ENGINEERING TEST REPORT

UHF MOBILE TRANSCEIVER
Model No.: IC-F6021
FCC ID: AFJ318002

Applicant:

ICOM Incorporated
1-1-32, Kaminami, Hirano-ku
Osaka
Japan, 547-0003

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Parts 2 and 90 (Subpart I)

UltraTech's File No.: ICOM-218F90

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: July 10, 2009	
Report Prepared by: JaeWook Choi Issued Date: July 10, 2009	Tested by: Wayne Wu Test Dates: June 12, 15, 16, 22 & 23, 2009

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech Group of Labs

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com , Email: vic@ultratech-labs.com , Email: tri@ultratech-labs.com

0685	91038	1309	46390-2049	200093-0	SL2-IN-E-1119R	CA2049

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 90
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication – Parts 2 & 90
Purpose of Test:	To obtain FCC Certification Authorization for Radio operating in the Frequency Band 450-512 MHz (25 KHz and 12.5 KHz Channel Spacing).
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA-603 (01-Nov-2002) – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2008	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA/EIA 603, Edition C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami, Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Takayuki Watanabe Phone #: +81-66-793-5302 Fax #: +81-66-793-0013 Email Address: export@icom.co.jp

MANUFACTURER	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami,d Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Takayuki Watanabe Phone #: +81-66-793-5302 Fax #: +81-66-793-0013 Email Address: export@icom.co.jp

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	ICOM Incorporated
Product Name:	UHF MOBILE TRANSCEIVER
Model Name or Number:	IC-F6021
Serial Number:	5200203
Type of Equipment:	Licensed Non-Broadcast UHF Handheld Transceivers
Power Supply Requirement:	13.6 VDC nominal
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	UHF Mobile Transceiver

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, Industrial or Business
Power Supply Requirement:	13.6 VDC nominal
RF Output Power Rating:	45 Watts (High) / 4.5 Watts (Low)
Operating Frequency Range:	450-512 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	25 KHz, 12.5 KHz
Occupied Bandwidth (99%):	10.41 kHz (for 25 KHz Channel Spacing) & 5.60 kHz (for 12.5 KHz Channel Spacing)
Emission Designation*:	16K0F3E, 11K0F3E
Antenna Connector Type:	J

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

For FM Voice Modulation:

Channel Spacing = 25 KHz, D = 5 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(5)(1) = **16 KHz**
Emission designation: 16K0F3E

Channel Spacing = 12.5 KHz, D = 2.5 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(2.5)(1) = **11 KHz**
Emission designation: 11K0F3E

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Shielded/Non-shielded
1	Microphone Connector	1	RJ45	N/A
2	Antenna Connector	1	J type	Shielded
3	External Speaker	1	Phone Jack	Non-shielded
4	DC Power Receptacle	1	Custom 2 pins	Non-shielded

2.5. General Test Setup

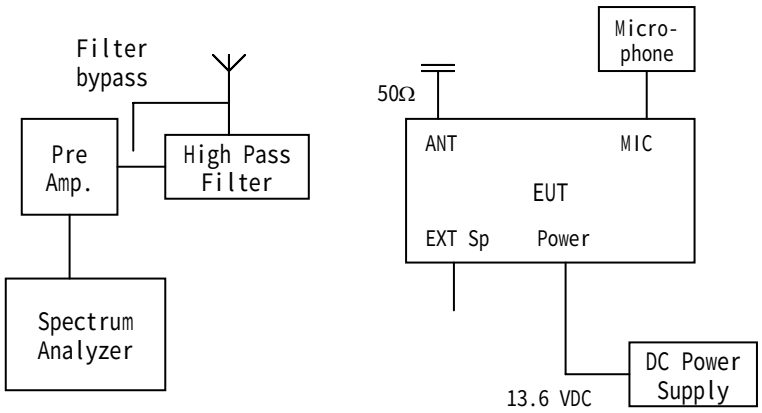


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power Input Source:	13.6 VDC Nominal

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s):	450-512 MHz
Test Frequencies: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	450.1 MHz, 481.1 MHz, 511.9 MHz
Transmitter Wanted Output Test Signals:	
Transmitter Power (measured maximum output power):	45 Watts High and 4.5 Watts Low
Normal Test Modulation:	FM Voice
Modulating signal source:	External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2011-05-01.

4.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	Yes
2.1046 & 90.205	RF Power Output	Yes
2.1047(a) & 90.242(b)(8)	Audio Frequency Response	Not applicable to new standard. However, tests are conducted under FCC's recommendation.
2.1047(b) & 90.210	Modulation Limiting	Yes
2.1049, 90.209 & 90.210	Emission Limitation & Emission Mask	Yes
2.1051, 2.1057 & 90.210	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057 & 90.210	Emission Limits - Field Strength of Spurious Emissions	Yes
2.1055 & 90.213	Frequency Stability	Yes
90.214	Transient Frequency Behavior	Yes
Mobile UHF MOBILE TRANSCEIVER, **Model No.: IC-F6021**, by **ICOM Incorporated** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class B Digital Devices**. The engineering test report has been documented and kept on file and it is available upon request.		

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.3.1. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in EXHIBIT 8. of this report

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 845 With a confidence level of 95%. Please refer to EXHIBIT 7. for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to communicate to and from radios over RF link.

5.5. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091]

5.5.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
(B) Limits for General Population/Uncontrolled Exposure				
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30

Note: f is frequency in MHz

5.5.2. Method of Measurements

Calculation Method of RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

5.5.3. Evaluation of RF Exposure Compliance Requirements

Maximum RF Power conducted, $\mathbf{P_{conducted}[dBm]}$ = 46.48 at 450.1 MHz

Maximum Antenna Gain, **G[dBi]** = 0

Maximum EIRP, $\mathbf{P_{EIRP}[dBm]}$ = 46.48

User-based time-average for PTT = 50%

MPE Limit for Occupational/Controlled Exposure, $\mathbf{S_{controlled}[mW/cm^2]}$ = 450/300 = 1.50

MPE Limit for General Population/Uncontrolled Exposure, $\mathbf{S_{uncontrolled}[mW/cm^2]}$ = 450/1500 = 0.30

Calculated RF Safety Distance for Occupational/Controlled Exposure, $\mathbf{r_{safety\_controlled}[cm]}$ = 34.34

Calculated RF Safety Distance for General Population/Uncontrolled Exposure, $\mathbf{r_{safety\_uncontrolled}[cm]}$ = 76.79

5.6. RF POWER OUTPUT [§§ 2.1046 & 90.205]

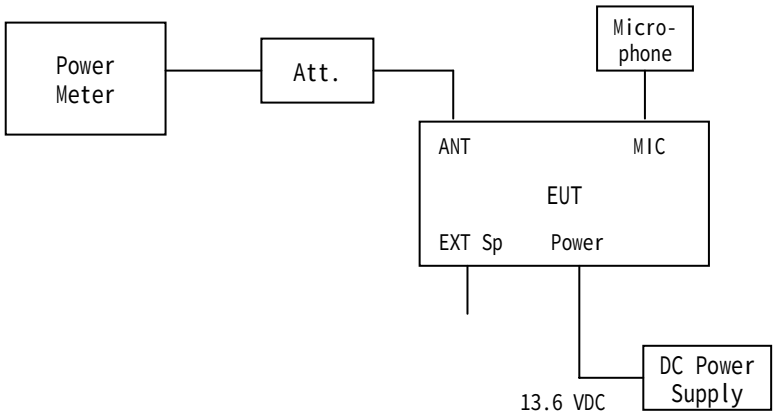
5.6.1. Limits

Please refer to FCC 47 CFR 90.205 for specification details.

5.6.2. Method of Measurements

Refer to Section 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

5.6.3. Test Arrangement



5.6.4. Test Data

Fundamental Frequency (MHz)	Measured (Average) Power (W)	Power Rating (W)
High Power Level, 45 Watts		
450.1	44.46	45
481.1	44.16	45
511.9	43.65	45
Low Power Level, 4.5 Watts		
450.1	4.58	4.5
481.1	4.40	4.5
511.9	4.23	4.5

5.7. AUDIO FREQUENCY RESPONSE [§§ 2.1047(a) & 90.242(b)(8)]

5.7.1. Limits

§ **2.1047(a):** Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

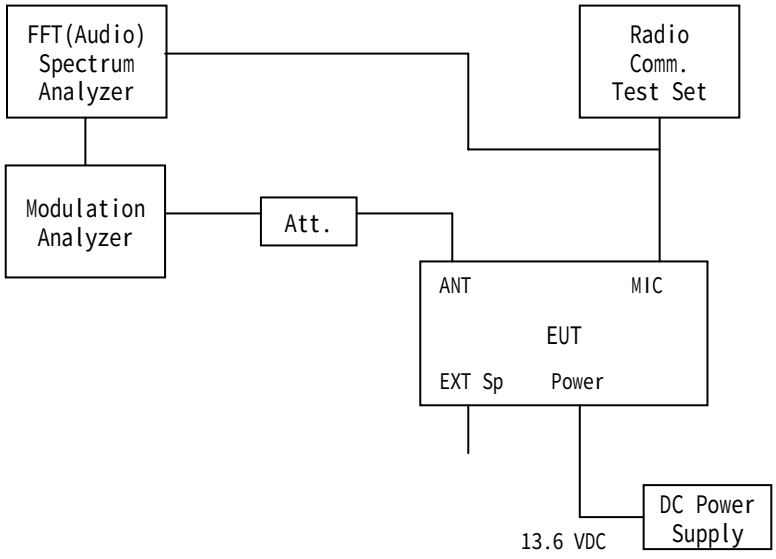
§ **90.242(b)(8):** Recommended audio filter attenuation characteristics are given below:

RF Band	Audio band	Minimum Attenuation Rel. to 1 KHz Attenuation
406.1-470 MHz	3 –20 KHz 20 – 30 KHz	60 $\log_{10}$(f/3) dB where f is in KHz 50dB

5.7.2. Method of Measurements

The rated audio input signal was applied to the input of the audio low-pass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT Digital Spectrum Analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 KHz.

5.7.3. Test Arrangement

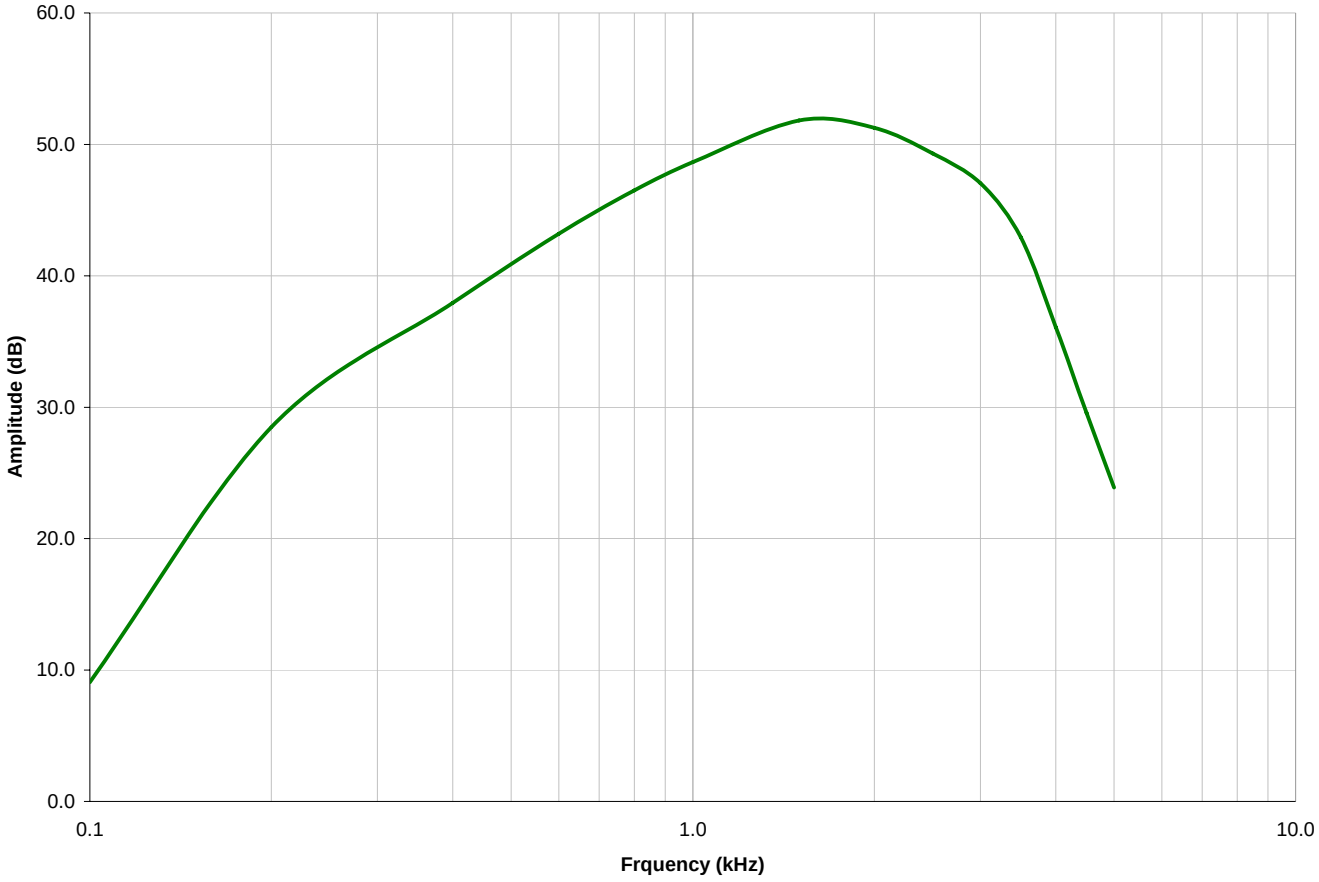


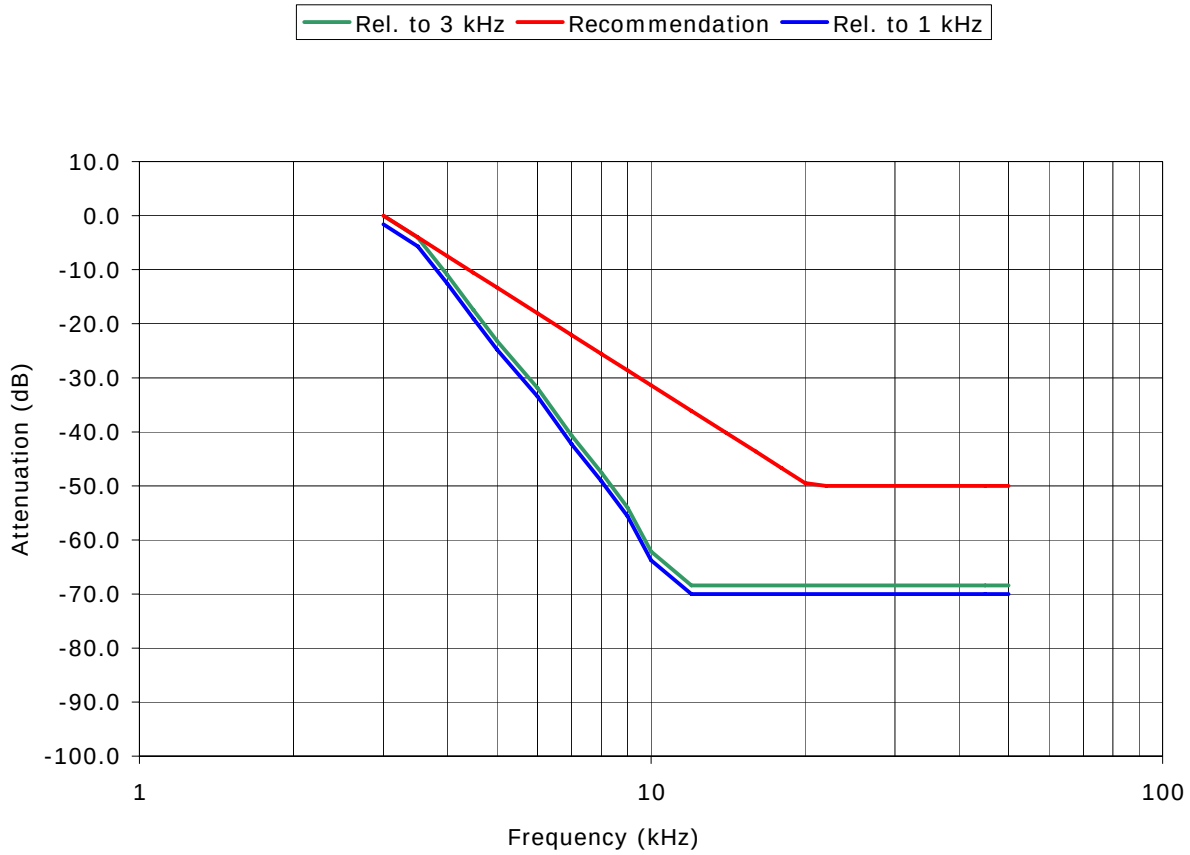
5.7.4. Test Data

5.7.4.1. 12.5 KHz Channel Spacing, F3E, Frequency of All Modulation States

Note: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 KHz in comparison with the recommended audio filter attenuation.

Frequency (KHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-48.64	-39.57	9.1	-38.0	--
0.2	-48.64	-20.16	28.5	-18.6	--
0.4	-48.64	-10.71	37.9	-9.1	--
0.6	-48.64	-5.44	43.2	-3.8	--
0.8	-48.64	-2.14	46.5	-0.5	--
1.0	-48.64	0.01	48.7	1.6	--
1.5	-48.64	3.18	51.8	4.8	--
2.0	-48.64	2.61	51.3	4.2	--
2.5	-48.64	0.67	49.3	2.3	--
3.0	-48.64	-1.59	47.1	0.0	0
3.5	-48.64	-5.69	43.0	-4.1	-4
4.0	-48.64	-12.54	36.1	-11.0	-7
4.5	-48.64	-19.07	29.6	-17.5	-11
5.0	-48.64	-24.75	23.9	-23.2	-13
6.0	-48.64	-33.45	15.2	-31.9	-18
7.0	-48.64	-42.26	6.4	-40.7	-22
8.0	-48.64	-49.11	-0.5	-47.5	-26
9.0	-48.64	-55.61	-7.0	-54.0	-29
10.0	-48.64	-63.73	-15.1	-62.1	-31
12.0	-48.64	-70.00	-21.4	-68.4	-36
14.0	-48.64	-70.00	-21.4	-68.4	-40
16.0	-48.64	-70.00	-21.4	-68.4	-44
18.0	-48.64	-70.00	-21.4	-68.4	-47
20.0	-48.64	-70.00	-21.4	-68.4	-49
22.0	-48.64	-70.00	-21.4	-68.4	-50
25.0	-48.64	-70.00	-21.4	-68.4	-50
30.0	-48.64	-70.00	-21.4	-68.4	-50
35.0	-48.64	-70.00	-21.4	-68.4	-50
40.0	-48.64	-70.00	-21.4	-68.4	-50
45.0	-48.64	-70.00	-21.4	-68.4	-50
50.0	-48.64	-70.00	-21.4	-68.4	-50

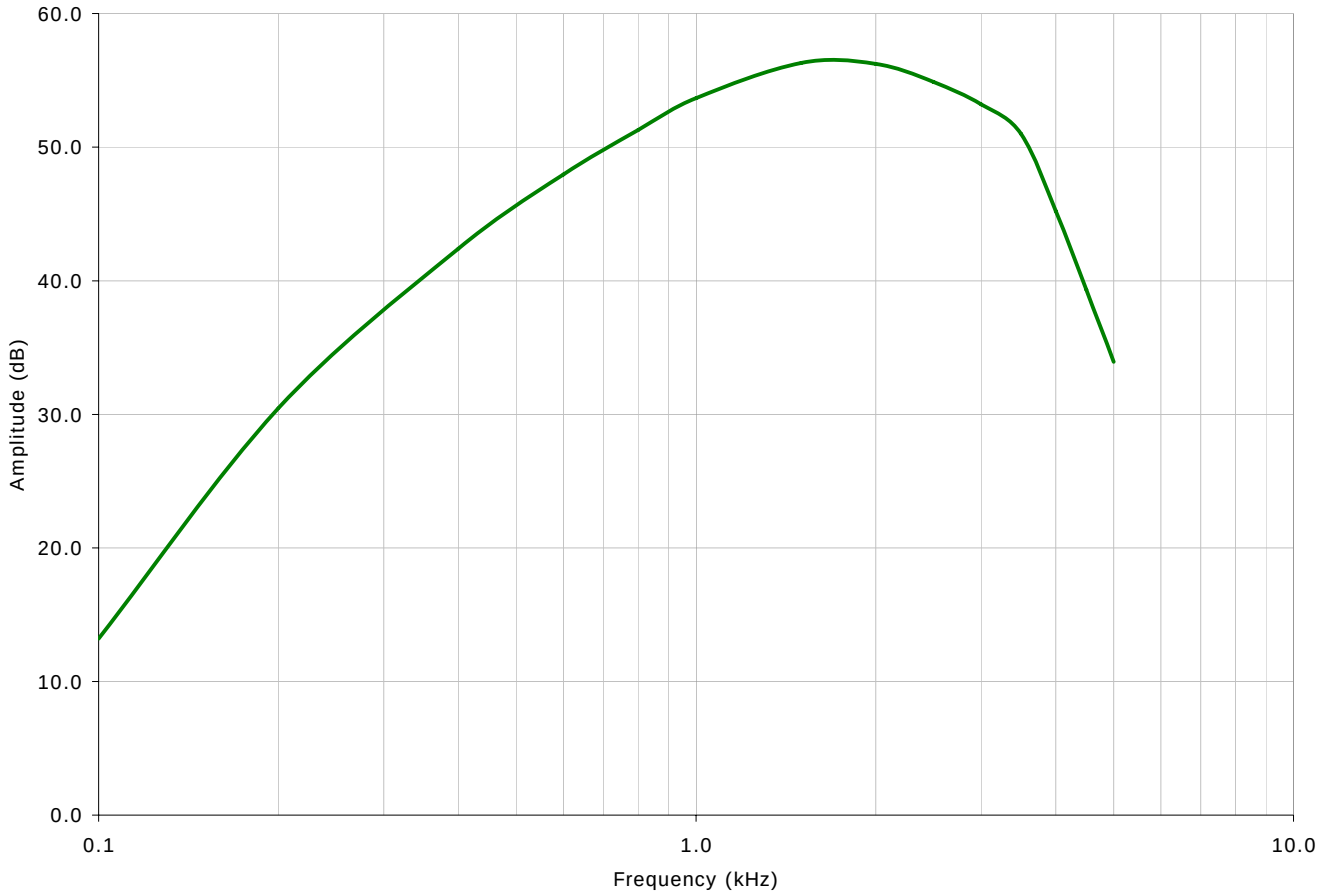

60.0
50.0
40.0
30.0
20.0
10.0
0.0
Amplitude (dB)
0.1
1.0
10.0
Frquency (kHz)


Rel. to 3 kHz
Recommendation
Rel. to 1 kHz
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
Attenuation (dB)
1
10
100
Frequency (kHz)

*5.7.4.2. 25 KHz Channel Spacing, F3E, Frequency of All Modulation States**

Note: Due to the difficulty of measuring the Frequency Response of the internal low-pass filter, the Frequency Response of All Modulation States is performed to show the roll-off at 3 KHz in comparison with the recommended audio filter attenuation.

Frequency (KHz)	Audio In (dBV)	Audio Out (dBV)	Attenuation (Out - In) (dB)	Attenuation Rel. to 1 KHz (dB)	Recommended Attenuation (dB)
0.1	-47.64	-34.43	13.2	-40.5	--
0.2	-47.64	-17.18	30.5	-23.2	--
0.4	-47.64	-5.25	42.4	-11.3	--
0.6	-47.64	0.31	48.0	-5.7	--
0.8	-47.64	3.64	51.3	-2.4	--
1.0	-47.64	6.04	53.7	0.0	--
1.5	-47.64	8.67	56.3	2.6	--
2.0	-47.64	8.60	56.2	2.6	--
2.5	-47.64	7.24	54.9	1.2	--
3.0	-47.64	5.56	53.2	-0.5	0
3.5	-47.64	3.36	51.0	-2.7	-4
4.0	-47.64	-2.41	45.2	-8.5	-7
4.5	-47.64	-8.31	39.3	-14.4	-11
5.0	-47.64	-13.71	33.9	-19.8	-13
6.0	-47.64	-22.23	25.4	-28.3	-18
7.0	-47.64	-30.37	17.3	-36.4	-22
8.0	-47.64	-37.51	10.1	-43.6	-26
9.0	-47.64	-45.25	2.4	-51.3	-29
10.0	-47.64	-51.17	-3.5	-57.2	-31
12.0	-47.64	-59.18	-11.5	-65.2	-36
14.0	-47.64	-70.00	-22.4	-76.0	-40
16.0	-47.64	-70.00	-22.4	-76.0	-44
18.0	-47.64	-70.00	-22.4	-76.0	-47
20.0	-47.64	-70.00	-22.4	-76.0	-49
22.0	-47.64	-70.00	-22.4	-76.0	-50
25.0	-47.64	-70.00	-22.4	-76.0	-50
30.0	-47.64	-70.00	-22.4	-76.0	-50
35.0	-47.64	-70.00	-22.4	-76.0	-50
40.0	-47.64	-70.00	-22.4	-76.0	-50
45.0	-47.64	-70.00	-22.4	-76.0	-50
50.0	-47.64	-70.00	-22.4	-76.0	-50


60.0
50.0
40.0
30.0
20.0
10.0
0.0
Amplitude (dB)
0.1
1.0
10.0
Frequency (kHz)


Rel. to 3 kHz
Recommendation
Rel. to 1 kHz
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100.0
Attenuation (dB)
1
10
100
Frequency (kHz)

5.8. MODULATION LIMITING [§§ 2.1047 (b) & 90.210]

5.8.1. Limits

§ **2.1047(b):** Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

Recommended frequency deviation characteristics are given below:

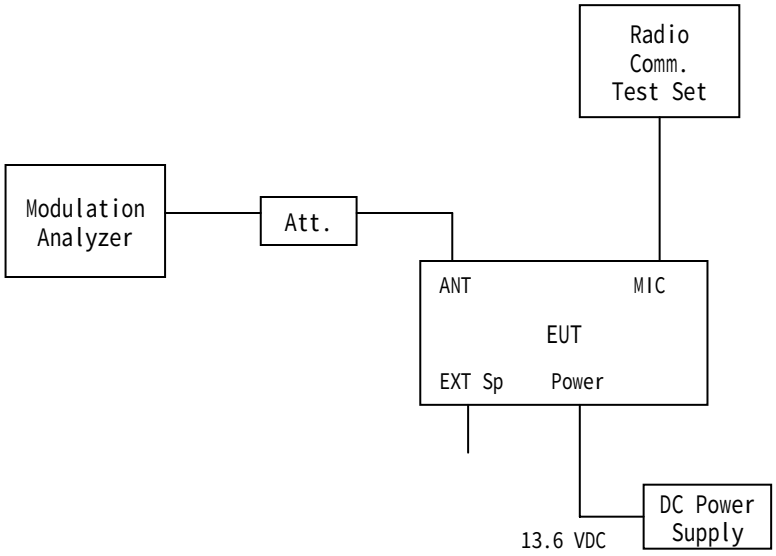
- 2.5 KHz for 12.5 KHz Channel Spacing System
- 5 KHz for 25 KHz Channel Spacing System

5.8.2. Method of Measurements

For Audio Transmitter: The carrier frequency deviation was measured with the tone input signal level varied from 0 Vp to audio input rating level plus 16 dB at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 KHz. The maximum deviation was recorded at each test condition.

For Data Transmitter with Maximum Frequency Deviation set by Factory: The EUT was set at maximum frequency deviation, and its peak frequency deviation was then measured using EUT's internal random data source.

5.8.3. Test Arrangement



5.8.4. Test Data

5.8.4.1. Voice Modulation Limiting for 12.5 KHz Channel Spacing Operation

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (KHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 KHz	0.5 KHz	1.0 KHz	3.0 KHz	5.0 KHz	(KHz)
1	0.11	0.28	0.43	0.56	0.12	2.5
2	0.11	0.36	0.82	0.97	0.14	2.5
4	0.11	0.65	1.53	1.18	0.19	2.5
6	0.11	0.96	1.94	1.19	0.23	2.5
8	0.11	1.27	1.98	1.19	0.23	2.5
10	0.11	1.54	1.99	1.19	0.23	2.5
15	0.13	1.74	2.01	1.19	0.23	2.5
20	0.16	1.98	2.02	1.19	0.23	2.5
25	0.18	2.01	2.02	1.19	0.23	2.5
30	0.20	2.02	2.02	1.19	0.23	2.5
35	0.22	2.02	2.02	1.19	0.23	2.5
40	0.24	2.02	2.02	1.19	0.23	2.5
45	0.24	2.02	2.02	1.19	0.23	2.5
50	0.26	2.02	2.02	1.19	0.23	2.5
60	0.28	2.03	2.02	1.19	0.23	2.5
70	0.34	2.03	2.02	1.19	0.23	2.5
80	0.36	2.04	2.02	1.19	0.23	2.5
90	0.39	2.04	2.02	1.19	0.23	2.5
100	0.43	2.04	2.02	1.19	0.23	2.5

Voice Signal Input Level = STD MOD Level + 16 dB
= 11.82 dB(mVrms) + 16 dB
= 27.82 dB(mVrms)
= 24.61 mVrms

Modulation Frequency (KHz)	Peak Deviation (KHz)	Maximum Limit (KHz)
0.1	0.18	2.5
0.2	0.75	2.5
0.4	1.93	2.5
0.6	2.01	2.5
0.8	2.02	2.5
1.0	2.02	2.5
1.2	1.99	2.5
1.4	1.99	2.5
1.6	2.02	2.5
1.8	2.02	2.5
2.0	1.94	2.5
2.5	1.55	2.5
3.0	1.18	2.5
3.5	0.91	2.5
4.0	0.56	2.5
4.5	0.34	2.5
5.0	0.23	2.5
6.0	0.12	2.5
7.0	0.08	2.5
8.0	0.07	2.5
9.0	0.07	2.5
10.0	0.07	2.5

5.8.4.2. Voice Modulation Limiting for 25 KHz Channel Spacing Operation

MODULATING SIGNAL LEVEL	PEAK FREQUENCY DEVIATION (KHz) at the following modulating frequency:					MAXIMUM LIMIT
(mVrms)	0.1 KHz	0.5 KHz	1.0 KHz	3.0 KHz	5.0 KHz	(KHz)
1	0.18	0.35	0.84	1.23	0.21	5.0
2	0.18	0.64	1.48	2.31	0.29	5.0
4	0.18	1.23	2.92	2.78	0.41	5.0
6	0.18	1.69	3.78	2.79	0.52	5.0
8	0.21	2.27	3.89	2.80	0.56	5.0
10	0.22	2.76	3.91	2.80	0.56	5.0
15	0.24	3.12	3.95	2.80	0.56	5.0
20	0.28	3.92	3.97	2.80	0.56	5.0
25	0.32	3.97	3.97	2.80	0.56	5.0
30	0.34	3.99	3.97	2.80	0.56	5.0
35	0.36	4.01	3.97	2.80	0.56	5.0
40	0.40	4.01	3.97	2.80	0.56	5.0
45	0.44	4.02	3.97	2.80	0.56	5.0
50	0.48	4.03	3.97	2.80	0.56	5.0
60	0.55	4.04	3.97	2.80	0.56	5.0
70	0.61	4.04	3.97	2.80	0.56	5.0
80	0.66	4.04	3.97	2.80	0.56	5.0
90	0.71	4.04	3.97	2.80	0.56	5.0
100	0.77	4.04	3.97	2.80	0.56	5.0

Voice Signal Input Level = STD MOD Level + 16 dB
= 12.36 dB(mVrms) + 16 dB
= 28.36 dB(mVrms)
= 26.18 mVrms

Modulation Frequency (KHz)	Peak Deviation (KHz)	Maximum Limit (KHz)
0.1	0.31	5.0
0.2	1.35	5.0
0.4	3.85	5.0
0.6	3.97	5.0
0.8	3.98	5.0
1.0	3.97	5.0
1.2	3.92	5.0
1.4	3.92	5.0
1.6	3.97	5.0
1.8	4.03	5.0
2.0	4.00	5.0
2.5	3.43	5.0
3.0	2.81	5.0
3.5	2.26	5.0
4.0	1.45	5.0
4.5	0.88	5.0
5.0	0.58	5.0
6.0	0.29	5.0
7.0	0.18	5.0
8.0	0.13	5.0
9.0	0.12	5.0
10.0	0.11	5.0

5.9. OCCUPIED BANDWIDTH & EMISSION MASK [§§ 2.1049, 90.209 & 90.210]

5.9.1. Limits

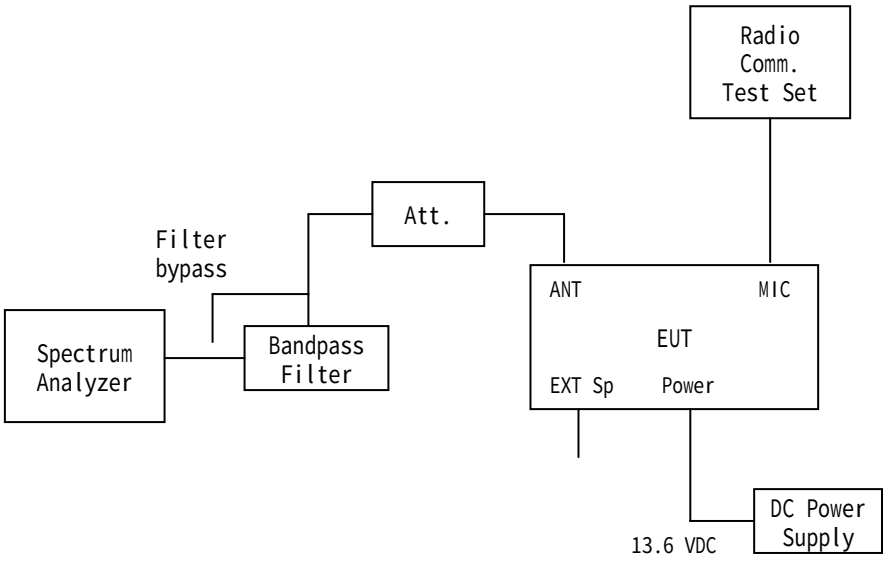
Emissions shall be attenuated below the mean output power of the transmitter as follows:

Frequency Range (MHz)	Maximum Authorized BW (KHz)	Channel Spacing (KHz)	Recommended Frequency Deviation (KHz)	FCC Applicable Mask
150-174, 421-512	20.0	25	5.0	Mask B – Voice Mask C – Data
156-174, 421-512	11.25	12.5	2.5	Mask D – Voice & Data
150-174, 421-512	6	6.25	1.25	Mask E – Voice & Data

5.9.2. Method of Measurements

Refer to Section 8.4 of this report for measurement details and TIA-102.CAAA-B.

5.9.3. Test Arrangement



5.9.4. Test Data

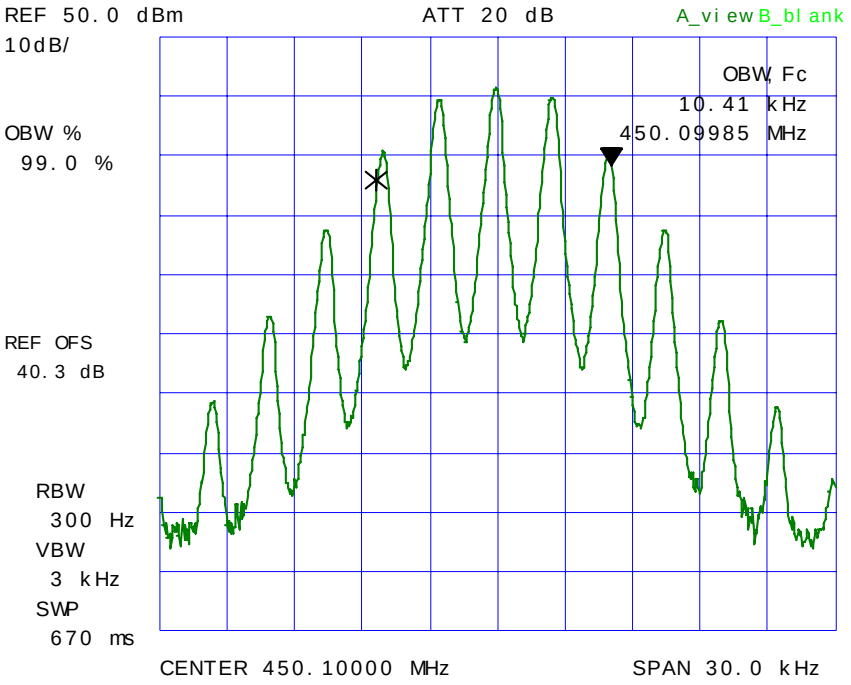
5.9.4.1. 99% Occupied Bandwidth

Frequency (MHz)	Channel Spacing (KHz)	Modulation	*Measured 99% OBW at Maximum Freq. Deviation (KHz)	Maximum Authorized Bandwidth (KHz)
450.1	25	FM with 2.5 KHz sine wave signal	10.41	20.0
481.1	25	FM with 2.5 KHz sine wave signal	10.37	20.0
511.9	25	FM with 2.5 KHz sine wave signal	10.33	20.0
450.1	12.5	FM with 2.5 KHz sine wave signal	5.51	11.25
481.1	12.5	FM with 2.5 KHz sine wave signal	5.60	11.25
511.9	12.5	FM with 2.5 KHz sine wave signal	5.57	11.25

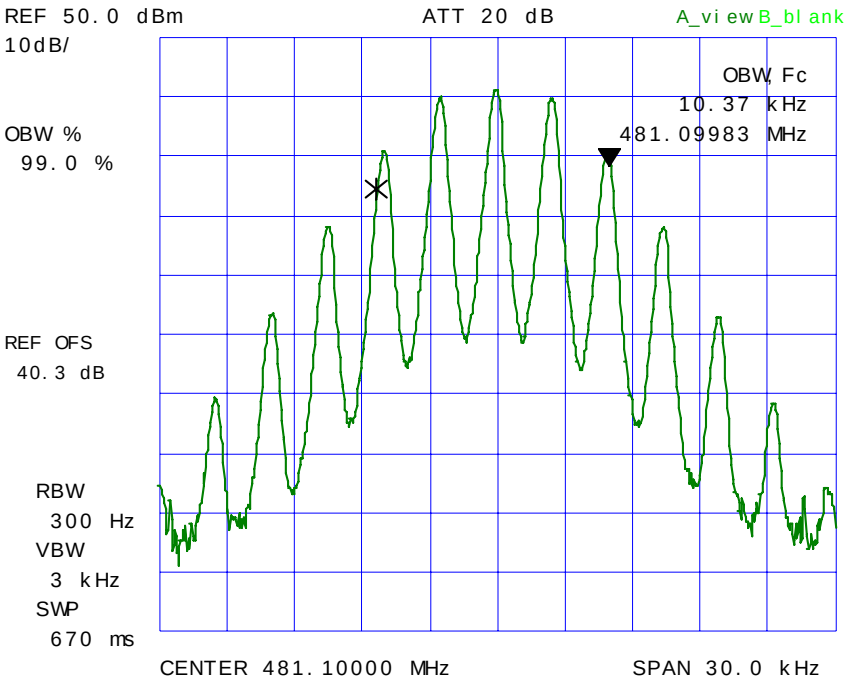
Note: 99% Occupied Bandwidth measurements were done using the built-in auto function of the analyzer.

*Refer to the following test data plots (1 through 6) for details.

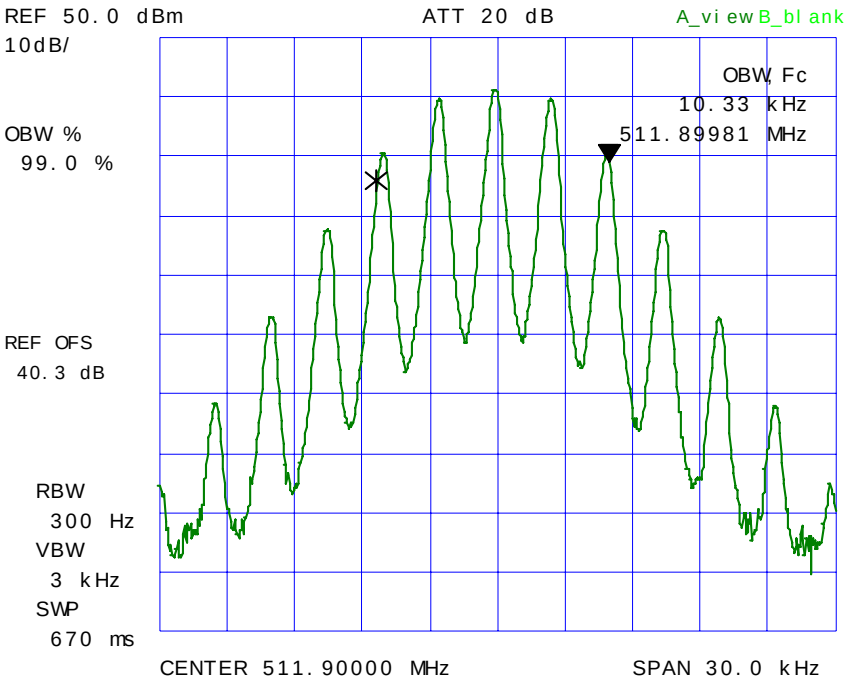
Plot # 1.:
Occupied Bandwidth
Carrier Frequency: 450.1 MHz
Channel Spacing: 25.0 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



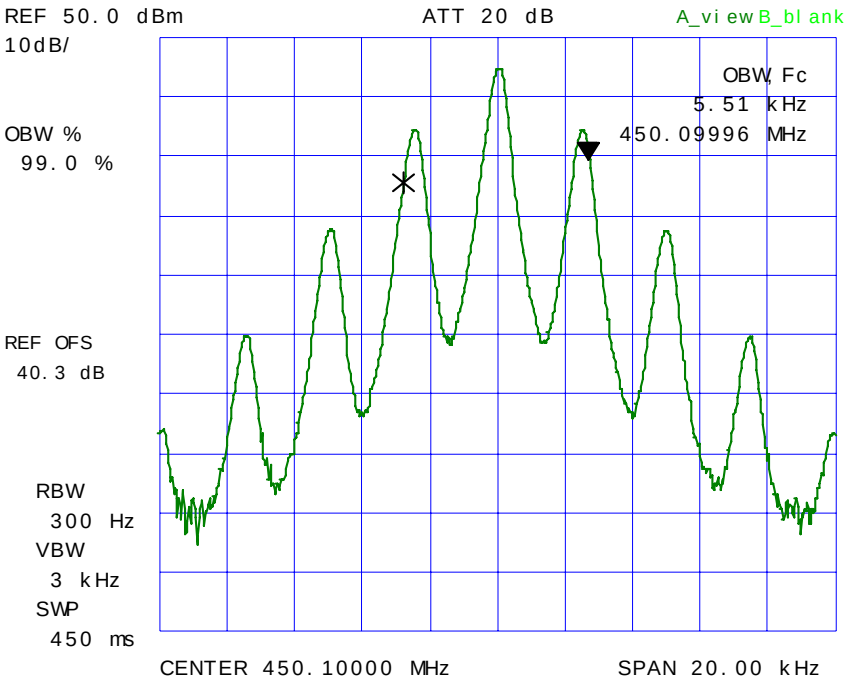
Plot # 2.:
Occupied Bandwidth
Carrier Frequency: 481.1 MHz
Channel Spacing: 25.0 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



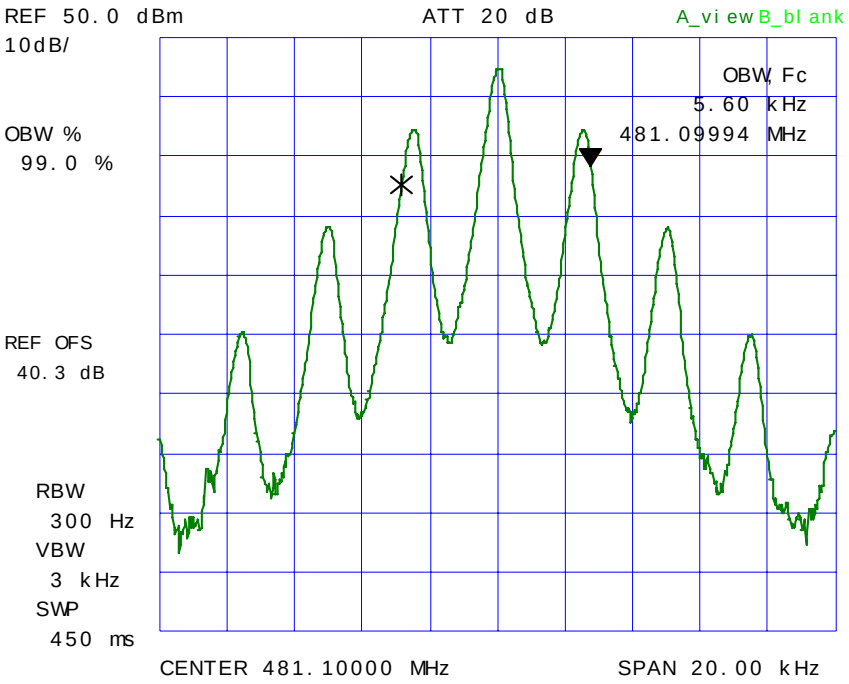
Plot # 3.:
Occupied Bandwidth
Carrier Frequency: 511.9 MHz
Channel Spacing: 25.0 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



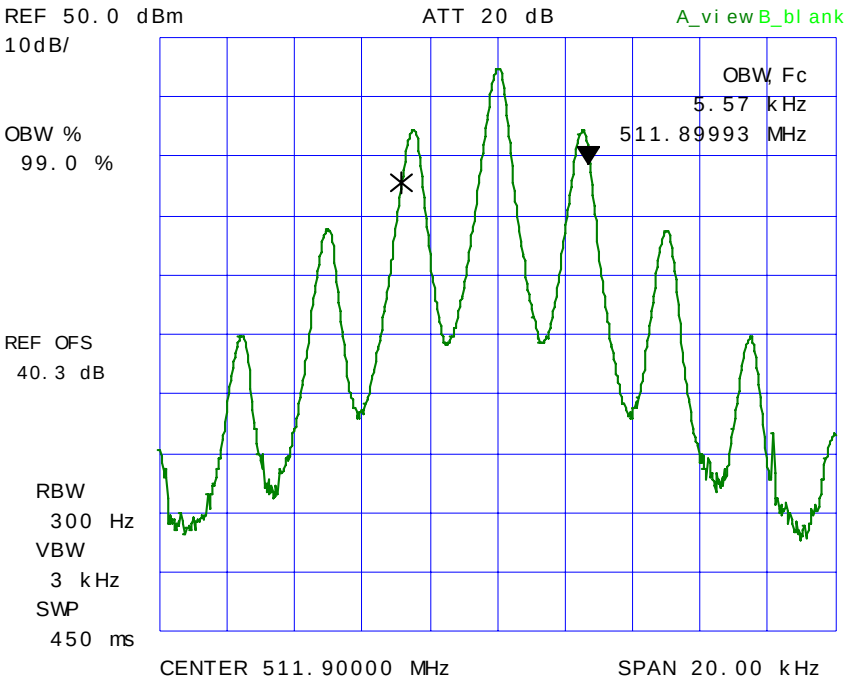
Plot # 4.:
Occupied Bandwidth
Carrier Frequency: 450.1 MHz
Channel Spacing: 12.5 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



Plot # 5.:
Occupied Bandwidth
Carrier Frequency: 481.1 MHz
Channel Spacing: 12.5 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



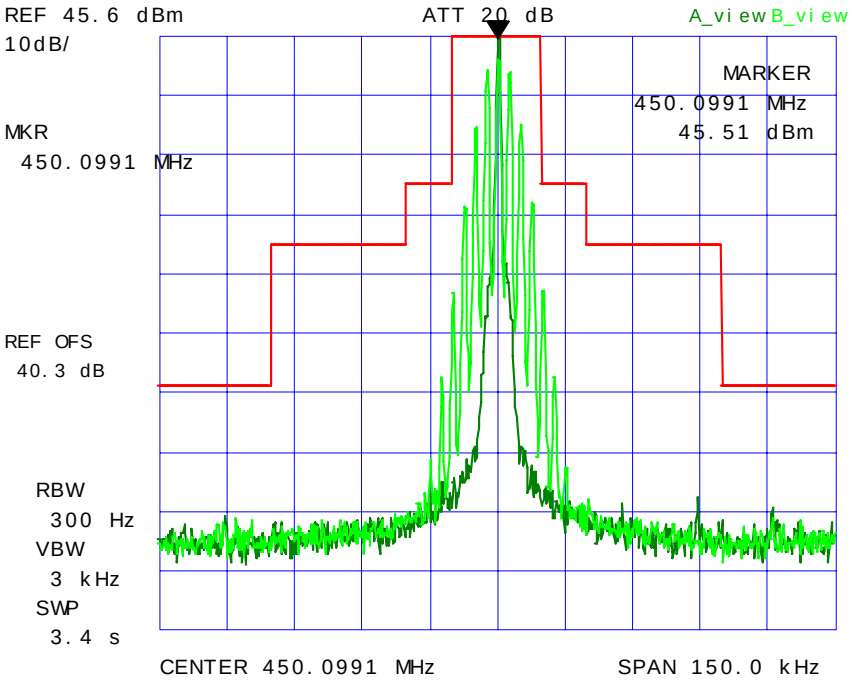
Plot # 6.:
Occupied Bandwidth
Carrier Frequency: 511.9 MHz
Channel Spacing: 12.5 KHz
Power: 45 W
Modulation: FM with 2.5 KHz sine wave signal



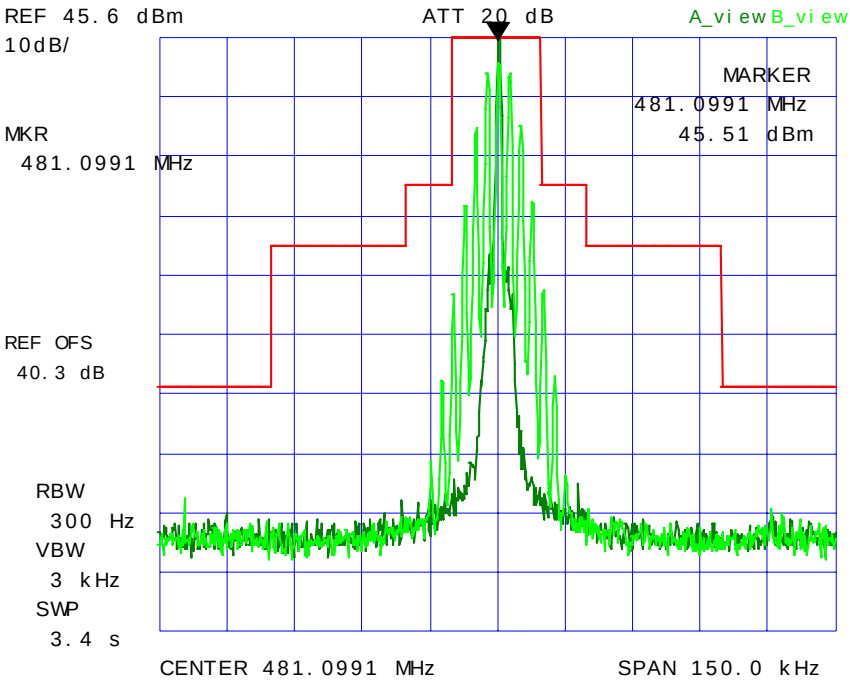
5.9.4.2. Emission Masks

Conform. See the following test data plots (7 through 18) for details.

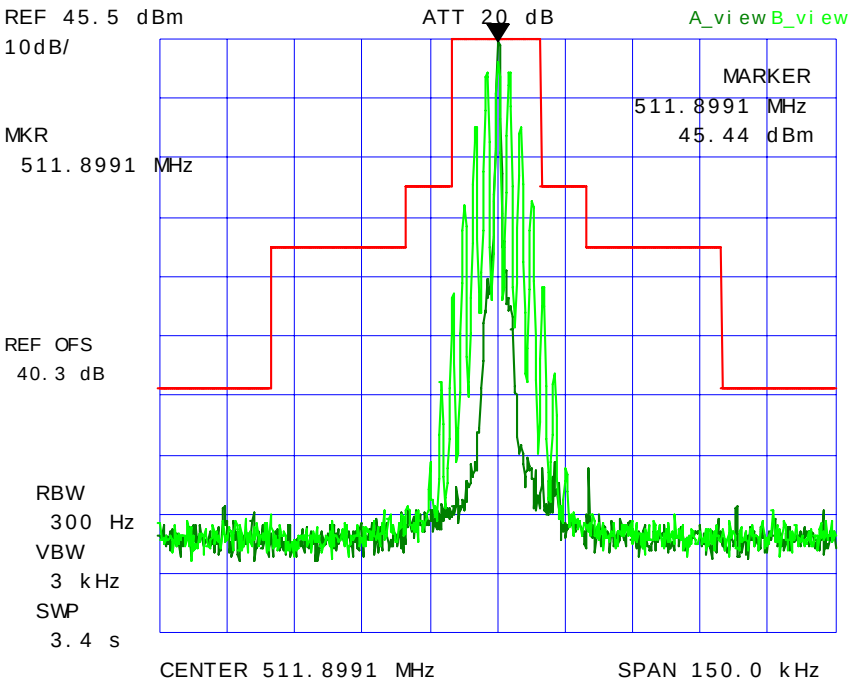
Plot # 7.:
Emission Mask B
Carrier Frequency: 450.1 MHz
Channel Spacing: 25 KHz
Power: 45 W
Modulation: FM with 2.5KHz sine wave



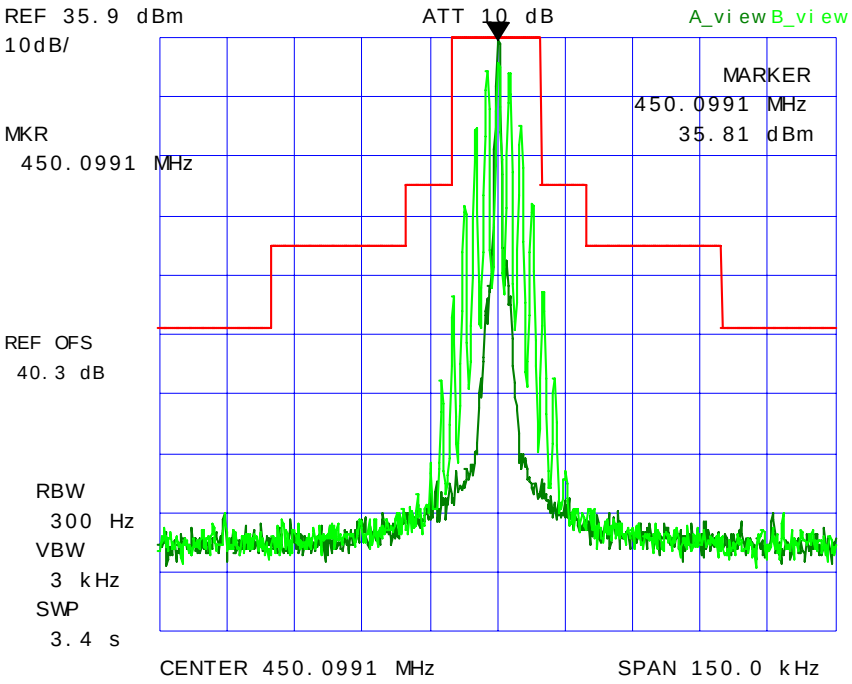
Plot # 8.:
Emission Mask B
Carrier Frequency: 481.1 MHz
Channel Spacing: 25 KHz
Power: 45 W
Modulation: FM with 2.5KHz sine wave



Plot # 9.:
Emission Mask B
Carrier Frequency: 511.9 MHz
Channel Spacing: 25 KHz
Power: 45 W
Modulation: FM with 2.5KHz sine wave



Plot # 10.:
Emission Mask B
Carrier Frequency: 450.1 MHz
Channel Spacing: 25 KHz
Power: 4.5 W
Modulation: FM with 2.5KHz sine wave



Plot # 11.:
Emission Mask B
Carrier Frequency: 481.1 MHz
Channel Spacing: 25 KHz
Power: 4.5 W
Modulation: FM with 2.5KHz sine wave