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E-SYSTEMS
Montek Division



Report No. 131500-621
19 August 1977

ELECTROMAGNETIC COMPATIBILITY TEST REPORT
FOR THE
AN/TRN-41 TACAN NAVIGATIONAL SET

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes the electromagnetic compatibility tests on the Navigational Set, TACAN, AN/TRN-41 as described in the Electromagnetic Compatibility Test Plan for the Navigational Set, TACAN, AN/TRN-41 Revision A, dated 12 November 1976.		

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

for the

NAVIGATIONAL SET, TACAN, AN/TRN-41

This report describes the electromagnetic compatibility tests on the Navigational Set, TACAN, AN/TRN-41 as described in the Electromagnetic Compatibility Test Plan for the Navigational Set, TACAN, AN/TRN-41 Revision A, dated 12 November 1976.

1. **Test Identification.** The electromagnetic compatibility tests are as outlined in the Electromagnetic Compatibility Test Plan and meet the requirements of paragraph 3.3.2 of Specification No. 404L-701-5017A, Part I of two parts, Prime Item Development Specification for Navigational Set, TACAN, AN/TRN-41.
2. **Functional Purpose.** These tests form a part of the AN/TRN-41 qualification tests.
3. **Test Objectives.** To demonstrate that the AN/TRN-41 will meet the CS-03 intermodulation, CS-04 rejection of undesired signals, CS-05 cross modulation, RE-02 electric field emission and RS-03 electric field susceptibility requirements of MIL-STD-461 as specified in Specification No. 404L-701-5017A.
4. **Description of Test Article.** The receiver-transmitter RT-1202/T of the AN/TRN-41 was tested for the CS-03, CS-04 and CS-05 tests. The AN/TRN-41 system was tested for the RE-02 and RS-03 tests.
5. **Summary of Test Results.** Following is a summary list of test results for the five electromagnetic compatibility tests conducted:

CS-03 Intermodulation

No intermodulation frequencies observed.

CS-04 Rejection of Undesired
Signals

One spurious frequency was measured at 889.3 MHz with the system set to channel 1X. This signal was rejected by 75 dB which is greater than the specification requirements of 65 dB.

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FILE	SYNOPSIS	
		

CS-05 Cross Modulation

No cross modulation products observed.

RE-02

Some areas out of specification, see paragraphs 9 and 11.

RS-03

By agreement with ESD the field strength was changed from 200 V/M to 100 V/M. Some areas were out of specification, see paragraphs 9 and 11.

6. Description of Test Facility and Procedures. The test facilities and test procedures are described in the Electromagnetic Compatibility Test Plan.

7. Test Setup Diagrams. The test setup diagrams are provided in the Electromagnetic Compatibility Test Plan.

8. List of Test Equipment. The following is a list of test equipment used, with manufacturer and model number and with calibration date at time of test if applicable. The list is divided in three parts; that used for conducted susceptibility tests, that used for radiated emissions tests and that used for radiated susceptibility tests.

TEST EQUIPMENT FOR CONDUCTED SUSCEPTIBILITY TESTS

<u>Name</u>	<u>Mfg. and P/N</u>	<u>Calibration Date</u>
RF Signal Generator	HP 608E	7/77
RF Signal Generator	HP 612A	6/77
RF Signal Generator	HP 612A	6/77
RF Signal Generator	HP 8614A	6/77
RF Signal Generator	HP 8616A	6/77
RF Signal Generator	HP 618C	6/77
RF Signal Generator	HP 620B	6/77
Oscilloscope	Tektronix 465	7/77
Pulse Generator	Datapulse 110B	8/77
Counter	Fluke 1953A	4/77
Transfer Oscillator	HP 540	8/77
Power Divider	Engleman D200M	N/A
Directional Coupler, 20 dB	Narda 3042B-20	N/A

<u>Name</u>	<u>Mfg. and P/N</u>	<u>Calibration Date</u>
Directional Coupler, 20 dB	HP 776D	N/A
Half Amplitude Detector	Montek 131500-702	N/A
Low Pass Filter	HP 360A	N/A

TEST EQUIPMENT FOR RADIATED EMISSIONS TESTS

<u>Name</u>	<u>Mfg. and P/N</u>	<u>Calibration Date</u>
EMI Receiver	Singer NM7	5/77
EMI Receiver	Singer NM 17/27	5/77
EMI Receiver	Singer NM 17/37	5/77
Spectrum Analyzer	AIL Tech 707	9/77
Antenna	Singer 93490-2	N/A
Antenna	Singer 94455-1	N/A
Antenna	Singer VA105A	N/A

TEST EQUIPMENT FOR RADIATED SUSCEPTIBILITY TESTS

<u>Name</u>	<u>Mfg. and P/N</u>	<u>Calibration Date</u>
RF Signal Generator	HP 612A	11/77
Pulse Generator	Data Pulse 1108	6/77
Linear Detector	Montek 135203-100	N/A
Oscilloscope	Tektronix 585	10/77
Directional Coupler	Narda 3042B-20	N/A
Directional Coupler	HP 776D	N/A
RF Signal Generator	HP 606	11/77
RF Signal Generator	HP 608D	11/77
RF Signal Generator	AIL Tech 125	3/78
TWT Microwave Amplifier	Servo Corporation	N/A
Power Amplifier	IFI 406L	N/A
RF Voltmeter	IFI EFS-1/LMT	9/77

9. Recorded Test Data. Following is a list of attachments containing recorded data.

Attachment 1

Data Sheet for Conducted Susceptibility Tests
CS-03, CS-04 and CS-05

Attachment 2	Graphs of Radiated Emissions Tests
Attachment 3	Data Sheets for Radiated Susceptibility Tests
Attachment 4	Pre Operational Test Data Sheet
Attachment 5	Changes considered and implemented

10. Ambient Conditions. The Electromagnetic Compatibility Tests were performed at ambient room temperature conditions.

11. Test Results Analysis. Following is an analysis of the test results for each test method used:

Intermodulation Products

The receiver-transmitter RT1202/T was tested for intermodulation products using method CS-03 of MIL-STD-462 as described in the electromagnetic compatibility test plan. No intermodulation products were observed. See Attachment 1.

Rejection of Undesired Signals

The receiver-transmitter RT 1202/T was tested for rejection of undesired signals using Method CS-04 of MIL-STD-462 as described in the electromagnetic compatibility test plan. One undesired response was observed at 899.3 MHz but was rejected by 75 dB. This is within specifications. See Attachment 1.

Cross Modulation

The receiver-transmitter RT1202/T was tested for cross modulation using method CS-05 of MIL-STD-462 as described in the electromagnetic compatibility test plan. No cross modulation frequencies were observed. See Attachment 1.

Radiated Emissions

First measurements of emissions showed very bad out-of-tolerance measurements in both narrow band and broadband in the ranges of 14 kHz to 1 MHz and from 6 MHz to 30 MHz. From 30 MHz to 300 MHz some areas were out-of-tolerance. Above 300 MHz, no out-of-tolerance readings were seen. The bad readings from 14 KHz to 1 MHz were

found to be caused by interaction between the transmitted signal and the circuitry in the receiving antenna for the test equipment. A passive antenna was substituted and the readings in this range were then in tolerance.

To correct the problems above 6 MHz the changes in Attachment 5 were tested and implemented as indicated.

After the indicated changes were made, the readings shown in Attachment 2 were obtained. Narrowband and broadband scans were made on channels 65X and 123X and with the system in standby.

Out of tolerance readings were as follows:

<u>Broadband</u>			<u>Narrowband</u>		
	<u>Frequency</u>	<u>dB/μV Out of Tolerance</u>	<u>Frequency</u>	<u>dB/μV Out of Tolerance</u>	
Channel 65X	43 MHz	5	13.5 to 14.5 MHz	5	
	290 MHz	8	31 MHz	6	
			43 MHz	12	
Channel 123X	123 MHz	5	13.5 to 14.5 MHz	5	
	130 MHz	5	Spike at 14.3 MHz	10	
	137 MHz	8	43 MHz	10	
			Spike at 189 MHz caused by test equipment not on previous scan at 189 MHz.		

In an attempt to isolate the source of the out-of-tolerance readings, tests were run with the system operating in the DME mode. In this mode, all readings in both narrowband and broadband tests were within tolerance. This indicates that the out-of-tolerance emissions are originating in the antenna (DC motor-speed control circuitry and/or trigger generating circuitry).

All reasonable methods have been used to reduce the emissions from these sources, therefore, E-Systems requests that the AN/TRN-41 system be accepted as is with the few out-of-tolerance areas as described above.

Radiated Susceptibility

During the first scans of the electric field at 200 V/M, it was found that at some frequencies the system circuit breaker would trip and at other frequencies the replies to interrogations would be affected. These failures were in the field frequency range of 15 MHz to 200 MHz.

The specification for the electric field strength in this test was reduced to 100 V/M by agreement with the Air Force. Using this field strength some frequencies were still affected until changes were made as described in Attachment 5. After these changes were made, the system was tested and the results are shown in Attachment 3.

The following out-of-tolerance readings were observed during the final test:

	<u>Frequency of failure</u>	<u>Failure level V/meter</u>
Channel 65X	63 MHz	75 V/M
	360 MHz	77 V/M
	560 MHz	55 V/M
	610 MHz	45 V/M
Channel 123X	63 MHz	70 V/M
	230 MHz	50 V/M
	265 MHz	50 V/M
	340 MHz	55 V/M
	450 MHz	55 V/M
	570 MHz	50 V/M

In all of the above cases, the failure mode was the loss of detected reply pulses.

E-Systems is not aware of any situation where the AN/TRN-41 system will be subjected to electric field strength even close to the magnitude of those where failures occurred. Therefore, it is requested that the AN/TRN-41 system be accepted as is with these out-of-tolerance readings as described above.

This test was found to be very difficult and hazardous to control and perform due to the very high field strengths required.

It should be noted also that the latest revision to MIL-STD-461A (6 March 1973) reduces the field strength to 1 volt/meter over the frequency range of 14 KHz to 10 GHz.

ATTACHMENT 1
DATA SHEET FOR CONDUCTED SUSCEPTIBILITY TESTS,
CS-03, CS-04 AND CS-05

DATA SHEET
FOR
CONDUCTED SUSCEPTIBILITY TESTS



7/6/77

Date 8 March 77

Serial No. 002

	Reading	Check if OK
1.1.2 Standard Reference Output		
b. Pulse width ($3.5 \pm 0.5 \mu s$)	<u>3.5 μs</u>	<u> </u>
Pulse pair spacing ($12.0 \pm 0.5 \mu s$)	<u>12.0 μs</u>	<u> </u>
Interrogation rate (200 ± 2 pulses/second)	<u>200 pps</u>	<u> </u>
c. Frequency f_0 (¹⁰²⁵ ~~1088~~ MHz ± 20 kHz)	<u>1025 MHz</u>	<u> </u>
h. Standard reference output level	<u>.80 V</u>	<u> </u>
1.1.3 Signal Generator Set Up		
f. Pulse width ($3.5 \pm 0.5 \mu s$)	<u>3.5 μs</u>	<u> </u>
Pulse pair spacing ($12.0 \pm 0.5 \mu s$)	<u>12.0 μs</u>	<u> </u>
Interrogation rate (200 ± 2 pps)	<u>200 pps</u>	<u> </u>
g.1 SIG GEN NO. 1 frequency (1025 MHz ± 20 kHz)	<u>1025 MHz</u>	<u> </u>
SIG GEN NO. 2 frequency (1025 MHz ± 20 kHz)	<u>1025 MHz</u>	<u> </u>
g.2 SIG GEN NO. 1 attenuator	<u>-80 dB</u>	<u> </u>
SIG GEN NO. 2 attenuator	<u>-56 dB</u>	<u> </u>
g.3 SIG GEN NO. 1 frequency (1150 MHz ± 20 kHz)	<u>1150 MHz</u>	<u> </u>
SIG GEN NO. 2 frequency (1150 MHz ± 20 kHz)	<u>1150 MHz</u>	<u> </u>
SIG GEN NO. 1 attenuator	<u>78 dB</u>	<u> </u>
SIG GEN NO. 2 attenuator	<u>-61 dB</u>	<u> </u>
1.1.4 Intermodulation, Method CS-03		
a. SIG GEN NO. 1 attenuator	<u>-124 dB</u>	<u> </u>
66 dB above 1.1.3.g.2		<u> </u>
f_0 1025 MHz		
b. Frequency f_1	<u>1052.3 MHz</u>	<u> </u>
c. $\Delta f = f_1 - f_0$	<u>27.3 MHz</u>	<u> </u>
d. SIG GEN NO. 2 frequency ($f_1 + \Delta f$)	<u>1079.6 MHz</u>	<u> </u>
e. SIG GEN NO. 2 attenuator	<u>-110 dB</u>	<u> </u>
66 dB above step g.		<u> </u>
h. Intermodulation frequency	<u> </u> MHz	<u> </u>
Intermodulation rejection	<u> </u> dB	<u> </u>
Intermodulation frequency	<u> </u> MHz	<u> </u>
Intermodulation rejection	<u> </u> dB	<u> </u>

1.1.4.h (continued)

	Reading	Check if OK
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
i. Frequency F_2	<u>1002</u> MHz	
j. $\Delta f_2 = f_0 - f_2$	<u>23</u> MHz	
k. SIG GEN NO. 2 frequency $f_2 - \Delta f_2$	<u>979</u> MHz	
m. Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
n. Repeat steps a through m.		
a. SIG GEN NO. 1 attenuator	<u>12</u> dB	
66 dB above 1.1.3.g.3.		
$f_0 = 1150$ MHz		
b. Frequency f_1	<u>1182.3</u> MHz	
c. $\Delta f = f_1 - f_0$	<u>32.3</u> MHz	
d. SIG GEN NO. 2 frequency ($f_1 + \Delta f$)	<u>1213.6</u> MHz	
e. SIG GEN NO. 2 attenuator	<u>+5</u> dB	
66 dB above 1.1.3.g.3		
h. Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	
Intermodulation frequency	<u> </u> MHz	
Intermodulation rejection	<u> </u> dB	

1.1.4.n (continued)

	Reading	Check if OK
Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	
Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	
l. Frequency F_2	<u>1137.9</u> MHz	
j. $\Delta f_2 = f_0 - f_2$	<u>12.1</u> MHz	
k. SIG GEN NO. 2 frequency $f_2 - \Delta f_2$	<u>1125.8</u> MHz	
m. Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	
Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	
Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	
Intermodulation frequency	_____ MHz	
Intermodulation rejection	_____ dB	

1.1.5 Rejection of Undesired Signals, Method CS-04.

b. SIG GEN NO. 2 frequency	<u>1062.6</u> MHz
e. Spurious frequency	_____ MHz
Rejection	_____ dB
Spurious frequency	_____ MHz
Rejection	_____ dB
g. Spurious frequency	_____ MHz
Rejection	_____ dB
Spurious frequency	_____ MHz
Rejection	_____ dB
l. SIG GEN NO. 2 frequency	<u>991.0</u> MHz
k. Spurious frequency	<u>899.3</u> MHz
Rejection	<u>-75</u> dB
Spurious frequency	_____ MHz
Rejection	_____ dB

1.1.5 (continued)

	Reading	Check if OK
l. SIG GEN NO. 2 frequency	<u>1183</u> MHz	
m. Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	
Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	
n. SIG GEN NO. 2 frequency	<u>1118.7</u> MHz	
p. Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	
Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	
r. Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	
Spurious frequency	<u> </u> MHz	
Rejection	<u> </u> dB	

1.1.6 Cross Modulation, Method CS-05

c. frequency f_1	<u> </u> MHz	
g. Cross modulation frequency	<u> </u> MHz	
Timing shift	<u> </u> nSec	
Cross modulation rejection	<u> </u> dB	
Cross modulation frequency	<u> </u> MHz	
Timing shift	<u> </u> nSec	
Cross modulation rejection	<u> </u> dB	
Cross modulation frequency	<u> </u> MHz	
Timing shift	<u> </u> nSec	
Cross modulation rejection	<u> </u> dB	
i. Frequency f_2	<u> </u> MHz	

Page B-11, 1.1.2.c, change frequency from 1088 MHz to 1025 MHz.

7. Add to 1.1.2 of data sheet the following

i. Frequency f_0 (1150 MHz $\pm$ 20 KHz)	<u>1150.01</u> MHz
Standard Reference Output Level	<u>.80</u> V

8. Replace paragraph 1.1.6 of the data sheets pages B-14 and B-15 with the following:

1.1.6 Cross-Modulation, CS-05

a. Attenuator of SIG GEN NO. 2	<u>+1</u> dB
c. Frequency of SIG GEN NO. 2	<u>1050</u> MHz
d. Frequency of SIG GEN NO. 1	<u>1025</u> MHz (1025 MHz $\pm$ 20 KHz)
SIG GEN NO. 1 Atten Setting	<u>-70</u> dB
e. Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

f. Attenuation of SIG GEN NO. 2 (step a)	<u>+1</u> dB
Frequency of SIG GEN NO. 2 (step c)	<u>1001</u> MHz

g. Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

Cross-Modulation Frequency	_____ MHz
SIG GEN NO. 2 Atten Setting	_____ dB
Cross-Modulation Rejection	_____ dB

h. Attenuation of SIG GEN NO. 2 (step a)	<u>+1</u> dB
Frequency of SIG GEN NO. 2 (step c)	<u>1176</u> MHz
Frequency of SIG GEN NO. 1	<u>1150</u> MHz (1150 MHz $\pm$ 20 KHz)
SIG GEN NO. 1 Atten Setting	<u>-68</u> dB

(step e)

Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation Frequency	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB

(step f)

Attenuation of SIG GEN NO. 2 (step a)	<u>f1.</u>	dB
Frequency of SIG GEN NO. 2 (step c)	<u>1129</u>	MHz

(step g)

Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB
Cross-Modulation	_____	MHz
SIG GEN NO. 2 Atten Setting	_____	dB
Cross-Modulation Rejection	_____	dB

ATTACHMENT 2
GRAPHS OF RADIATED EMISSIONS TESTS

The charts on pages 21 through 26 of this attachment are the recordings of the broadband and narrowband emissions from the AN/TRN-41. Pages 17 through 20 are charts that list the correction factors required to determine the radiated emissions limits for the charts. These charts use the broadband and narrowband specification limits of Figures 21 and 22 of MIL-STD-461A and then add in the relaxation of Notice 3 and the antenna factor. Bandwidth compensation and antenna orientation is also corrected for if required.

Broadband emissions were taken with 0 dB attenuation in the line so the corrected specification limit is shown on the broadband charts as a line.

Narrowband emissions were taken with -20 dB in line so the readings would be high enough on the chart to be readable. Therefore, 20 dB was added to the corrected limits of pages 17 through 20 for the limit line on the narrowband charts.

CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3
41" ROD ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3	BROADBAND			NARROWBAND	
			Specification Limit MIL-STD-461A Fig. 22	Bandwidth Compensa. 50 kHz to 1 MHz	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
.014		+10	100.0	-26		35	
.05		+10	94.0	-26		32.5	
.10		+10	91.0	-26		31.5	
.15	-35.5	+10	89.0	-26	37.5	30.5	5.0
.20	-36.2	+10	87.0	-26	34.8	30	3.8
.25	-36.7	+10	86.0	-26	33.3	29.5	2.8
.30	-38.0	+10	85.5	-26	31.5	29	1.0
.35	-38.5	+10	85.0	-26	30.5	28.5	0.0
.40	-32.0	+10	84.0	-26	36.0	28.5	6.5
.45	-32.8	+10	83.5	-26	34.7	28.0	5.2
.50	-33.5	+10	83.0	-26	33.5	28.0	4.5
.60	-34.5	+10	82.0	-26	31.5	27.5	3.0
.70	-35.5	+10	81.5	-26	30.0	27.0	1.5
.80	-36.0	+10	81.0	-26	29.0	27.0	1.0
.90	-27.1	+10	80.0	-26	36.9	26.5	9.4
1.0	-27.5	+10	79.5	-26	36.0	26.5	9.0
1.2	-28.0	+10	79.0	-26	35.0	26.5	8.5
1.4	-29.0	+10	78.0	-26	33.0	26.0	7.0
1.6	-29.5	+10	77.5	-26	32.0	25.5	6.0
1.8	-30.5	+10	77.0	-26	30.5	25.5	5.0
2.0	-30.8	+10	76.5	-26	29.7	25.0	4.2
2.5	-24.5	+10	75.5	-26	35.0	24.5	10
3.0	-24.2	+10	74.5	-26	34.3	24.5	10.3
3.5	-24.6	+10	74.0	-26	33.4	24.0	9.4
4.0	-25.0	+10	73.0	-26	32.0	24.0	9.0
4.5	-25.0	+10	72.5	-26	31.5	23.5	8.5
5.0	-25.3	+10	72.0	-26	30.7	23.5	8.2
5.5	-21.6	+10	72.0	-26	34.4	23.0	11.4
6.0	-21.0	+10	71.5	-26	34.5	23.0	12.0
6.5	-20.7	+10	71.0	-26	34.3	23.0	12.3
7.0	-20.5	+10	70.5	-26	34.0	22.5	12.0

**CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3**

41" ROD ANTENNA (Contd)

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3	BROADBAND			NARROWBAND	
			Specification Limit MIL-STD- 461A Fig. 22	Bandwidth Compensa. 50 kHz to 1 MHz	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
7.5	-20.0	+10	70.0	-26	34.0	22.5	12.5
8.0	-20.0	+10	70.0	-26	34.0	22.5	12.5
9.0	-20.0	+10	69.5	-26	33.5	22.0	12.0
10.0	-20.0	+10	69.0	-26	33.0	22.0	12.0
11.0	-20.0	+10	68.5	-26	32.5	22.0	12.0
12.0	-20.0	+10	68.0	-26	32.0	21.5	11.5
13.0	-19.0	+10	68.0	-26	33.0	21.5	12.5
14.0	-19.0	+10	67.0	-26	32.0	21.0	12.0
15.0	-19.2	+10	67.0	-26	31.8	21.0	11.8
16.0	-19.3	+10	67.0	-26	31.7	21.0	11.7
18.0	-19.5	+10	66.5	-26	31.0	20.5	11.0
20.0	-19.5	+10	66.0	-26	30.5	20.5	11.0
22.0	-20.2	+10	65.5	-26	29.3	20.5	10.3
24.0	-20.7	+10	65.0	-26	28.3	20.0	9.3
26.0	-21.0	+10	65.0	-26	28.0	20.0	9.0
28.0	-21.5	+10	64.0	-26	26.5	20.5	9.0
30.0	-22.0	+10	64.0	-26	26.0	21.0	9.0

**CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3**

BICONICAL ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3	45° Antenna Orientation Correction	BROADBAND		NARROWBAND	
				Specification Limit MIL-STD- 461A Fig. 22	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
30	-12.5	+10	-3	64	58.5	21	15.5
40	-14.0	+10	-3	62.5	55.0	23	16.0
50	-11.5	+10	-3	61	56.5	25	20.5
57	-9.0	+10	-3	61	59.0	25	23.0
55	-10.0	+10	-3	61	58.0	25	22.0
60	-8.0	+10	-3	60	59.0	26	25.0
70	-6.75	+10	-3	60	60.25	27	27.25
80	-9.25	+10	-3	59	56.75	28	25.75
90	-11.25	+10	-3	58.5	54.25	29	24.75
100	-12.5	+10	-3	58	52.5	30	24.5
105	-12.5	+10	-3	58	52.0	30	24.5
101	-12.5	+10	-3	58	52.0	30	24.5
110	-12.5	+10	-3	57.5	52.5	30	24.5
120	-13.0	+10	-3	57	51.0	31	25.0
130	-15.0	+10	-3	57	49.0	31	23.0
140	-17.5	+10	-3	56.5	46.0	31	20.5
150	-18.5	+10	-3	56	44.5	32	20.5
160	-18.0	+10	-3	56	45.0	32	21.0
170	-17.0	+10	-3	55.5	45.5	32	22.0
180	-15.0	+10	-3	55.5	47.5	33	25.0
190	-13.0	+10	-3	55	49.0	33	27.0

**CORRECTION FACTORS FOR RADIATED TESTS RE-02
MIL-STD-461A, NOTICE 3**

CONICAL LOG SPIRAL ANTENNA

Frequency MHz	Antenna Factor	Relaxation MIL-STD-421A Notice 3	BROADBAND		NARROWBAND	
			Specification Limit MIL-STD- 461A, Fig. 22	Corrected Specification Limit	Specification Limit MIL-STD-461A Figure 22	Corrected Specification Limit
190	-21	10	55	44	33	22
210	-20	10	56	46	34	24
230	-18.5	10	56.5	48	34.5	26
250	-17.5	10	57	49.5	35	27.5
270	-17	10	57.5	50.5	35.5	28.5
290	-17	10	58	51	36	29
300	-17	10	59	52	37	30
320	-17	10	59	52	37.5	30.5
340	-17.5	10	59.5	52	38	30.5
360	-17.5	10	60	52	38.5	31
380	-18	10	60.5	52	39	31
400	-18.5	10	61	52.5	39	30.5
420	-19	10	61.5	52.5	39.5	30.5
440	-19.5	10	62	52.5	39.5	30
480	-20	10	63	53	40	30
520	-20.5	10	63.5	53	40	29.5
560	-21	10	64	53	40.5	29.5
600	-21.5	10	65	53.5	41	29.5
640	-22	10	66	54	41	29
680	-22.5	10	66.5	54	41.5	29
720	-23	10	67	54	42	29
760	-23	10	67.5	54.5	42.5	29.5
800	-24	10	68	54	43	29
840	-24	10	68	54	43.5	29.5
880	-24.5	10	68.5	54	44	29.5
920	-25	10	69	54	44	29
960	-25.5	10	69.5	54	44.5	29
1000	-26	10	70	54	45	29

UNIVAC

ATTENUATOR SETTINGS

Date MAY 20 1977

Page No. 1

Customer _____

Test Sample _____

Part No. MM-41

Serial No. 001

Specification UNIVAC 11/22/77

Notice _____

Test Method _____

- ☐ Conducted
- ☒ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode _____

Test Equipment _____

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

☐ Current Probe - PC105 S/N H-301

☐ LISN - 7010

☐ 10µF-Capacitor

☐ Antenna Loop

☐ Antenna Rod 41" - 95010-1 S/N 169

☐ Antenna Biconical 94455-1 S/N 47

☐ Antenna Conical 93490-1 S/N 109

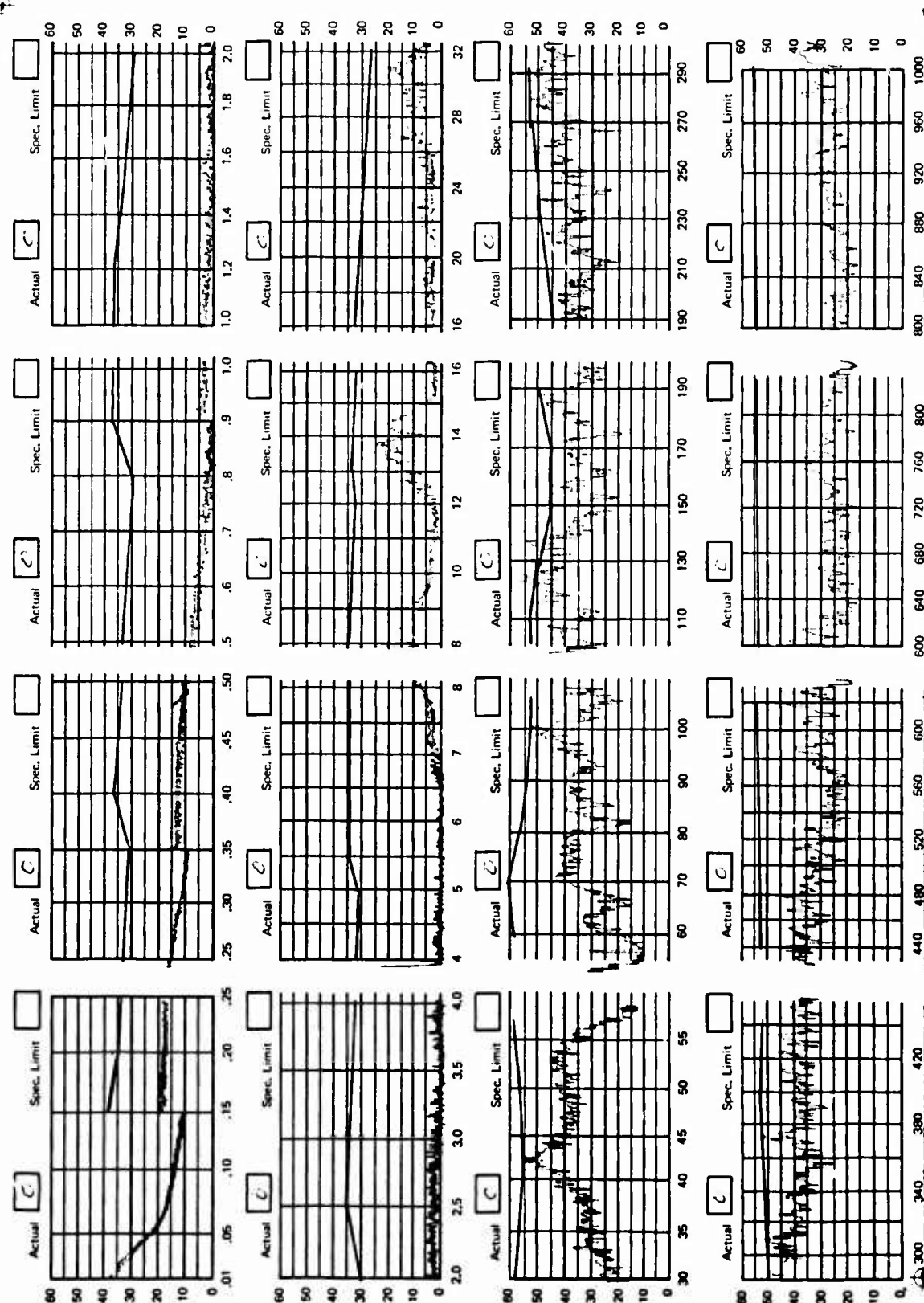
Bandwidth _____

Scan Speed _____

Remarks 12.3X

Conducted by _____

Witnessed by _____



Frequency MHz

U01 8266-3

LNIVAC

ATTENUATOR SETTINGS

A.O. _____
 Customer _____
 Test Sample _____
 Part No. AN/7RN-41
 Serial No. 001
 Specification 11111-1
 Notice _____
 Test Method _____

☐ Conducted
☒ Radiated
☐ Broadband
☐ Narrowband
☐ Transient

Test Mode _____

Test Equipment _____

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

☐ Current Probe - PC105 S/N H 301

☐ LISN - 7010

☐ 10µf - Capacitor

☐ Antenna Loop

☐ Antenna Rod 41" - 95010-1 S/N 169

☐ Antenna Biconical 94455-1 S/N 47

☐ Antenna Conical 93490-1 S/N 109

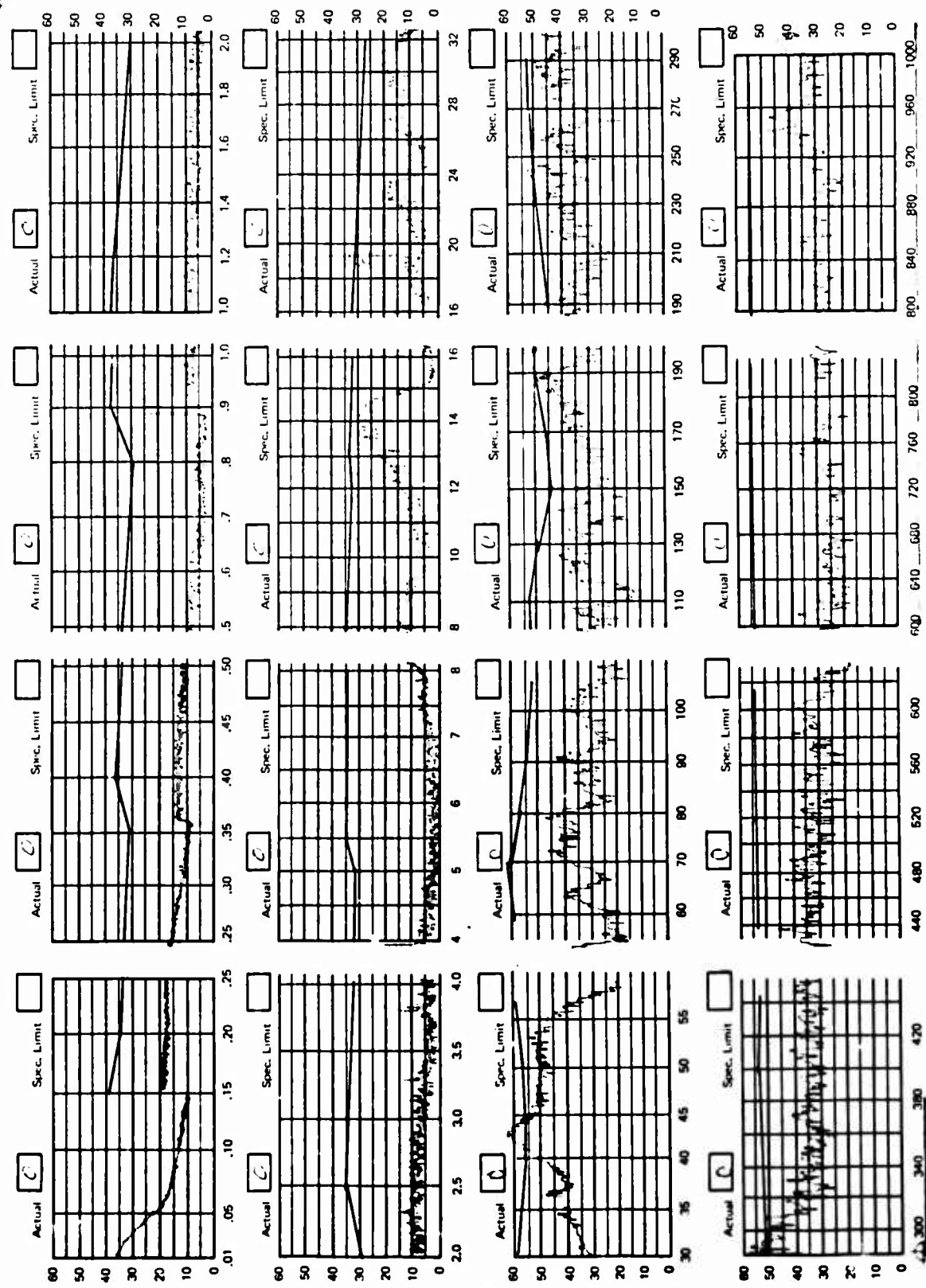
Bandwidth _____

Scan Speed _____

Remarks 65 X

Conducted by _____

Witnessed by _____



Frequency MHz

U01 8284-2

LINIVAC

ATTENUATOR SETTINGS

A.O. _____
 Customer _____
 Test Sample AN/TRN-41
 Part No. CC-1
 Serial No. 500-651
 Specification _____
 Notice _____
 Test Method _____

☐ Conducted
☒ Radiated
☐ Broadband
☐ Narrowband
☐ Transient

Test Mode _____

Test Equipment _____

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

☐ Current Probe - PC105 S/N H-301

☐ LISN - 7010

☐ 10µF-Capacitor

☐ Antenna Loop

☐ Antenna Rod 41" - 95010-1 S/N 169

☐ Antenna Bi-conical 94455-1 S/N 47

☐ Antenna Conical 93490-1 S/N 109

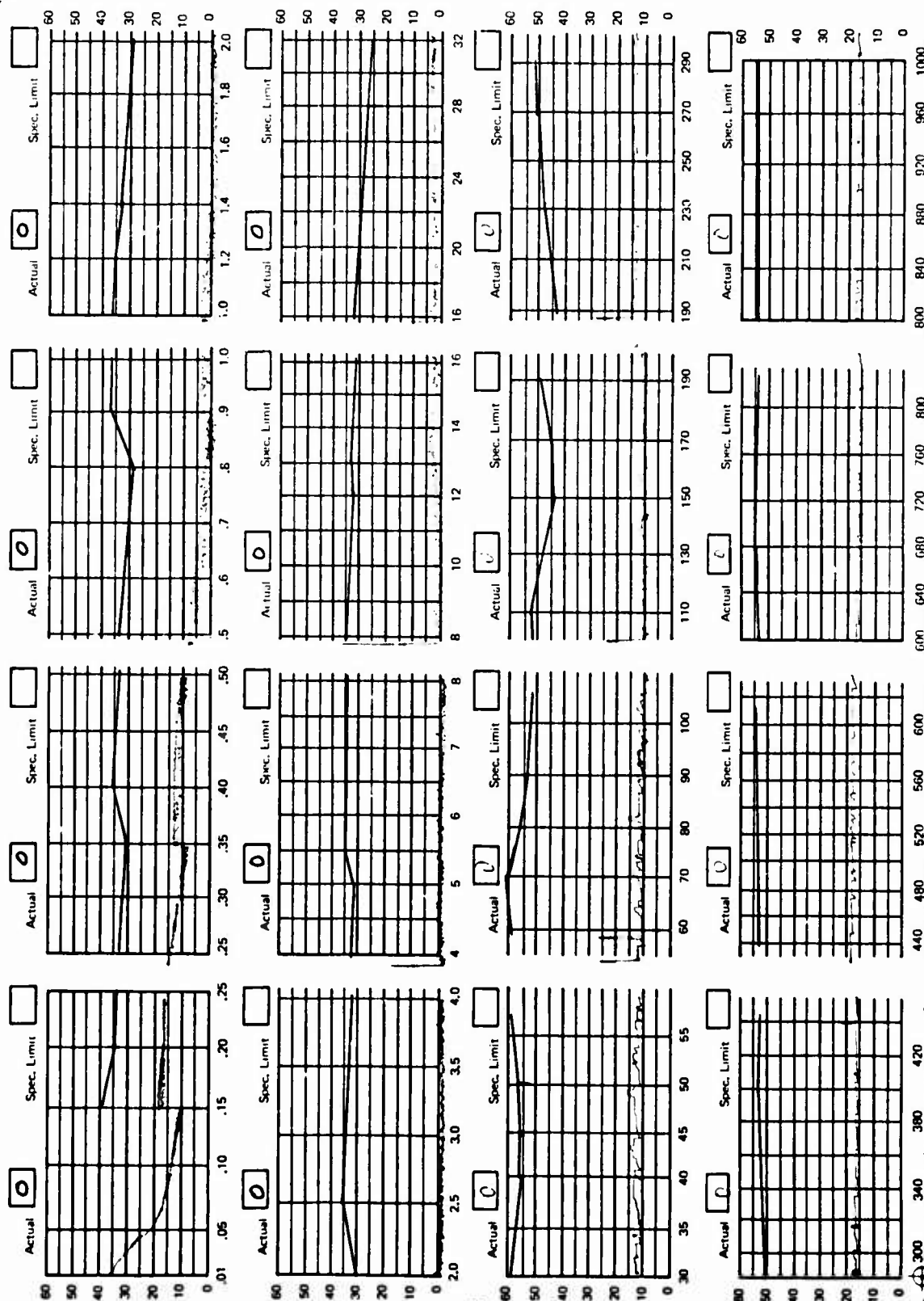
Bandwidth _____

Scan Speed _____

Remarks Steady

Conducted by _____

Witnessed by _____



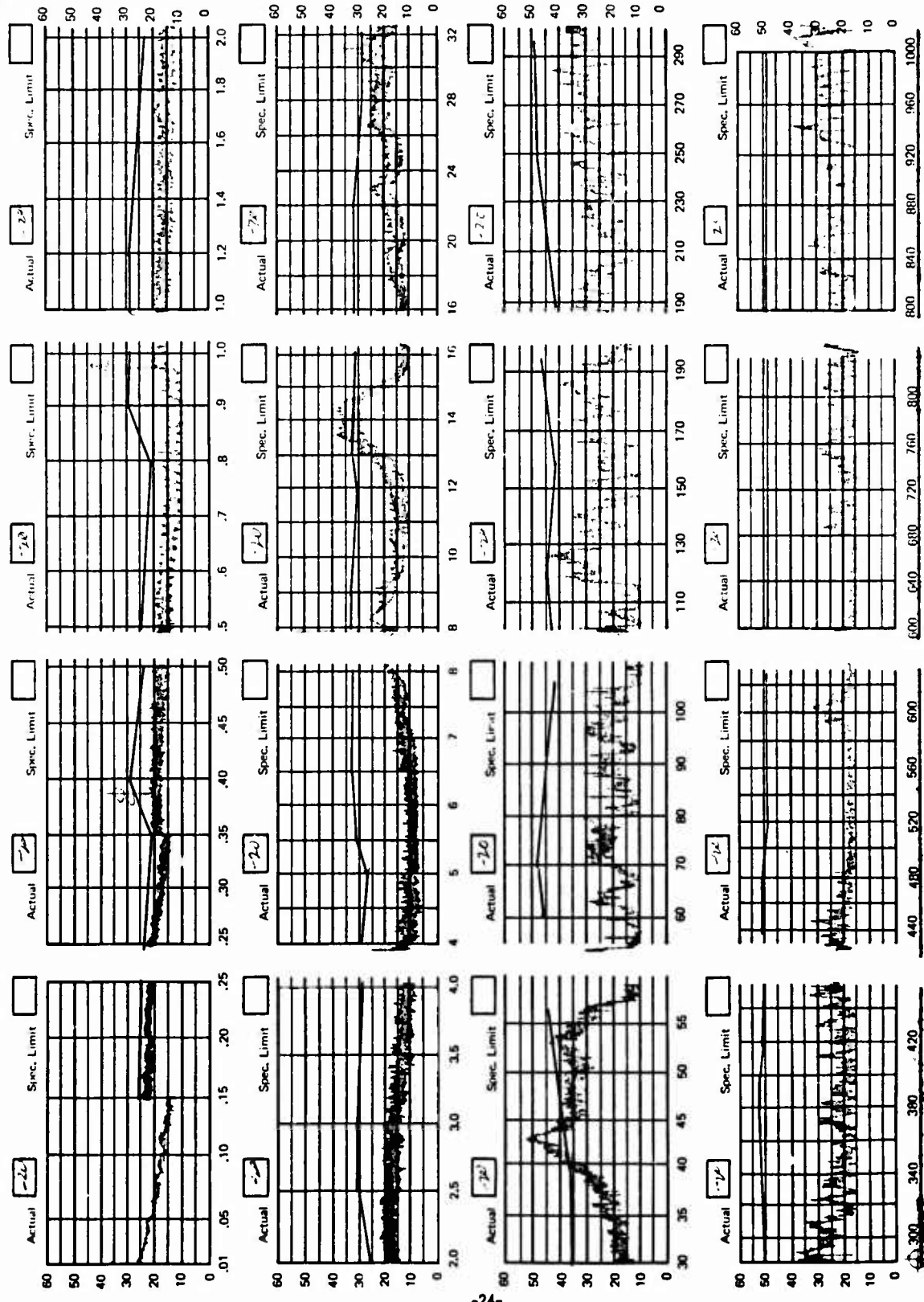
Frequency MHz

UD1 9266-2

LNIVAC

Date 11/17/77 Page No. 4

ATTENUATOR SETTINGS



4+

A.O. _____
 Customer _____
 Test Sample _____
 Part No. AN/TKN-41
 Serial No. 601
 Specification AN/TKN-41
 Notice _____
 Test Method _____

- ☐ Conducted
- ☒ Radiated
- ☐ Broadband
- ☐ Narrowband
- ☐ Transient

Test Mode _____

Test Equipment _____

EMI Receiver NM 17/27 S/N 0157-04224

EMI Receiver NM 37/57 S/N 0218-04225

- ☐ Current Probe - PC105 S/N H-301
- ☐ LISN - 7010
- ☐ 10µF Capacitor
- ☐ Antenna Loop
- ☐ Antenna Rod 41" - 96010-1 S/N 169-
- ☒ Antenna Biconical 94455-1 S/N 47
- ☒ Antenna Conical 93490-1 S/N 109

Bandwidth _____

Scan Speed _____

Remarks 4.5 X

Conducted by _____

Witnessed by _____

Frequency MHz

UD1 8256-2

A.O. _____
 Customer _____
 Test Sample _____
 Part No. AN/724-41
 Serial No. 001
 Specification 100-500-001
 Notice _____
 Test Method _____

☐ Conducted
☒ Radiated
☐ Broadband
☐ Narrowband
☐ Transient

Test Mode _____
 Test Equipment _____

EMI Receiver NM 1727 S/N 0157-04224

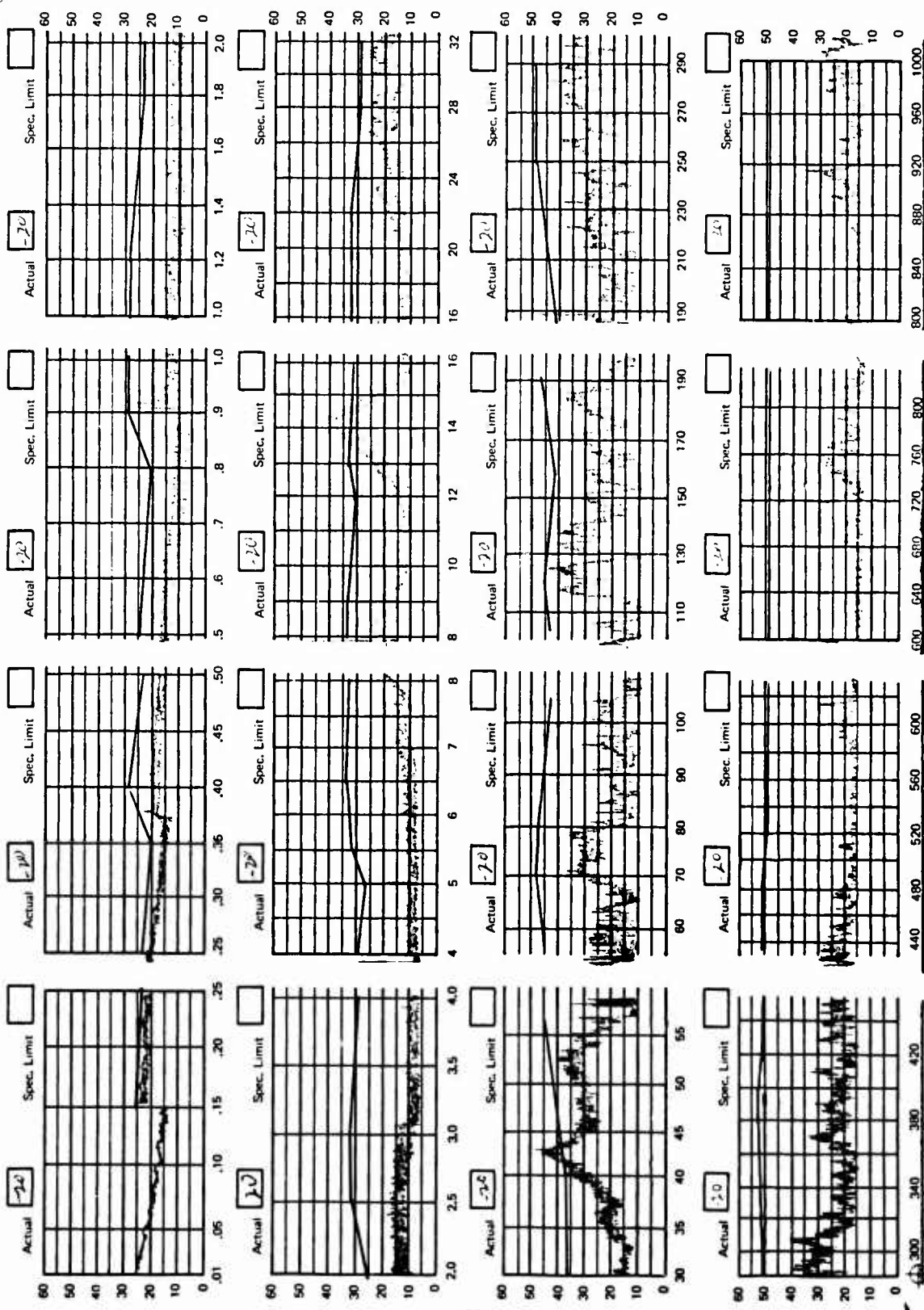
EMI Receiver NM 3757 S/N 0218-04225

☐ Current Probe - PC105 S/N H-301
☐ LISN - 7010
☐ 10µf-Capacitor
☐ Antenna Loop
☐ Antenna Rod 41" - 96010-1 S/N 109
☒ Antenna Biconical 94455-1 S/N 47
☒ Antenna Conical 83490-1 S/N 108

Bandwidth _____
 Scan Speed _____

Remarks J231
 Conducted by _____
 Witnessed by _____

ATTENUATOR SETTINGS



Frequency MHz

U01 8244-2

LINIVAC

ATTENUATOR SETTINGS

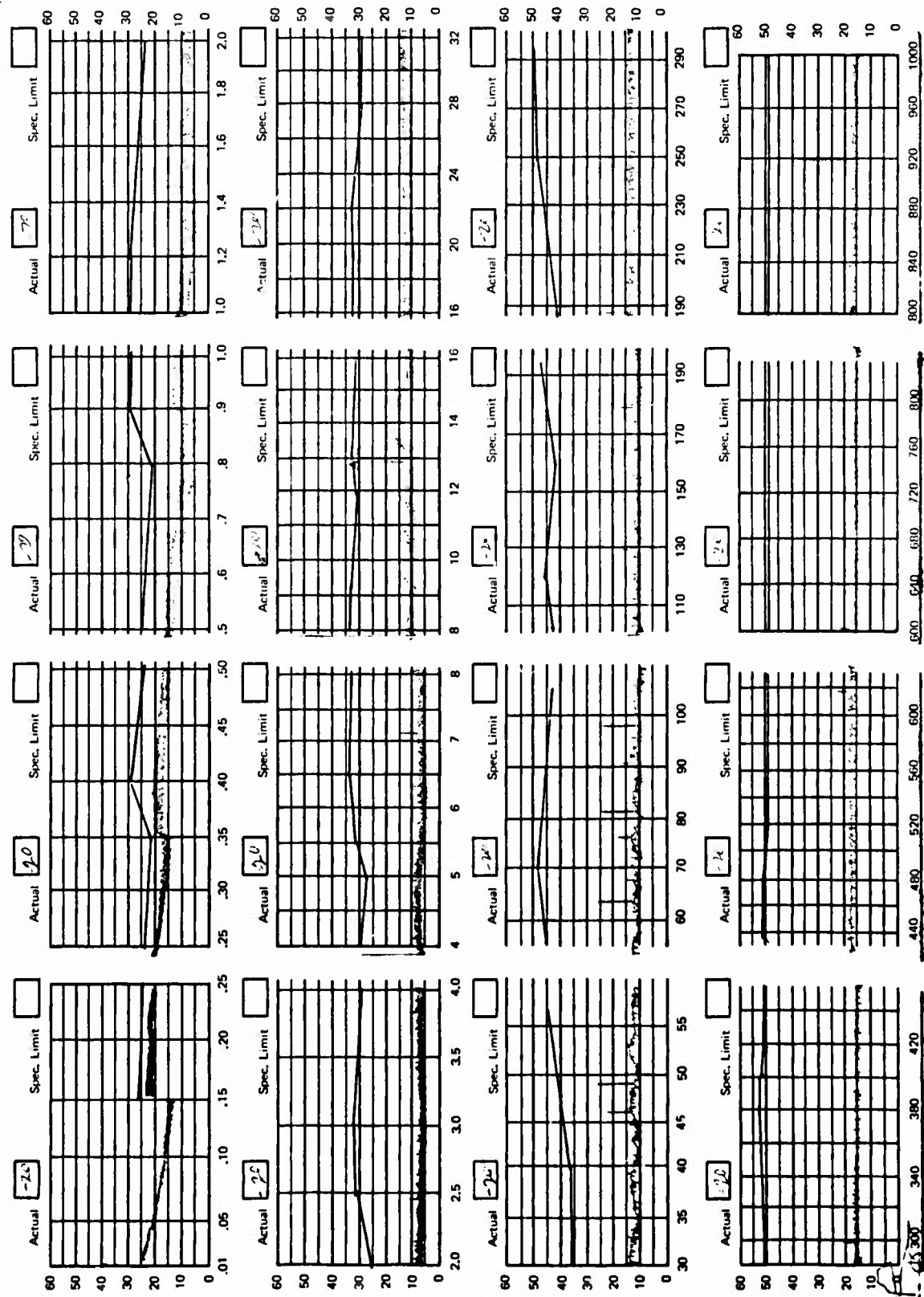
A.O. _____
 Customer _____
 Test Sample _____
 Part No. 1117RN-41
 Serial No. 021
 Specification _____
 Notice _____
 Test Method _____

☐ Conducted
☒ Radiated
☐ Broadband
☐ Narrowband
☐ Transient
 Test Mode _____
 Test Equipment _____

EMI Receiver NY 1727 S/N 0157-04224
 EMI Receiver NM 3757 S/N 0218-04225

☐ Current Probe - PC105 S/N H-301
☐ LISN - 7010
☐ 10µf-Capacitor
☐ Antenna Loop
☒ Antenna Rod 41" - 96010-1 S/N 109
☒ Antenna Biconical 94455-1 S/N 47
☒ Antenna Conical 93490-1 S/N 109

Bandwidth _____
 Scan Speed _____
 Remarks Standing
 Conducted by _____
 Witnessed by _____



Frequency MHz

U01 8256-2

DIVISION OF CARRY SANDS CORPORATION

EMI DATA RECORD

TEST NO.

SHEET ____ OF ____

TEST SPECIMEN

AN/TRN-41

PROGRAM OR MODE

RADIATED EMISSIONS

TESTED BY

DATE _____

PA

3/15/77

INSTRUMENTATION

See Paragraph 6.1

CALIBRATION DUE

1-10	PICKUP DEVICE
------	---------------

TEST PARAMETER	TEST METHOD	TEST RESULTS
----------------	-------------	--------------

RS02

NOTES

1 GHz

Frequency range ~~14-18~~ to 10 GHz

Channel

65x

240

HARMONIC.

-90 d6m

3 ED

HARMONIC

 $+105 \text{ kNm}$

123X

245

HARMENIC

-70 dBm

2 RD

HARMONIC.

- 75d BM

-75d BM 64
w/ The 5 in
PC 45

A-2074

ATTACHMENT 3
DATA SHEETS FOR RADIATED SUSCEPTIBILITY TESTS

DIVISION OF BERRY AND COMPANY

EMI DATA RECORD

TEST NO.

SHEET 1 OF 2

TEST SPECIMEN	AN/TRN-41
---------------	-----------

PROGRAM OR MODE	RADIATED SUSCEPTIBILITY
-----------------	-------------------------

TESTED BY R 12	DATE 5/27/77
-------------------	-----------------

INSTRUMENTATION See Paragraph 6.1

CALIBRATION DUE

PICKUP	DEVICE
--------	--------

TEST PARAMETER	TEST RESULT
RS02	OK

NOTES

Frequency range 14 KHZ to 10 GHZ

[illegible]

A-2078

DIVISION OF SPERRY RAND CORPORATION

TEST NO.

SHEET 2 OF 2

TEST SPECIMEN

AN/TRN-41

PROGRAM OR MODE

RADIATED SUSCEPTIBILITY

TESTED BY

DATE _____

5/27/77

INSTRUMENTATION

See Paragraph 6.1

CALIBRATION DUE

PICKUP DEVICE

[illegible]

NOTES

Frequency range 14 KHZ to 10 GHZ

RS02

[illegible]

A-2073

ATTACHMENT 4
PRE-OPERATIONAL TEST DATA SHEET

June 30, 1976

DATA SHEET
OPERATIONAL TESTS
AN/TRN-41

Test *EMC*Date *3-3-77*System *#002*

Time

Tech *Car Daudel*

Para. No.	Description	Pre Test	Test	Post Test	Requirements	Units
6.1	Calibrated RF insertion loss $P_L = 31.3$ dB Used in determining RF peak power.	N/A	N/A	N/A	N/A	N/A
6.2	System turn on normal operation	✓			Check if OK	N/A
6.3.1	Antenna radiated signal 15 Hz	✓			Check if OK	N/A
	135 Hz	✓			Check if OK	N/A
6.3.2	Antenna Speed	66.667			66.667 ± .133	ms
6.4.1.1	Correct identity code	✓			Check if OK	N/A
6.4.1.2	Identity period	36.5			37.5 ± 3.75	Seconds
6.4.2	Peak power (1) Reading of peak power meter $P_m =$ (2) Convert to dBm - 10 log $P_m \times 10^3 = P_m \text{ dBm}$ Total power output in dBm $P_{m \text{ dBm}} + P_L =$ *Insertion loss see 6.1 above.	87 49.4 50.7			N/A N/A 50 dBm	Watts dBm dB
6.4.3.3	Pulse count	7200			7200 ± 180	Counts
6.4.4.2	Pulse shape Width (50%) Rise time (10-90%) Fall time (90-10%)	3.42 2.07 2.72			3.5 ± 0.5 2 ± 0.25 2.5 ± 0.5	μs μs μs
6.4.4.4	Pulse spacing	12.05			12.0 ± 0.1	μs
6.4.5.2	Delay - 60 ± 10 μs 15 Hz trig to first burst pulse.	60 ✓			Check if OK	

June 30, 1976

DATA SHEET
OPERATIONAL TESTS
AN/TRN-41 (Continued)

Para. No.	Description	Pre Test	Test	Post Test	Requirements	Units
6.4.5.3	Correct north Burst - 12 pulse pairs spaced $30 \pm 0.1 \mu s$	30 μs			Check if OK	
6.4.5.5	Delay $60 \pm 10 \mu s$ - 135 Hz trig to first burst pulse	✓			Check if OK	
6.4.5.6	Correct Aux burst - 6 pulse pairs spaced $24 \pm 0.1 \mu s$	✓			Check if OK	
6.4.6.5	RT replies to 3300 interrogations	2706			≥ 2310 (Counts/Sec)	
6.4.6.7	Demand only mode - times to switch from ON to STBY within 70 seconds	✓			Check if OK	
6.4.6.8	STBY mode	✓			Check if OK	
6.4.6.9	Demand Only mode - time to switch from STBY to ON ≤ 15 sec	✓			Check if OK	
6.4.6.10	ON AIR mode	✓			Check if OK	
6.4.7.1	DME ONLY mode	✓			Check if OK	
6.4.7.2	Switch from DME to TACAN	✓			Check if OK	
6.4.8.1	Antenna Alarm - Within four seconds	✓			Check if OK	
6.4.8.2	Alarm Reset	✓			Check if OK	
6.4.8.3	RT Alarm - Within five seconds	✓			Check if OK	
6.4.8.4	Alarm Reset	✓			Check if OK	

ATTACHMENT 5
CHANGES TO AN/TRN-41 THAT WERE CONSIDERED TO IMPROVE EMC

CHANGES TO AN/TRN-41 CONSIDERED TO IMPROVE EMC

1. Shielding of the power cable to the system. Shielded cables were used to see the effect on radiated emissions and radiated susceptibility. The radiated emissions were reduced considerably in the range of 6 to 30 MHz. This change also eliminated the RT circuit breaker tripping in the electric fields between 15 and 200 MHz. This change has been incorporated in the system by EC.
2. EMI Filters. Several EMI filters were tested to see what effect they had on emissions and susceptibility. The filters that were small enough to physically be installed in the RT had no effect on the electromagnetic characteristics. The larger EMI filters had about the same effect as shielding the power cables. No changes were made.
3. Proper grounding of antenna. The RF gaskets on the speed control and motor drive assembly were not making proper connection. It was found that the coating on the covers for these assemblies was zinc chromate and good connection was not being made. The zinc chromate was removed where the gaskets made contact and an irridite finish applied. The drawings called out the proper finish but the preproduction units had been finished wrong.

The antenna grounds were not connected to the RT through the antenna control cable shields. This was caused by the surface on the speed control cover, that the connector was fastened to, being anodized. An EC has been processed to change this finish.

These changes improved the radiated emissions in the 30 to 300 MHz range.

4. Bandpass Filter. A bandpass filter with upper cutoff at 1400 MHz and lower cutoff at 700 MHz was installed in place of the lowpass filter in the RT output RF line. This filter has some effect on both emissions and susceptibility in the 6 to 200 MHz range. An EC has been submitted to make this change.

5. Reducing noise on motor brush leads. Various combinations of capacitors and shielding leads were tried on the motor brush leads and motor drive assembly to reduce noise. A .47 uf capacitor between the positive and negative motor brush blocks and two shielding leads on each lead, to the brushes, in the motor drive assembly cavity seemed to reduce noise better than other combinations tried. These changes have been made by EC.

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