ENGINEERING TEST REPORT

VHF Air Band Transceiver
Model Nos.: IC-A120
FCC ID: AFJ369710

Applicant:

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

Tested in Accordance with

Federal Communications Commission (FCC)
47 CFR, Parts 2 and 87 (Subpart D) – Aviation Services

UltraTech's File No.: 18ICOM497_FCC87

This Test report is Issued under the Authority of Tri M. Luu, BASc Vice President of Engineering UltraTech Group of Labs Date: December 7, 2018	
Report Prepared by: Santhosh Fernandez Issued Date: December 7, 2018	Tested by: Nimisha Desai Test Dates: October 26- November 20, 2018

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 87
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication – Parts 2 & 87
Purpose of Test:	To gain FCC Equipment Authorization Certification for Radio operating in Part 87.
Test Procedures:	• ANSI/TIA-603-E • ANSI C63.26-2015

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

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2018	Code of Federal Regulations, Title 47 – Telecommunication
ANSI C63.4	2014	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
ANSI/TIA-603-E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

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. Atsushi Tomiyama Phone #: +81 6 6793 5302 Fax #: +81 6 6793 0013 Email Address: world_support@icom.co.jp

MANUFACTURER	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Atsushi Tomiyama Phone #: +81 6 6793 5302 Fax #: +81 6 6793 0013 Email Address: world_support@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:	VHF Air Band Transceiver
Model Name or Number:	IC-A120
Serial Number:	00000701
External Power Supply:	DC 13.75V / 27.5V
Transmitting/Receiving Antenna Type:	Non-integral
Type of Equipment:	Non-broadcast Radio Communication Equipment
Primary User Functions of EUT:	VHF air band transceiver for voice communication in Occupational environment.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile or Base
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	DC 13.75V / 27.5V
RF Output Power Rating:	9W (CW) Conducted
Operating Frequency Range:	118.00-136.99166 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	25.0 kHz, 8.33 kHz
Emission Designation*:	6K00A3E, 5K60A3E
Antenna Connector Type:	UHF

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

Calculation of Necessary Bandwidth for Telephony (Commercial Quality)

Telephony, double-sideband (single channel):

Bn = 2M

Where: Bn = Necessary bandwidth in hertz
M = Maximum modulation frequency in hertz

M = 3000Hz

Bn =2(3000) = 6000 Hz = 6.00 KHz

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Antenna	1	ICOM Unique	Shielded
2	Microphone Headphone Jack	1	8 position jack	Non-Shielded
3	DC power	1	2-wire	Non-Shielded
4.	Ext Speaker	1	Directly connected	Non-Shielded
5.	Headset Adaptor/ Mic hanger cable	1	Directly connected	Non-Shielded

EXHIBIT 3. EUT OPERATING CONDITION AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C - 24°C
Humidity:	30% - 57%
Pressure:	102 kPa
Power input source:	13.75V & 27.5V DC Power Supply

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:	Test jig was provided by the manufacturer.
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ω Load.

Transmitter Test Signals	
Frequency Band(s):	118.00-136.99166 MHz
Test Frequency(ies): (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	118.025, 127.525 and 136.975 MHz Note: for 8.33 kHz channel spacing the above frequencies are displayed as 118.030, 127.530 and 136.980 MHz
Transmitter Wanted Output Test Signals:	
▪ RF Power Output (measured maximum output power):	9 W
▪ Normal Test Modulation:	AM or 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation
▪ 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 ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 87.131	RF Power Output	Yes
2.1047(a) & 87.141(f)	Modulation Characteristics - Audio Frequency Response	Yes
2.1047(b) & 87.141	Modulation Characteristics - Modulation Limiting	Yes
2.1049, 87.135, 87.137 & 87.139	Occupied Bandwidth and Emission Limitations	Yes
2.1051, 2.1057 & 87.139,	Spurious Emissions at Antenna Terminals	Yes
2.1053, 2.1057 & 87.139	Field Strength of Spurious Radiation	Yes
2.1055 & 87.133	Frequency Stability	Yes
1.1307, 1.1310 & 2.1091	Radiofrequency Radiation Exposure Evaluation	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

4.4. 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 the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.
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 correctly communicate to and from radios over RF link.

5.5. RF POWER OUTPUT [§§ 2.1046 & 87.131]

5.5.1. Limits

The following table lists authorized emissions and maximum power. Power must be determined by direct measurement.

Class of station	Frequency band/ frequency	Authorized emission(s) [2]	Maximum power [1]
Aeronautical advisory	VHF	A3E	10 watts[3]
Aeronautical multicom	VHF	A3E	10 watts
Aeronautical search and rescue	VHF	A3E	10 watts
Aviation support	VHF	A3E	50 watts
Airport control tower	VHF	A3E	50 watts
Aeronautical utility mobile	VHF	A3E	10 watts
Aircraft	VHF	A3E	55 watts

Notes:
(1) The power is measured at the transmitter output terminals and the type of power is determined according to the emission designator as follows:
(i) Mean power (pY) for amplitude modulated emissions and transmitting both sidebands using unmodulated full carrier.
(ii) Peak envelope power (pX) for all emission designators other than those referred to in paragraph (i) of this note.
(2) Excludes automatic link establishment.
(3) Power is limited to 0.5 watt, but may not exceed 2 watts when station is used in an automatic unattended mode.

5.5.2. Method of Measurements

Refer to Exhibit 8, Section 8.1 of this report for measurement details.

5.5.3. Test Data

13.75 V DC

Channel	Frequencies MHz	25KHz/ 8.33KHz	Actual Power dBm	Power Rating dBm	Power Rating Watts	Actual Power Watts
1	118.025	25KHz	39.71	39.54	9	9.35
2	127.525	25KHz	39.68	39.54	9	9.29
3	136.975	25KHz	39.63	39.54	9	9.18
4	118.030	8.33KHz	39.71	39.54	9	9.35
5	127.530	8.33KHz	39.68	39.54	9	9.29
6	136.980	8.33KHz	39.62	39.54	9	9.16

27.5 V DC

Channel	Frequencies MHz	25KHz/ 8.33KHz	Actual Power dBm	Power Rating dBm	Power Rating Watts	Actual Power Watts
1	118.025	25KHz	39.71	39.54	9	9.35
2	127.525	25KHz	39.69	39.54	9	9.31
3	136.975	25KHz	39.62	39.54	9	9.16
4	118.030	8.33KHz	39.71	39.54	9	9.35
5	127.530	8.33KHz	39.68	39.54	9	9.29
6	136.980	8.33KHz	39.63	39.54	9	9.18

5.6. OCCUPIED BANDWIDTH AND EMISSION LIMITATIONS [§§ 2.1049, 87.135 & 87.139]

5.6.1. Limits

§ 87.139(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the frequency bands 1435–1535 MHz and 2310–2390 MHz or digital modulation (G7D) for differential GPS, the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

(1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;

(2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.

(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10}$ pY dB.

5.6.2. Method of Measurements

Refer to Exhibit 8, Section 8.4 of this report for measurement details.

5.6.3. Test Data

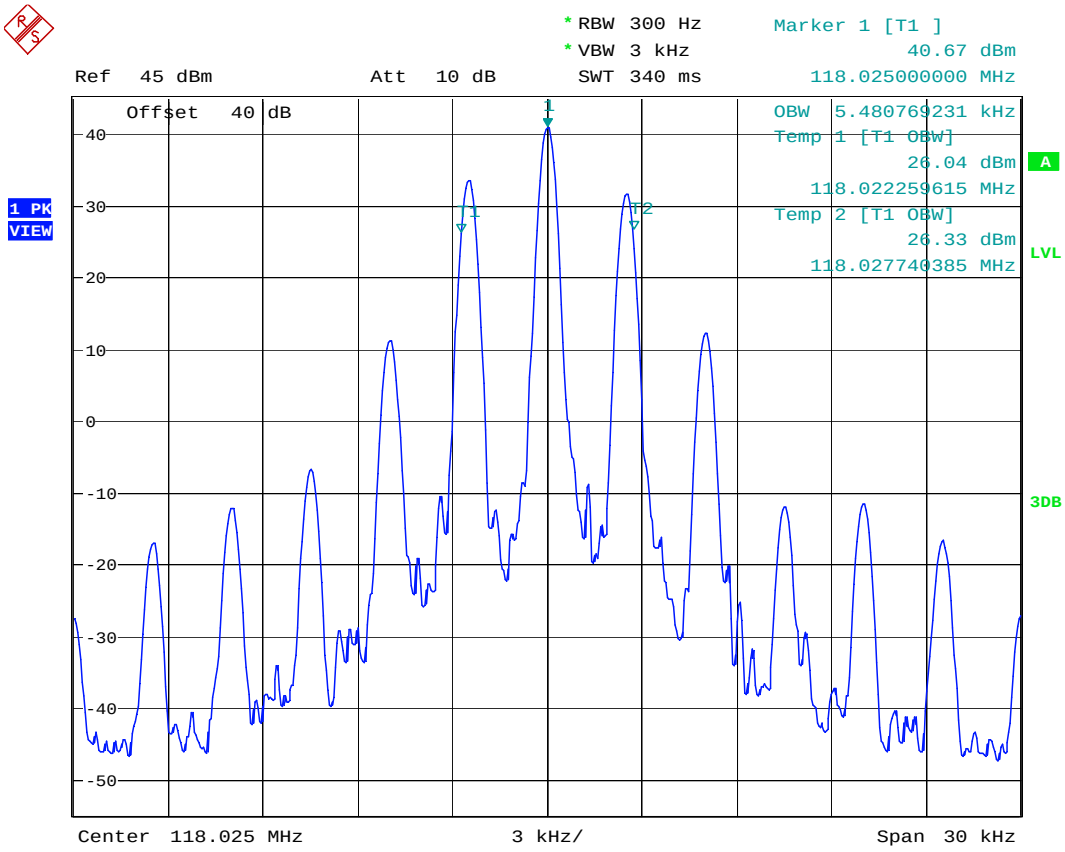
5.6.3.1. 99% Occupied Bandwidth

Frequency (MHz)	*Measured 99% OBW (kHz)	Authorized Bandwidth (kHz)
118.025	5.48	25.0
127.525	5.53	25.0
136.975	5.48	25.0
118.030	5.38	8.33
127.530	5.43	8.33
136.980	5.38	8.33

* See the following plots for details of measurements

5.6.3.2. Configuration: 99%OBW, 118.025 MHz, 25 KHz

OBW: 5.48 KHz



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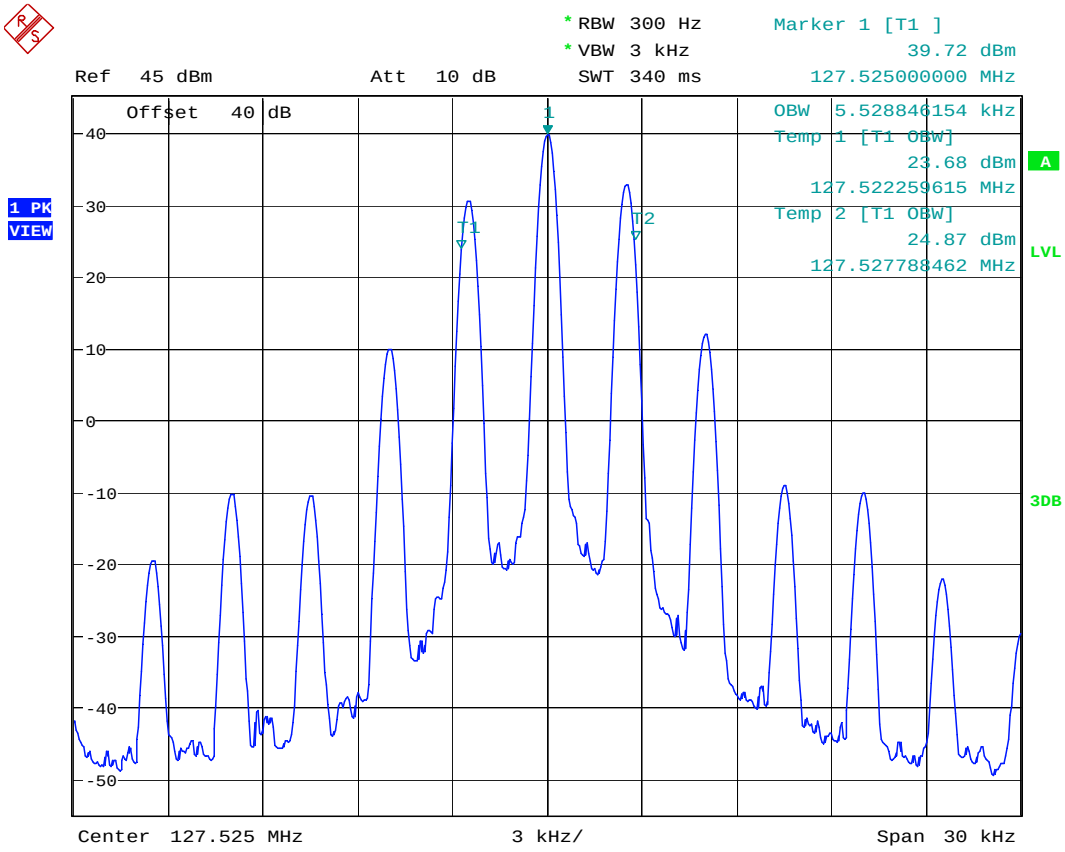
5.6.3.3. Configuration: 99%OBW, 127.525 MHz, 25 KHz

OBW: 5.53 KHz



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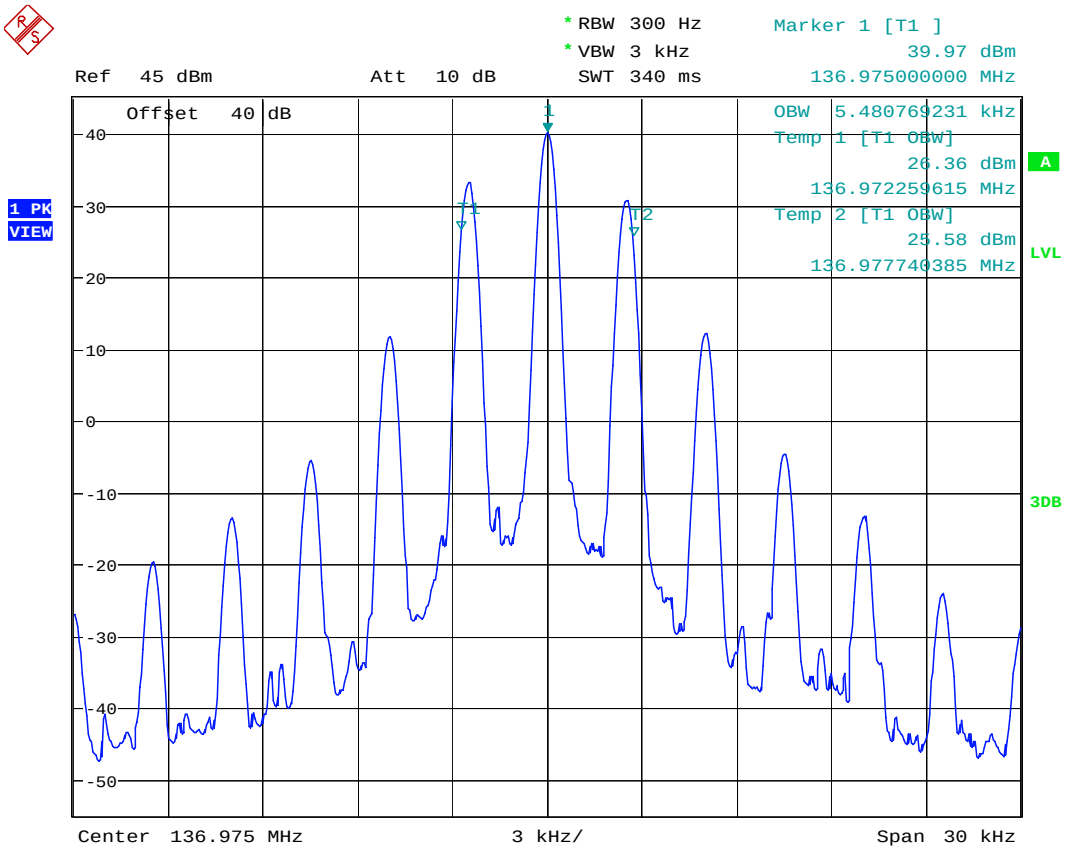
5.6.3.4. Configuration: 99%OBW, 136.975 MHz, 25 KHz

OBW: 5.48 KHz



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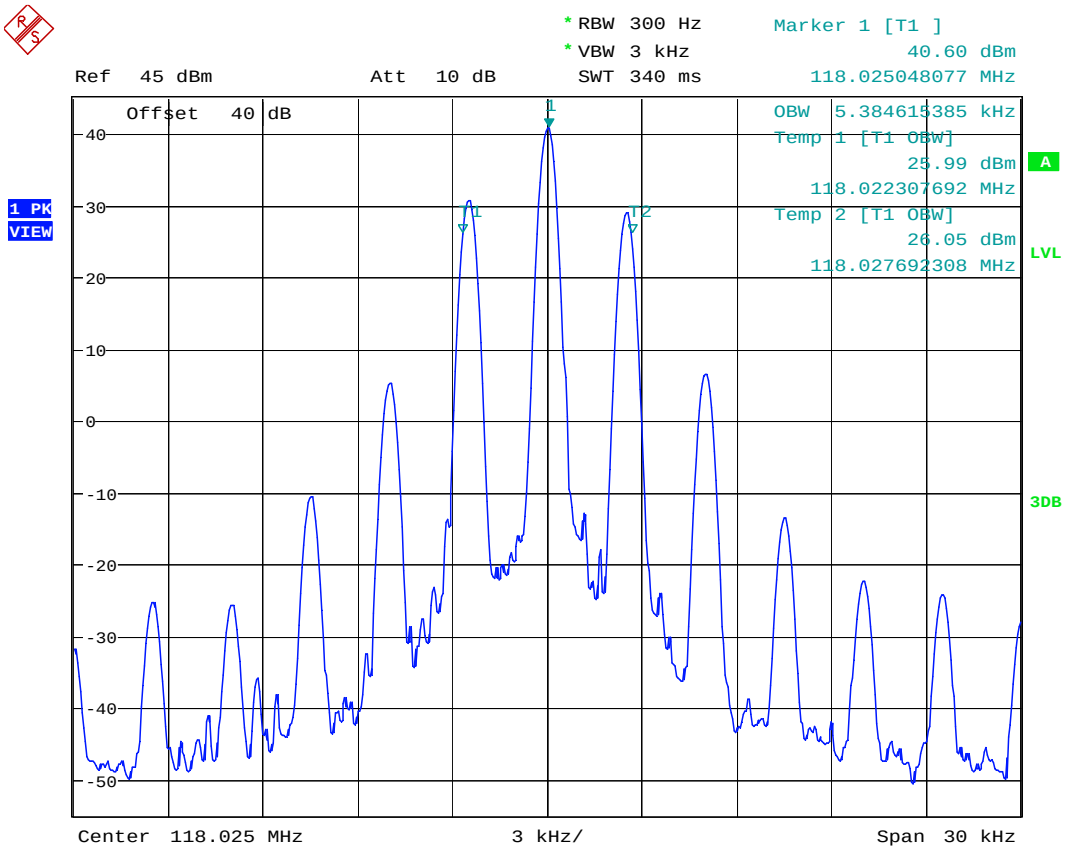
5.6.3.5. Configuration: 99%OBW, 118.030 MHz, 8.33 KHz

OBW: 5.38 KHz



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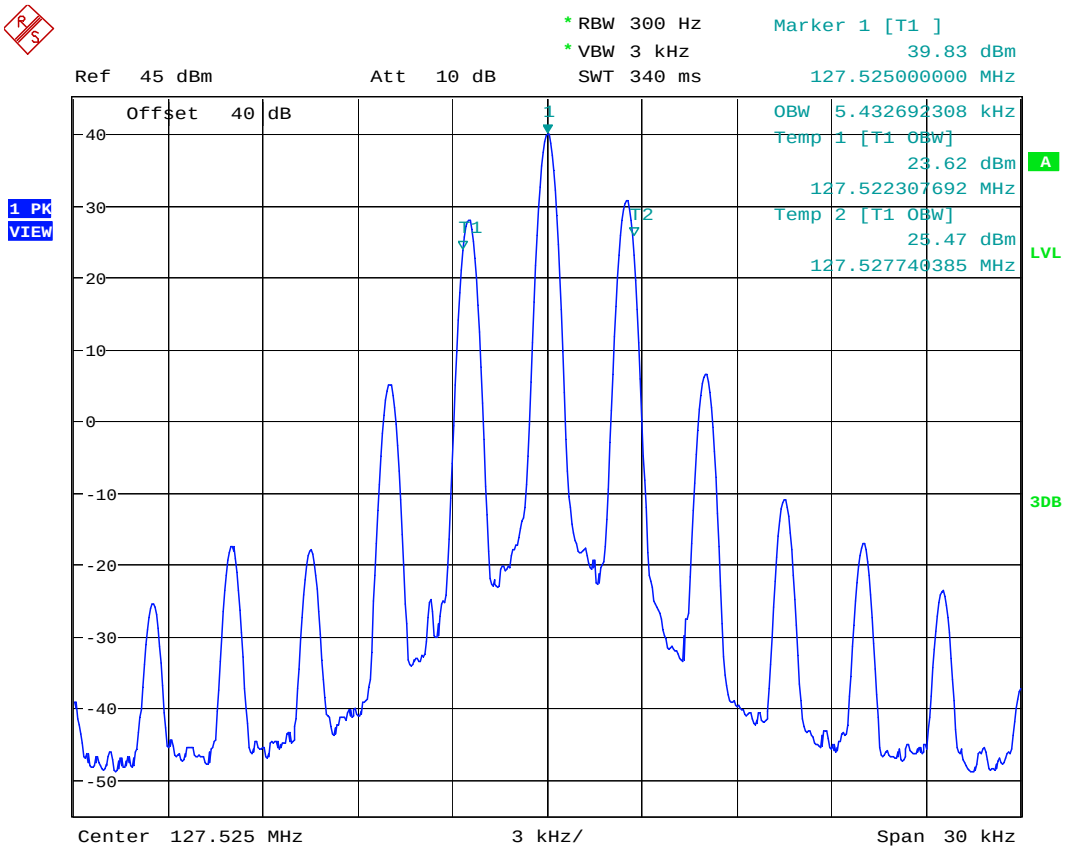
5.6.3.6. Configuration: 99%OBW, 127.530 MHz, 8.33 KHz

OBW: 5.43 KHz



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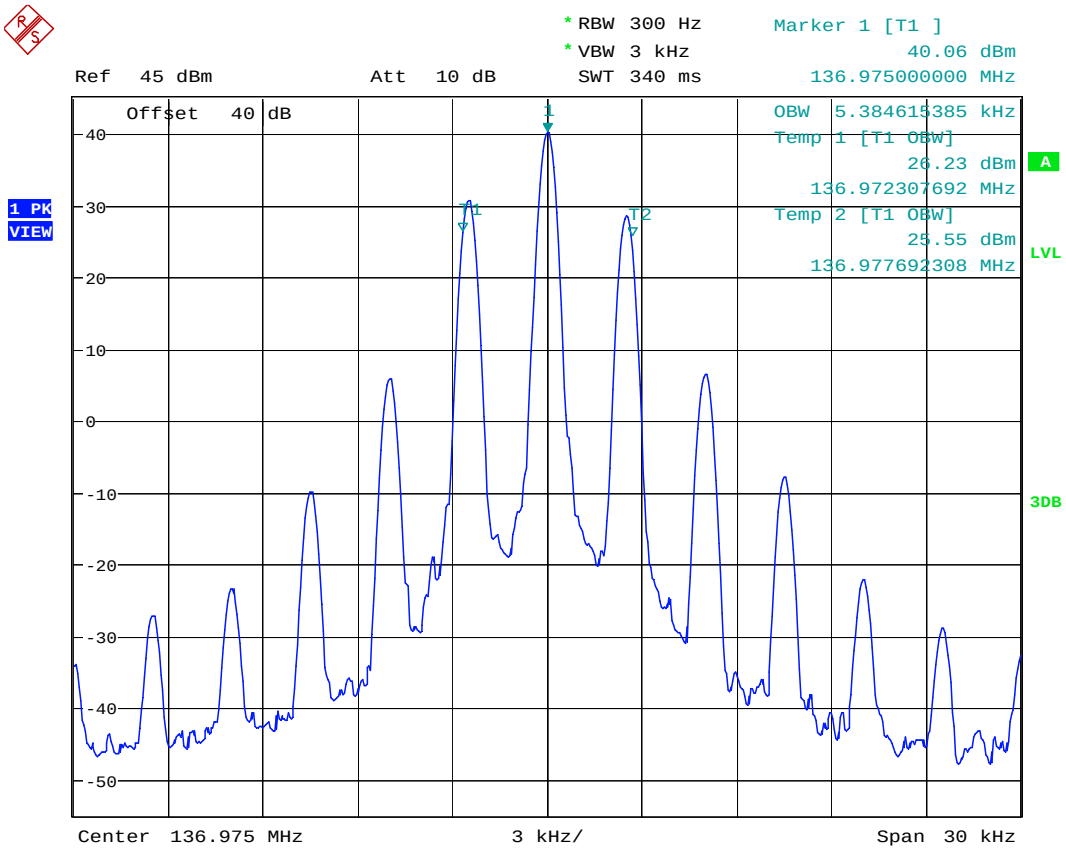
5.6.3.7. Configuration: 99%OBW, 136.980 MHz, 8.33 KHz

OBW: 5.38 KHz



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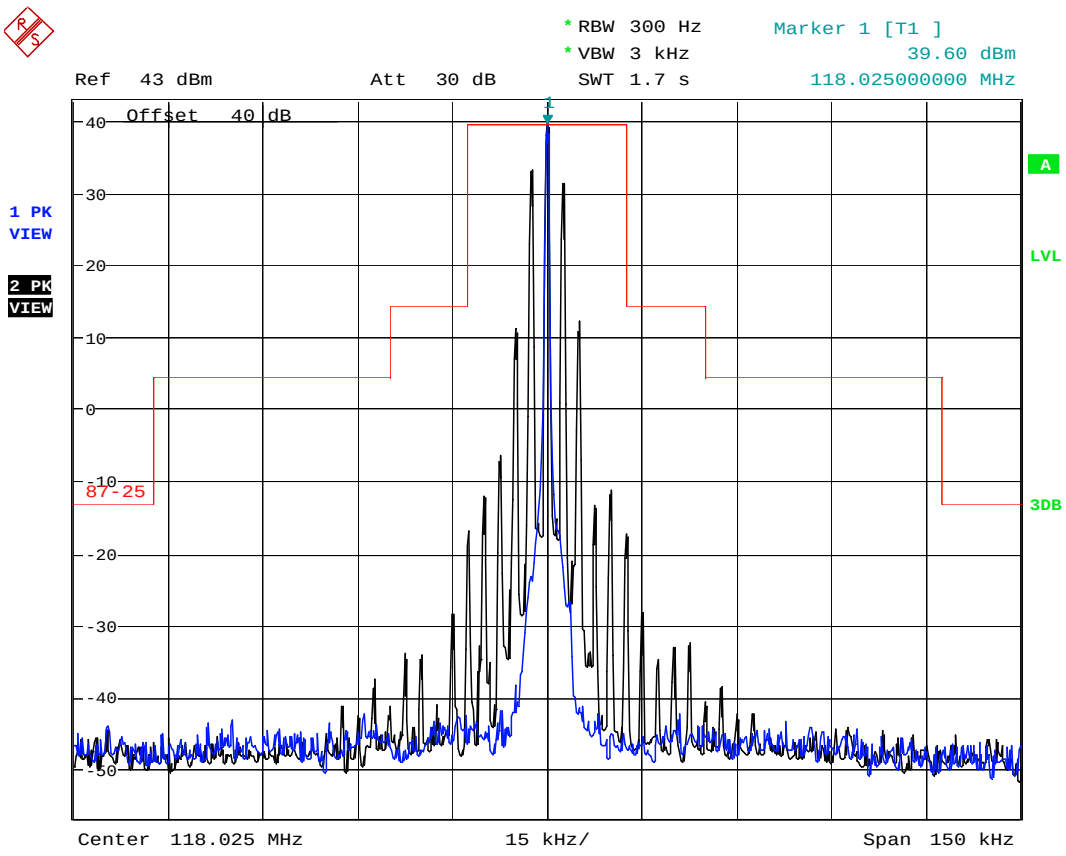
5.6.3.8. Configuration: Emission limitations, 118.025 MHz, 25 KHz



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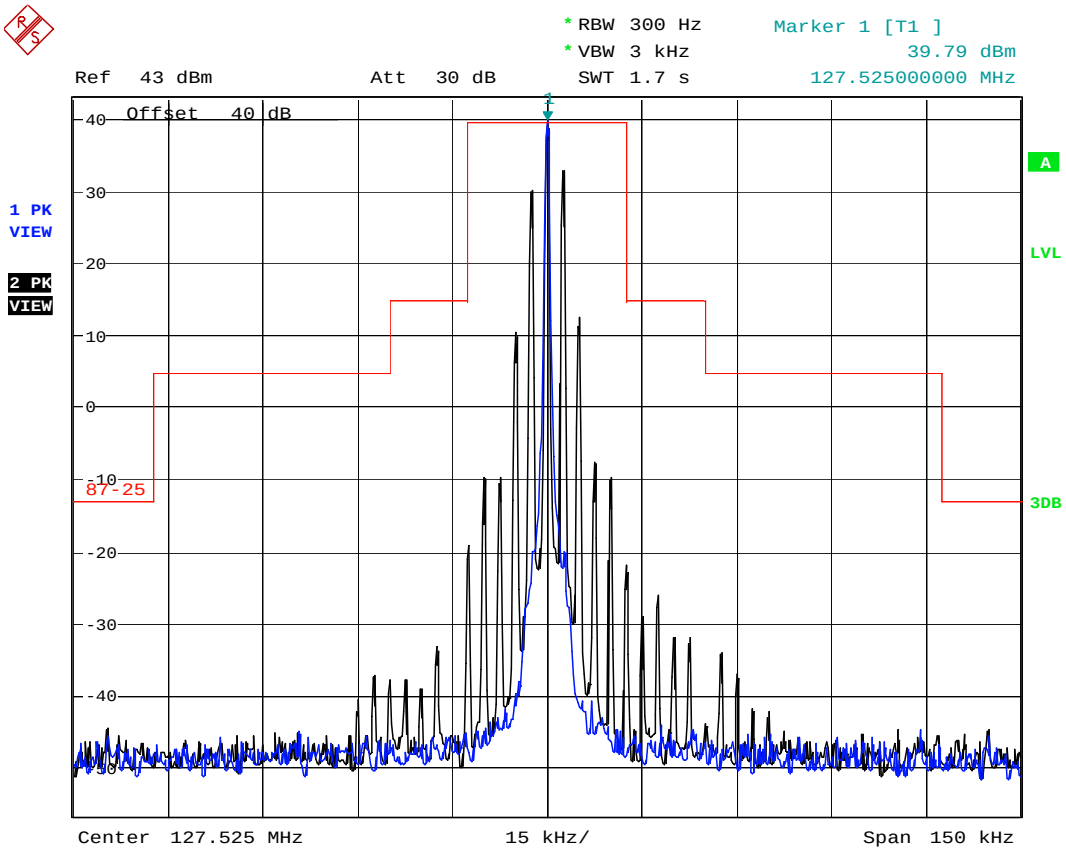
5.6.3.9. Configuration: Emission Limitations, 127.525 MHz, 25 KHz



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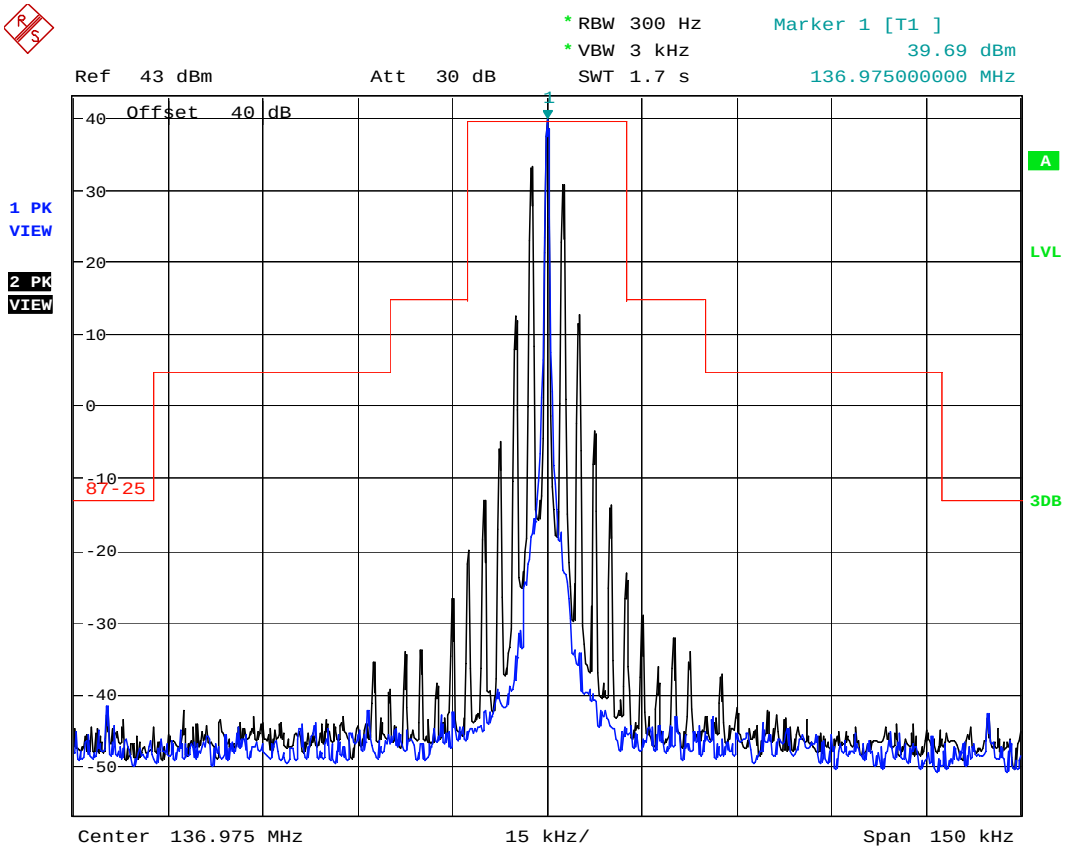
5.6.3.10. Configuration: Emission Limitations, 136.975 MHz, 25 KHz



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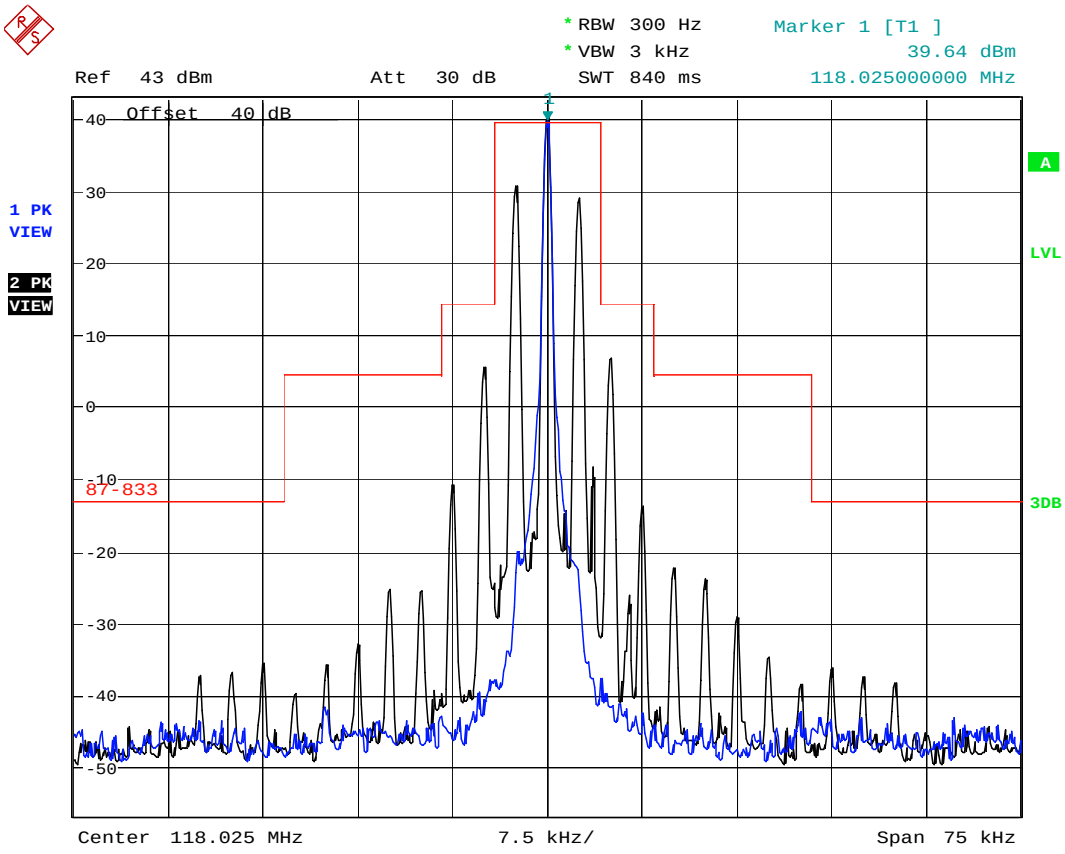
5.6.3.11. Configuration: Emission Limitations, 118.030 MHz, 8.33 KHz



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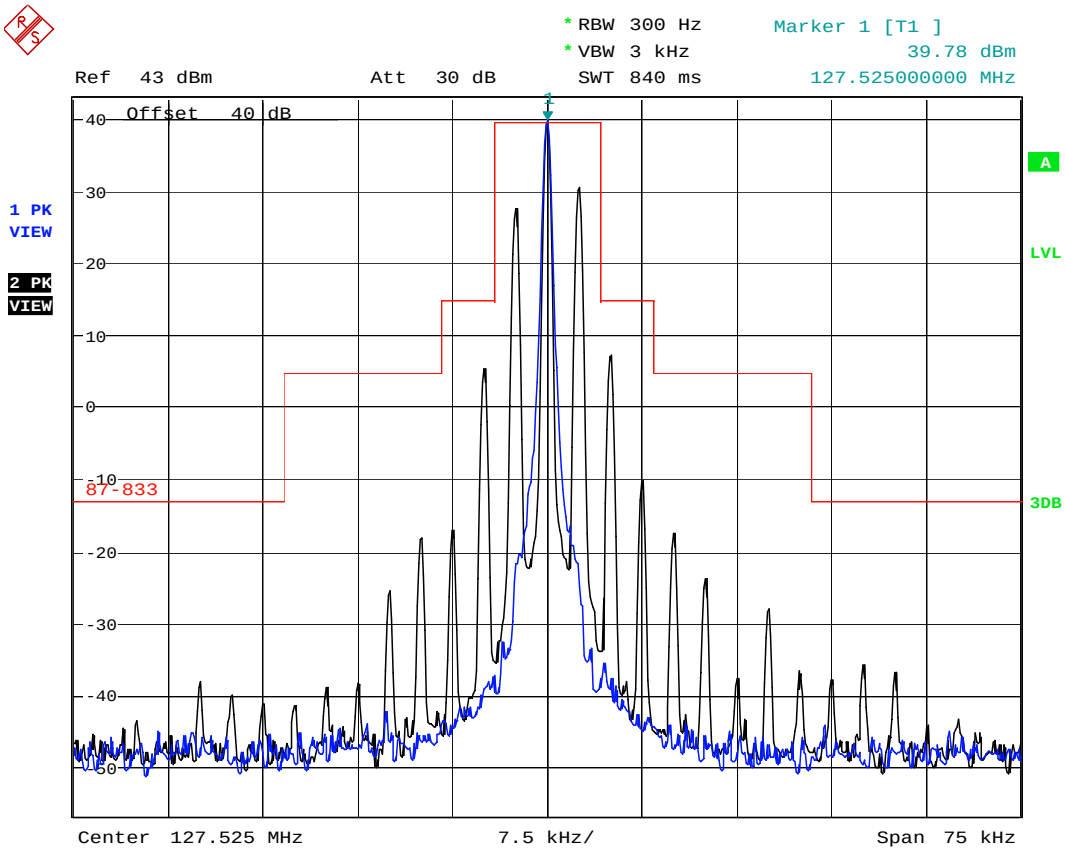
5.6.3.12. Configuration: Emission Limitations, 127.530 MHz, 8.33 KHz



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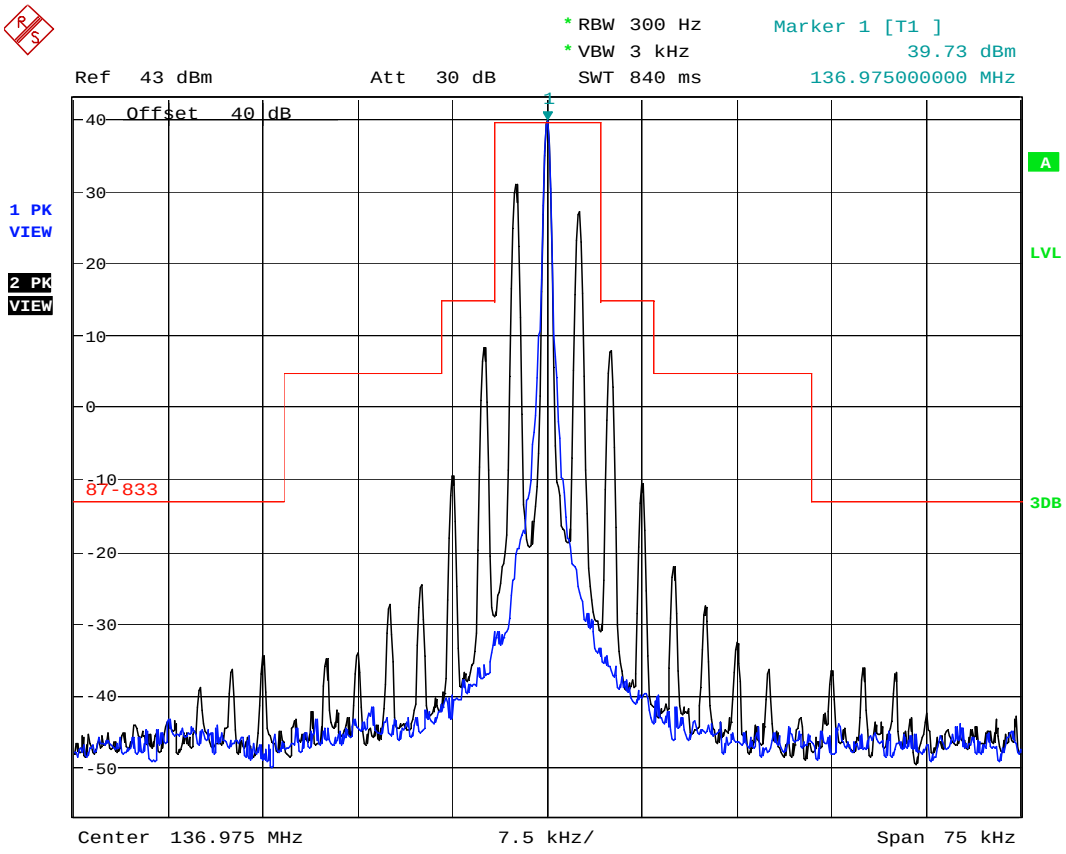
5.6.3.13. Configuration: Emission Limitations, 136.980 MHz, 8.33 KHz



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5.7. MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE [§§ 2.1047(a) & 87.141(a)]

5.7.1. Limits

87.141(a) When A3E emission is used, the modulation percentage must not exceed 100 percent. This requirement does not apply to emergency locator transmitters or survival craft transmitters.

(f) Each frequency modulated transmitter equipped with a modulation limiter must have a low pass filter between the modulation limiter and the modulated stage. At audio frequencies between 3 kHz and 15 kHz, the filter must have an attenuation greater than the attenuation at 1 kHz by at least 40 $\log_{10}$ (f/3) db where "f" is the frequency in kilohertz. Above 15 kHz, the attenuation must be at least 28 db greater than the attenuation at 1 kHz.

5.7.2. Method of Measurements

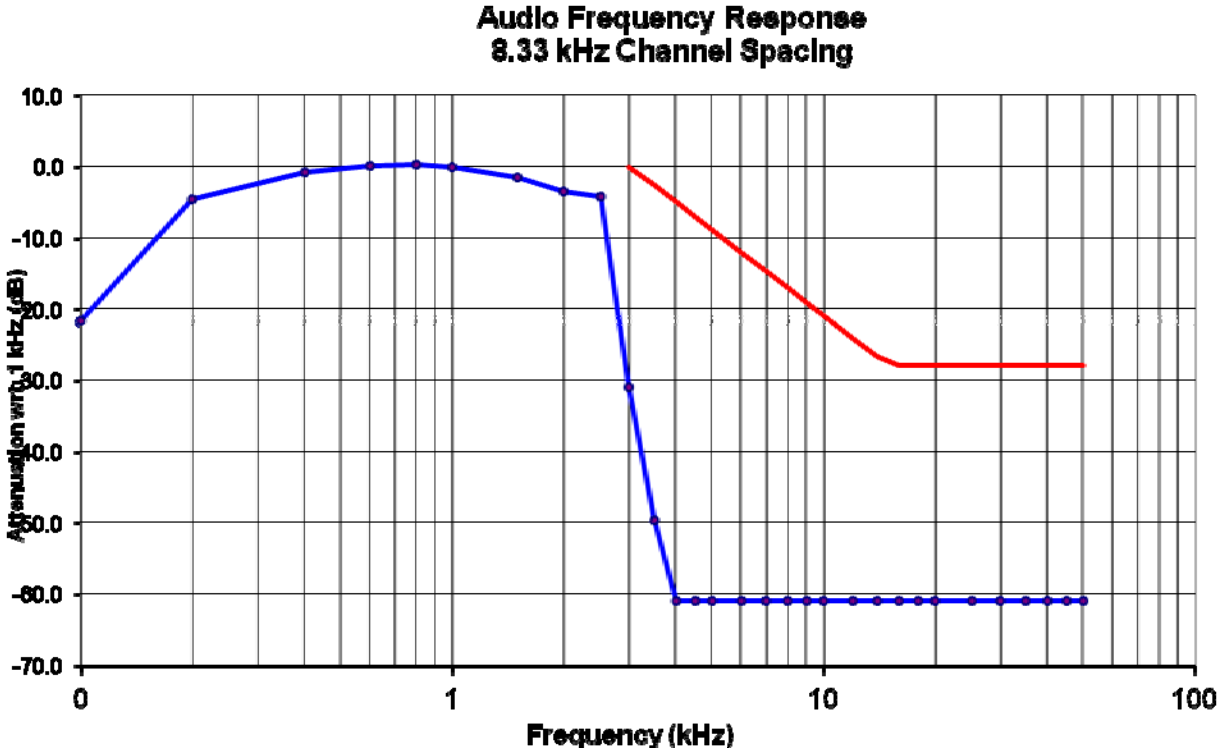
The rated audio input signal was applied to the input of the audio lowpass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT (Audio) spectrum analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 kHz.

5.7.3. Test Data

Note: Due to the difficulty of measuring the frequency response of the internal low-pass filter, the frequency response of all modulation states was performed to show the roll-off at 3 kHz in comparison with FCC Limit for audio low-pass filter.

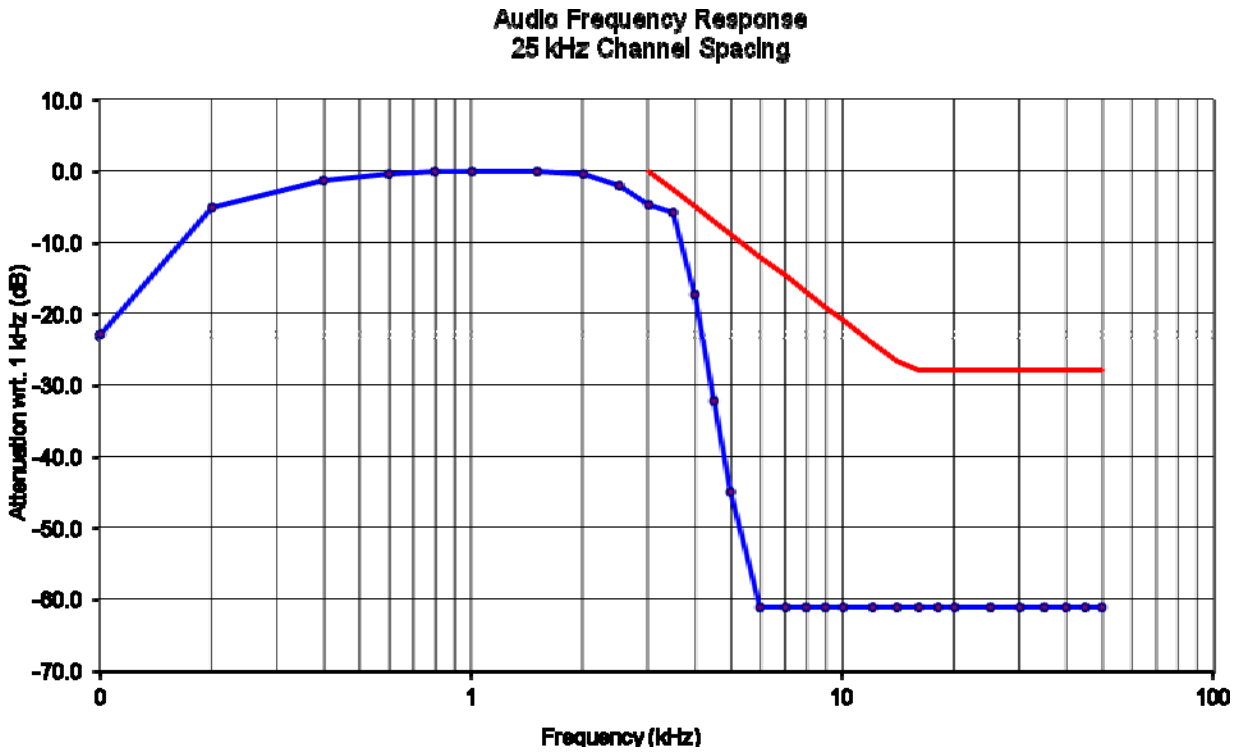
5.7.3.1. Audio Frequency Response of All Modulation States for 8.33 kHz Channel Spacing

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation wrt. 1 kHz (dB)	Recommended Attenuation wrt. 1 kHz (dB)
0.1	-55.6	-30.80	24.8	-21.7	--
0.2	-55.6	-13.63	42.0	-4.5	--
0.4	-55.6	-9.82	45.8	-0.7	--
0.6	-55.6	-9.02	46.6	0.1	--
0.8	-55.6	-8.88	46.7	0.2	--
1.0	-55.6	-9.09	46.5	0.0	--
1.5	-55.6	-10.58	45.0	-1.5	--
2.0	-55.6	-12.52	43.1	-3.4	--
2.5	-55.6	-13.33	42.3	-4.2	--
3.0	-55.6	-40.08	15.5	-31.0	0
3.5	-55.6	-58.83	-3.2	-49.7	-3
4.0	-55.6	-70.00	-14.4	-60.9	-5
4.5	-55.6	-70.00	-14.4	-60.9	-7
5.0	-55.6	-70.00	-14.4	-60.9	-9
6.0	-55.6	-70.00	-14.4	-60.9	-12
7.0	-55.6	-70.00	-14.4	-60.9	-15
8.0	-55.6	-70.00	-14.4	-60.9	-17
9.0	-55.6	-70.00	-14.4	-60.9	-19
10.0	-55.6	-70.00	-14.4	-60.9	-21
12.0	-55.6	-70.00	-14.4	-60.9	-24
14.0	-55.6	-70.00	-14.4	-60.9	-27
16.0	-55.6	-70.00	-14.4	-60.9	-28
18.0	-55.6	-70.00	-14.4	-60.9	-28
20.0	-55.6	-70.00	-14.4	-60.9	-28
25.0	-55.6	-70.00	-14.4	-60.9	-28
30.0	-55.6	-70.00	-14.4	-60.9	-28
35.0	-55.6	-70.00	-14.4	-60.9	-28
40.0	-55.6	-70.00	-14.4	-60.9	-28
45.0	-55.6	-70.00	-14.4	-60.9	-28
50.0	-55.6	-70.00	-14.4	-60.9	-28



5.7.3.2. Audio Frequency Response of All Modulation States for 25 kHz Channel Spacing

Frequency (kHz)	Audio IN (dBV)	Audio OUT (dBV)	Attenuation (OUT - IN) (dB)	Attenuation wrt. 1 kHz (dB)	Recommended Attenuation wrt. 1 kHz (dB)
0.1	-55.76	-31.66	24.1	-22.8	--
0.2	-55.76	-13.92	41.8	-5.1	--
0.4	-55.76	-10.10	45.7	-1.3	--
0.6	-55.76	-9.28	46.5	-0.5	--
0.8	-55.76	-9.00	46.8	-0.2	--
1.0	-55.76	-8.83	46.9	0.0	--
1.5	-55.76	-8.87	46.9	0.0	--
2.0	-55.76	-9.19	46.6	-0.4	--
2.5	-55.76	-10.90	44.9	-2.1	--
3.0	-55.76	-13.59	42.2	-4.8	0
3.5	-55.76	-14.68	41.1	-5.9	-3
4.0	-55.76	-26.10	29.7	-17.3	-5
4.5	-55.76	-41.15	14.6	-32.3	-7
5.0	-55.76	-53.82	1.9	-45.0	-9
6.0	-55.76	-70.00	-14.2	-61.2	-12
7.0	-55.76	-70.00	-14.2	-61.2	-15
8.0	-55.76	-70.00	-14.2	-61.2	-17
9.0	-55.76	-70.00	-14.2	-61.2	-19
10.0	-55.76	-70.00	-14.2	-61.2	-21
12.0	-55.76	-70.00	-14.2	-61.2	-24
14.0	-55.76	-70.00	-14.2	-61.2	-27
16.0	-55.76	-70.00	-14.2	-61.2	-28
18.0	-55.76	-70.00	-14.2	-61.2	-28
20.0	-55.76	-70.00	-14.2	-61.2	-28
25.0	-55.76	-70.00	-14.2	-61.2	-28
30.0	-55.76	-70.00	-14.2	-61.2	-28
35.0	-55.76	-70.00	-14.2	-61.2	-28
40.0	-55.76	-70.00	-14.2	-61.2	-28
45.0	-55.76	-70.00	-14.2	-61.2	-28
50.0	-55.76	-70.00	-14.2	-61.2	-28



5.8. MODULATION CHARACTERISTICS – MODULATION LIMITING [§§ 2.1047(b) & 87.141]

§ 87.141

(a) When A3E emission is used, the modulation percentage must not exceed 100 percent. This requirement does not apply to emergency locator transmitters or survival craft transmitters.

(c) If any licensed radiotelephone transmitter causes harmful interference to any authorized radio service because of excessive modulation, the Commission will require the use of the transmitter to be discontinued until it is rendered capable of automatically preventing modulation in excess of 100 percent.

5.8.1. 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.

5.8.2. Test Data

5.8.2.1. Modulation Limiting at 8.33 kHz Channel Spacing

Modulating Signal Level	Peak Modulation depth %					Maximum Limit
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	(%)
1	0.87	28.36	28.85	1.31	0.52	100
2	12.22	57.90	59.60	2.11	0.53	100
4	25.34	75.80	77.90	2.71	0.48	100
6	26.32	76.10	78.40	2.64	0.29	100
8	25.09	75.80	78.10	2.55	0.22	100
10	24.66	75.70	77.90	2.53	0.21	100
15	24.50	75.60	77.80	2.51	0.21	100
20	24.34	75.40	77.60	2.52	0.17	100
25	24.25	75.30	77.60	2.54	0.17	100
30	24.17	75.30	77.50	2.49	0.16	100
35	24.16	75.20	77.40	2.51	0.17	100
40	24.06	75.10	77.40	2.51	0.17	100
45	24.06	75.10	77.40	2.50	0.17	100
50	24.03	75.00	77.30	2.51	0.16	100

Voice Signal Input Level = STD MOD Level + 16 dB
= 1.66mV+ 16 dB
= 20.40 dB(m Vrms)
= 10.47 mVrms

Standard Modulation Level measured at 50% Modulation @ 1.0 kHz.

Modulation Frequency (kHz	Peak Depth (%)	Maximum Limit (%)
0.1	26.86	100.0
0.2	53.60	100.0
0.4	72.40	100.0
0.6	79.20	100.0
0.8	80.40	100.0
1.0	78.60	100.0
1.2	75.40	100.0
1.4	71.30	100.0
1.6	64.80	100.0
1.8	58.70	100.0
2.0	56.70	100.0
2.5	52.60	100.0
3.0	2.50	100.0
3.5	0.44	100.0
4.0	0.23	100.0
4.5	0.20	100.0
5.0	0.20	100.0
6.0	0.22	100.0
7.0	0.24	100.0
8.0	0.21	100.0
9.0	0.22	100.0
10.0	0.22	100.0

5.8.2.2. Modulation Limiting at 25 kHz Channel Spacing

Modulating Signal Level	Peak Modulation depth %					Maximum Limit
(mVrms)	0.1 kHz	0.5 kHz	1.0 kHz	3.0 kHz	5.0 kHz	%
1	1.14	28.18	30.72	18.88	1.24	100
2	13.57	56.80	62.50	37.88	1.20	100
4	24.47	74.10	81.00	53.00	1.05	100
6	24.06	74.30	81.50	53.00	0.88	100
8	23.67	74.00	81.10	53.10	0.81	100
10	23.56	73.90	81.00	53.10	0.84	100
15	23.94	73.70	80.80	53.20	0.75	100
20	23.58	73.70	80.60	53.30	0.75	100
25	23.41	73.60	80.60	53.20	0.72	100
30	23.32	73.50	80.50	53.20	0.72	100
35	23.27	73.40	80.30	53.10	0.72	100
40	23.23	73.40	80.30	52.90	0.71	100
45	23.18	73.30	80.30	52.80	0.71	100
50	23.16	73.30	80.30	52.80	0.71	100

Voice Signal Input Level = STD MOD Level + 16 dB
= 1.63 mV + 16 dB
= 20.24 dB(mVrms)
= 10.28 mVrms

Standard Modulation Level measured at 50% Modulation @ 1.0 kHz.

Modulation Frequency (kHz	Peak Depth (%)	Maximum Limit (%)
0.1	24.32	100.0
0.2	51.40	100.0
0.4	70.30	100.0
0.6	76.90	100.0
0.8	79.60	100.0
1.0	81.40	100.0
1.2	82.40	100.0
1.4	82.60	100.0
1.6	82.40	100.0
1.8	82.00	100.0
2.0	80.90	100.0
2.5	67.40	100.0
3.0	51.40	100.0
3.5	46.10	100.0
4.0	12.78	100.0
4.5	2.44	100.0
5.0	0.73	100.0
6.0	0.26	100.0
7.0	0.23	100.0
8.0	0.22	100.0
9.0	0.23	100.0
10.0	0.23	100.0

5.9. FIELD STRENGTH OF SPURIOUS EMISSIONS [§§ 2.1053, 87.139]

5.9.1. Limits @ FCC 87.139

§ 87.139(a)(3) - When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB.

5.9.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = Pc dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

5.9.3. Test Data

Remark(s):

- The emissions were scanned from 30 MHz to 6 GHz; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.
- There was no difference in spurious/harmonic emissions on the pre-scans for different channel spacing and input voltage levels. Therefore, the RF spurious/harmonic emissions in this section would be performed for 25 KHz channel spacing with 27.5 VDC level and limit of 43 + 10 log10 pY dB applied for worst case.

Carrier Frequency:		118.025 MHz				
Power:		9.35 W				
Limit:		-13 dBm				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
1062.225	66.77	Peak	H	-31.75	-13	-18.75

* All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		127.525 MHz				
Power:		9.29 W				
Limit:		-13 dBm				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
1275.250	68.95	Peak	H	-26.22	-13	-13.22

* All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		136.975 MHz				
Power:		9.18 W				
Limit:		-13 dBm				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP (dBm)**	**Limit (dBm)**	**Margin (dB)**
1232.775	65.75	Peak	V	-31.36	-13	-18.36
1232.775	70.65	Peak	H	-25.29	-13	-12.29

* All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.10. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§§ 2.1051, 87.139]

5.10.1. Limits

§§ 87.139(a)(3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB.

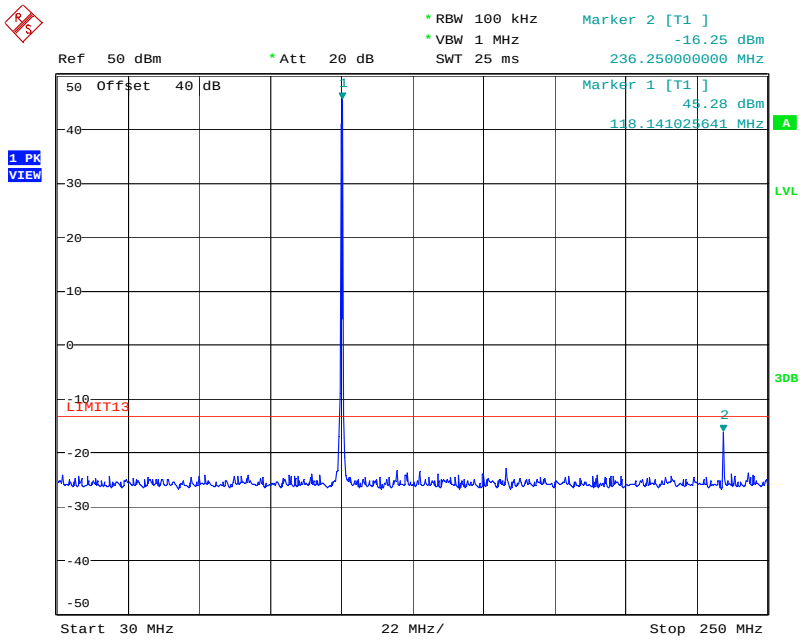
5.10.2. Method of Measurements

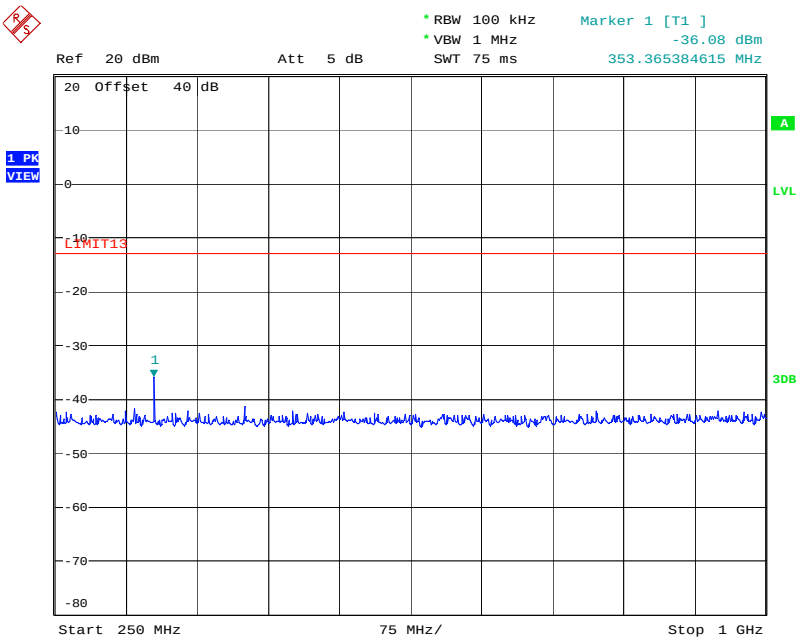
Refer to Exhibit 8 of this report for measurement method.

5.10.3. Test Data

Note: There was no difference in spurious/harmonic emissions on the pre-scans for different channel spacing and input voltage levels. Therefore, the RF spurious/harmonic emissions in this section would be performed for 25 KHz channel spacing with 27.5 VDC level and limit of 43 + 10 log10 pY dB applied for worst case.

5.10.3.1. Configuration: Tx Conducted, 118.025 MHz, 25 KHz





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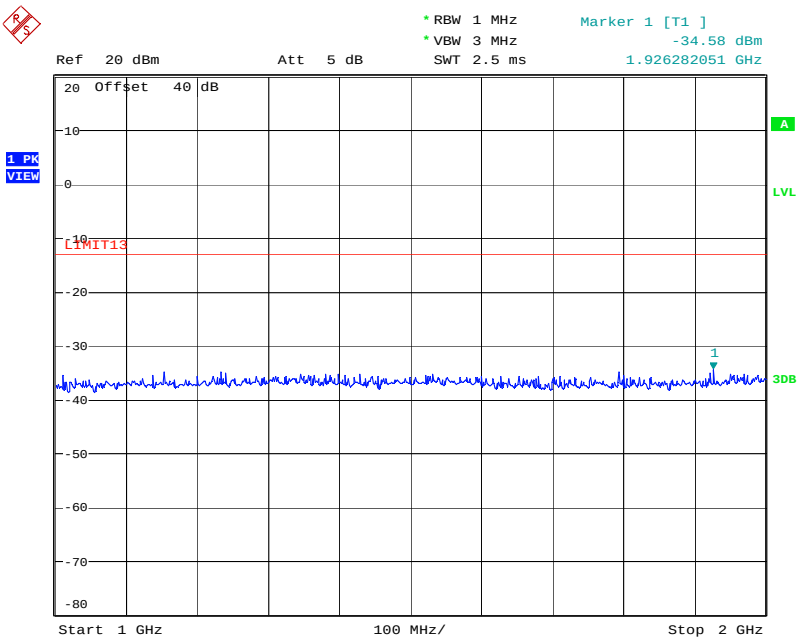

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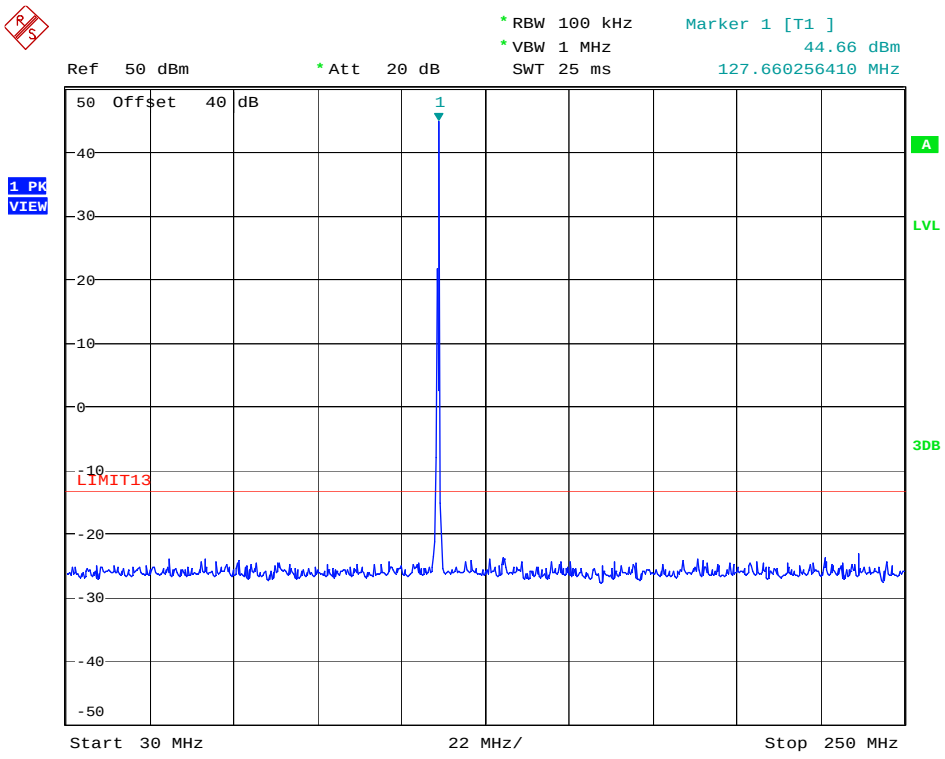
5.10.3.2. Configuration: Tx Conducted, 127.525 MHz, 25 KHz



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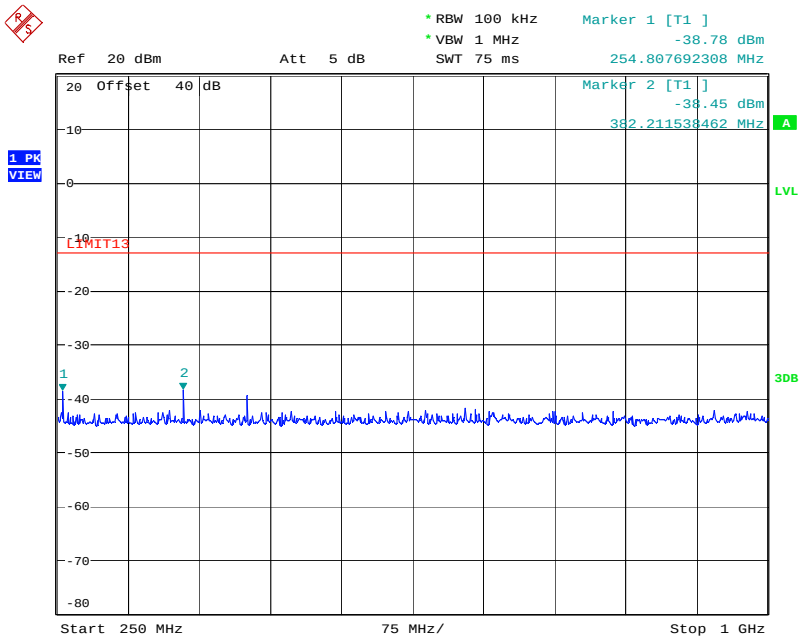

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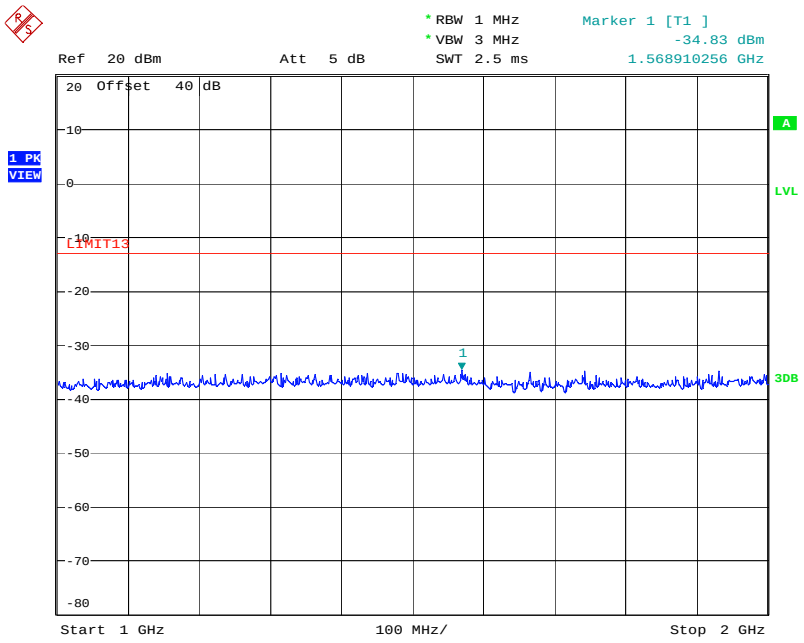

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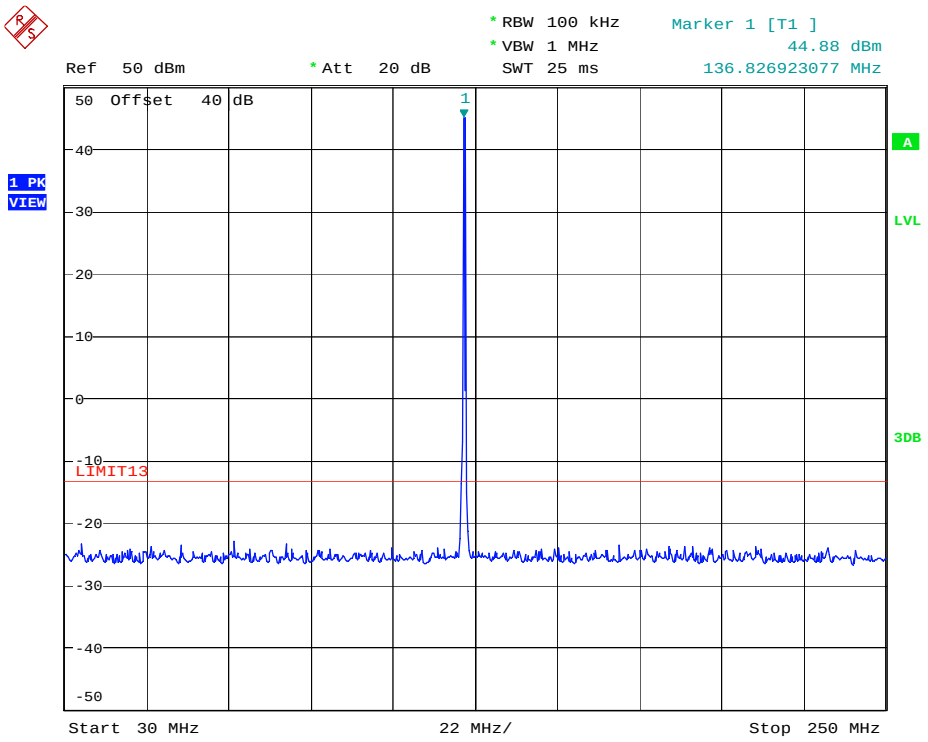
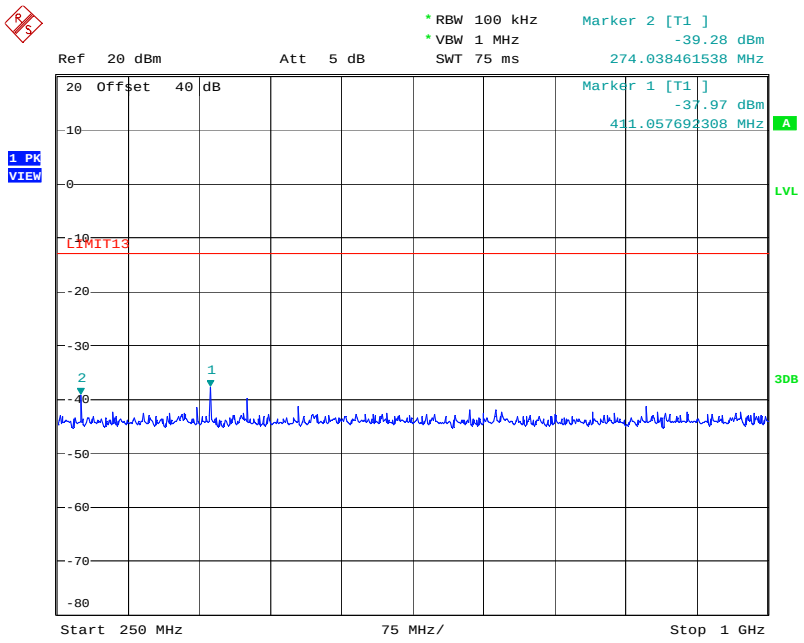
5.10.3.3. Configuration: Tx Conducted, 136.975 MHz, 25 KHz





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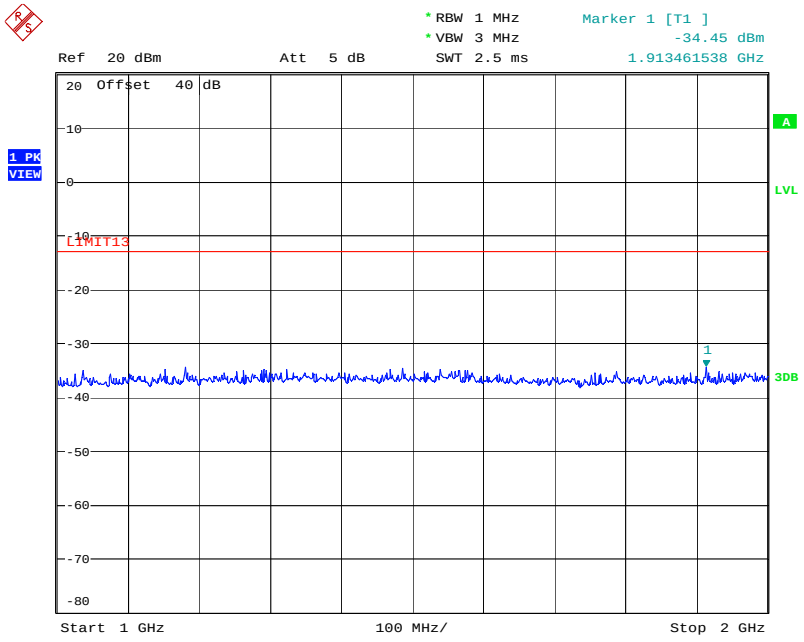

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5.11. FREQUECNY STABILITY [§§ 2.1055 & 87.133]

5.11.1. Limits

§ 87.133 The carrier frequency of each station must be maintained within the tolerance in the following table:

Frequency band (lower limit exclusive, upper limit inclusive), and categories of station	Tolerance (ppm)
(5) Band - 108 to 137 MHz: Aircraft and other mobile stations in the Aviation Services.	*30

* For emissions G1D and G7D, the tolerance is 5 parts per 10^6.

5.11.2. Method of Measurements

47 CFR 2.1049, ANSI C63.26 and TIA-603-E

5.11.3. Test Data

Center Frequency:	118.025 MHz
Full Power Level:	39.22 dBm
Frequency Tolerance Limit (Worst Case):	30 ppm or 3540.75 Hz (Manufacturer's rating: ± 5 ppm)
Max. Frequency Tolerance Measured:	71 Hz or 0.60 ppm
Input Voltage Rating:	13.75 / 27.5 V DC

Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 27.5 VDC	Supply Voltage (Lowest, 85% of 13.75V) 11.6875 VDC	Supply Voltage (115% of Nominal) 31.625 VDC
-30	41	--	--
-20	28	--	--
-10	22	--	--
0	27	--	--
10	22	--	--
20	17	17	17
30	27	--	--
40	38	--	--
50	62	--	--
60	71	--	--

5.12. EXPOSURE OF HUMANS TO RF FIELD [[§§ 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.12.1. Method of Measurements

See RSS-102 & FCC 47 CFR §§ 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements, the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

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

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

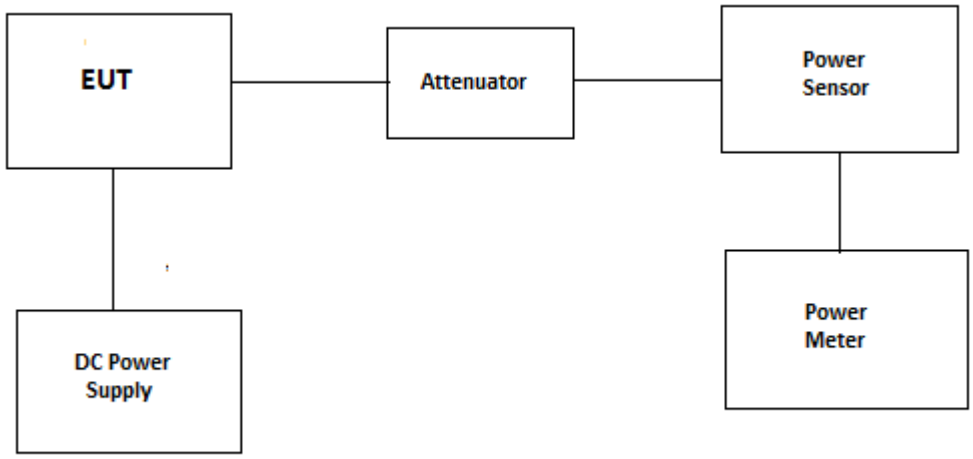
5.12.2. RF Evaluation

Frequency (MHz)	Max. Conducted Power (dBm)	Max. Antenna Gain (dBi)	EIRP (dBm)	EIRP* (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm^2)	MPE Limit (mW/cm2)
118.000	39.71	0	39.71	9350/2*	56	0.1187	0.2

*50% duty cycle applied

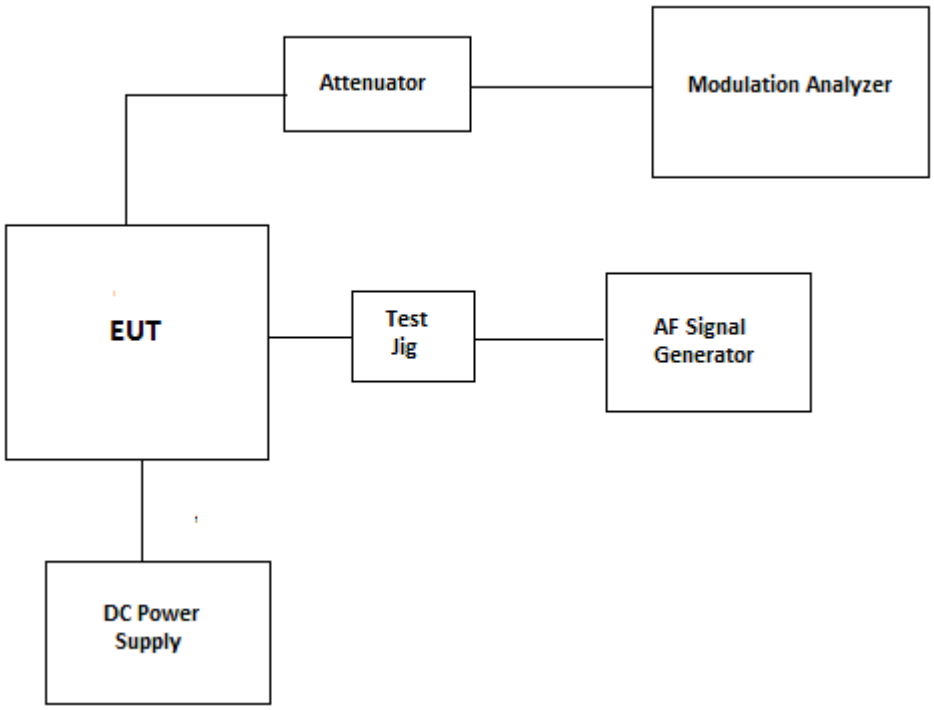
EXHIBIT 6. TEST EQUIPMENT LIST AND SETUP

6.1. Conducted Power



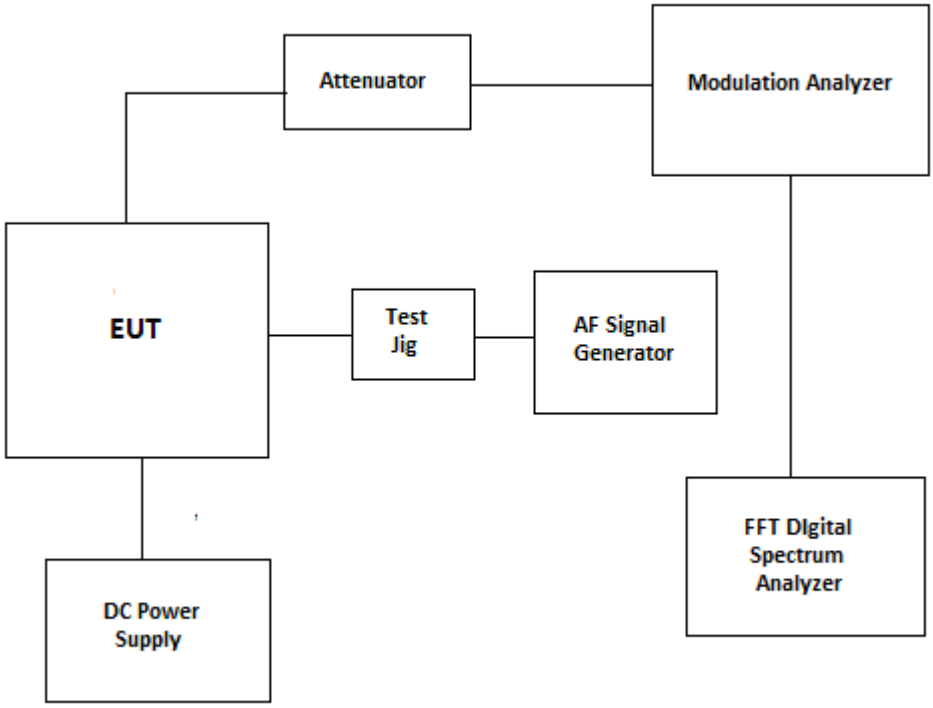
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Power Meter	HP	436A	2709A27515	100KHz-sensor dependant	04 May 2019
Power Sensor	HP	8482A	MY41172054	10MHz-18GHz	26 Oct 2019
Attenuator	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.2. Modulation Limit



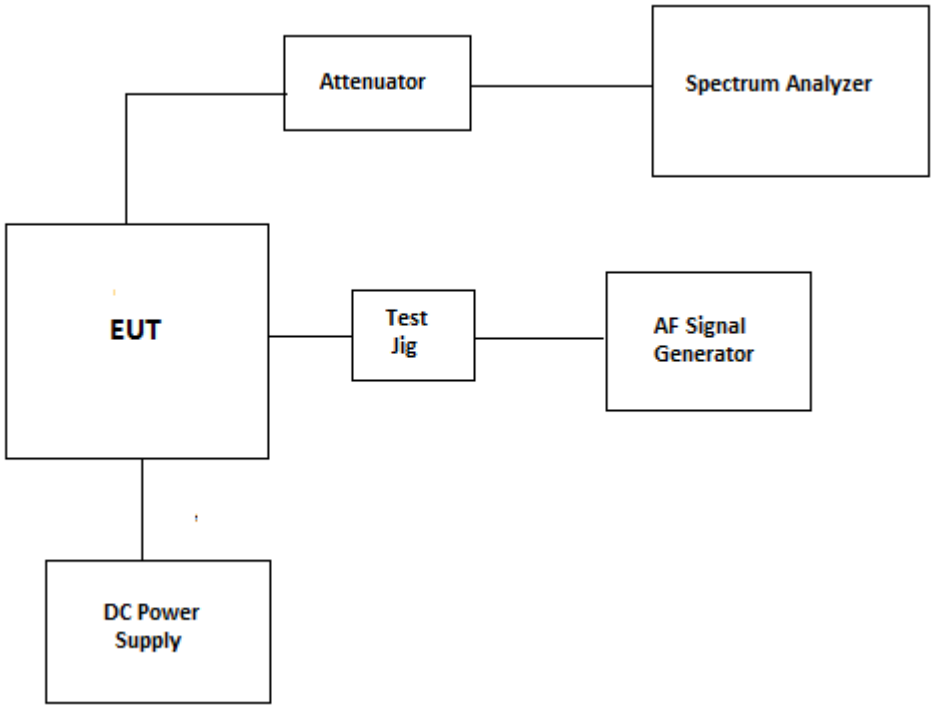
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Modulation Analyzer	HP	HP-8901B	3226A04606	150KHz-1300MHz	23 Mar 2020
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	20 Mar 2020
Digital Voltmeter	HP	3456A	2015A04523	--	19 Dec 2019
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.3. Audio Frequency Response



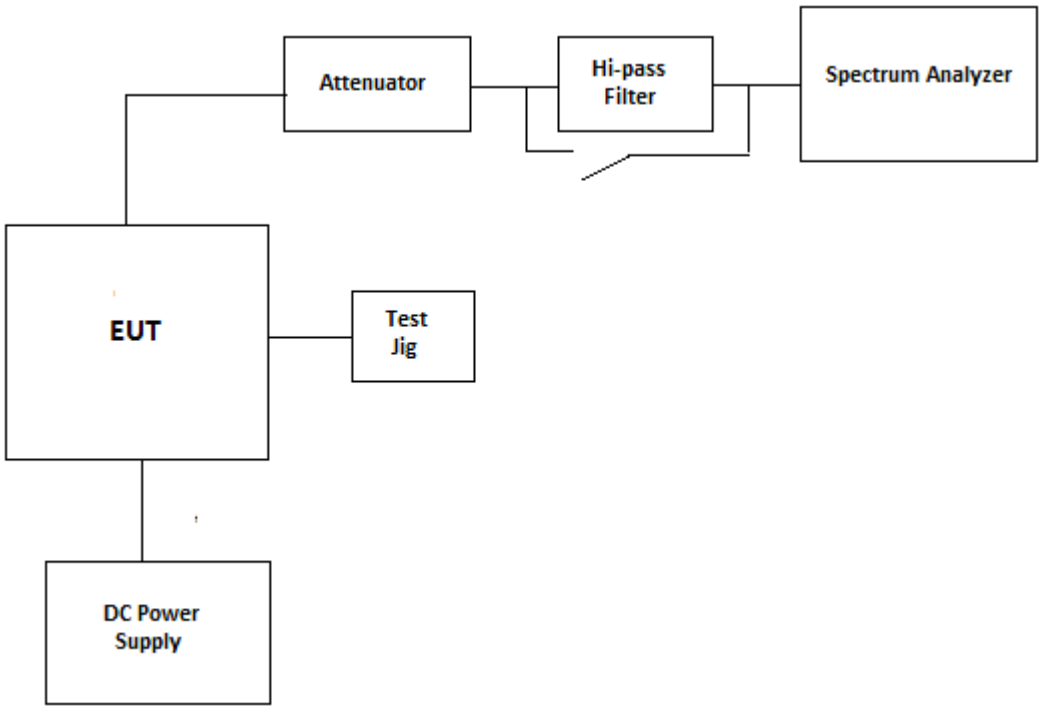
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Modulation Analyzer	HP	HP-8901B	3226A04606	150KHz-1300MHz	23 Mar 2020
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	20 Mar 2020
Digital Voltmeter	HP	3456A	2015A04523	--	19 Dec 2019
FFT Digital Spectrum Analyzer	Advantest	R9211E	8202336	10MHz-100KHz	12 Sep 2020
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.4. 99% OBW and Mask



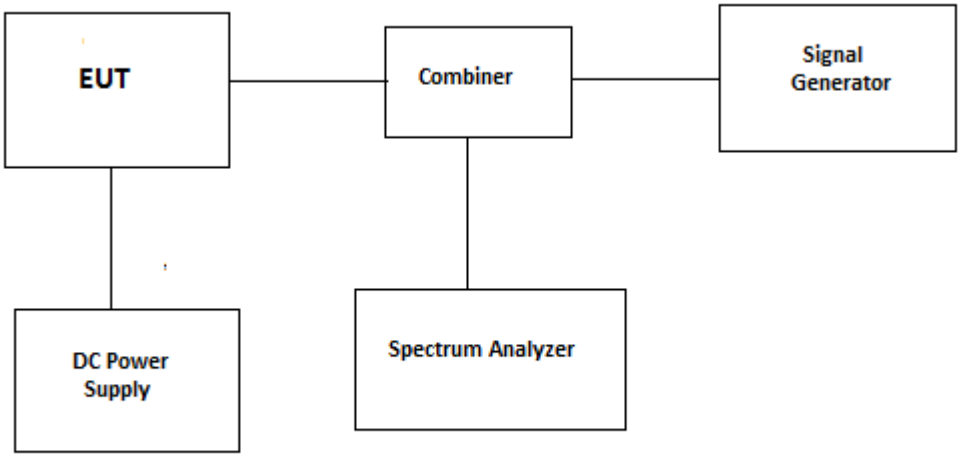
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	20 Mar 2020
Digital Voltmeter	HP	3456A	2015A04523		19 Dec 2019
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.5. Tx Conducted Emission



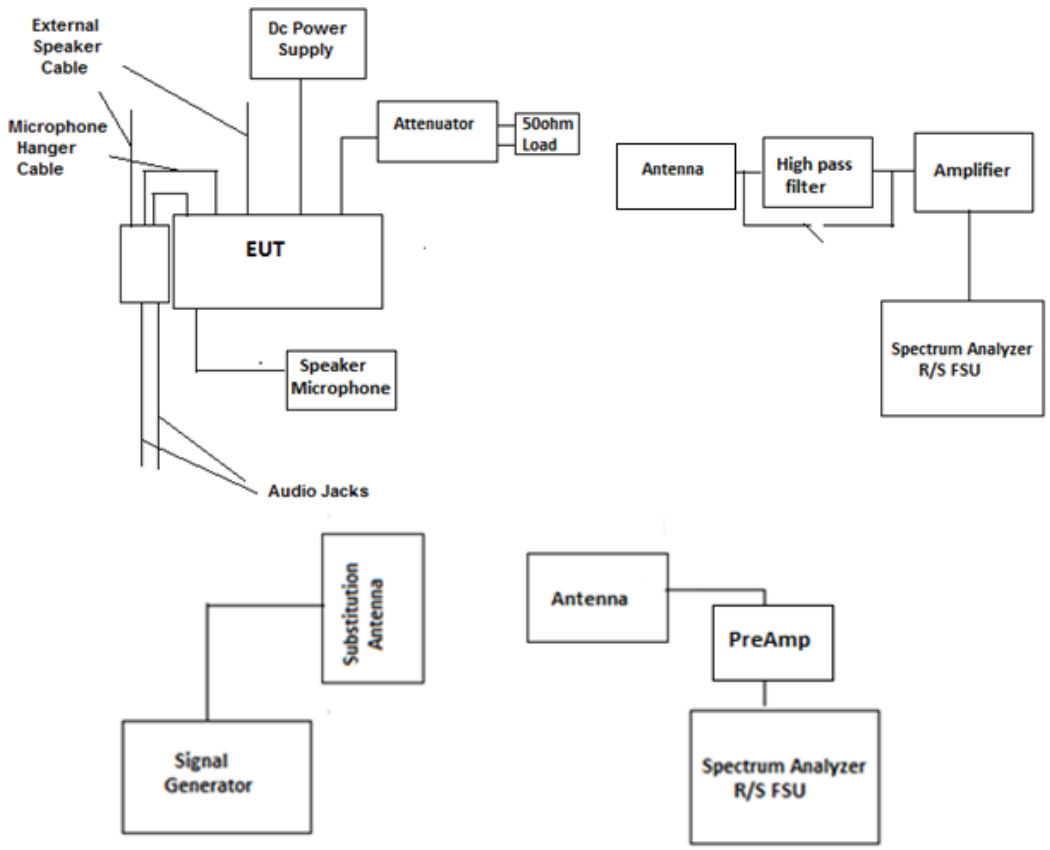
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	20 Mar 2020
Hi-pass filter	Mini-Circuit	SHP-250	--	Cut off 250MHz	Cal on use
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.6. Rx Conducted Emission



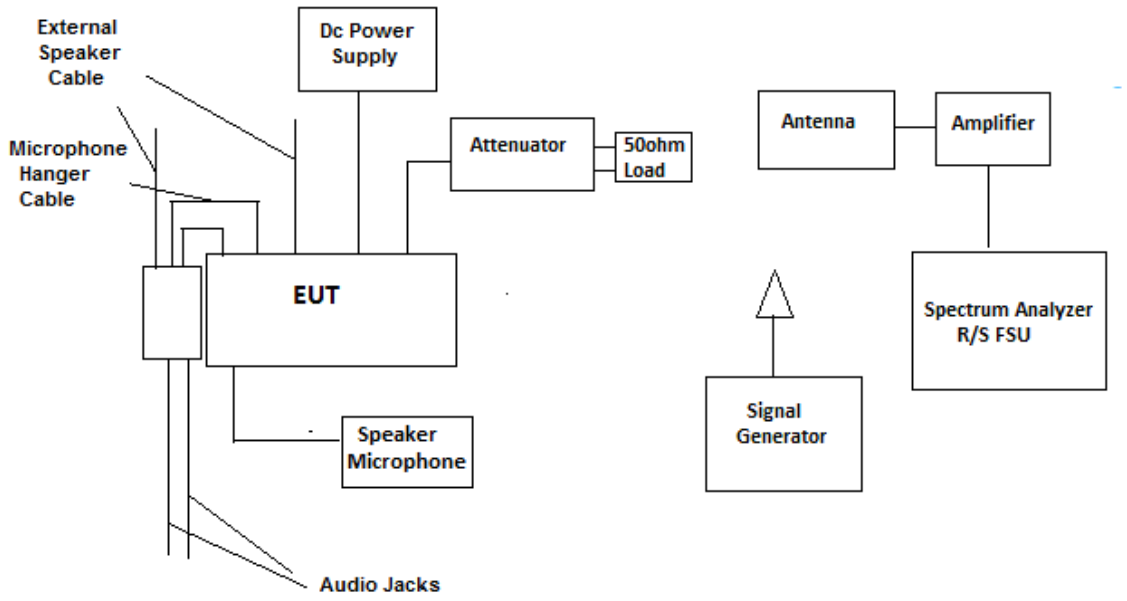
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
Signal Generator	Marconi	2024	112255/164	9KHz-2.4GHz	29 Aug 2019
Combiner	Weinschel 93458	1515	PS119	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.7. Tx Radiated



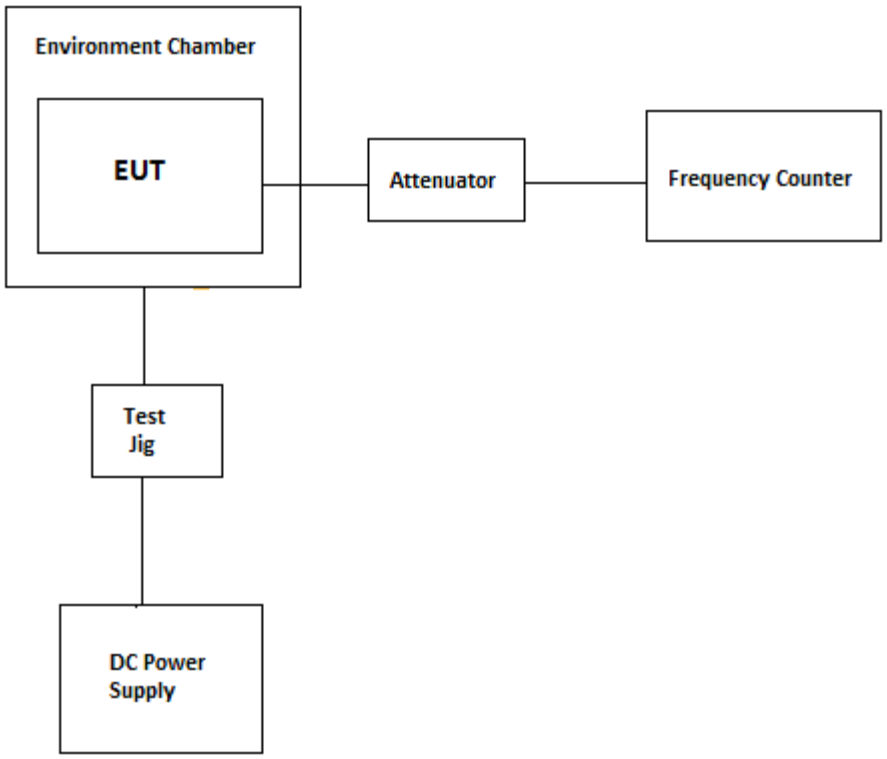
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
Bicon Antenna	ETS	3110B	3379	30-200MHz	06 Feb 2020
Log Periodic Antenna	ETS	3148	00023845	200-2000MHz	02 Aug 2020
Horn Antenna	ETS	3117	00119425	1-18GHz	29 Jun 2019
Dipole	ETS-Lindgren	3121C-DB3	434	140-400	02 Aug 2020
Horn Antenna	ETS	3115	5061	1-18GHz	30 Apr 2020
Signal Generator	Rhode & Schwarz	SMIQ 06ATE	100086	300KHz-6.4GHz	22 Mar 2019
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	09 Mar 2019
Preamplifier	Com-Power	PA-103	161040	1-1000MHz	16 May 2019
Hi-pass filter	Mini-Circuit	SHP-250	--	Cut off 250MHz	Cal on use
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Load(50ohm)	Mini-Circuits	KARN-50+	--	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.8. Rx Radiated



Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	06 Oct 2019
Bicon Antenna	ETS	3110B	3379	30-200MHz	06 Feb 2020
Log Periodic Antenna	ETS	3148	00023845	200-2000MHz	02 Aug 2020
Horn Antenna	ETS	3117	00119425	1-18GHz	29 Jun 2019
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	09 Mar 2019
Preamplifier	Com-Power	PA-103	161040	1-1000MHz	16 May 2019
Signal Generator	Marconi	2024	112255/164	9KHz-2.4GHz	29 Aug 2019
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Load(50ohm)	Mini-Circuits	KARN-50+	--	DC-18GHz	Cal on use
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----
Multimeter	Tenma	72-6202	02080027	---	14 Dec 2019

6.9. Frequency Stability



Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177° C	15 Jun 2019
Frequency Counter	EIP	545A	2683	10MHz-1GHz	07 Aug 2020
Attenuator(20dB)	Aeroflex\Weinschel	34-20-34	BP6023	DC-18GHz	Cal on use
Attenuator(20dB)	Narda	26298	A577	DC-1GHz	Cal on use
Multimeter	Fluke	8842A	5021295	---	23 Oct 2019
Power Supply	Tenma	72-7295	490300297	1-40V, DC 5A	----

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.14**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.29**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.52**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.04**	**Under consideration**

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- If the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

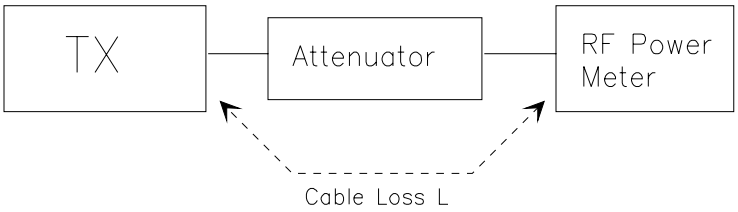
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions Using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

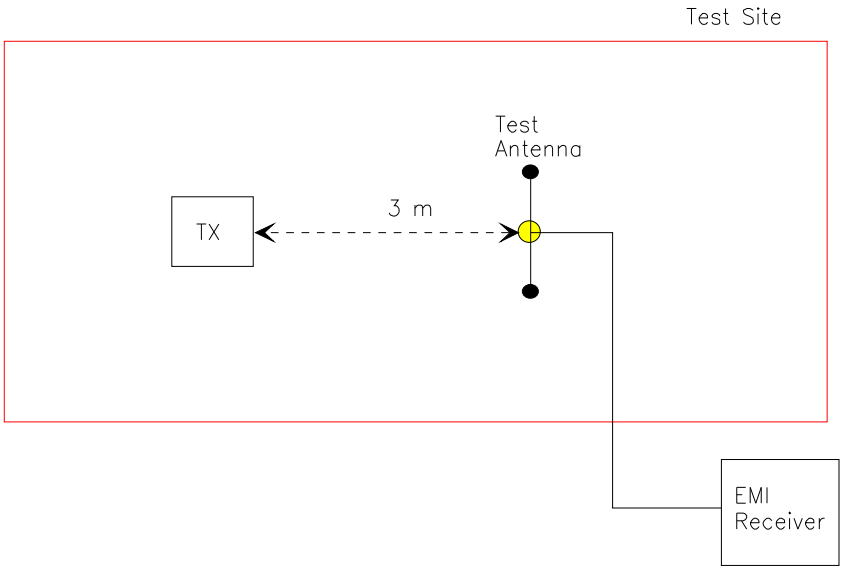
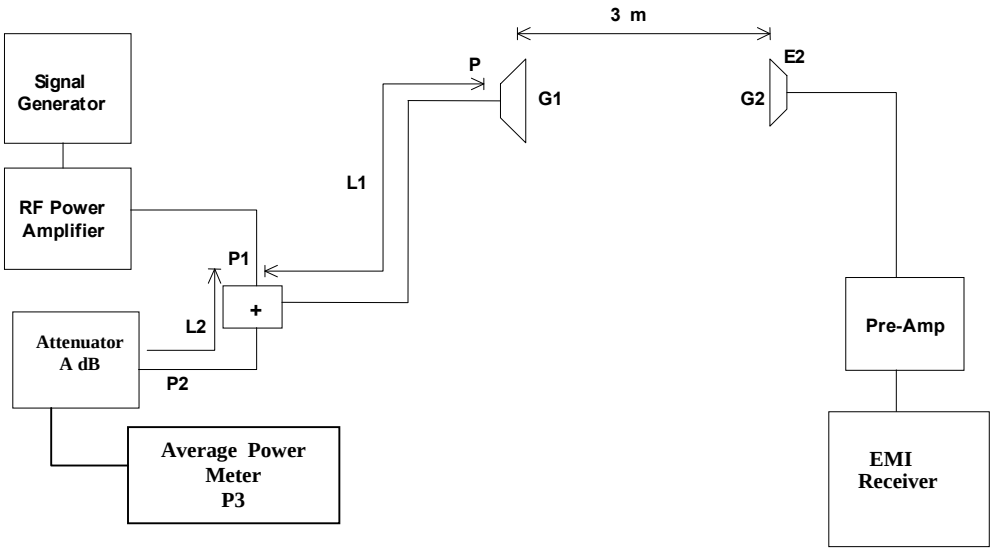


Figure 3



8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

8.4. EMISSION LIMITATIONS

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

(1) For 25 kHz Channel Spacing: RBW = 300 Hz
(2) For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:- The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC CFR 47, Para. 2.1051 - Spurious Emissions at Antenna Terminal:- The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.