1.2 Procedure

A. With the MXI - LOI Switch of Receiver A in the LOI position, note and record on the Data Sheet the reading on Meter M202 (Right-hand Meter).

B. Repeat Step A for Receiver B.

8.2 Receiver Sensitivity

8.2.1 Test Equipment

A. Adapter, IF Input, Collins Part No. 562 8839 003.

B. Generator, SHF Signal, HP 620A.

C. VTVM HP 400 D.

D. Adapter, Waveguide - N Female, HP - H281A.

E. Cable, HP AC-16B

F. Cable, above 4 GC, HP-AC-16Q.

8.2.2 Procedure

A. The distant transmitter(s) must be turned off in order to prevent its signal from interfering with the test.

B. Ascertain that Receiver A of a Hot Standby configuration is in service.

C. At Receiver A, disconnect the male BNC connector from the Mixer Output, J-205.

D. Connect the end of the IF Input Adapter marked IF to the male BNC connector just removed from the Mixer Output.

E. Connect the VTVM, HP400D, to the OUTPUT jack of the IF Amplifier of Receiver A and read the noise level. Refer to Figure 3. Record this level on the Data Sheet.

F. Connect the test equipment as shown in Figure 4. Disconnect the IF Input Adapter from the IF Amplifier input cable and reconnect the input cable to the Receiver A Mixer Output, J205.

NOTE: Be certain that the local Transmitters are turned OFF when the SHF Generator is connected to the equipment.

G. Place the Receiver A Meter Switch S205 in the DISC turn AFC OFF position. Put the Generator MOD SELECTOR in the CW position. Tune the SHF Signal Generator, HP 620A, to obtain a center-scale (0) reading on Meter M201. Set the Generator OUTPUT ATTENUATOR for maximum attenuation.

H. Keeping the Generator Output adjusted properly, decrease the attenuation of the Generator OUTPUT ATTENUATOR until the Receiver A noise output, as read on the VTVM, HP400D, decreases by 3 db.

I. Calculate the 3 db Quieting Sensitivity of Receiver A in the following fashion:

Subtract the insertion loss of the cable and adapter (approximately 2.5 db) and the loss of the directional coupler (obtained from the decal on the coupler name-plate by interpolation) from the Signal Generator Output, as accurately determined from the ATTENUATOR DIAL.

EXAMPLE:	SHF Sig Generator Output -	-65.5 dbm
	Directional Coupler Insertion Loss -	-19.0 db
	Cable & Adapter Inserion Loss	- 2.5 db
	3 db Quieting Sensitivity	-87.0 dbm

Record the calculated Sensitivity on the Data Sheet.

NOTE: If the calculated Quieting Sensitivity is marginal, the HP AC-16Q cable insertion loss may be greater than anticipated. To determine its actual loss, connect a HP431A Power Meter to the HP 620A Generator Output, obtain a reference level on the Power Meter. Then substitute the cable under test between the Generator and the Power Meter. The difference in Power levels is the AC16-Q insertion loss.

J. Return Receiver A to normal operation.

K. Repeat Steps A through K for Receiver B.

L. Turn on the distant transmitter(s).

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8.3 I-F Amplifier Deviation Sensitivity

8.3.1 Test Equipment

A. Deviation Calibrator, Collins 477Z-2

B. Adapter, I-F Input, Collins 562-8839-003.

C. VTVM, HP 400 D.

D. Cable, Banana - BNC, HP AC-16B.

8.3.2 Procedure

A. Disconnect the I-F Input Cable from the Mixer Output, J205, of Receiver A and connect to the I-F Input Adapter. Connect the remaining test equipment as shown in Figure 5.

B. Set the Deviation Calibrator, 477Z-2, FUNCTION SWITCH to the CAL position. Please refer to the Deviation Calibrator Manual for additional information.

C. Set the VTVM, HP400D, to the -10 db scale and note the reading. Subtract -14.2 db from this reading and record the value, as Deviation Sensitivity,. on the Data Sheet.

EXAMPLE: VTVM Reads -15.2 db, therefore, the Deviation Sensitivity will be -1.0 db. (-15.2 db - -14.2 db -1.0db)

D. Return Receiver A to normal operation.

E. Repeat Steps A through E for Receiver B.

9. TRANSMISSION LINE (DATA SHEET BRII/83)

9.1 Waveguide VSWR Measurement

9.1.1 Test Equipment

A. Sweep Oscillator, HP-HO1 686C

B. Directional Coupler, HP-H752C

C. Directional Coupler, HP-H752D

D. Adapter, W/G - N, HP-H281A

E. Attenuator, Variable W/G, HP-H375A

F. Adjustable Short, HP-H920A

G. Cable, Use above 4 KMC, HP-AC16Q

H. Ratio Meter, HP 416A

I. (2) Crystal Detectors, Matched Pair, HP-H421A

9.1.2 Procedure

A. Set up the equipment as shown in Figure 6, with the Adjustable Short, HP-H920A connected to the Directional Coupler, HP-H752C.

B. Place the Ratio Meter, HP416A EXCESS COUPLER LOSS switch in the 10 db position.

C. Initially adjust the Variable Attenuator, HP-H375A, for approximately 6 db.

D. Adjust the Sweep Oscillator, HP-H01 686C, in the following fashion:

SWEEP SELECTOR - OFF; AMPL MOD SELECTOR - INT. Set the FREQUENCY Dial to first frequency indicated on the Data Sheet. Adjust the MOD (frequency) CONTROL on the Sweep Oscillator to obtain a peak indication, narrowest eye opening, on the Ratio Meter RF POWER MONITOR.

E. Momentarily disconnect the BNC cables from the Ratio Meter's REFLECTED/PROBE and INCIDENT inputs. If the RF POWER MONITOR tuning eye shadow does not move, increase the signal level by increasing the Sweep Generator output and decreasing the Variable Attenuator attenuation. Make the MOD CONTROL adjustment of Step D if it was not possible before. If the shadow moves appreciably, (approximately 1/16 inch from closing), without overlapping, proceed with the calibration, Step F. An overlapping shadow indicates an overload. Additional signal level adjustments can be made using the Variable Attenuator, HP 375A.

F. Calibrate the Ratio Meter, HP-416A, in the following manner:

1. Connect the Adjustable Short, HP-H920A to the end of the waveguide, refer to Figure 6.

2. Place the Ratio Meter RANGE switch in the 0 db 100% position.

3. Adjust 416A SET TO FULL SCALE control for convenient reference on PERCENT REFLECTION (REFLECTOMETER) scale; 90 is recommended.

4. Slide short while noting maximum and minimum indications on reflectometer scale.

5. Subtract minimum reading from maximum, and divide by two.

   FOR EXAMPLE: If maximum and minimum readings noted while the short is slid are .89 and .93 respectively: The difference is .04, and half the difference is .02.

6. Slide short to get minimum indication again.

7. Adjust SET TO FULL SCALE TO obtain a meter indication which is equal to the reflection coefficient of the calibrating load (100) minus the quantity obtained in Step 5.

   (For the values used above, SET TO FULL SCALE would be adjusted to obtain a meter indication of .98).

G. Connect the directional couplers to the transmission line as close as possible to the microwave equipment. It may be necessary to remove a section of the existing waveguide to provide adequate space to install the test equipment.

H. The PERCENT REFLECTION (REFLECTOMETER) scale on the Ratio Meter is used for these tests. The percent reflection is converted to VSWR by use of the following relationship:

$$\text{VSWR} \quad \frac{100 + R\%}{100 - R\%}$$

Where R% is the percent reflection.

EXAMPLE: Percent Reflection = 1.0%

$$\text{VSWR} = \frac{100 + 1.0\%}{100 - 1.0\%} = \frac{101}{99} = 1.02$$

Record the percent reflection, R%, and the calculated VSWR on the Data Sheet in the appropriate place, determined by the type of diversity employed at the station.

I. Determine the VSWR at every frequency, both transmit and receive, associated with the waveguide run under test as indicated on the Data Sheet. Both waveguide runs of a Space Diversity System must be tested. Repeat Steps A through H for each frequency.

J. Restore the waveguide runs to their normal configuration.

10. ALARM TESTS (DATA SHEET BRII/84)

10.1 Test Equipment - None required

10.2 Procedure

A. The following steps indicate the Alarm Systems that are to be checked along with the methods of failure simulation required to activate the alarm. The Data Sheet contains the result requirements with check list. All equipment should be ON and functioning properly before these tests are started.

B. "A" AC Power Failure - Turn "A Circuit Breaker OFF. Refer to the Data Sheet for required results and check list. Restore power after observations.

C. "B" AC Power Failure - Turn "B" Circuit Breaker OFF. Refer to the Data Sheet for required results and check list. Restore power after observations.

D. "A" Modulation Alarm - Note reading of "A" AFC Pilot Level Meter then rotate level ADJ Control on "A" Reference Amplfier for -6.5 db on meter. Return to normal after test.

E. "B" Modulation Alarm - Note reading of "B" AFC Pilot Level Meter then rotate level ADJ Control on "B" AFC Reference Amplifier for -6.5 db on meter. Return to normal level after test.

F. "A" RF Power Alarm - Set red vane on meter M1 of the Transmitter A AFC Alarm Unit to 5. Place the TX (A) OFF-ON Switch in the OFF position. Restore Switch to normal after the test.

G. "B" RF Power Alarm - Set red vane on Meter M1 of the Transmitter "B" AFC Alarm Unit to 5. Place the TX (B) OFF-ON Switch in the OFF position. Restore the Switch to normal after the test.

11. LOS MICROWAVE, MW-503A, LINK TESTS (DATA SHEET BRII/85)

11.1 Diversity Equipment Tests (Frequency or Space Diversity Systems only) - Pilot Tone and Deviation.

11.1.1 Test Equipment

A. Selective Voltmeter, Sierra 125B

11.1.2 Procedure

A. The distant transmitter(s) must be transmitting a correctly adjusted 308KC Pilot Tone to the receivers feeding the diversity equipment. The local receiver must be functioning normally.

B. Tune the Selective Voltmeter, Sierra 125B, to the Pilot Tone frequency 308KC. Set the FUNCTION SELECTOR to SEL VM (250 cps). Put the LINE IMPEDANCE switch to 600 ohms. Connect the Input terminals for an unbalanced line by placing the ground strap on the lower terminal.

C. Connect the Selective Voltmeter to the A IN jack and GRD jack on the diversity equipment Control Panel. Read the Pilot Tone level from Receiver A and record it on the Data Sheet.

D. Connect the Selective Voltmeter to the B IN jack and GRD jack on the diversity equipment Control Panel. Read the Pilot Tone level from Receiver B and record it on the Data Sheet.

E. Connect the Selective Voltmeter to the SIG OUT jack and GRD jack on the diversity equipment Control Panel. The Voltmeter should still be tuned to 308KC.

F. Move the SERVICE SWITCH to the A-DISABLE position. (The A SW ALARM lamp should light). Read the Pilot tone level from the SIG OUT jack and record it on the Data Sheet.

G. Return the SERVICE SWITCH to the center position, wait approximately 5 seconds, and then move the service switch to the B-DISABLE position. (The A SW ALARM lamp should go off and the B SW ALARM lamp should light.) Read the Pilot Tone level from the SIG OUT jack and record it on the Data Sheet.

H. Return the SERVICE SWITCH to the center position. (Both SW ALARM lamps should go off).

I. With the Selective Voltmeter connect as in Step E, note and record on the Data Sheet the stabilized change in Pilot Tone level caused by turning off "A" Circuit Breaker. Restore the "A" Breaker after the test.

J. With the Voltmeter connected as in Step E, note and record on the Data Sheet the stabilized change in Pilot Tone level caused by turning off "B" Circuit Breaker. Restore the "B" Breaker after the test. Disconnect the Voltmeter at Frequency Diversity Stations.

K. Space Diversity System - Connect the Selective Voltmeter as in Step E. Have the distant station switch to transmitter "B". Read the Pilot Tone level and record it on the Data Sheet. Disconnect the Voltmeter. Have the distant station return to Transmitter A.

11.2 Diversity-Switchover Equipment Tests (Hot-Standby System Only) Pilot Tone Level and Deviation.

11.2.1 Test Equipment

A. Selective Voltmeter, Sierra 125B

11.2.2 Procedure

A. The distant transmitter must be transmitting a correctly adjusted 308 KC Pilot Tone to the receiver feeding the diversity equipment. The local receiver must be functioning normally.

B. Tune the Selective Voltmeter, Sierra 125B, to the Pilot Tone frequency 308KC. Set the Function Selector to SEL VM (250 cps). Put the Line Impedance switch to 600 ohms. Connect the Input terminals for an unbalanced line by placing the ground strap on the lower terminal.

C. Set the Switchover Test Unit, 18B1-MW, control to the "B" TEST position. Connect the Selective Voltmeter to the A IN jack and GRD jack on the diversity equipment control panel. Read the Pilot Tone level from Receiver A and record it on the Data Sheet.

D. Set the Switchover Test Unit, 18B1-MW, control to the "A" TEST position. Connect the Selective Voltmeter to the B IN jack and GRD jack on the diversity equipment Control Panel. Read the Pilot Tone level from Receiver B and record it on the Data Sheet.

E. Connect the Selective Voltmeter to the SIG OUT jack and GRD jack on the diversity equipment Control Panel. The Voltmeter should still be turned to 308KC.

F. Move the SERVICE SWITCH on the diversity equipment auxiliary Control Panel to the A-DISABLE position and the Switchover Test Unit Control to "A" TEST position. (The SW ALARM lamp should light. The "A" TEST and the B IN-SERVICE lamps on the Switchover Unit should be lit.) Read the Pilot Tone level from the SIG OUT jack and record it on the Data Sheet.

G. Return the SERVICE SWITCH on the diversity equipment auxiliary Control Panel to the center position, wait approximately 5 seconds, and then move the SERVICE SWITCH to the B-DISABLE position. Set the Switchover Test Unit test switch to "B" TEST position. (The A SW ALARM lamp should extinguish and the B SW ALARM lamp should light. The "B" TEST and the A IN-SERVICE lamps on the Switchover Units should be lit.) Read the Pilot Tone level from the SIG OUT jack and record it on the Data Sheet.

H. Return the Service Switch to the center position. Set the test switch to the NORMAL position. (Both SW ALARM lamps should extinguish. The A IN-SERVICE lamp on the Switchover Control Unit should be lit.)

I. With the Selective Voltmeter connected as in Step E, note and record on the Data Sheet the stabilized change in Pilot Tone level caused by turning off "A" Circuit Breaker. Restore the "A" Breaker after the test.

J. With the Voltmeter connected as in Step E, note and record on the Data Sheet the stabilized change in Pilot Tone level caused by turning off "B" Circuit Breaker. Restore the "B" Breaker after the test.

K. Have the distant station switch to Transmitter "B". With the Voltmeter connected as in Step E, read the Pilot Tone level and record it on the Data Sheet. Disconnect the Voltmeter. Have the distant station return to Transmitter A.

11.3 Base Band Level and Frequency Response

11.3.1 Test Equipment

A. Audio Oscillator, HP 200 CD

B. VTVM, HP 400D

C. Termination, 75 ohm Resistor

D. Selective Voltmeter, SIERRA 125 (GPA ONLY)

11.3.2 Procedure (See 11.3.3 for GA-GPA Link)

NOTE: The order wire should NOT be used while link measurements are being made.

A. Transmit Station - disconnect the jumper cable from jack J6 on the front of the RF Patch Panel, 499J-3. Connect the Audio Oscillator, HP 200 CD, to jack J6.

Connect the VTVM, HP400D, across the output of the oscillator. Adjust the oscillator for an output of -44 db as read on the VTVM at a frequency of 100 KC. This frequency is the reference used throughout the test.

B. Receive station - disconnect the jumper cable from jack J8 on the front of the RF Patch Panel, 499J-3. Connect the VTVM to jack J8. Place a 75 ohm resistor across the input terminals of the VTVM. Record on the Data Sheet the 100 KC level as read on the VTVM.

C. Transmit Station - vary the oscillator from 60 KC to 500 KC in steps as indicated on the Data Sheet, while keeping the oscillator output CONSTANT at -44 db as monitored on the VTVM.

D. Receive Station - record on the Data Sheet the test frequency levels as read on the VTVM.

E. The two stations in the link should now reverse their roles of transmitting and receiving of the baseband test frequencies and repeat Steps A through D.

F. Return the equipment to normal operation.

11.3.3 Procedure for GA-GPA Link Only

NOTE: The order wire should not be used while the link measurements are being made.

A. At site GA - disconnect the jumper cable from jack J1 on the front of the RF Patch Panel, 499 J-3. Connect the Audio Oscillator, HP 200 CD, to jack J1. Connect the VTVM, HP 400D, across the output of the oscillator. Adjust the oscillator for an output of -39.5 db as read on the VTVM at a frequency of 100 KC. This frequency is the reference used throughout the test.

B. At Site GPA - disconnect the jumper cable from jack J3 on the front of the RF Patch Panel 499 J-3. Connect the Selective Voltmeter to jack J3. Place a 75 ohm resistor across the input terminals of the Selective Voltmeter. Record on Data Sheet the 100 KC level as read on the Selective Voltmeter.

C. At Site GA - vary the oscillator from 12 KC to 500 KC in steps as indicated on the Data Sheet, while keeping the oscillator output CONSTANT at -39.5 db as monitored on the VTVM.

D. At Site GPA - record on the Data Sheet the test frequency levels as read on the Selective Voltmeter.

E. At Site GPA - disconnect the jumper cable from jack J6 on the front of the RF Patch Panel 499 J-3. Connect the Audio Oscillator, HP 200 CD, to jack J6. Connect the VTVM, HP 400D, across the output of the oscillator. Adjust the oscillator for an output of -44 db as read on the VTVM at a frequency of 100 KC. This frequency is the reference used throughout the test.

F. At Site GA - disconnect the jumper cable from jack J5 on the front of the RF Patch Bay, 499 J-3. Connect the Selective Voltmeter to jack J5. Place a 75 ohm resistor across the input terminals of the Selective Voltmeter. Record on the Data Sheet the 100 KC level as read on the Selective Voltmeter.

G. At Site GPA - vary the oscillator from 12 KC to 500 KC in steps as indicated on the Data Sheet, while keeping the oscillator output CONSTANT at -44 db as monitored on the VTVM.

H. At Site GA - record on the Data Sheet the test frequency levels as read on the Selective Voltmeter.

I. Return all equipment to normal operation.

11.4 Order Wire Level and Frequency Response

11.4.1 Test Equipment

A. Audio Oscillator, HP 200 CD, or equivalent.

B. VTVM, HP 400D, or equivalent.

11.4.2 Procedure

Note: Before this procedure is attempted, the Tributary Order Wire T&A Procedure should be conducted on the Tributary Order Wire configurations.

A. Transmit Station - connect the equipment as shown in Figure 7 for the appropriate station Order Wire configuration. Adjust the Audio Oscillator for a frequency of 1 KC at the level indicated in Figure 7. Connect an unterminated VTVM to the INPUT BNC connector located on the left-hand side of the Collins Microwave Modulator 27C2-MW. If permitted, disconnect the baseband at J-2 on the RF Patch Panel 499J-3. (If the baseband cannot be interrupted, see Note 1.) Adjust the LEVEL control on the Collins Order Wire Modulator (TX) Unit 30A2-MX to obtain -40 db as read on the VTVM. Remove the VTVM from the INPUT BNC connector and reconnect the baseband.

NOTES:
1. If the baseband cannot be interrupted for the above adjustment, connect an unterminated HP 400D VTVM across the OUTPUT Test Points on the Collins OW Modulator (TX) Unit. Adjust this unit to obtain -8 dbm at the Test Points.

2. After the Collins Order Wire Modulator (TX) Unit 30A2-MX is adjusted, make the following measurement: Ascertain that the 1 KC Test Tone level at the INPUT Test Points of this unit is a NOMINAL -22 dbm ($\pm$1 db). This measurement can be made by placing an unterminated HP 400D VTVM across these Test Points.

3. The 308 KC Pilot Tone is present at the Microwave Modulator INPUT connector, but will not affect the 1 KC VTVM indication by more than a few tenths of a db.

B. Receive Station - Connect the equipment as shown in Figure 7. Record on the Data Sheet the Demodulator (RX) output as read on the VTVM. Adjust the Demodulator as required.

C. Transmit Station - vary the Audio Oscillator frequency from 300 cps to 3 KC in the steps indicated on the Data Sheet. The Audio Oscillator output level must be kept constant at the level shown in Figure 7.

D. Receive Station - record on the Data Sheet the Demodulator (RX) output levels as read on the VTVM as the frequency is varied.

E. The two stations of the link should now reverse their roles of transmitting and receiving. Repeat Steps A through D.

F. Return the equipment to normal operation.

11.5 Intermodulation Distortion Test

11.5.1 Test Equipment

A. Signal-to-Noise Test Set, Collins 476B-1.

B. Noise Loading Test Set, Collins 476C-1.

C. VTVM HP 400D.

D. Adapter, Tee, BNC.

E. Termination, 180 ohm, 1/2 W Resistor.

11.5.2 Procedure

NOTE: The transmitter and receiver must have been properly tuned and the system level adjustments completed before the test can be started. No modulating signals, except Pilot should be present.

A. Transmit Station - disconnect the BNC jumper cable from J1 on the front of the RF Patch Panel, 499 J-3. Mount the BNC tee adapter on J1 and reconnect the BNC jumper cable to one side of the adapter. Connect the output from the Noise Loading Test Set to the other end of the tee adapter. Use a tee adapter on the OUTPUT jack of the Noise Loading Test Set and connect the VTVM, HP 400D, to the output jack. Use the short cable for this connection. Refer to Figure 8.

B. Adjust the Noise Loading Test Set in the following manner:

1. Set the 455 KC NOTCH Switch to the OUT position.

2. Set the LO PASS FILTER Switch to the 1200 KC position. (240 channel loading)

3. Set the 308 KC NOTCH Switch to the IN position.

4. Set the HIGH PASS FILTER switch to the IN position.

5. Adjust the LEVEL control on the noise measuring test set for a reading of -33 db as read on the VTVM.

C. Receive Station - disconnect the BNC jumper cable for J3 on the front of the RF Patch Panel, 499-J-3. Connect the IN jack of the Signal-to-Noise Test Set to J3 on the RF Patch Panel, using a BNC Tee Adapter with a 180 ohm resistor attached. Connect the VTVM to the OUT jack of the Signal-to-Noise Test Set. Refer to Figure 8. Set the ATTENUATION IN DB Switches for 50 db and adjust the LEVEL ADJ control for a reading of -40 db as read on the VTVM.

D. Transmit Station - place the 455 KC NOTCH switch to the IN position. Readjust the output of the Noise Loading Set to -33 db.

E. Receive Station - remove attenuation by operating the ATTENUATION IN DB controls until the VTVM again indicates -40 db. DO NOT change the setting of the LEVEL ADJ control.

F. Determine the amount of attenuation removed in Step E by subtracting the remaining attenuation from 50 db. Record this amount on the Data Sheet. This value is the intermodulation product in db.

G. The two stations involved in this test should now reverse their roles of transmitting and receiving and repeat Steps A through F.

H. Restore all equipment to normal operation.

11.6 Net Path Loss (NPL) Measurement

11.6.1 Test Equipment

A. Generator, SHF Signal, HP 620A.

B. Adapter, Waveguide - N Female, HP-H281A.

C. Cable, above 4 GC, HP-AC-16Q.

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11.6.2 Procedure

NOTES:
1. Before NPL measurement is attempted, the transmitter of the test link must be functioning properly with the required power output.
2. This measurement should be performed when propagation fading is at a minimum. This usually occurs around mid-day.
3. The NPL must be determined for both directions of transmission.
4. Ascertain that Receiver A of a Hot Standby Configuration is in service for this test.

A. Place the Receiver A meter switch, S203, which is located on the receiver front panel, in the RX 3 position. CAREFULLY note the Meter M 201 (left-hand meter) of Receiver A. For a Frequency Diversity or Space Diversity Configuration repeat and CAREFULLY note this meter reading for Receiver B.

B. Have all the distant transmitter(s) of this test link turned off in order to prevent their signals from interfering with the following measurements.

C. Set up the test equipment for Receiver A as shown in Figure 4.

NOTE: Be certain the local Transmitters are turned OFF when the SHF Generator is connected to the equipment.

D. Place the Receiver A Meter Switch S203 in the DISC position. Put the Generator MOD SELECTOR in the CW position. Tune the SHF Signal Generator, HP 620A, to obtain a center-scale (0) reading on Meter M201. Set the Generator OUTPUT ATTENUATOR FOR maximum attenuation.

E. Keeping the Generator output adjusted properly, decrease the attenuation of the Generator OUTPUT ATTENUATOR until the reading of Meter M201 of Receiver A is the same as that obtained in Step A, Receiver A. Be certain that the meter switch S203 is in the same position as in Step A, namely, RX3.

F. Calculate the Received Signal Power in the following fashion:

Subtract the directional coupler insertion loss (obtained from the decal on the coupler nameplate by interpolation) and the insertion loss of the cable and adapter (approx. 2.5db) from the SHF Signal Generator Output (obtained from the Generator ATTENUATOR DIAL).

EXAMPLE:	SHF Sig Generator Output	-20.0 dbm
	Directional Coupler Insertion Loss	-19.0 db
	Cable and Adapter Insertion Loss	-2.5 db.
	Received Signal Power, Rec A	-41.5 dbm

Record this Received Signal Power, Rec A, on the Data Sheet.

G. For a Hot Standby Configuration, Received Signal Power, Rec B is the same as measured for Receiver A and should be recorded on the Data Sheet as such. Restore Hot Standby Configuration equipment to normal operation.

For a Frequency Diversity Configuration, repeat Steps B, D, E and F, to determine and record on the Data Sheet the Received Signal Power, Rec B.

For a Space Diversity Configuration, repeat Steps B, C, D, E and F, to determine and record on the Data Sheet the Received Signal Power, Rec B.

H. Calculate the Net Path Loss (NPL), Path A in the following manner:

Subtract the Received Signal Power, Rec A (calculated in Step F) from the appropriate distant Transmitter Power (calculated in Section 7.1 of procedure by the other station participating in this link test.) BE CERTAIN that the distant Transmitter Power obtained is from the transmitter used in the link measurement of Step A.

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EXAMPLE:	Distant Transmitter Power	+ 28.0 dbm
	Received Signal Power	-(-41.5) dbm
	NPL, Path A	69.5 db

Record the NPL, Path A, on the Data Sheet.

I. For a Hot Standby Configuration, only one NPL measurement is required; therefore, this test is completed.

For the Frequency Diversity and Space Diversity Configuration, calculate the NPL, Path B by repeating Step H, using the Received Signal Power, Rec B.

NOTE: The same distant transmitter is used for both paths of a Space Diversity System; therefore, the distant Transmitter Power will be the same in both NPL calculations. Two distant transmitters are used in the Frequency Diversity System, so the distant Transmitter Power will be DIFFERENT for each NPL calculation.

J. Restore all equipment to normal operation.

11.7 Signal-To-Noise Ratio Measurement

11.7.1 Test Equipment

A. Test Oscillator, HP 200 CD

B. Selective Voltmeter, Sierra 125B

C. VTVM, HP 400 D

D. Signal-To-Noise Test Set, Collins 476B-1

11.7.2 Procedure

NOTE: All the link adjustment procedures must be successfully completed before attempting this test.

A. Have the MUX INPUT to the distant transmitters of the test link temporarily disconnected by removing the cable connected to J2 on the RF Patch Panel, 499J-3. The Pilot Tone and Order Wire will remain connected.

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B. Disconnect the cable from jack J204 located on the rear of Receiver B chassis.

C. Connect the Selective Voltmeter, Sierra 125A, between the SIG OUT AND GRD jacks on the Diversity auxiliary Control Panel. Tune the Selective Voltmeter to the Pilot Tone Frequency, 308KC. Set the FUNCTION SELECTOR to SEL VM (250 cps). Put the LINE IMPEDANCE Switch to 600 ohms. Connect the INPUT terminals for an unbalanced line by placing the ground strap on the lower terminals. Measure the pilot tone level on the Selective Voltmeter.

D. Adjust the ATTENUATION IN DB Switches for 80 db on the 476 B-1 Test Set.

E. Connect the input of the 476B-1 Signal-to-Noise Test Set across the Selective Voltmeter. Recheck and note the pilot level on the Selective Voltmeter.

F. Connect the output from the Audio Oscillator, HP 200 CD across the Selective Voltmeter. The Oscillator terminals are to be connected for unbalanced operation by placing the ground strap on the appropriate terminals. Temporarily connect the VTVM, HP 400D, to the Oscillator terminals for correct Oscillator output adjustment. Set the Oscillator to 455 KC for -40 db as read on the VTVM plus the difference in pilot level noted in Steps C and E.

FOR EXAMPLE: If the pilot level dropped 3 db when the 476B-1 was connected in Step D, the Oscillator should be adjusted for -43 db output.

G. Connect the VTVM, HP 400D, across the output of the 476B-1 and adjust the LEVEL ADJ control of the 476B-1 for a reading on the VTVM, equal to the value determined in Step F. Ascertain that the Audio Oscillator, HP 200 CD, frequency is properly adjusted by carefully moving the Oscillator frequency dial to obtain a peak indication on the VTVM. After this adjustment, recheck the Oscillator output level of Step F and the 476B-1 output of this Step.

H. Remove the Audio Oscillator.

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I. Remove the attenuation from the 476B-1 until the VTVM, HP 400D, reads the level determined in Step F. The Signal-to-Noise Ratio is 80 minus the attenuation remaining in the 476B-1. This Signal-to-Noise Radio is for Receiver A and should be recorded as such on the Data Sheet.

J. Reconnect the cable to Jack J204 of Receiver B. Disconnect the cable from jack J204 of Receiver A.

NOTE: 1. In a Hot Standby Configuration, the system should automatically switch to Receiver B.

2. Be certain the condition obtained in Step A is still in effect.

K. Repeat Steps C through I to obtain and record on the Data Sheet the Signal-to-Noise Ratio for Receiver B.

L. Restore all the equipment to normal operation.

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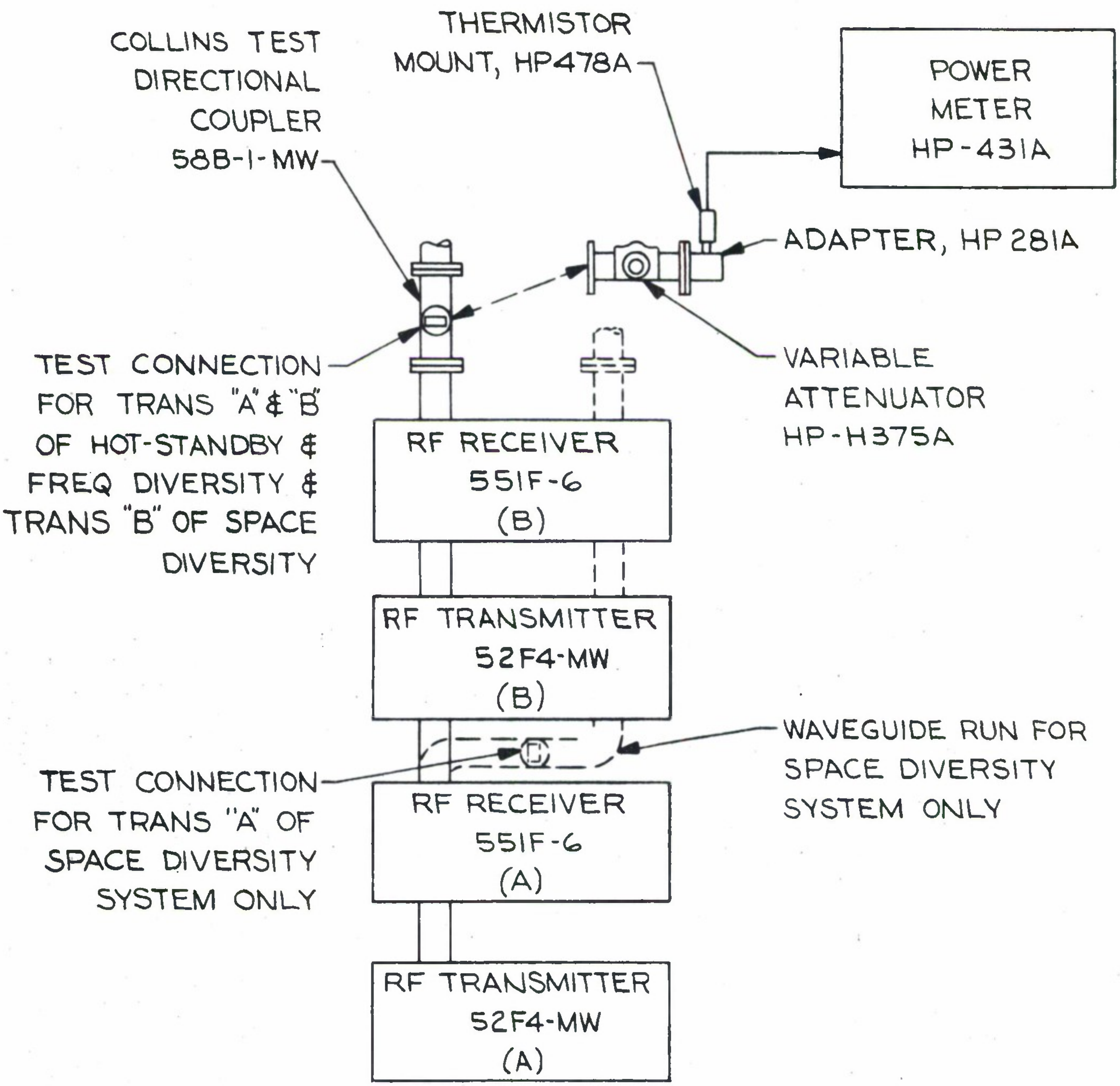

FIGURE-1

FEE-2A (E)

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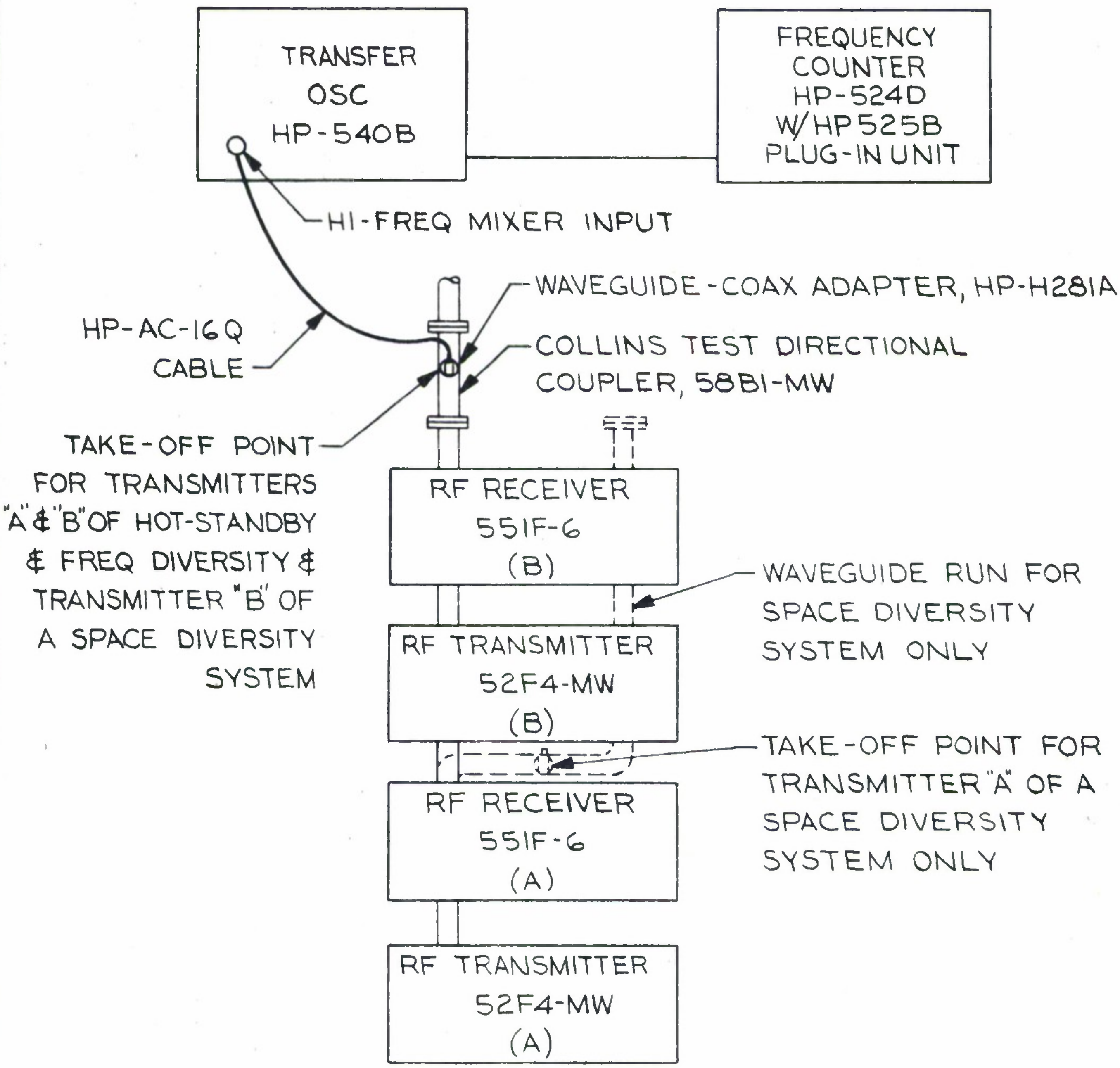

FIGURE-2

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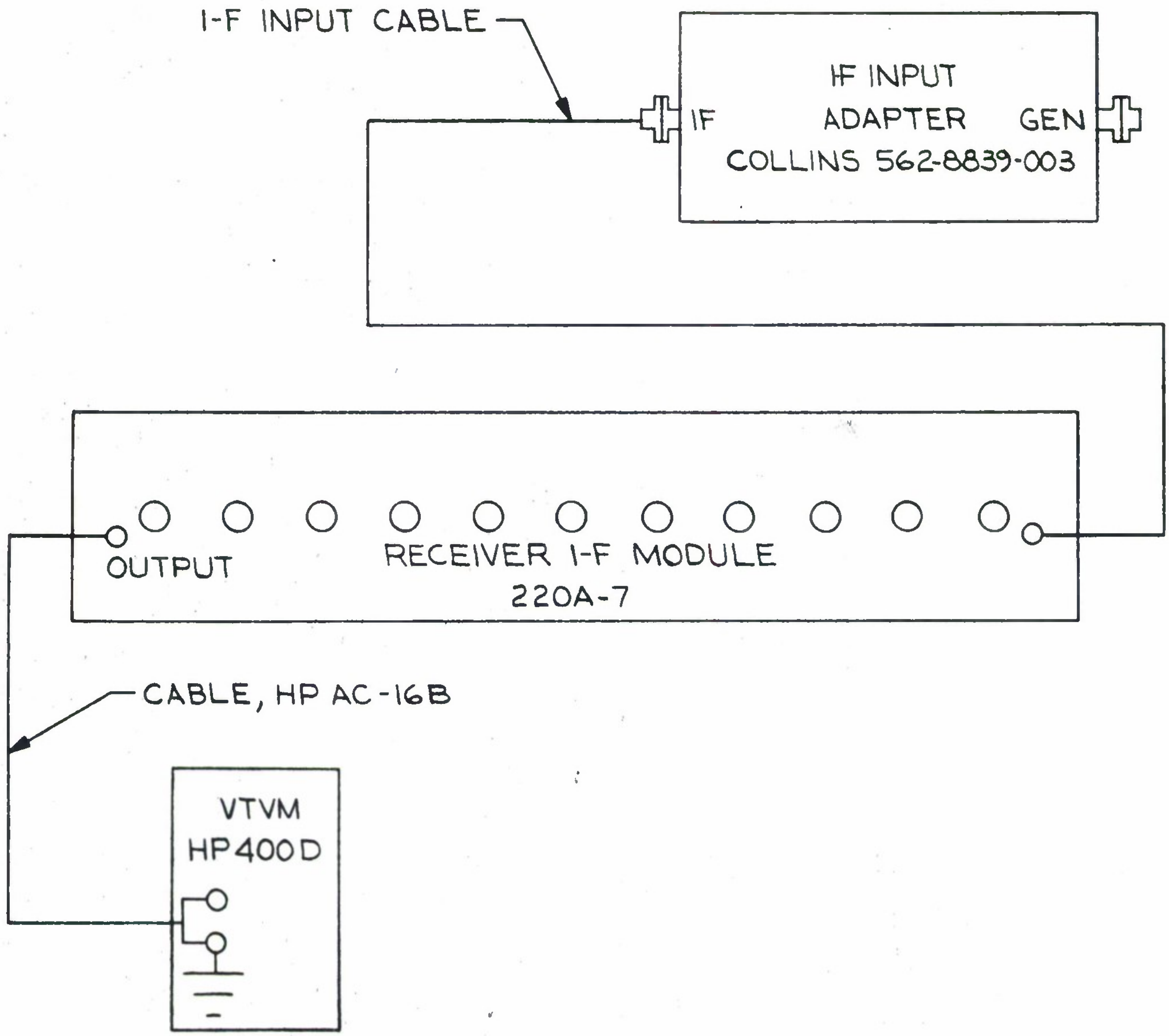

FIGURE - 3

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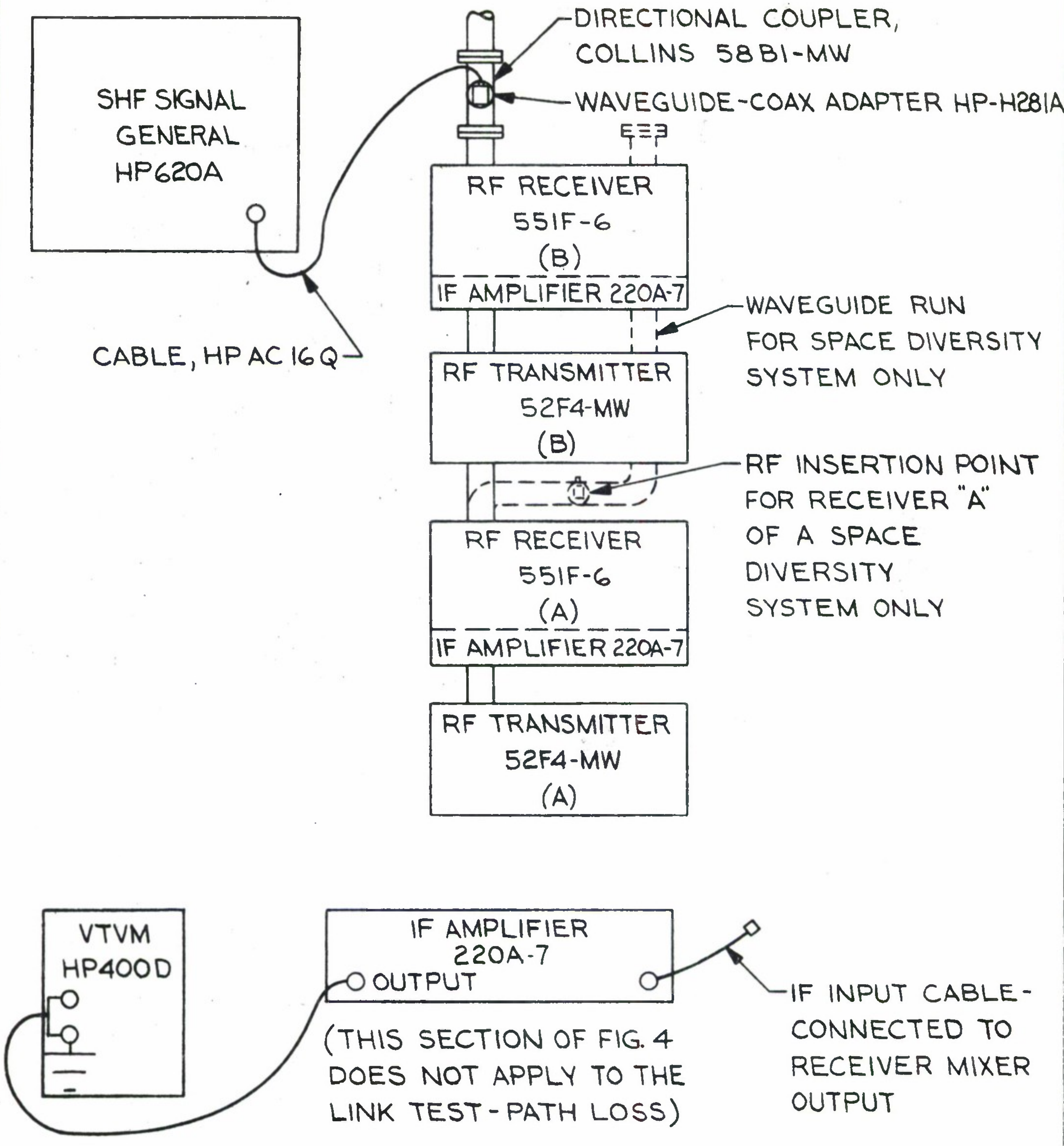

FIGURE-4

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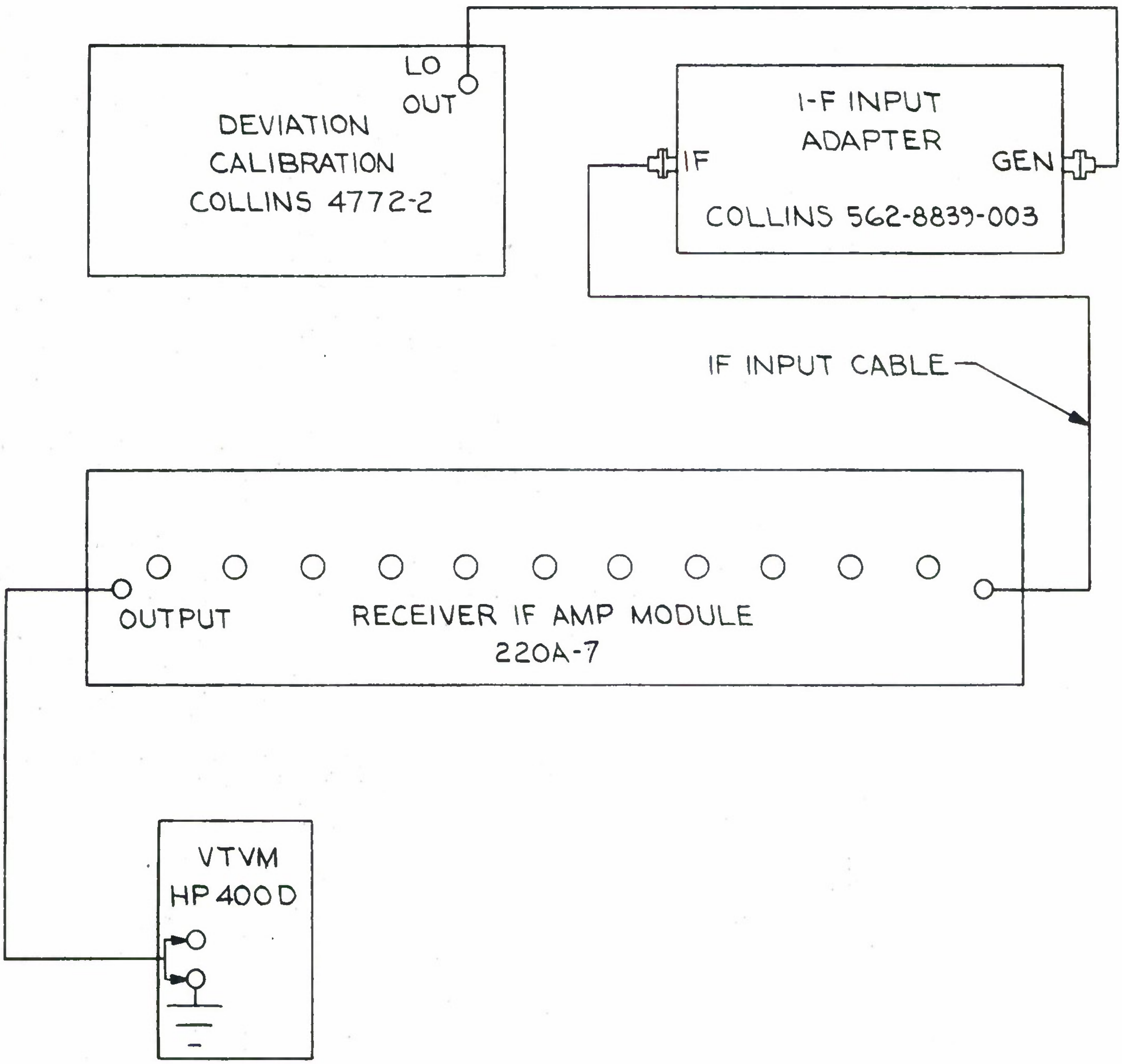

FIGURE-5

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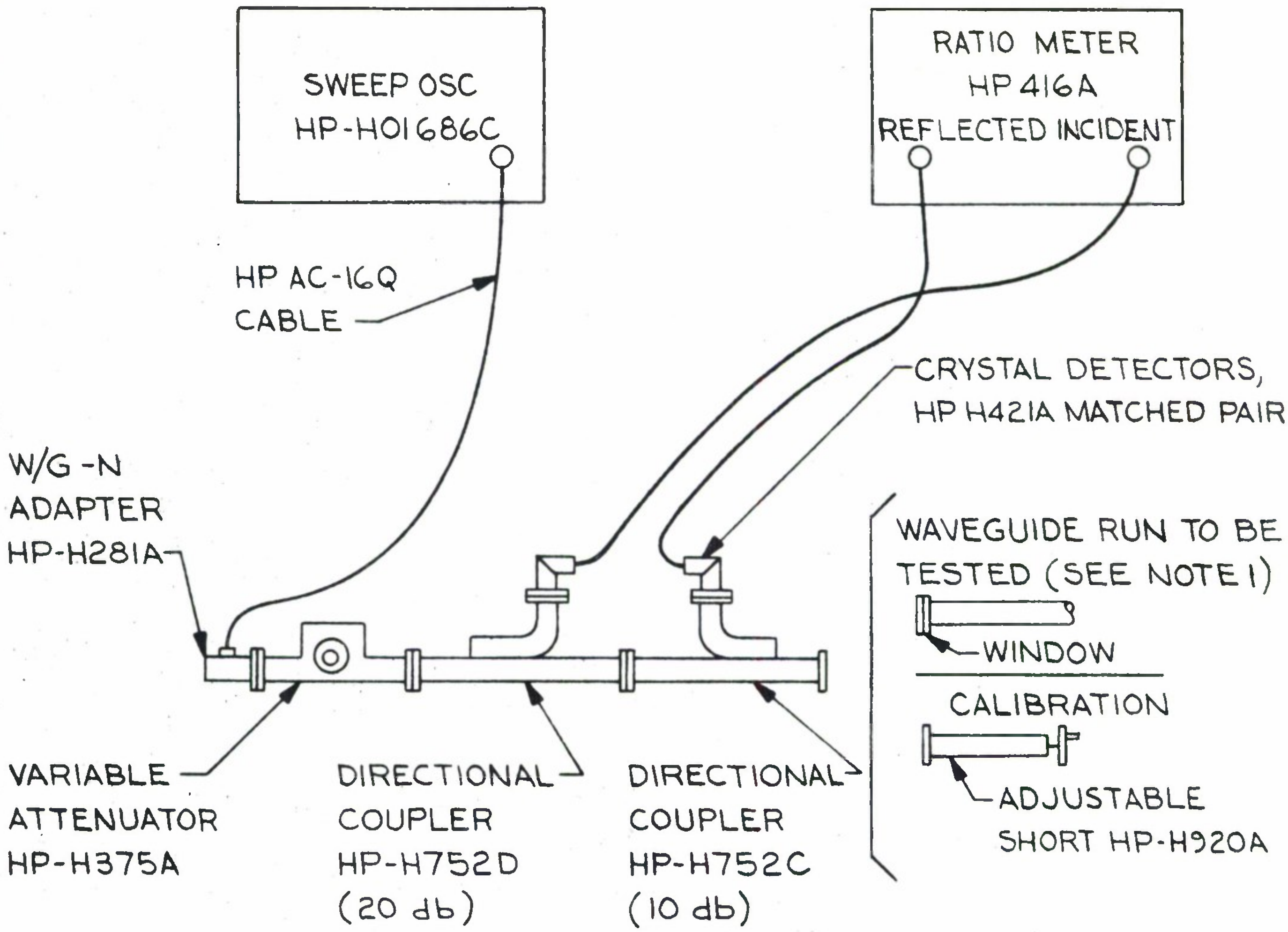

NOTE:

1. BE CERTAIN THAT THE WAVEGUIDE IS ADEQUATELY SUPPORTED DURING THE VSWR TESTS

FIGURE - 6

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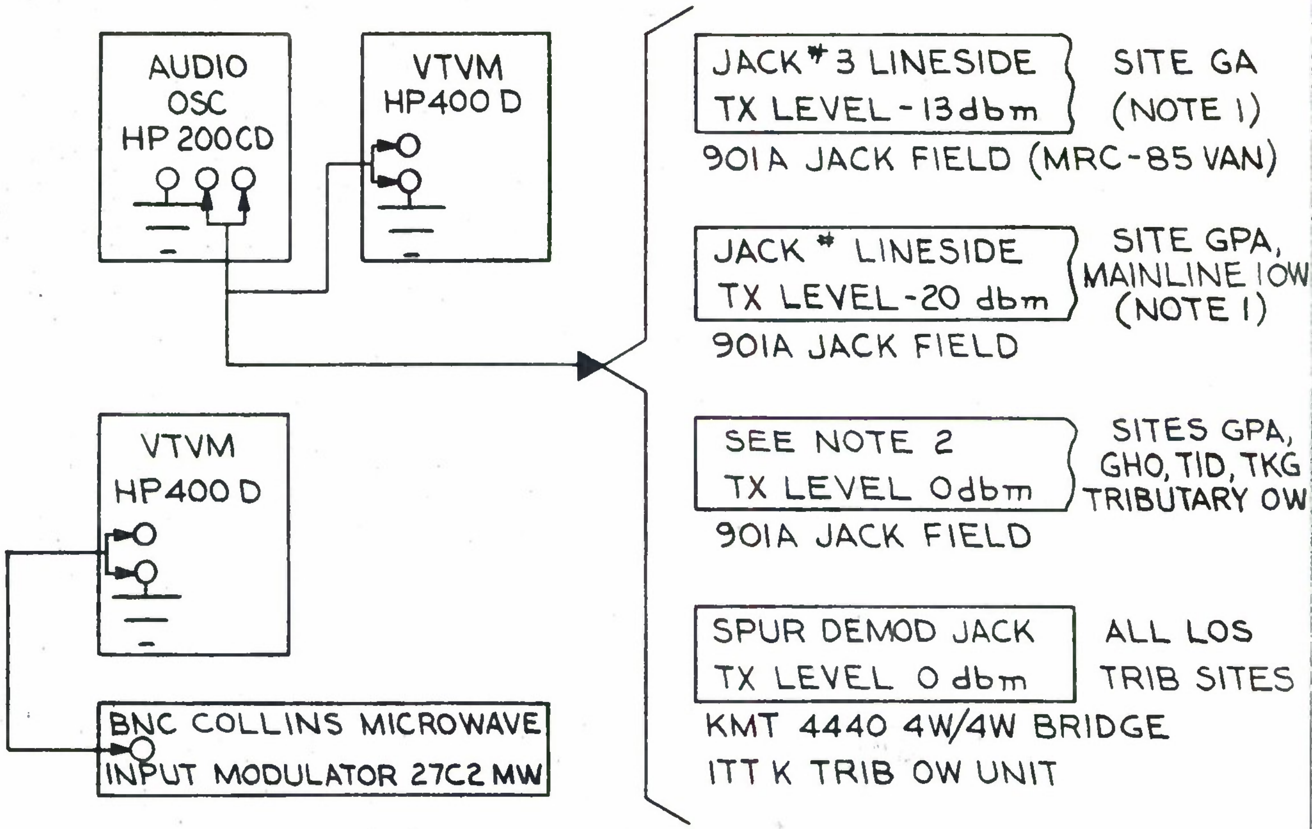
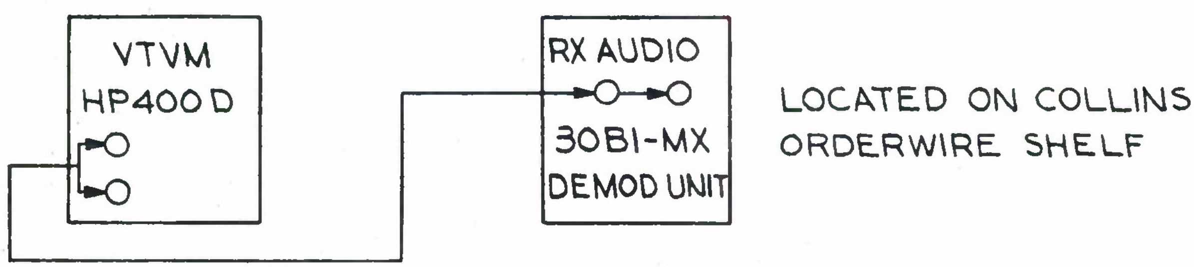
TRANSMIT STATION LOS

FIGURE-7



RECEIVE STATION



NOTES:

1. REFER TO MAINLINE ORDERWIRE T & A PROCEDURE FOR ADDITIONAL INFO
2. REFER TO TRIBUTARY ORDERWIRE T & A PROCEDURE FOR JACK LOCATIONS AND ADDITIONAL INFORMATION

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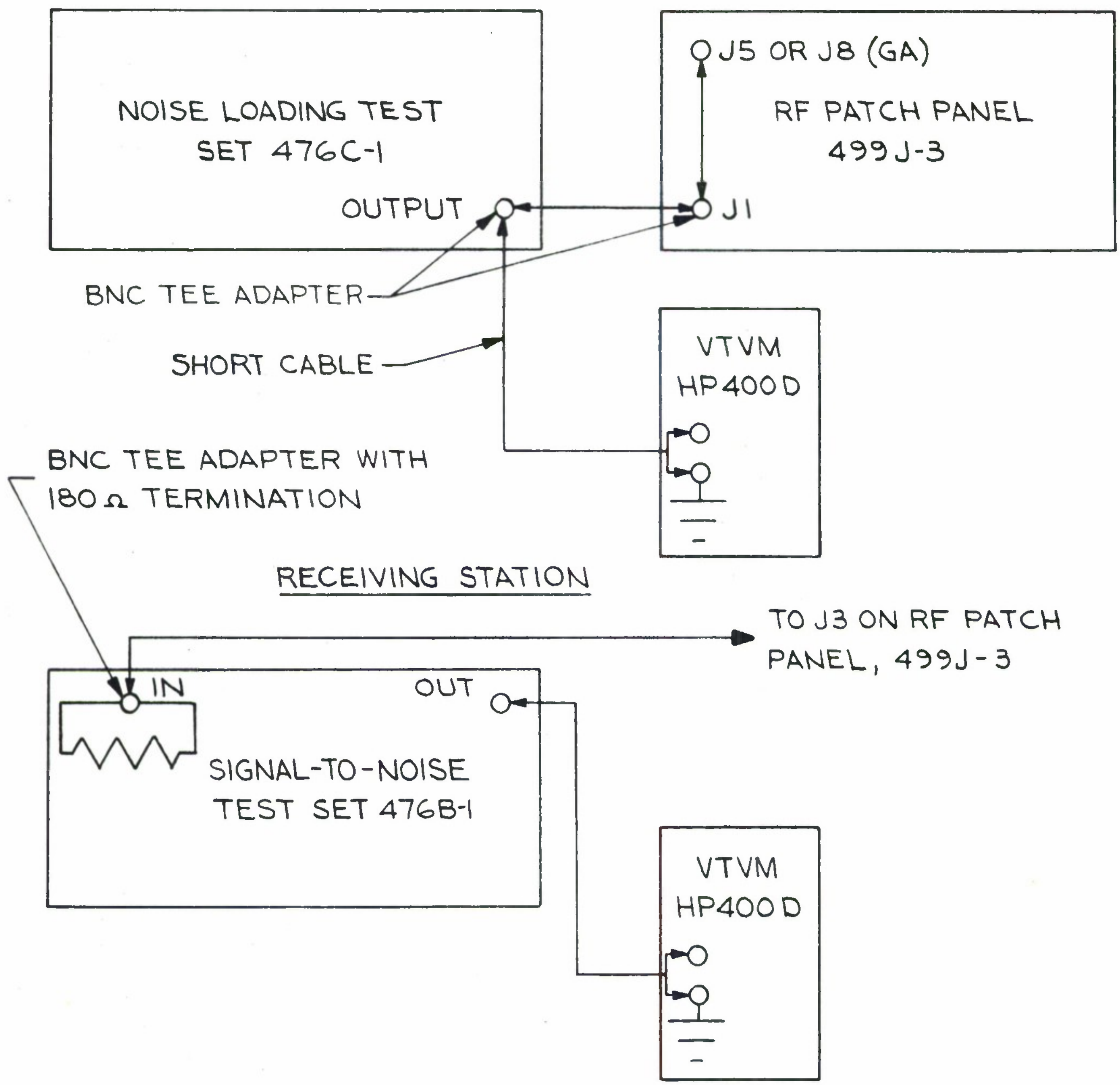

FIGURE-8

FEE-2A (E)

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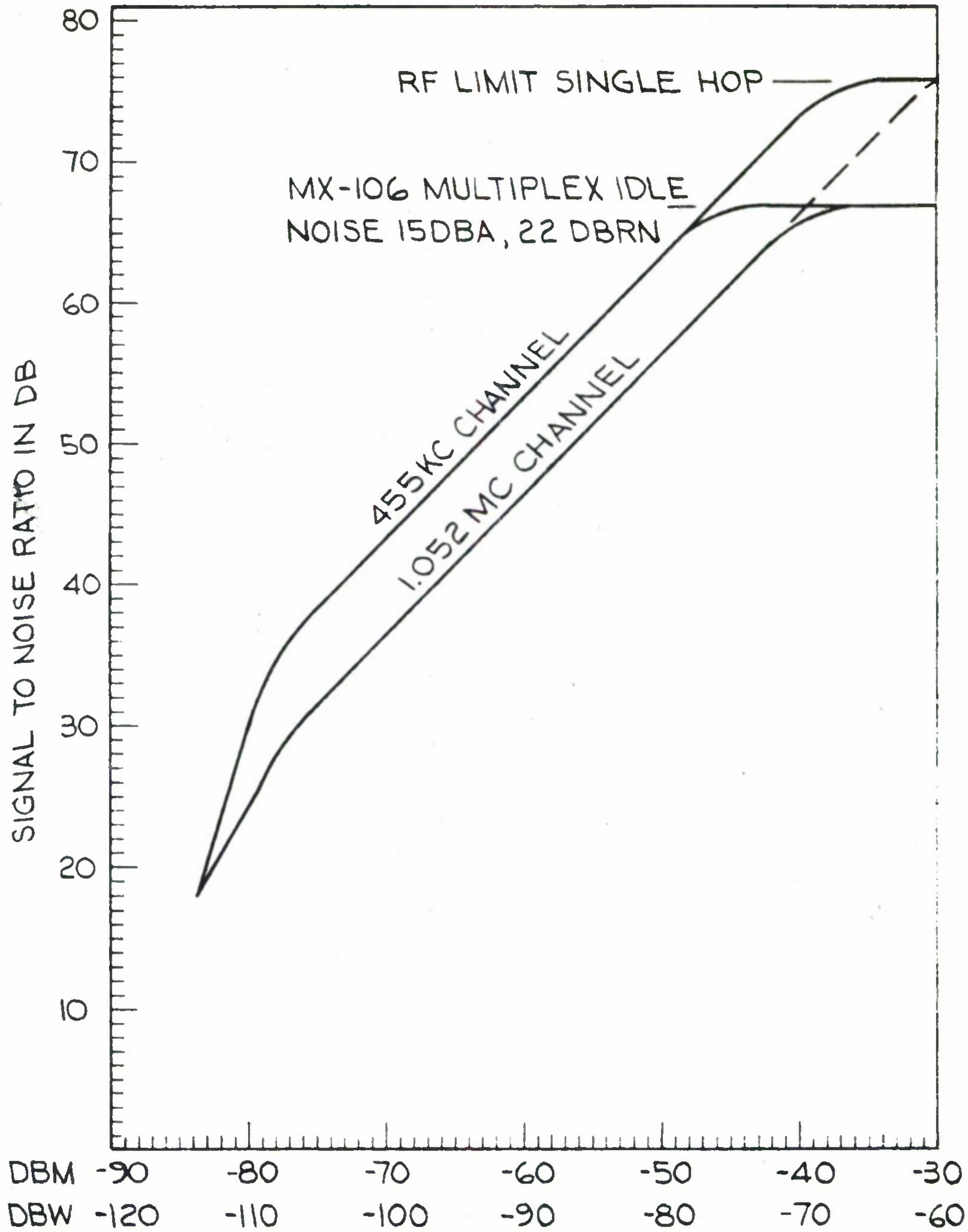

FIGURE-9

SIGNAL TO NOISE RATIO VS RECEIVED SIGNAL POWER

NOTED:

1. RECEIVED POWER IN DBM IS OBTAINED IN STEP G OF THE NPL MEASUREMENT (SECTION 11.6) OF THE PROCEDURE AND RECORDED ON DATA SHEET BR II/85, ITEM 6
2. THE 455 KC CHANNEL IS USED IN THIS TEST
3. RF LIMIT SINGLE HOP IS THE S/N LIMIT OF THIS MEASUREMENT

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3. REPORT TITLE

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report

5. AUTHOR(S) (Last name, first name, initial)

None

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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	486L SPO ESD, L.G. Hanscom Field, Bedford, Mass.

13. ABSTRACT

Test Procedures for MC-50 Multiplex, AN/TCC-3 Multiplex, Main Line Order wire, ETC.

DD FORM 1 JAN 64 1473

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Communications Systems						
Big Rally II						
Tests						
Multiplex						
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