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TEST PROCEDURE

FOR TMC

HFTM-1KJ

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1.1 TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
$egin{array}{c} 1.0 \\ 1.1 \\ 1.2 \end{array}$	Title Sheet Table of Contents Introduction	1 2
1.3	Mechanical Inspection	3 4
1.4	Preliminary Electrical Inspection	4
$egin{array}{c} 2.1 \ 2.2 \end{array}$	Power Output and VSWR	5,6,7
2.2	Noise Hum and Spurious Intermodulation	8,9
2.4	Sideband Rejection and Carrier	10,11
	Suppression	12,13
2.5	AM Distortion	14,15
2.6	ALDC Test	16,17
$egin{array}{c} 2.7 \ 2.8 \end{array}$	CW Kweing Test	18,19
2.9	FSK Keying Test Audio Response	20,21,22
3.0	Harmonic Suppression	23, 24 25,26,27
3.1	Frequency Allocation	28, 29
	Appendix	30
	TEST DATA FORMS:	
	Form #2.1 2.2	31
	2.2	32 33
	2.4	34
	2.4A	35
	2.5	36
	2.6 2.7	37
	2.8	38 39
	2.9	39 40
	3.0	41
	3.1	$\overline{42}$

TMC FORM SPEC 1

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1.2

INTRODUCTION

GENERAL:

The TMC series of HFTM-1KJ transmitters are general purpose High Frequency Radio Transmitters capable of providing CW, AM, SSB, ISB, FAX, FSK operation. The transmitter will supply 1KW average or PEP power. The HFTM-1KJS operates over the frequency range of 1.5 to 28 MHz.

OBJECTIVE:

The procedures outlined herein are intended to serve as verification of system operation and to insure the compatability and performance of the various individual modular assemblies which have been completely tested and inspected on an individual basis prior to system integration.

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1.3

- A. Mechanical Inspection
 - 1. Check all knobs and switches for proper operation.
 - 2. Carefully check PA bandswitches for good mechanical condition, obvious miswiring and loose connections.
 - 3. Check power supply for loose connections and correct value of circuit components.

1.4

- A. Preliminary Electrical Inspection
 - 1. With main wall breaker OFF, check input phase for possible short to ground.
 - 2. Check high voltage power supply for possible shorts to ground.
 - 3. Check complete unit for correct value of fuses.

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2.1 POWER OUTPUT AND VSWR PROTECTION

A. Performance Criteria

- 1. Power Output The linear power amplifier is capable of providing 1.0KW Average and PEP in continuous keydown service.
- 2. VSWR Protection The transmitter has a nominal RF output impedance of 50 ohms and has sufficient tuning range to operate into a load whose impedance can have any phase producing a maximum VSWR of 3 to 1. The transmitter is equipped with an adjustable trip that will automatically disable the transmitter HV when a selected VSWR is exceeded.

B.	Test Arrangement	Relevant Figure
	 Power Output VSWR Protection 	2.1 2.1

C.	Test Equipment Required	Schematic Reference	Item No. In Appendix 1	Required For Arrangement
	 Wattmeter Dummy Load Audio Generat Oscilloscope 	A B Or C D	1 2 3 9	1.2 1.2 1.2

D. Test Procedure

1. Power Output

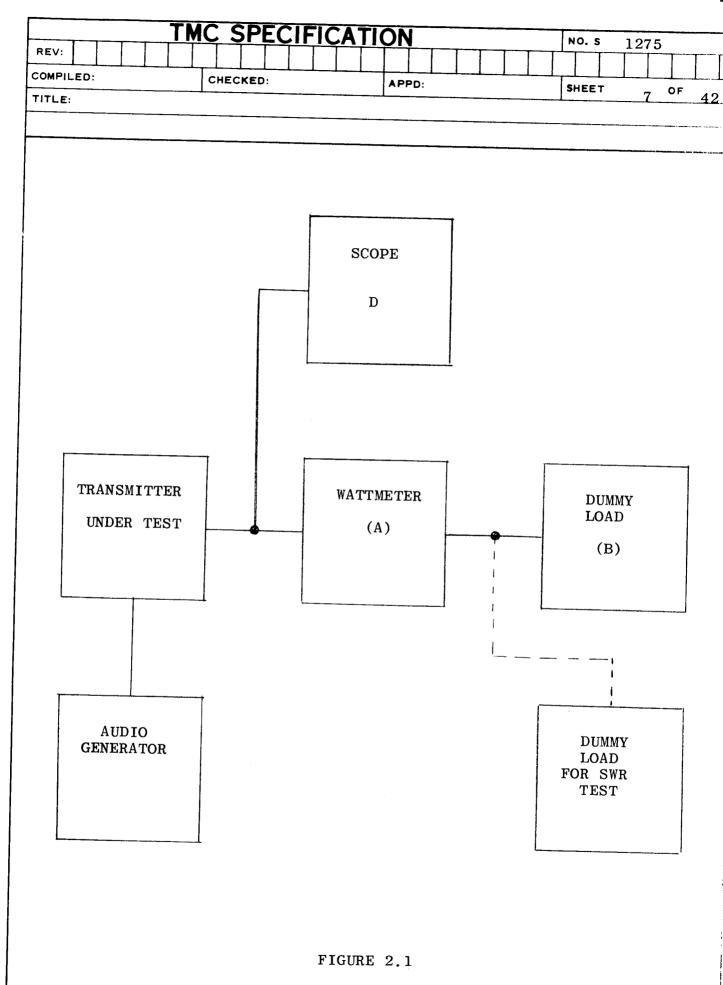
- a. Connect the equipment as shown in Figure 2.1
- b. Tune the transmitter to 1.5 MHz at rated average power output in CW mode.
- c. Record the power output as indicated on the transmitter power meter. This reading must be within 7% of the calibrated wattmeter.
- d. Record the audio input level. This level must be within -20 to +10 dbm.

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e. Repeat parts b to d at frequencies listed on test data form No. 2.1.

E. VSWR Protection

- a. Connect the equipment as shown in Figure 2.1.
- b. Set the variable capacitor on the dummy load for minimum capacitance.
- c. Tune the transmitter for rated avarage power output at 1.5 MHz.
- d. Depress reflected power button below output meter.
- e. Slowly increase the capacitance on the dummy load, until the reflected power indicates 250 watts (red scale).
- f. Verify proper operation of SWR overload, adjust SWR overload control until high voltage deactivates.
- g. Record reflected power at time of deactivation.
- h. Repeat steps B-G at frequencies listed on test data form #2.1.



POWER OUTPUT VSWR PROTECTION

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2.2 NOISE, HUM AND SPURIOUS EMISSIONS

- Performance Criteria Α.
 - Noise, hum and spurious emission output levels 1. shall be at least 50 db below PEP.
- В. Test Arrangement

Relevant Figure

1. Noise, hum and spurious emission levels

2.2

- Test Equipment Required С. Schematic Item No. In Reference Appendix 1 Spectrum Analyzer 1. Α 4 2. Dummy Load B 2 Oscilloscope C 9
- D. Test Procedure
 - Connect the equipment as shown in Figure 2.2 а.
 - Tune the transmitter to 1.5 MHz at rated average b. power output in the CW mode.
 - Adjust the spectrum analyzer for a full scale presentation of the carrier and establish a 0 db reference level.
 - Remove 20 db of attenuation from the spectrum d. analyzer expanding the calibrated display from 0 thru -40db to -20 thru -60 db.
 - Adjust the spectrum analyzer for a 500 Hz bandwidth and record the noise and hum level.
 - Increase the spectrum bandwidth to maximum and f. record the level of any spurious emissions.
 - Repeat parts b to f at frequency listed on test g. data form No. 2.2

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FIGURE 2.2

NOISE LEVEL AND SPURIOUS EMISSIONS

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2.3 INTERMODULATION

- A. Performance Criteria
 - 1. At rated PEP, third and higher order intermodulation distortion products shall be at least 40db below either tone of two tones of equal amplitude.
- B. <u>Test Arrangement</u>

Relevant Figures

1. Intermodulation Distortion

2.3

С.	Tes	st Equipment Required	Schematic Reference	Item No. In Appendix 1
	1.	Two Tone Generator	А	5
	2.	Spectrum Analyzer	B	4
	3.	Dummy Load	C	$\dot{\hat{2}}$
	4	Oscilloscope	D	a q

D. Test Procedure

- 1. Intermodulation Distortion:
 - a. Connect the equipment as indicated in Figure 2.3.
 - b. Adjust the two tone input for a convenient level in the upper sideband channel. Set the carrier insert control for maximum carrier suppression.
 - c. Tune the transmitter for rated PEP power output at 1.5 MHz.
 - d. Adjust the spectrum analyzer for a full scale presentation, thus establishing a Odb reference level.
 - e. Remove 20db of attenuation from the spectrum analyzer expanding the calibrated display from 0 thru -40db to -20 thru -60db.
 - f. Record the third order intermodulation product level. Third and higher order intemodulation products must be at least 40db down from either tone.
 - g. Repeat steps b to f at frequency listed on test data form No. 2.3.

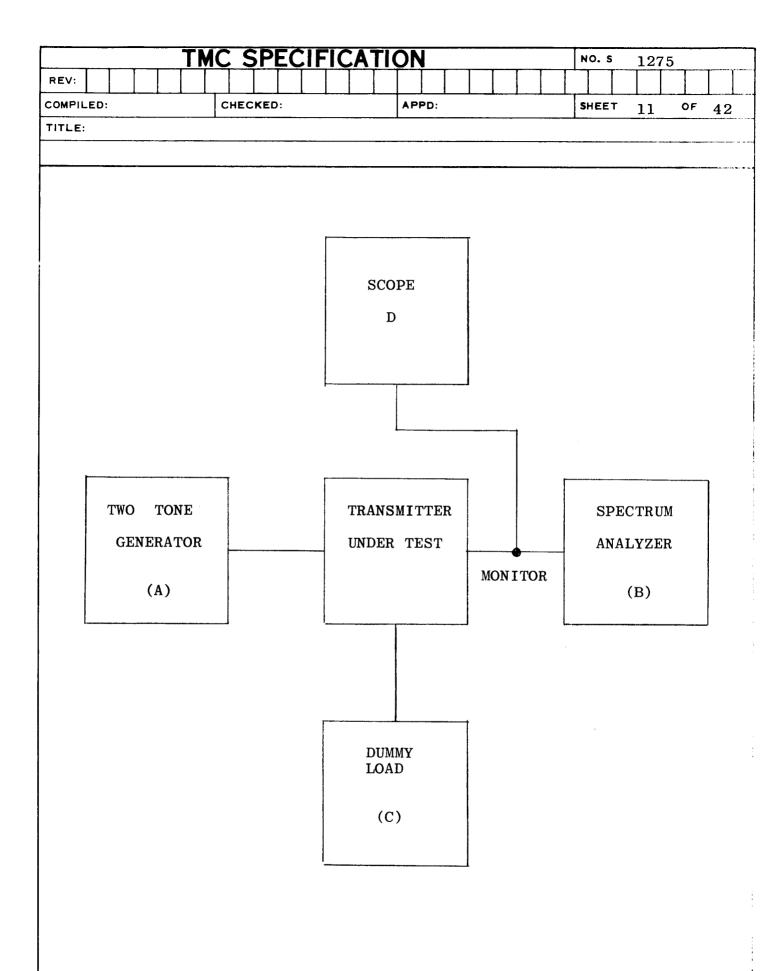


FIGURE 2.3
INTERMODULATION

THE FORM SPEC 1

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2.4 SIDEBAND REJECTION AND CARRIER SUPPRESSION

- Α. Performance Criteria
 - Sideband Rejection Unwanted sidebands shall be suppressed at least 50db below PEP.
 - Carrier Suppression The carrier level must 2. be continuously adjustable from full output to at least -55db below PEP.
- В. Test Arrangement

Relevant Figure

1 and 2. Sideband Rejection and Carrier Suppression

2.4

C.	Tes E		Schematic Reference	Item No. In. Appendix 1	Required For Arrangement
	3.	Dummy Load Spectrum Analyze Audio Generator Oscilloscope	A B C D	2 4 3 9	1 & 2 1 & 2 1 & 2

- D. Test Procedure
 - Connect the equipment as shown in Figure 2.4. a.
 - Tune the transmitter to 1.5 MHz at rated average power output, in USB mode, with full carrier insertion.
 - Adjust the spectrum analyzer for a full scale presentation of the carrier signal to establish a Odb reference level. Now remove 20db of attenuation from spectrum analyzer.
 - Reduce carrier insertion to maximum suppression. d.
 - Record carrier suppression on test data form No. Repeat steps B to D on other frequencies listed on test data form. f.
 - Tune transmitter to full rated output at 2 MHz, using a 500 Hz in the USB.
 - Set up spectrum analyzer as in Step C.
 - Observe the display and record the level of h. 500 Hz tone in unwanted sideband, on test data form No. 2.4.
 - Also repeat steps F to L at frequencies listed on test data form No. 2.4.

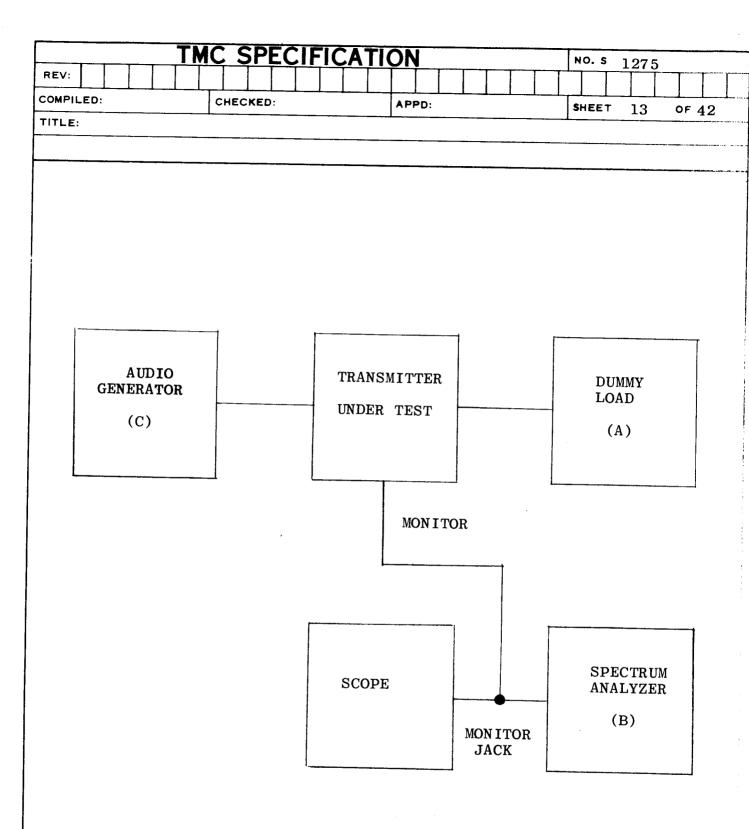


FIGURE 2.4

SIDEBAND REJECTION AND CARRIER SUPPRESSION

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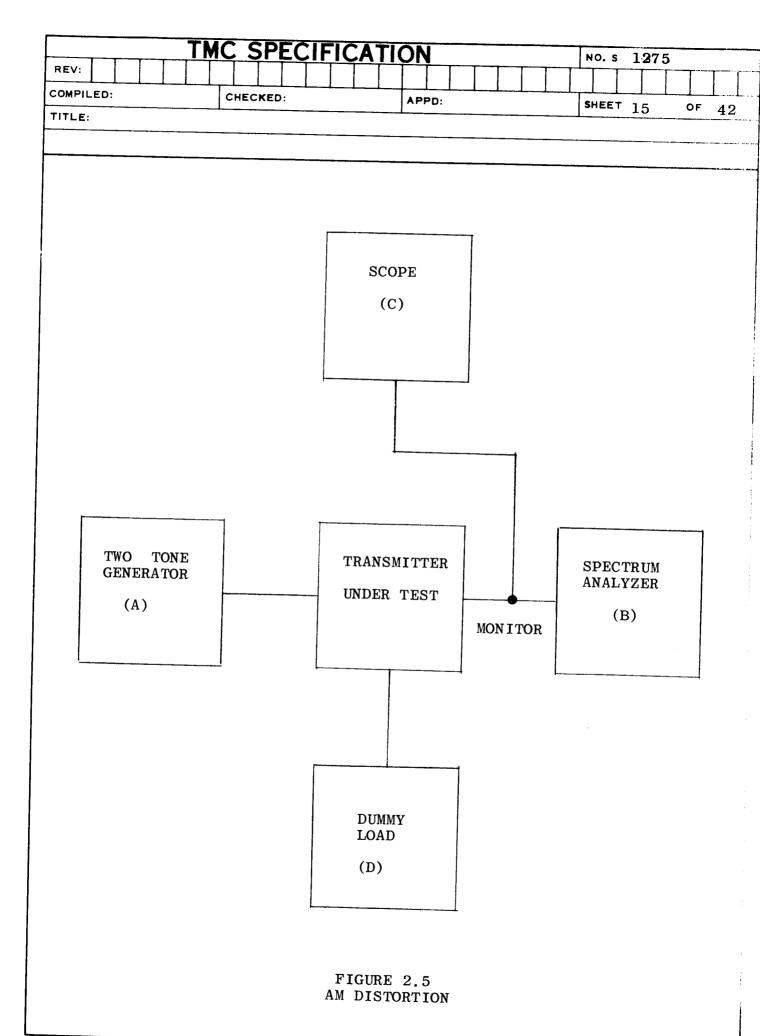
2.5 AM DISTORTION

- A. Performance Criteria
 - At rated PEP output, all harmonic distortion must be at least 33db below the carrier.
- B. Test Arrangement Relevant Figure

 1. AM Distortion 2.5
- С. Test Equipment Required Schematic Item No. In Reference Appendix 1 Two Tone Generator 1. Α 5 2. Oscilloscope C 9 3. Spectrum Analyzer В 4 4. Dummy Load D
- D. Test Procedure
 - a. Connect the equipment as indicated in Figure 2.5.
 - b. Place MMX meter switch in USB position. Adjust one tone audio input for an indication of four on MMX meter.

NOTE: This meter reading indicates approximately 90% modulation.

- c. Tune transmitter to full rated output in CW mode at 1.5 MHz.
- d. Reduce driver to zero.
- e. Place MMX mode switch in AM position.
- f. Advance drive until transmitter output indicates 250 watts.
- g. Adjust the spectrum analyzer for a full scale presentation, thus establishing a Odb reference level.
- h. Remove 20db of attenuation from the analyzer expanding the display from 0 thru -40 to -20 thru -60db.
- All harmonic distortion must be down at least 33db.
- j. Repeat steps c to j at frequencies indicated on test data form No. 2.5.



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Test Equipment Required Schematic Item No. In Reference Appendix 1

1. Dummy Load

Α

2

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- D. Test Procedure
 - Connect the equipment as shown in Figure 2.6. a.
 - Tune the transmitter to 1.5 MHz at 1.2 KW in b. CW mode.
 - Slowly engage ALDC until output drops to about 1 KW. c.
 - When increasing transmitter drive to maximum, d. output must remain within +20%.
 - e. Record output.
 - Repeat steps b to e at frequencies listed on f. test data form No. 2.6.
 - Also check rated power on all modes. g.

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TRANSMITTER UNDER TEST	DUMMY LOAD (A)
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FIGURE 2.6

ALDC

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2.7 CW KEYING

- A. Performance Criteria
 - 1. Transmitter must be capable of transmitting a CW signal with no more than 5% keying distortion.
- B. <u>Test Arrangement</u> <u>Relevant Figure</u>

 CW Keying 2.7

C.	st Equipment Required	Schematic Reference	Item No. In Appendix
	Dummy Load Oscilloscope Keyer	B C A	2 9

- D. Test Procedure
 - a. Connect equipment as show in Figure 2.7.
 - b. Tune transmitter to rated output at 1.5 MHz in CW mode, with test key switch in up position.
 - c. Set keyer frequency at $12\frac{1}{2}$ cycles. This is equivalent to 25 Bauds.
 - d. Using oscilloscope with TIME/CM Switch in 10 millisec position, record mark space pulse duration in millisec.
 - e. Mark space deviation must not exceed 4 millisec.
 - f. Repeat steps B to E using keying frequencies listed on test data form No. 2.7.

Note: 25 cycles = 50 Bauds. 50 cycles = 100 Bauds.

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FIGURE 2.7
CW KEYING

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2.8 FSK DISTORTION

A. Performance Criteria

 Transmitter must be capable of transmitting an FSK signal with no more than 5% of distortion.

B.	Tes	t Arrangement		Relevant	Figure		
	FSK	Distortion	2.8				
С.	Tes	t Equipment Required		Schematic Reference	Item No. Appendix		
	1. 2. 3.	Dummy Load Telegraph Character Frequency Counter	Gen.	B A C	2 13 11		

D. Test Procedure

- a. Connect the equipment as shown in Figure 2.8.
- b. Place switch # S.110 in back of MMX in the + 53 cycle position. Also place switch #S111 in 20 M.A. position.
- c. Place the output select switch on the character generator in the space position.
- d. Tune the transmitter to full rated output in the FSK mode, at 1.5 MHz. Record space frequency on test data form No. 2.8.
- e. Place output select switch in mark position, record mark frequency on test data form.
- f. Set the character generator output select switch to Dot cycle, set speed switch to 45.5 Bauds., set frequency counter time base to 10 sec., and record measured frequency on test data form No. 2.8.
- g. Obtain the FSK distortion from the following equation.

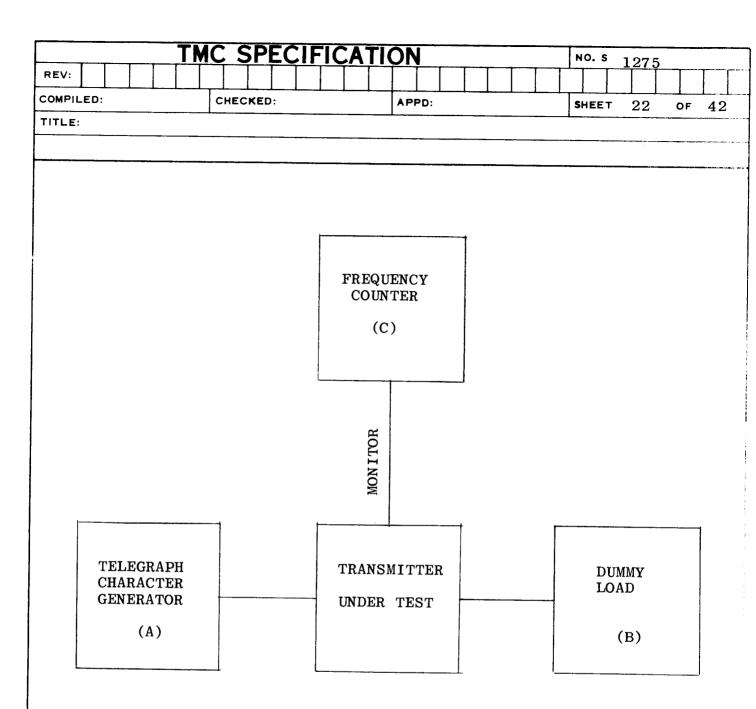
PERCENT DISTORTION = $\frac{\text{MEASURED FREQ.}}{1/2 \text{ TOTAL SHIFT}}$ X100

DISTORTION MUST NOT EXCEED 5%.

THE FORM SPEC 1

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- h. Repeat steps e to g with speed switch set at 100 Bauds.
- i. Place switch S110 on MMX in ± 425 position and repeat steps c to h.
- j. Repeat entire procedure at 26 MHz.



FSK DISTORTION
FIGURE 2.8

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2.9 AUDIO RESPONSE

- A. Performance Criteria
 - 1. Transmitter audio response must be \pm 1.5db from 250 to 3040 cycles.
- B. <u>Test Arrangement</u> <u>Relevant Figure</u>
 Audio Response 2.9

C.	Test Equipment Required	Schematic Reference	Item No. In Appendix 1
	1. Dummy Load	В	2
	2. Audio Generator	Α	$\overline{12}$
	3. High Frequency Counter	C	11

- D. Test Procedure
 - a. Connect Equipment as shown in Figure 2.9.
 - b. Tune transmitter for output of 1KW, at 1.5 MHz, in CW mode.
 - c. Adjust audio generator for an output of Odb, at a frequency of 1 KHz.
 - d. Reduce transmitter drive to min., and place MMX in USB mode.
 - e. Increase drive until transmitter output indicates .5 KW.
 - f. Slowly reduce frequency and record output as indicated on test data form No. 2.9.
 - g. Return generator frequency to 1KHz, now slowly increase frequency and record output as indicated on test data form.
 - h. Output should not deviate more than 3 db thru the range of 250-3040 cycles.
 - i. Repeat steps d to h on LSB.

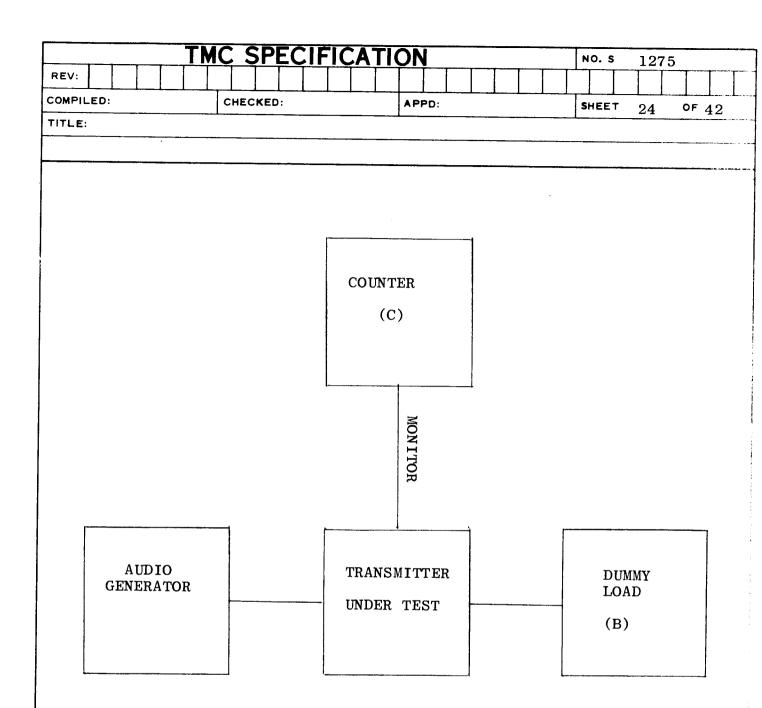


FIGURE 2.9
AUDIO RESPONSE

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3.0 HARMONIC SUPPRESSION

A. Performance Criteria

1. The transmitter is capable of producing full rated average power output with the second harmonic suppressed at least 45db below PEP, the third and higher harmonics suppressed at least 55db below PEP.

B. Test Arrangement

Relevant Figure

1. Harmonic Suppression

3.0

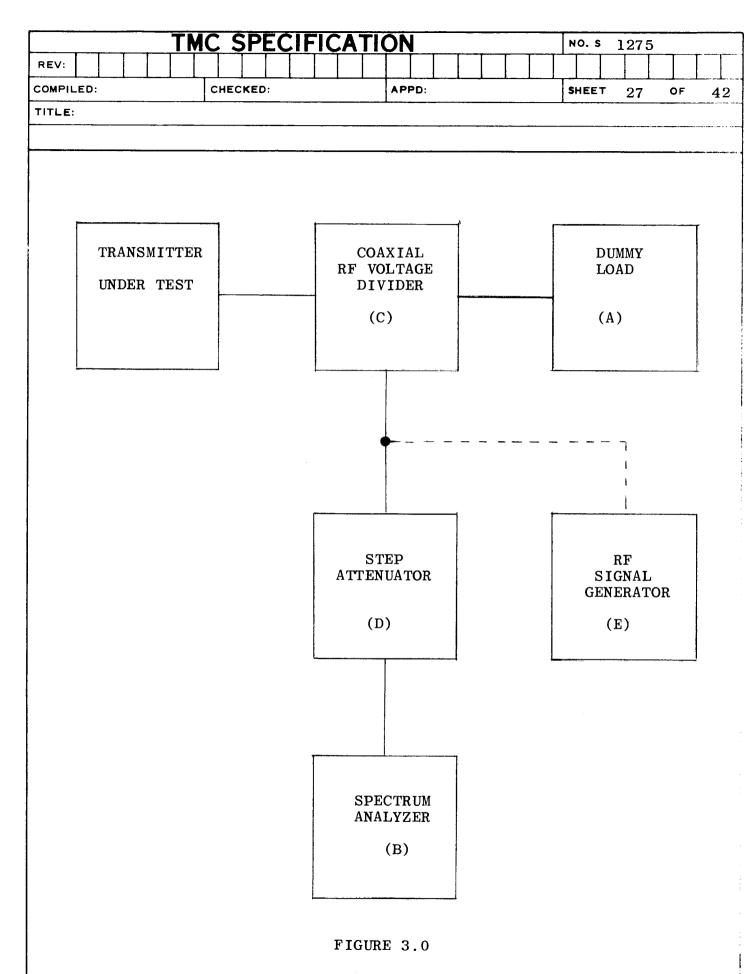
C.	Tes		Schematic Reference	Item No. In Appendix 1
	3. 4.	Dummy Load Spectrum Analyzer Coaxial RF Voltage Divide Step Attenuator RF Signal Generator	A B C C D E	2 4 8 6 7

D. Test Procedure

- a. Connect the equipment as shown in Figure 3.0.
- b. Tune the transmitter to 1.7 MHz and load it to full rated average power output in the CW mode.
- c. Tune the spectrum analyzer to the fundamental frequency and establish a Odb reference level. Disconnect the step attenuator from the coaxial divider and correct the signal generator. Tune the signal generator to the test frequency and note the level required to produce a full scale deflection on the analyzer.
- d. Tune the spectrum analyzer and signal generator to the frequency of the second harmonic. Set the signal generator input level to the level noted in part c and adjust the spectrum analyzer for full scale deflection. Disconnect the signal generator from the step attenautor and connect the step attenuator to the coaxial divider.
- e. Remove 20db of attenuation from the spectrum analyzer and note the level of the second harmonic. add the attenuation correction factor for the coaxial divider and obtain the level of the second harmonic. Record this level.

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- f. Repeat parts d and e for the third and higher harmonics.
- g. Repeat parts b to f at frequencies listed on test data form No. 3.0.



DOTTED LINE INDICATES ALTERNATE CONNECTION.
HARMONIC SUPPRESSION

TMC FORM SPEC 1

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3.1 FREQUENCY ALLOCATION

A. Test Arrangement

Relevant Figure

Frequency Allocation

3.1

B. Test Equipment Required

Schematic Reference

Item No. In Appendix 1

1. Frequency Counter

Α

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- C. Test Procedure
 - . Connect the equipment as shown in Figure 3.1.
 - b. Allow MMX Exciter at least a one hour warm up before starting test.
 - c. Using test data form No. 3.0 record exciter output frequency as listed on form No. 3.1.
 - d. Measured frequency must be within + one cycle.

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APPENDIX 1

TEST EQUIPMENT LIST

ITEM NUMBER	DESCRIPTION	MANUFACTURER AND MODEL USED
1	Wattmeter /	Bird Electronics Model 3127 or equivalent
2	Dummy Load	TMC 18K/50 (modified) or equivalent
3	Audio Generator	General Radio Model 1304-B or equivalent
4	Spectrum Analyzer	Lavoie Labs Model LA-40A or equivalent
5	Two Tone Generator	TMC Model TTG-1 or equivalent
6	Step Attenuator	Telenic TG950 or equivalent
7.	RF Signal Generator	Hewlett-Packard 606A or equivalent
8	Coaxial RF Voltage Divider	TMC Fabricated
9	Oscilloscope	Tektronix
10	CW Keyer	TMC
11	Frequency Counter	Hewlett-Packard
12	Audio Generator	Hewlett-Packard
13	Telegraph Character Generator	Digitech Inc.

REV:			
			
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TITLE:			

APPENDIX 1

TEST EQUIPMENT LIST

ITEM		MANUFACTURER	TMC	CALIBRA-
NUMBER	DESCRIPTION	& MODEL USED	SERIAL #	TION DATE
1	Wattmeter	Bird Electronics Model 3127 or equiv.		
2	Dummy Load	TMC 18K/50 (Modified)		
3	Audio Generator	or equivalent General Radio Model		
4	Spectrum Analyzer	1304-B or equivalent Lavoie Labs Model		
5	Two Tone Generator	LA-40A or equivalent TMC Model TTG-1 or		
6	Step Attenuator	equivalent Telonic TG950 or		
7	RF Signal Generator	equivalent Hewlett-Packard 606A		
8	Coaxial RF Voltage Divider	or equiv alent p/o TMC 18K/50(modi- fied)or equivalent		
9	Oscilloscope	Tektronix		
10	CW Keyer	TMC Model AK-100		
11	Frequency Counter	Hewlett-Packard		
12	Audio Generator	Hewlett-Packard		
13	Telegraph Character Generator	Digitech Inc.		

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FACTORY TEST - TEST DATA SHEET FOR VSWR																											
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	•	C.E.I	. OTAN				
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BAND	FREQUENCY mHz	DIRECT POWER KW	REFLECTED POWER	VSWR	ToDA	I	
		I OWER RU	TOWER	VSWIC	Ia P.A.	S2 P.A.	
1.5-1.8	1.6						
1.8-2.6	2					i.e. ·	
2.6-4	2.7				<u> </u>		
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	TMC SPECIFI	CATION		NO. S	1275
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TEST DA	TA FOR NOISE AND	HUM LEVEL	AND SPURI	OUS EMISSI	ONS WITH AL
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	TEST	HUM	NOISE	SPURIOUS	
BAND	FREQUENCY MHz	LEVEL db belo	LEVEL w referer	EMISSION ce level	
1.5-2.0	1.5				
2.0-2.6	2.3				
2.6-3.0	2.8				
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5.0-8.0	6.5				
8.0-12.0	10.0			<u> </u>	
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EXCITER SERIAL NO DATE												
Signature (TMC) Signature (Page Europa)												
C.E.I. OTAN												
	TEST	HUM	NOISE	SPURIOUS								
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2.6-4	2.7											
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TMC FORM SPEC 1

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0.000	2 2				USB				
2.0-2.6	2.3								
2.6-3.0	2.8		 		USB	<u> </u>		1	
3.0-5.0	4.0				USB	ļ		+	
5.0-8.0	6.0				USB				
8.0-12.0	8.0				USB				=
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12.0-16	14.0		 		USB				
16.0-24.0	16.0				USB	<u> </u>			
16.0-24	20.0				USB				
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24.0-30	28.0	<u> </u>		<u> </u>	LSB			1	
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EXCITER						DAT							
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	TEST						INTER MOD	AUDIO					
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1.5-1.8	1.5	-	_			USB		 					
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2.6-4	2.7	+											
2.6-4	3.5	 				USB							
4-5	4					USB							
4-5	4.5					USB							
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5-8	7					USB							
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	Signature C.E.I. OTAN POWER SIDE- SIDEBAND SIDEBAND															<u></u>				
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FREQ. mHz	OUTPU		REJECT	ION									
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TITLE: FACTORY	Y TEST - CARRIER SU	PPRESSION		
	CER SERIAL NO		TEST DA	ΓA FORM #2.4A
			DATE	
Signature	(TMC)		Signature (I	Page Europa)
	C.E.I	. OTAN		
FREQUENCY	CARR. SUPPRESS.	MODE		NOTES
1.5		USB		
5		USB		
9		IICB		

USB

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T	MC SPEC	CIFICATI	ON		NO. S 127	75
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FACTORY	TEST A-3	H DISTORTIC	ON		
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ALDC TEST 10KW OUTPUT		
TRANSMITTER SERIAL	NO	TEST DATA FORM #2.6
EXCITER SERIAL NO.		DATE
Signature (TMC)		Signature (Page Europa)
	C.E.I. OTAN	

72 4 3 7 72	FREQ.	CU	AM	USB	LSB	FSK	FAX	Ip	Is	LOAD
BAND	mHz	CW	AM	035	1,31	FOR	IA	10	13	10112
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1.8-2.6	2.2									
2.6-4	2.8									
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4-5	4.5									
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	C.E.I.	OTAN													
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	FREQUENCY 2 mHz (Test with ALDC)														
	FREQUENCY 2 mHz (Test with ALDC)														
	MARK SPACE														
25 BAUDS															
50 BAUDS															
100 BAUDS															
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	FREQUENCY 2	8 mHz(Test wi	th AL	DC)										
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TMC FORM SPEC 1

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