FCC Part 90 Rules
Test Report

Report No.: AGC03393200701FE10

FCC ID	:	U7GPKTPLUS
PRODUCT DESIGNATION	:	two way radio
BRAND NAME	:	Blackbox
MODEL NAME	:	Pocket +
APPLICANT	:	Klein Electronics, Inc.
DATE OF ISSUE	:	Jul. 31, 2020
STANDARD(S)	:	FCC Part 90 Rules
REPORT VERSION	:	V 1.0

***A**ttestation of **G**lobal **C**ompliance (Shenzhen) Co., Ltd*

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Jul. 31, 2020	Valid	Initial release

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1. VERIFICATION OF COMPLIANCE

Applicant:	Klein Electronics, Inc.
Address	349 N. Vinewood St Escondido, CA 92029,United States
Manufacturer:	Klein Electronics, Inc.
Address	349 N. Vinewood St Escondido, CA 92029,United States
Factory	Klein Electronics, Inc.
Address	349 N. Vinewood St Escondido, CA 92029,United States
Product Designation:	two way radio
Brand Name:	Blackbox
Test Model	Pocket +
Measurement Procedure	TIA/EIA 603-E-2016
Deviation	No any deviation from the test method.
Date of Test:	Jul. 02, 2020~Jul. 31, 2020
Condition of Test Sample	Normal
Test Result	Pass

WE HEREBY CERTIFY THAT:

The above equipment was tested by Shenzhen Attestation of Global Compliance Science & Technology Co., Ltd.The data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI/TIA-603-E (2016). The sample tested as described in this report is in compliance with the FCC Rules Part 90 requirements.The test results of this report relate only to the tested sample identified in this report.

Prepared By — Calvin Liu (Project Engineer) — Jul. 31, 2020

Reviewed By — Max Zhang (Reviewer) — Jul. 31, 2020

Approved By — Forrest Lei (Authorized Officer) — Jul. 31, 2020

2. GENERAL INFORMATION

2.1PRODUCT DESCRIPTION

The EUT is a **two way radio** designed for voice communication. It is designed by way of utilizing the FM/4FSK modulation achieves the system operating.

A major technical description of EUT is described as following:

Communication Type	Voice/ Tone only
Hardware Version	V1.1
Software Version	V6
Modulation	FM
Emission Type	11K0F3E
Emission Bandwidth	10.18KHz
Peak Frequency Deviation	1.74KHz
Audio Frequency Response	6.06dB
Maximum Transmitter Power	31.45dBm
Output power Modification	1.5W (It was fixed by the manufacturer, any individual can't arbitrarily change it.)
Data Rate	12.5KHz(Channel Spacing)
Antenna Designation	Inseparable
Antenna Gain	1.5dBi
Power Supply	DC 3.7V,1200mAh by battery, charging for DC4.2V
Limiting Voltage	DC 3.15V-4.26V
Battery endpoint	DC 3.15V
Operation Frequency Range and Channel	Frequency Range: 450 MHz to 470 MHz Channel Separation: 12.5KHz(Analog)
	Bottom Channel: 450.025MHz Middle Channel: 454.025MHz Middle Channel: 460.025MHz High Channel: 469.975MHz
Frequency Tolerance	1.093ppm

Frequency Range (MHz)	Rated Transmit Power(W)(Conducted)	Transmit Mode/Emission Designator
450-470	1.5W	11K0F3E(Analog Vioce;NB)

Channel No. (6.25KHz)	Channel No. (12.5KHz)	12.5KHz Channel Spaced 400MHz Band Plan(MHz)
1	1-2	450.025
2		
3	3-4	460.025
4		
5	5-6	469.975
6		

FCC Rules and Regulations Part 2.202: Necessary Bandwidth and Emission Bandwidth

For FM Mode (ChannelSpacing:12.5kHz)

Emission Designator 11K0F3E
In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.
BW = 2(M+D) = 2*(3.0 kHz + 2.5 kHz) = 11 kHz = 11K0
portion of the designator represents an FM voice transmission
Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

For FM Mode (Channel Spacing: 20kHz)

Emission Designator 16K0F3E
In this case, the maximum modulating frequency is 3.0 kHz with a 5.0 kHz deviation.
BW = 2(M+D) = 2*(3.0 kHz + 5.0 kHz) = 16 kHz = 16K0
F3E portion of the designator represents an FM voice transmission
Therefore, the entire designator for 20 kHz channel spacing FM mode is 16K0F3E.

For FM Mode (Channel Spacing: 25kHz)

Emission Designator 16K0F3E
In this case, the maximum modulating frequency is 3.0 kHz with a 5.0 kHz deviation.
BW = 2(M+D) = 2*(3.0 kHz + 5.0 kHz) = 16 kHz = 16K0
F3E portion of the designator represents an FM voice transmission
Therefore, the entire designator for 25 kHz channel spacing FM mode is 16K0F3E.

2.2RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for FCC ID: **U7GPKTPLUS,** filing to comply with Part 2, Part 22, and Part 90 of the Federal Communication Commission rules.

2.3 TEST METHODOLOGY

The radiated emission testing was performed according to the procedures of ANSI/TIA-603-E (2016).

2.4 TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong,China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA

2.5 SPECIAL ACCESSORIES

Not available for this EUT intended for grant.

2.6 EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

3. SYSTEM TEST CONFIGURATION

3.1EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

3.3 GENERAL TECHNICAL REQUIREMENTS

For FCC Part 90 requirements:

(1). Section 90.205 : RF Output Power

(2). Section 90.207 : Modulation Characteristic

(3). Section 90.209 : Occupied Bandwidth

(4). Section 90.210 : Emission Mask

(5). Section 90.213 : Frequency Tolerance

(6). Section 90.214: Transmitter Frequency Behavior

(7). Section 90.210 : Spurious Emission on Antenna Port

(8). Section 90.210 : Spurious Ratiated Emission

3.4CONFIGURATION OF TESTED SYSTEM

Fig. 2-1 Configuration of Tested System

Table 2-1 Equipment Used in Tested System

Item	Equipment	Model No.	Identifier	Note
1	two way radio	Pocket +	FCC ID: U7GPKTPLUS	EUT
3	Adapter	CW0501000US	Input: AC 100-240V, 50/60Hz, 0.2A Output: DC 5V 1A	Accessory
4	Battery	F10	DC 3.7V 1200mAh	Accessory
5	Back clip	N/A	N/A	Accessory

Note：The battery is full-charged during the test

4. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§90.205& 2.1046	Maximum Transmitter Power	Compliant
§90.207& 2.1047	Modulation Characteristic	Compliant
§90.209& 2.1049	Occupied Bandwidth	Compliant
§90.210& 2.1049	Emission Mask	Compliant
§90.213& 2.1055	Frequency Tolerance	Compliant
§90.214	Transmitter Frequency Behavior	Compliant
§90.210& 2.1051	Spurious Emission on Antenna Port	Compliant
§90.210& 2.1053	Spurious Ratiated Emission	Compliant

LIST OF EQUIPMENTS USED

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	May 15, 2020	May 14, 2022
EXA Signal Analyzer	Aglient	N9020A	W1312-60196	Oct. 08, 2019	Oct. 07, 2020
EXA Signal Analyzer	Aglient	N9020A	MY52090123	Oct. 08, 2019	Oct. 07, 2020
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Sep.16, 2019	Sep.15, 2021
preamplifier	ChengYi	EMC184045SE	980508	Oct.29, 2019	Oct 28, 2020
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May. 17, 2019	May. 16, 2021
Broadband Preamplifier	SCHWARZBECK	BBV 9718	9718-205	Jun. 09, 2020	Jun. 08, 2021
HORN ANTENNA	EM	EM-AH-10180	/	Feb.28, 2020	Feb.27, 2021
SIGNAL GENERATOR	AGILENT	E4421B	MY43351603	Jun. 09, 2020	Jun. 08, 2021
SIGNAL GENERATOR	R&S	SMT03	A0304261	Jun. 09, 2020	Jun. 08, 2021
ANTENNA	SCHWARZBECK	VULB9168	VULB9168-494	Jan. 09, 2019	Jan. 08, 2021
ANTENNA	SCHWARZBECK	VULB9168	D69250	Sep.26, 2018	Sep.25, 2020
Modulation Domain Analyzer	HP	53310A	3121A02467	Oct. 30, 2019	Oct. 29, 2020
Small environmental tester	ESPEC	SH-242	--	Feb. 23, 2020	Feb. 22, 2021
RF Communication Test Set	HP	8920B	--	Jun. 09, 2020	Jun. 08, 2021
Attenuator	Weinachel Corp	58-30-33	ML030	Oct. 28, 2019	Oct. 27, 2020
RF Cable	R&S	1#	--	Each time	N/A
RF Cable	R&S	2#	--	Each time	N/A
Fliter-UHF	Microwave	N25155M2	498705	May. 11, 2020	May. 10, 2021

NOTE: 8920B can generate audio modulation frequency.

5. DESCRIPTION OF TEST MODES

RF TEST MODES

The EUT (**two way radio**) has been tested under normal operating condition. (The top channel, the middle channel and the bottom channel) are chosen for testing at each channel separation.

Analog:

No.	TEST MODES	CHANNEL SEPARATION
1	Low Channel	12.5 KHz
2	Middle Channel	12.5 KHz
3	High Channel	12.5 KHz

Note: 1.Only the result of the worst case was recorded in the report.
2. The manufacturer provides the laboratory with a temporary external antenna connection for conducting measurements.

6. FREQUENCY TOLERANCE

6.1 PROVISIONS APPLICABLE

a). According to FCC §2.1055 and §90.213, the frequency stability shall be measured with variation of ambient temperature from –30℃ to +50℃ centigrade.

b). According to FCC Part 2 Section 2.1055(d)(2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacturer.

c). According to FCC Part 90 Section 90.213, the frequency tolerance must be maintained within 0.00025% for 12.5 KHz channel separation and 0.0001% for 6.25 KHz channel separation.

6.2 MEASUREMENT PROCEDURE

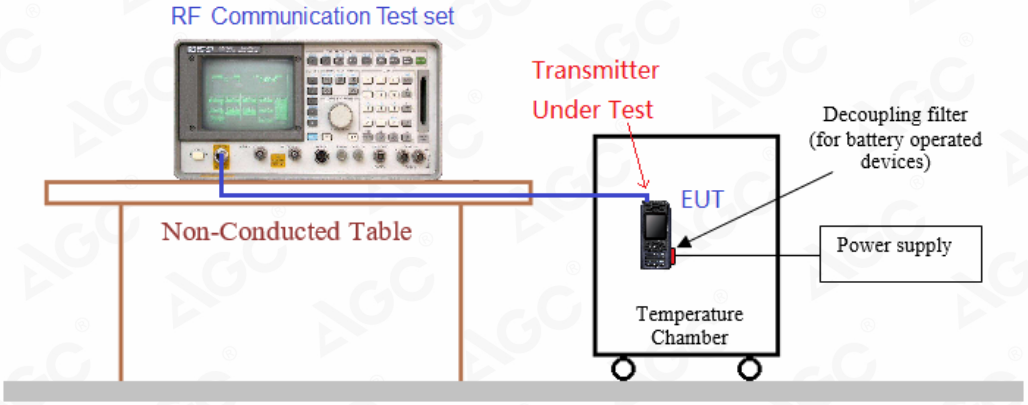
6.2.1 Frequency stability versus environmental temperature

1. Setup the configuration per figure 1 for frequencies measurement inside an environment chamber, Install new battery in the EUT.
2. Turn on EUT and set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 1KHz and Video Resolution Bandwidth to 1KHz and Frequency Span to 50KHz.Record this frequency as reference frequency.
3. Set the temperature of chamber to 50℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10℃ decreased per stage until the lowest temperature -30℃ is measured, record all measured frequencies on each temperature step.

6.2.2 Frequency stability versus input voltage

1. Setup the configuration per figure 1 for frequencies measured at temperature if it is within 15℃ to 25℃. Otherwise, an environment chamber set for a temperature of 20℃ shall be used. The EUT shall be powered by DC 3.7V.
2. Set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 1 KHz and Video Resolution Bandwidth to 1KHz. Record this frequency as reference frequency.
3. Supply the EUT primary voltage at the operating end point which is specified by manufacturer and record the frequency.

6.3 TEST SETUP BLOCK DIAGRAM



6.4 TEST RESULTS

(1) Frequency stability versus input voltage (Supply nominal voltage is 3.7V)**-1.5W-12.5KHz**

Environment Temperature(℃)	Power Supply (V)	Reference Frequency				Limit: ppm
		450.025MHz	454.025MHz	460.025MHz	469.975MHz	
50	DC 3.70V	0.870	0.653	0.700	0.372	2.5
40	DC 3.70V	0.604	1.093	0.610	0.681	
30	DC 3.70V	0.947	1.037	0.912	0.646	
20	DC 3.70V	0.829	0.609	0.700	0.353	
10	DC 3.70V	0.628	0.858	0.808	0.609	
0	DC 3.70V	0.670	0.894	0.836	0.354	
-10	DC 3.70V	0.758	0.714	0.852	0.652	
-20	DC 3.70V	0.726	1.092	0.934	0.904	
-30	DC 3.70V	0.637	0.974	0.508	0.661	
Result	Pass					

(2) Frequency stability versus input voltage (Battery endpoint is 3.15V) **-1.5W-12.5KHz**

Environment Temperature(℃)	Power Supply (V)	Reference Frequency				Limit: ppm
		450.025MHz	454.025MHz	460.025MHz	469.975MHz	
50	DC 3.15V	0.604	0.993	1.054	0.417	2.5
40	DC 3.15V	0.957	1.006	0.684	0.498	
30	DC 3.15V	0.953	0.963	0.949	0.841	
20	DC 3.15V	0.974	1.090	0.613	0.449	
10	DC 3.15V	0.776	0.963	0.881	0.869	
0	DC 3.15V	0.525	0.614	1.058	0.993	
-10	DC 3.15V	0.944	0.729	1.024	0.388	
-20	DC 3.15V	0.719	0.928	0.798	0.535	
-30	DC 3.15V	0.653	1.074	0.948	0.408	
Result	Pass					

Note: 1.Battery terminal voltage is declared and specified by the manufacturer.
2. All test values are in “ppm”

7. EMISSION BANDWIDTH

7.1 PROVISIONS APPLICABLE

For FCC Part 90 requirements:

The authorized bandwidth shall be 11.25 KHz for 12.5 KHz channel separation and 6 KHz for 6.25 KHz channel separation.

7.2 MEASUREMENT PROCEDURE

1). The EUT was placed on a turn table which is 0.8m above ground plane.

2). The EUT was modulated by 2.5 KHz Sine wave audio signal, The level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing).

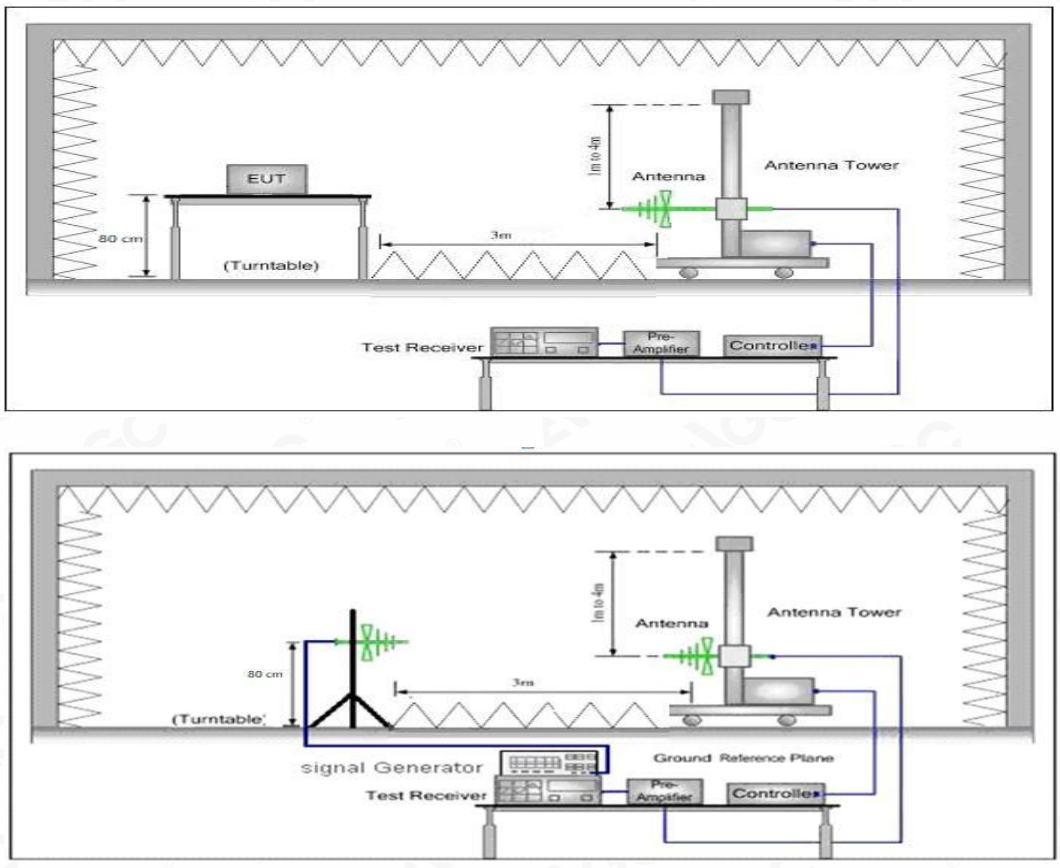
3). Set SPA Center Frequency = fundamental frequency, RBW=100Hz.VBW= 300 Hz, Span =50 KHz.

4). Set SPA Max hold. Mark peak, -26 dB.

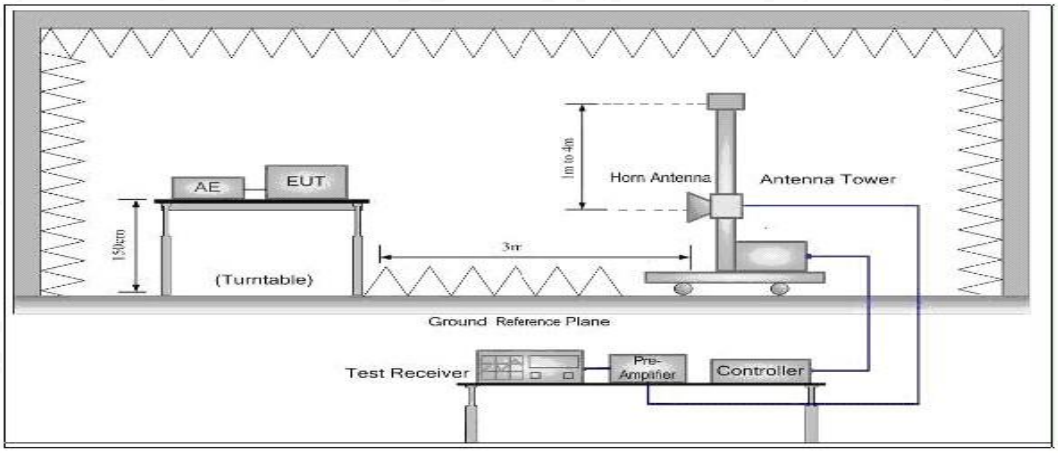
7.3 TEST SETUP BLOCK DIAGRAM

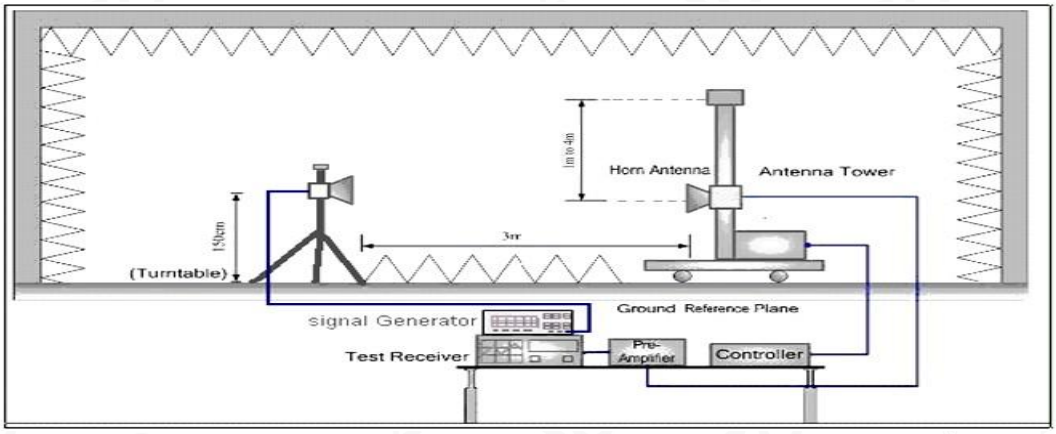
Radiation method:

Radiated Below1GHz

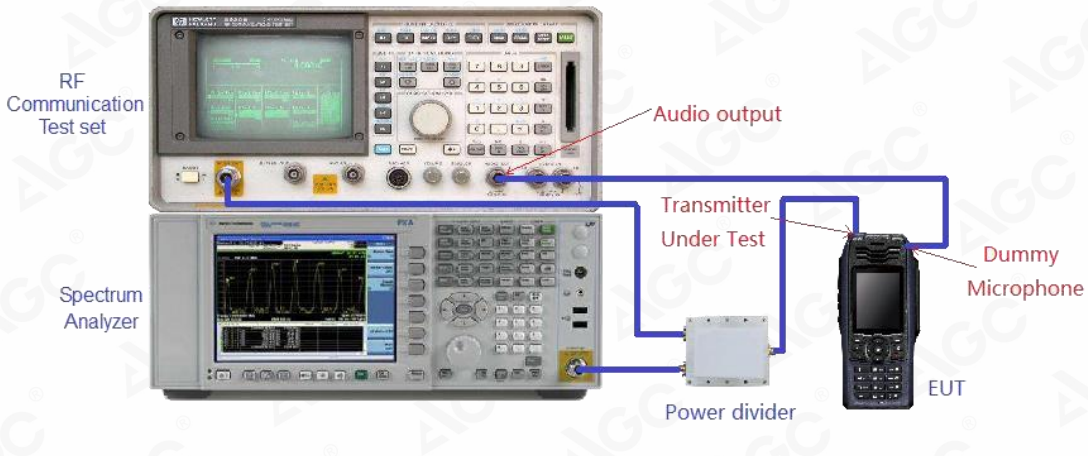


Radiated Above 1 GHz





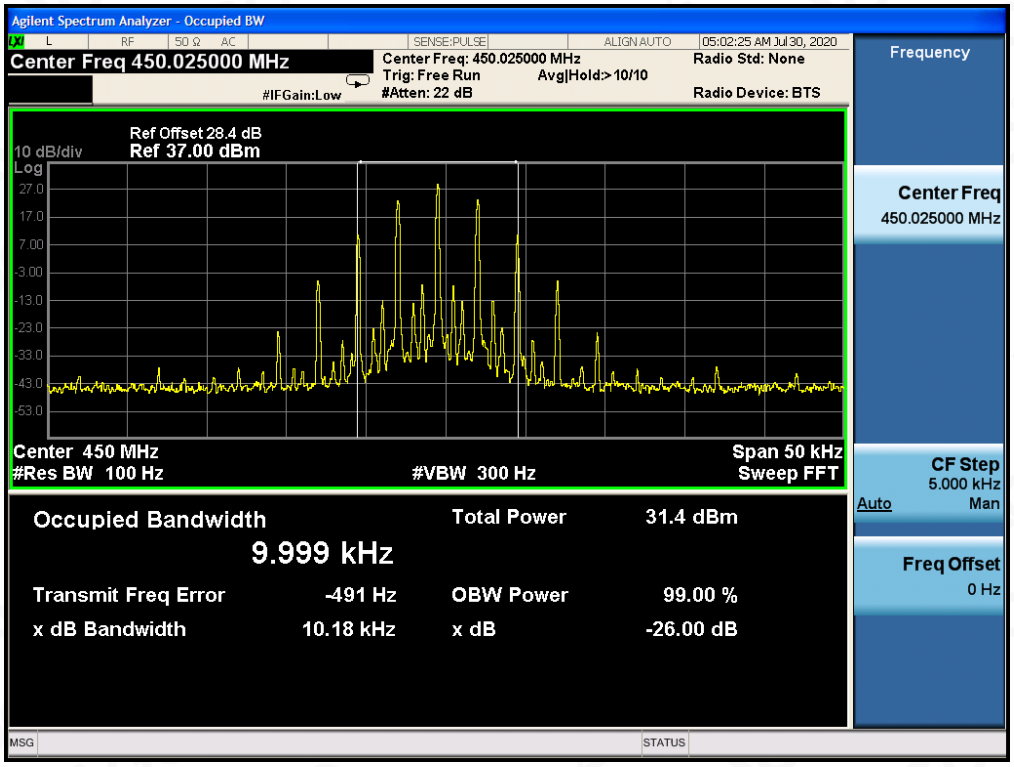
Conduction method:



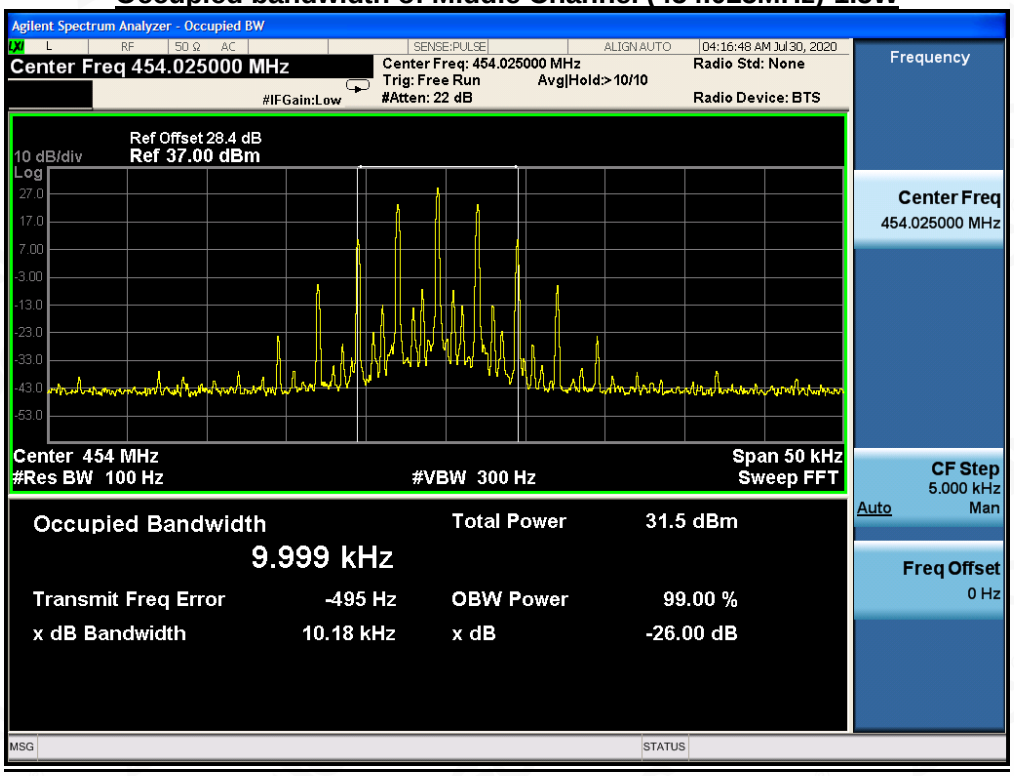
7.4 MEASUREMENT RESULT

Emission Bandwidth Measurement Result				
Operating Frequency	12.5 KHz Channel Separation			
	Occupied Bandwidth (KHZ)	Emission Bandwidth (KHZ)	Limits	Result
450.025MHz	9.999 KHz	10.18 KHz	11.25 KHz	Pass
454.025MHz	9.999 KHz	10.18 KHz	11.25 KHz	Pass
460.025MHz	9.999 KHz	10.18 KHz	11.25 KHz	Pass
469.975MHz	9.999 KHz	10.18 KHz	11.25 KHz	Pass

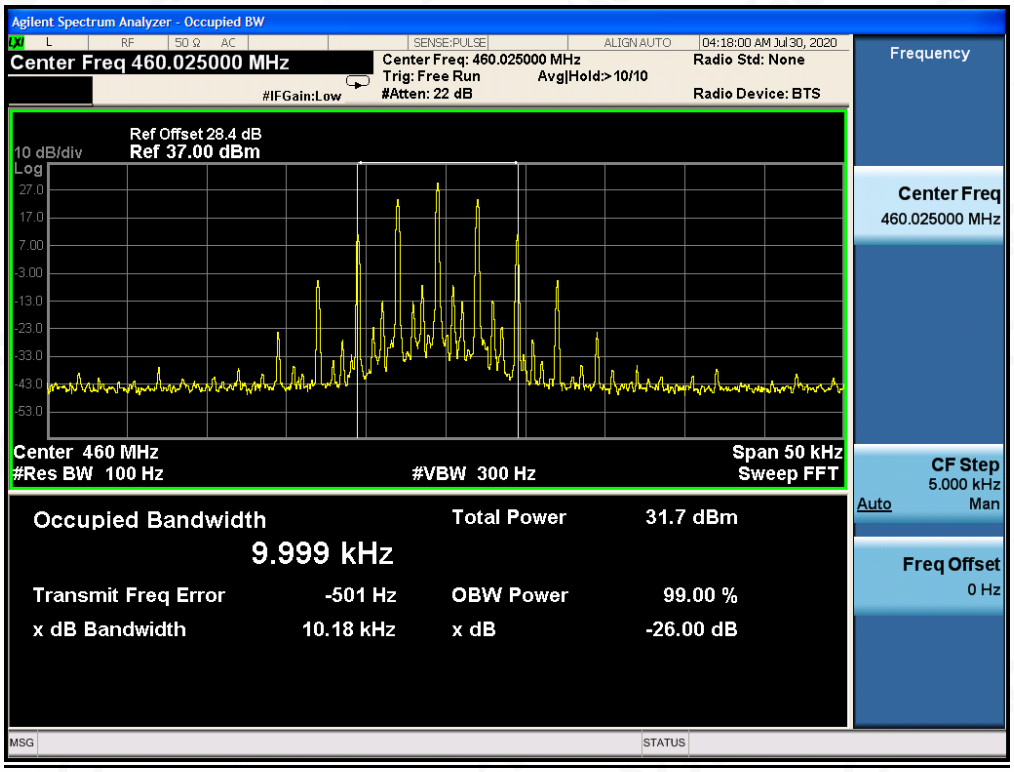
Occupied bandwidth of Bottom Channel (450.025MHz)-1.5W



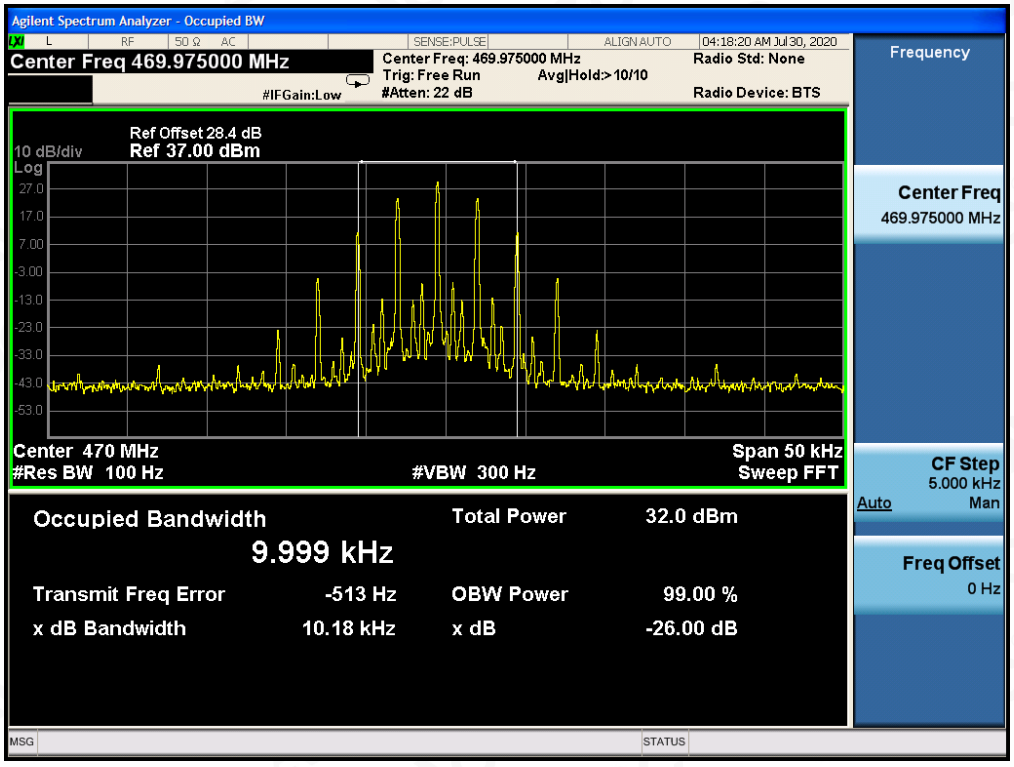
Occupied bandwidth of Middle Channel (454.025MHz)-1.5W



Occupied bandwidth of Middle Channel (460.025MHz)-1.5W



Occupied bandwidth of Top Channel (469.975MHz)-1.5W



8. UNWANTED RADIATION

8.1 PROVISIONS APPLICABLE

According to FCC §2.1049 and §90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with each channel separation.

Emission Mask D -for 12.5 KHz Channel Separation:

(1).On any frequency removed from the center of the authorized bandwidth fo to 5.625 KHz removed from fo: Zero dB.

(2).On any frequency removed from the center of the authorized bandwidth by a displacement Frequency (fd in KHz) fo of more than 5.625 KHz but no more than 12.5 KHz: At least 7.27(fd-2.88 KHz) dB

(3).On any frequency removed from the center of the authorized bandwidth by a displacement Frequency (fd in KHz)fo of more than 12.5 KHz: At least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.

8.2 MEASUREMENT PROCEDURE

(1)On a test site, the EUT shall be placed on a turntable, and in the position closest to the normal use as declared by the user.

(2)The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the transmitter.

(3)The output of the antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit.

(4)The transmitter shall be switched on; if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test.

(5)The test antenna shall be raised and lowered through the specified range of height until the measuring receiver detects a maximum signal level.

(6)The transmitter shall than be rotated through 360°in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

(7)The test antenna shall be raised and lowered again through the specified range of height until the measuring receiver detects a maximum signal level.

(8)The maximum signal level detected by the measuring receiver shall be noted.

(9)The measurement shall be repeated with the test antenna set to horizontal polarization.

(10) Replace the antenna with a proper Antenna (substitution antenna).

(11)The substitution antenna shall be oriented for vertical polarization and, if necessary, the length of the substitution antenna shall be adjusted to correspond to the frequency of transmitting.

(12)The substitution antenna shall be connected to a calibrated signal generator.

(13)If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver.

(14)The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received.

(15)The input signal to substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuation setting of the measuring receiver.

(16)The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

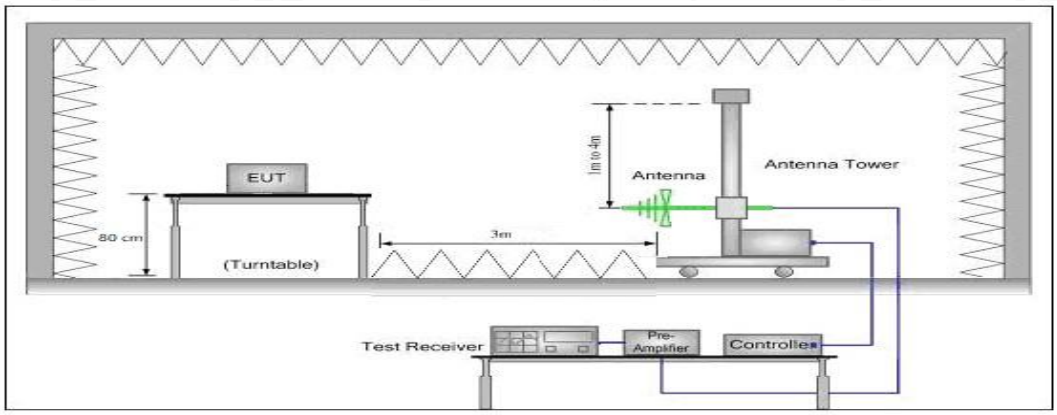
(17)The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

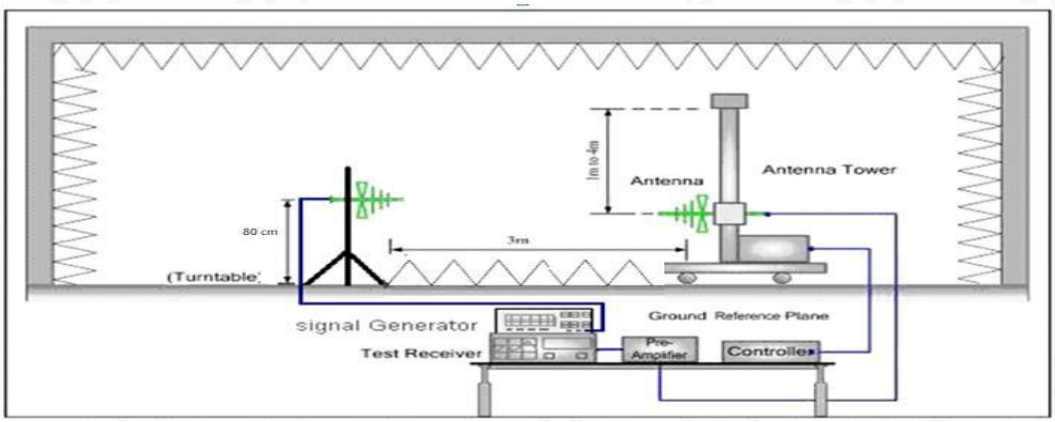
8.3 TEST SETUP BLOCK DIAGRAM

SUBSTITUTION METHOD: (Radiated Emissions)

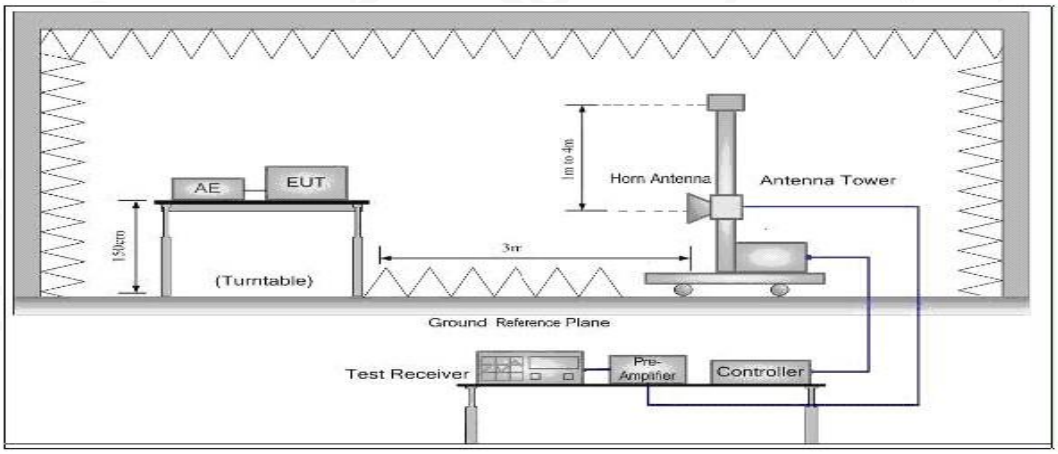
Radiation method:

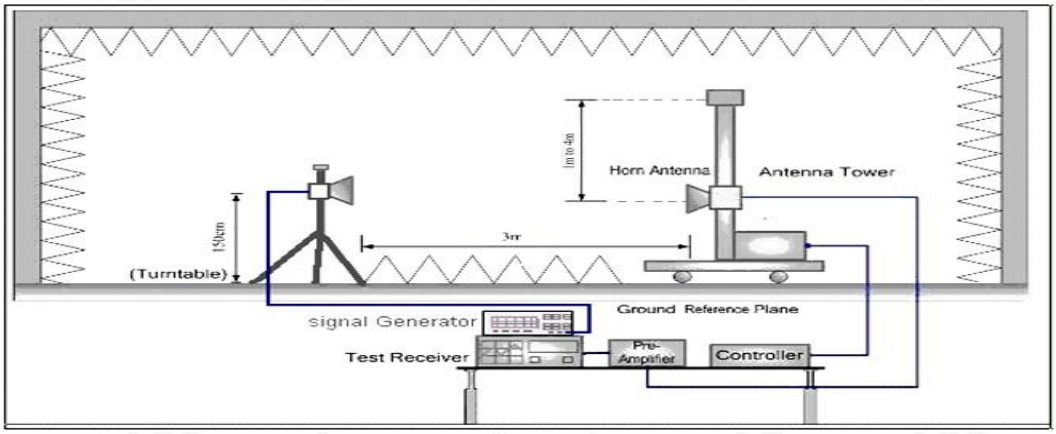
Radiated Below1GHz





Radiated Above 1 GHz





8.4 MEASUREMENT RESULTS:

Applicable Standard

FCC §2.1053 and §90.210

On any frequency removed from the center of the authorized bandwidth by a displacement

Frequency (fd in KHz)for of more than 12.5 KHz: at least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10 harmonic.

In the semi-anechoic chamber, setup as illustrated above the DUT placed on the 0.8m height of Turn Table, rotated the table 45 degree each interval to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power for each degree interval. The “Read Value” is the spectrum reading of maximum power value.

The substitution antenna is substituted for DUT at the same position and signals generator (S.G) export the CW signal to the substitution antenna via a TX cable. The receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum radiation power. Record the power level of maximum radiation power from spectrum. So, the Measured substitution value = Ref level of S.G + TX cables loss – Substituted Antenna Gain.

EIRP = “Read Value” + Measured substitution value + 2.15.

Limit: At least 50+10 log (P) =50+10log (1.5) =51.76 (dB)—1.5W 31.76-51.76=-20dBm

Measurement Result for 12.5 KHz Channel Separation @ 450.025MHz-1.5W

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
450.025	H	-		pass
900.050	H	-26.32	-20	pass
1350.075	H	-28.04	-20	pass
1800.100	H	-28.90	-20	pass
2250.125	H	-29.60	-20	pass
2700.150	H	-30.31	-20	pass
3150.175	H	-32.85	-20	pass
3600.200	H	-28.94	-20	pass
4050.225	H	-29.45	-20	pass
4500.250	H	-30.74	-20	pass

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
450.025	V	-		pass
900.050	V	-25.14	-20	pass
1350.075	V	-26.64	-20	pass
1800.100	V	-28.80	-20	pass
2250.125	V	-30.95	-20	pass
2700.150	V	-29.93	-20	pass
3150.175	V	-33.83	-20	pass
3600.200	V	-27.98	-20	pass
4050.225	V	-31.29	-20	pass
4500.250	V	-33.44	-20	pass

Measurement Result for 12.5 KHz Channel Separation @ 454.025MHz-1.5W

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
454.025	H	-		pass
908.050	H	-29.98	-20	pass
1362.075	H	-29.29	-20	pass
1816.100	H	-29.05	-20	pass
2270.125	H	-31.62	-20	pass
2724.150	H	-30.06	-20	pass
3178.175	H	-34.31	-20	pass
3632.200	H	-31.42	-20	pass
4086.225	H	-31.64	-20	pass
4540.250	H	-33.44	-20	pass

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
454.025	V	-		pass
908.050	V	-26.00	-20	pass
1362.075	V	-24.93	-20	pass
1816.100	V	-28.21	-20	pass
2270.125	V	-28.70	-20	pass
2724.150	V	-32.76	-20	pass
3178.175	V	-34.01	-20	pass
3632.200	V	-29.80	-20	pass
4086.225	V	-34.22	-20	pass
4540.250	V	-33.96	-20	pass

Measurement Result for 12.5 KHz Channel Separation @ 460.025MHz-1.5W

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
460.025	H	-		pass
920.050	H	-28.08	-20	pass
1380.075	H	-28.05	-20	pass
1840.100	H	-28.48	-20	pass
2300.125	H	-31.27	-20	pass
2760.150	H	-30.67	-20	pass
3220.175	H	-30.72	-20	pass
3680.200	H	-28.11	-20	pass
4140.225	H	-30.51	-20	pass
4600.250	H	-33.00	-20	pass

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
460.025	V	-		pass
920.050	V	-27.03	-20	pass
1380.075	V	-29.38	-20	pass
1840.100	V	-30.21	-20	pass
2300.125	V	-31.21	-20	pass
2760.150	V	-28.93	-20	pass
3220.175	V	-31.35	-20	pass
3680.200	V	-28.52	-20	pass
4140.225	V	-30.72	-20	pass
4600.250	V	-32.48	-20	pass

Measurement Result for 12.5 KHz Channel Separation @ 469.975MHz-1.5W

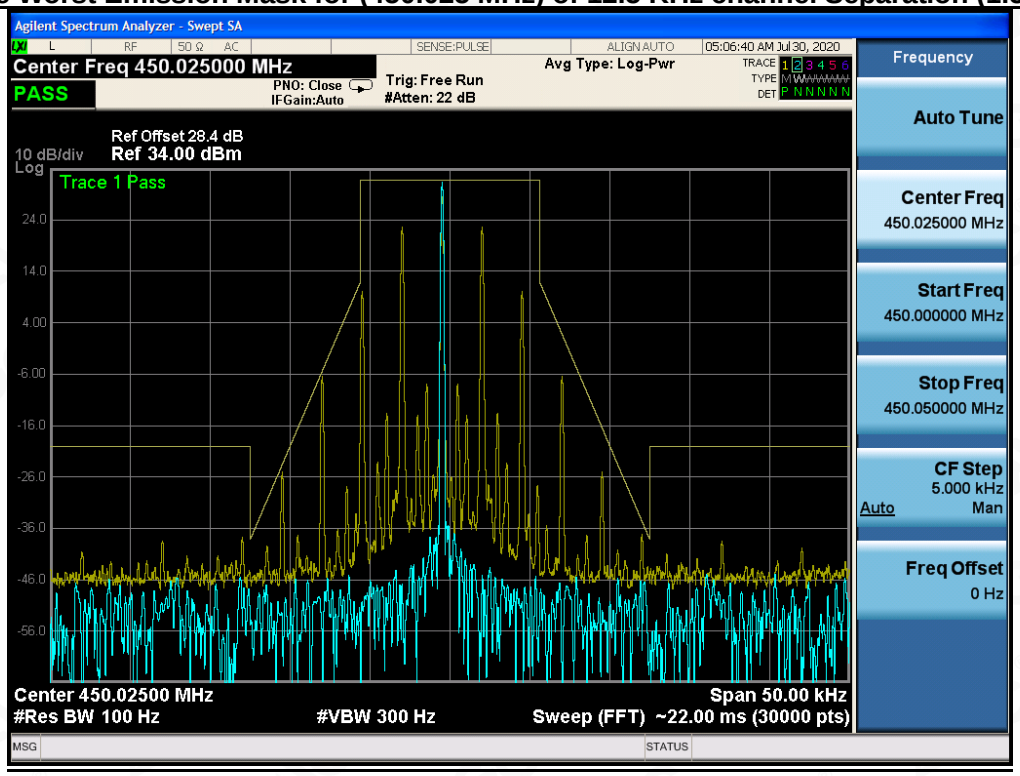
Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
469.975	H	-		pass
939.950	H	-31.16	-20	pass
1409.925	H	-32.14	-20	pass
1879.900	H	-32.05	-20	pass
2349.875	H	-30.87	-20	pass
2819.850	H	-30.88	-20	pass
3289.825	H	-31.50	-20	pass
3759.800	H	-28.91	-20	pass
4229.775	H	-31.06	-20	pass
4699.750	H	-35.31	-20	pass

Emission Frequency (MHz)	Ant.Polarity (H/V)	Measurement Result (dBm)	Limit (dBm)	Result (P/F)
469.975	V	-		pass
939.950	V	-27.21	-20	pass
1409.925	V	-29.37	-20	pass
1879.900	V	-29.17	-20	pass
2349.875	V	-29.72	-20	pass
2819.850	V	-30.62	-20	pass
3289.825	V	-32.33	-20	pass
3759.800	V	-28.64	-20	pass
4229.775	V	-30.48	-20	pass
4699.750	V	-34.08	-20	pass

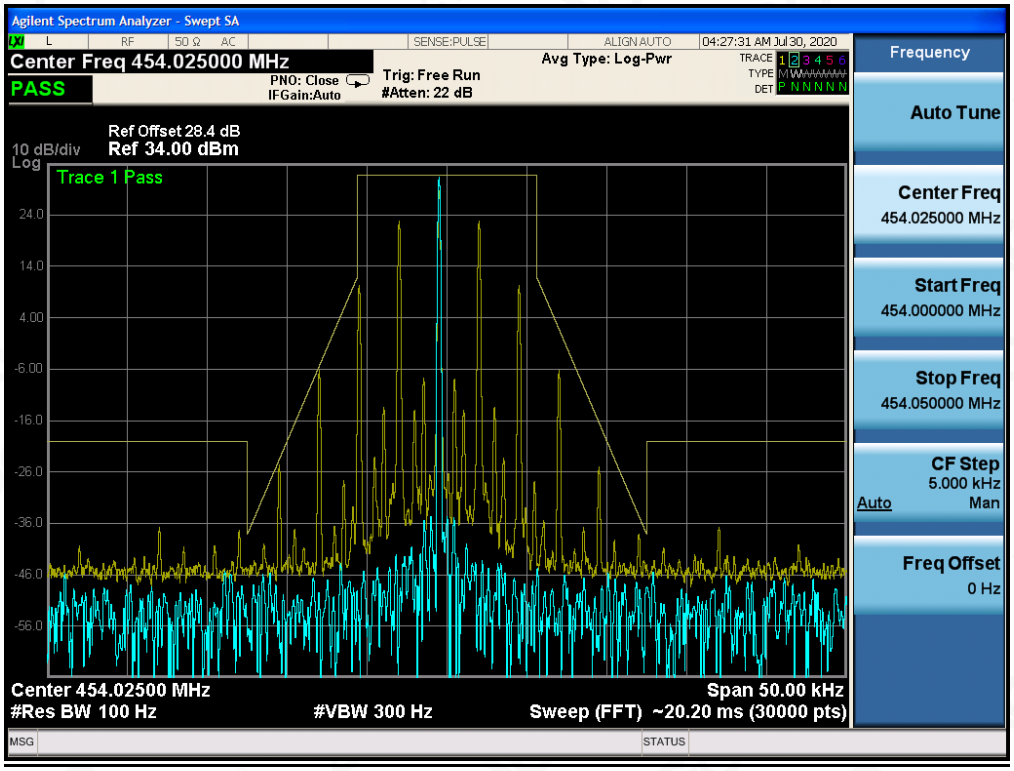
8.5 EMISSION MASK PLOT

The detailed procedure employed for Emission Mask measurements are specified as following:
- The transmitter shall be modulated by a 2.5 kHz audio signal,
- The level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz.

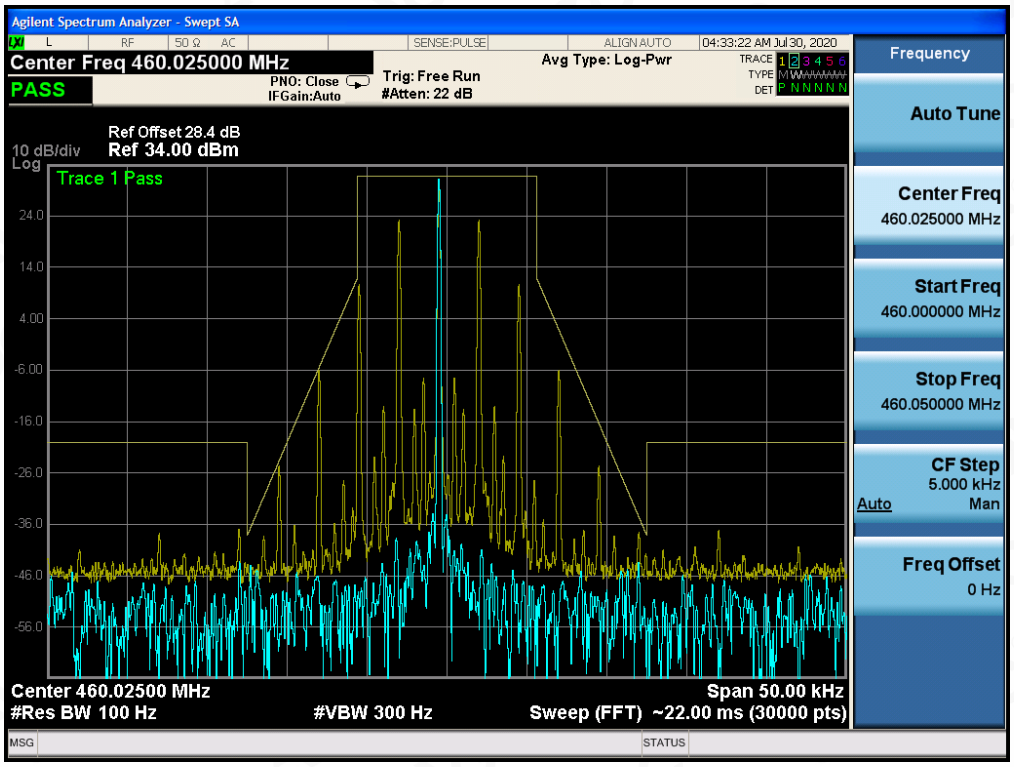
The Worst Emission Mask for (450.025 MHz) of 12.5 KHz channel Separation (1.5W)



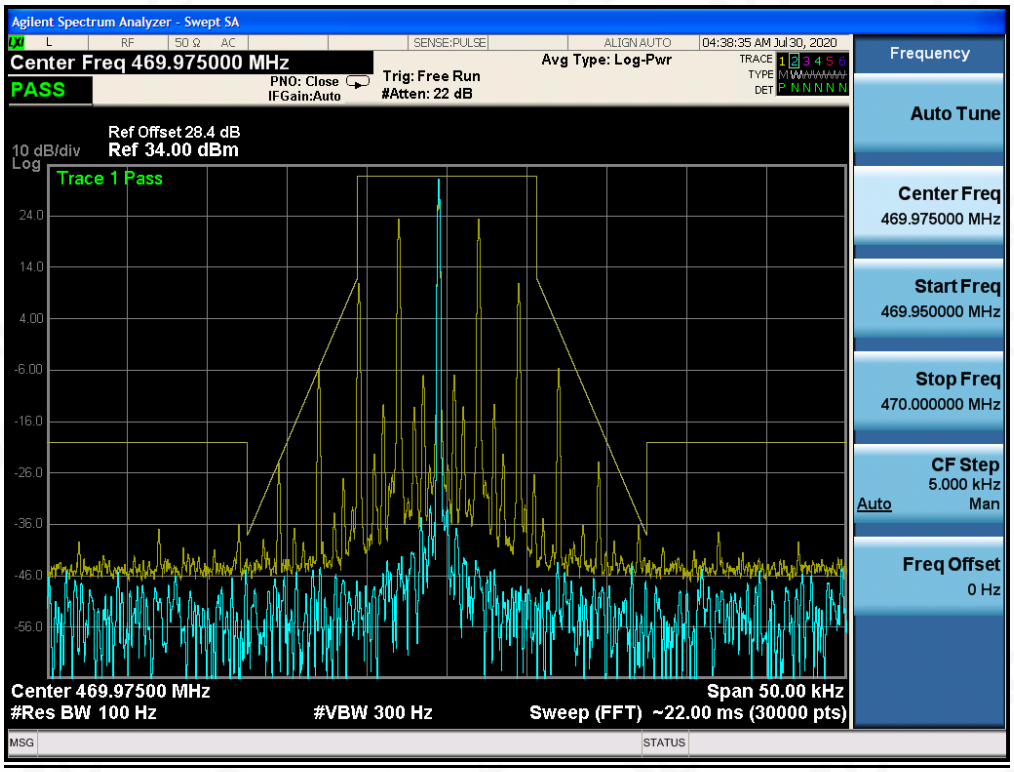
The Worst Emission Mask for (454.025 MHz) of 12.5 KHz channel Separation (1.5W)



The Worst Emission Mask for (460.025 MHz) of 12.5 KHz channel Separation (1.5W)



The Worst Emission Mask for (469.975 MHz) of 12.5 KHz channel Separation (1.5W)



9.MODULATION CHARACTERISTICS

9.1 PROVISIONS APPLICABLE

According to FCC§2.1047 and §90.207, for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.

9.2 MEASUREMENT METHOD

9.2.1 Modulation Limit

(1). Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1KHz using this level as a reference (0dB) and vary the input level from –20 to +20dB. Record the frequency deviation obtained as a function of the input level.

(2). Repeat step 1 with input frequency changing to 300, 1000, 1500 and 3000Hz in sequence.

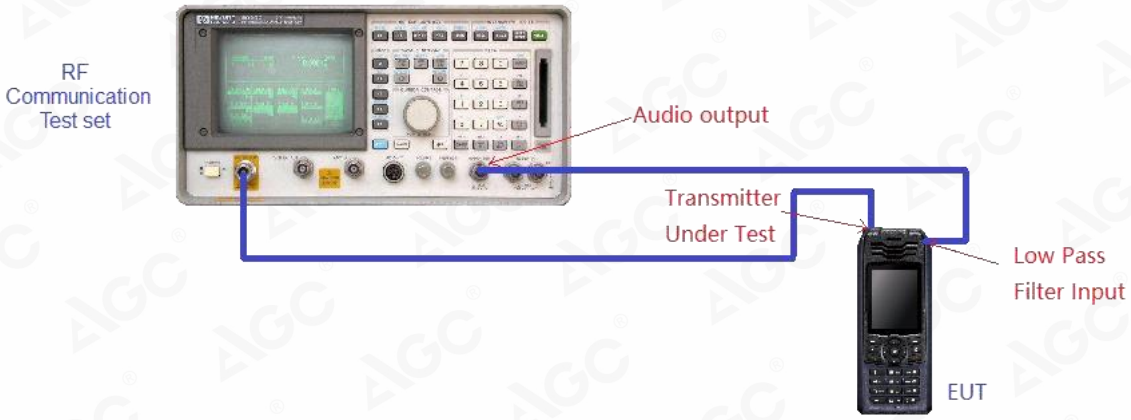
9.2.2 Audio Frequency Response

(1). Configure the EUT as shown in figure 1.

(2). Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0 dB).

(3). Vary the Audio frequency from 100 Hz to 10 KHz and record the frequency deviation.

(4). Audio Frequency Response = 20log10 (Deviation of test frequency/Deviation of 1 KHz reference).



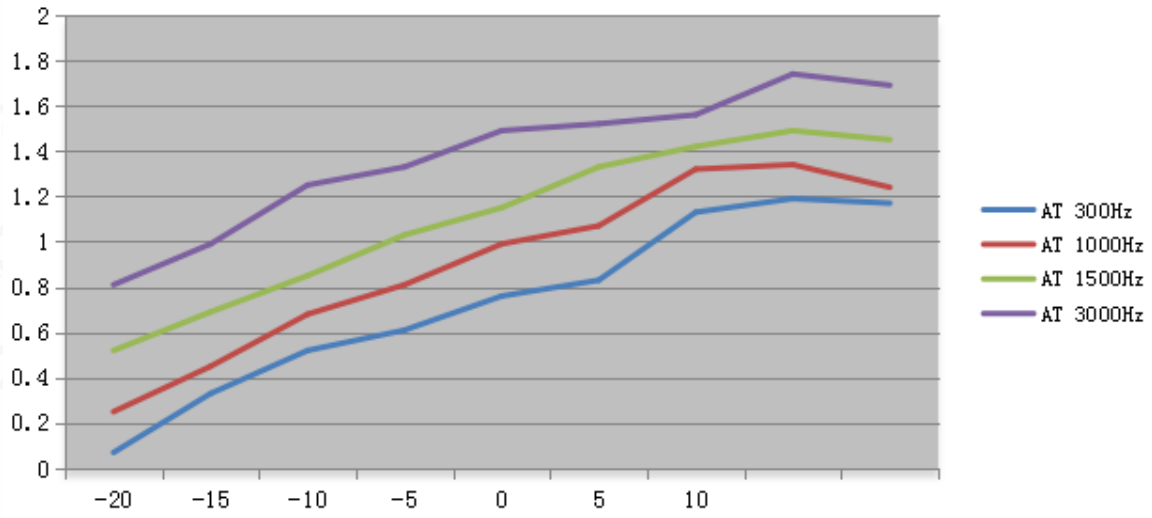
9.3 MEASUREMENT RESULT

TEST RESULT TS FOR 1.5W

(A). MODULATION LIMIT:

Bottom Channel @ 12.5 KHz Channel Separations

Modulation Level (dB)	Peak Freq. Deviation At 300 Hz	Peak Freq. Deviation At 1000 Hz	Peak Freq. Deviation At 1500 Hz	Peak Freq. Deviation At 3000 Hz
-20	0.07	0.25	0.52	0.81
-15	0.33	0.45	0.69	0.99
-10	0.52	0.68	0.85	1.25
-5	0.61	0.81	1.03	1.33
0	0.76	0.99	1.15	1.49
+5	0.83	1.07	1.33	1.52
+10	1.13	1.32	1.42	1.56
+15	1.19	1.34	1.49	1.74
+20	1.17	1.24	1.45	1.69



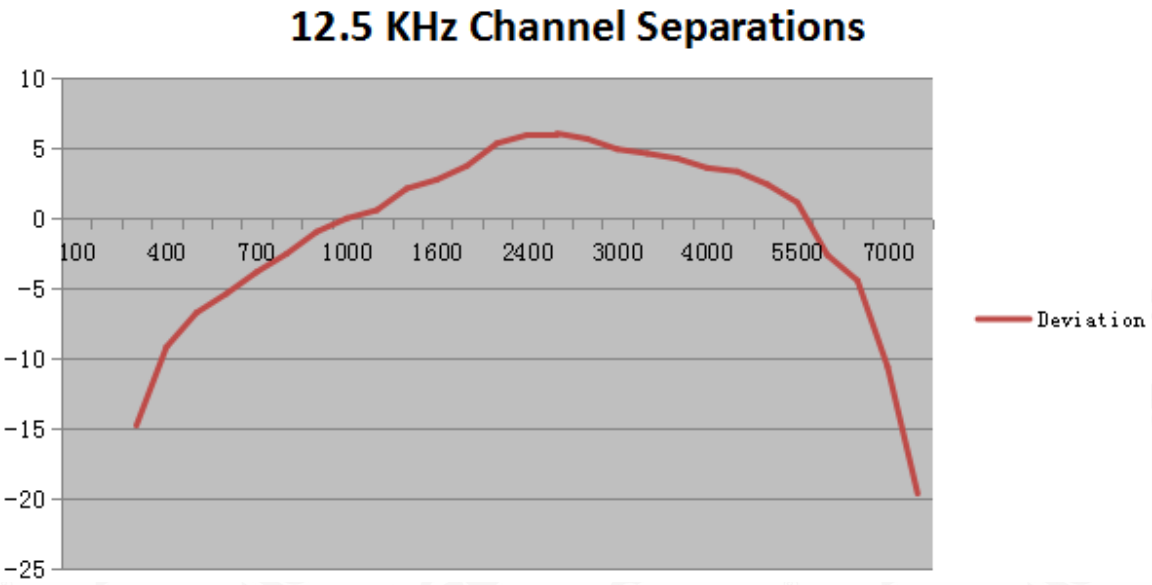
Note: All the modes had been tested, but only the worst data recorded in the report.

(B). AUDIO FREQUENCY RESPONSE:

Bottom Channel @ 12.5 KHz Channel Separations

Frequency (Hz)	Deviation (KHz)	Audio Frequency Response(dB)
100	--	--
200	--	--
300	0.21	-14.77
400	0.4	-9.17
500	0.53	-6.73
600	0.62	-5.37
700	0.74	-3.83
800	0.86	-2.52
900	1.03	-0.96
1000	1.15	0.00
1200	1.23	0.58
1400	1.47	2.13
1600	1.58	2.76
1800	1.77	3.75
2000	2.13	5.35
2400	2.28	5.94
2500	2.31	6.06
2800	2.21	5.67
3000	2.03	4.94
3200	1.96	4.63
3600	1.88	4.27
4000	1.74	3.60
4500	1.69	3.34
5000	1.52	2.42
5500	1.31	1.13
6000	0.85	-2.63
6500	0.69	-4.44
7000	0.34	-10.58
7500	0.12	-19.63
9000	--	--
10000	--	--
14000	--	--
18000	--	--
20000	--	--
30000	--	--

Frequency Response of Bottom Channel



Note: All the modes had been tested, but only the worst data recorded in the report.

10.MAXIMUMN TRANSMITTER POWER (CONDUCTED OUTPUT POWER) PEAK POWER

10.1 PROVISIONS APPLICABLE

Per FCC §2.1046 and §90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.

10.2 TEST PROCEDURE

The RF output of two way radiowas conducted to a spectrum analyzer through an appropriate attenuator.

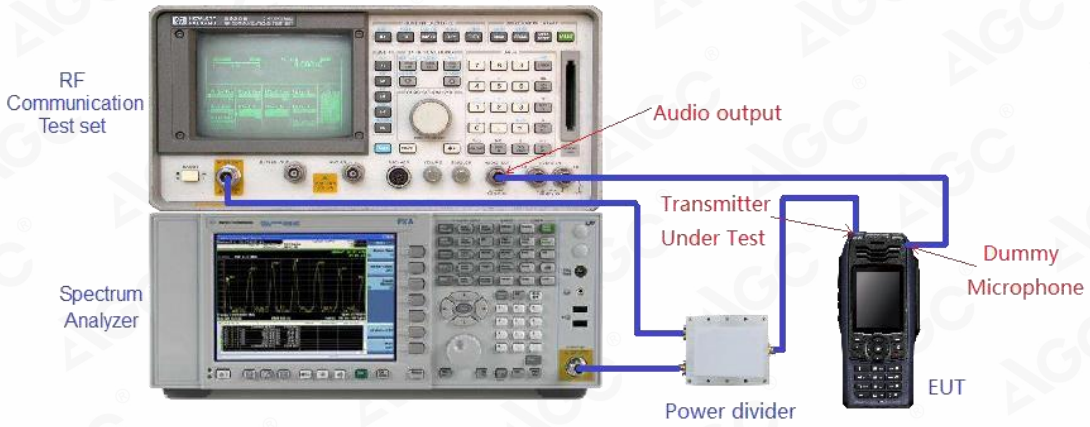
In the semi-anechoic chamber, setup as illustrated above the DUT placed on the 0.8m height of Turn Table, rotated the table 45 degree each interval to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power for each degree interval. The "Read Value" is the spectrum reading of maximum power value.

The substitution antenna is substituted for DUT at the same position and signals generator (S.G) export the CW signal to the substitution antenna via a TX cable. The receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum radiation power. Record the power level of maximum radiation power from spectrum. So, the Measured substitution value = Ref level of S.G + TX cables loss – Substituted Antenna Gain.

EIRP = "Read Value" + Measured substitution value + 2.15.

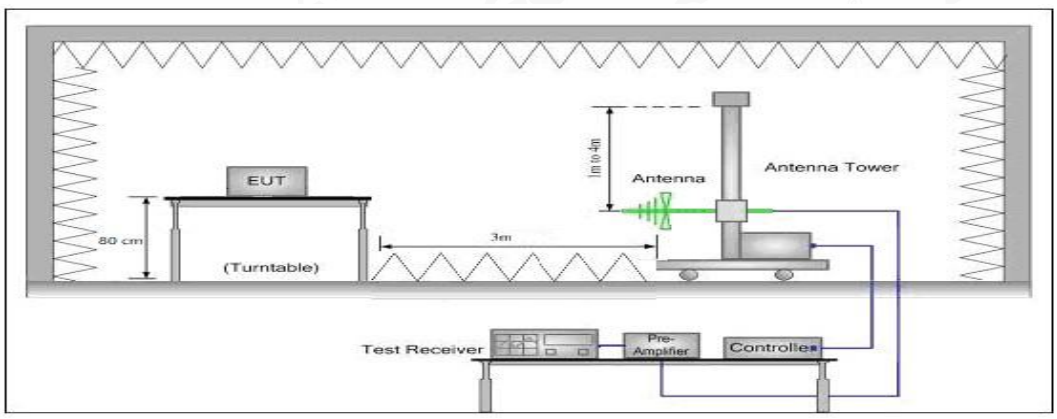
10.3 TEST CONFIGURATION

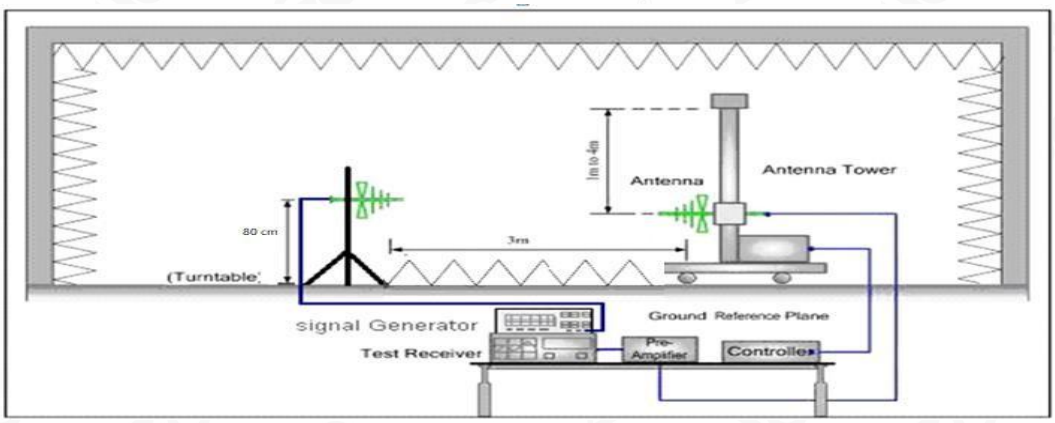
Conducted Output Power:



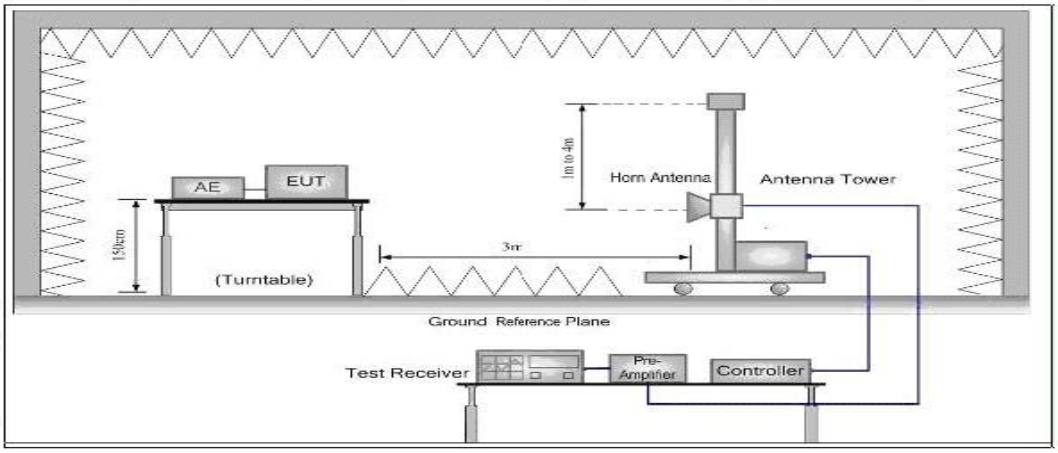
Effective Radiated Power

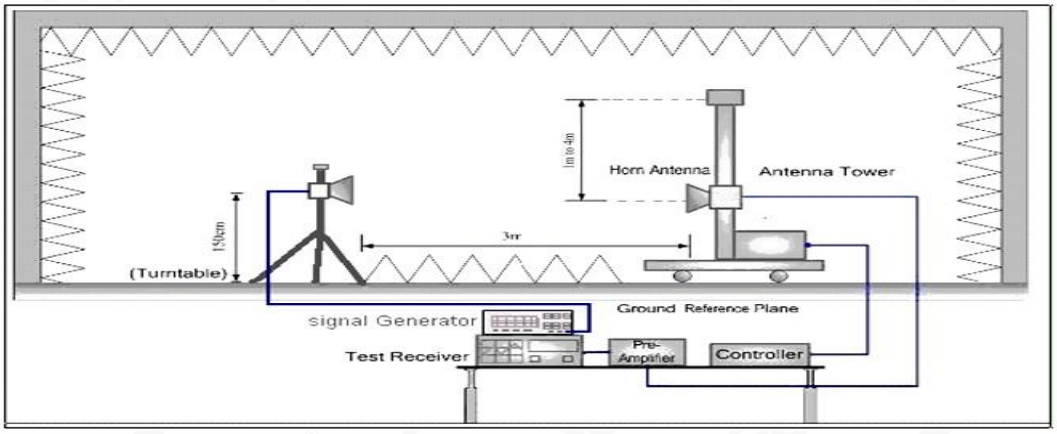
Radiated Below1GHz





Radiated Above 1 GHz





10.4 TEST RESULT

The maximum Conducted Power (CP) for UHF is
Analog: 1.5W for 12.5 KHz Channel Separation UHF
Calculation Formula: CP = R + A + L
Note:
CP: The final Conducted Power
R : The reading value from spectrum analyzer
A : The attenuation value of the used attenuator
L : The loss of all connection cables

Conducted Power Measurement Results-1.5W		
Channel Separation	**Channel**	**Measurement Result (dBm)**
		For 31.76dBm(1.5W)
12.5 KHz	Bottom(450.025MHz)	**31.45**
	Middle(454.025MHz)	31.42
	Middle (460.025MHz)	31.39
	Top(469.975Hz)	31.41

Radiated Power Measurement Results-1.5W		
Channel Separation	**Channel**	**Measurement Result (dBm)**
		For 31.76dBm(1.5W)
12.5 KHz	Bottom(450.025MHz)	31.28
	Middle(454.025MHz)	31.22
	Middle (460.025MHz)	31.21
	Top(469.975Hz)	31.20

11.SPURIOUS EMISSION ON ANTENNA PORT

11.1 PROVISIONS APPLICABLE

Please refer to FCC 47 CFR 2.1051, 2.1057 & 90.210 for specification details.
Emissions shall be attenuated below the mean output power of the transmitter as follows:

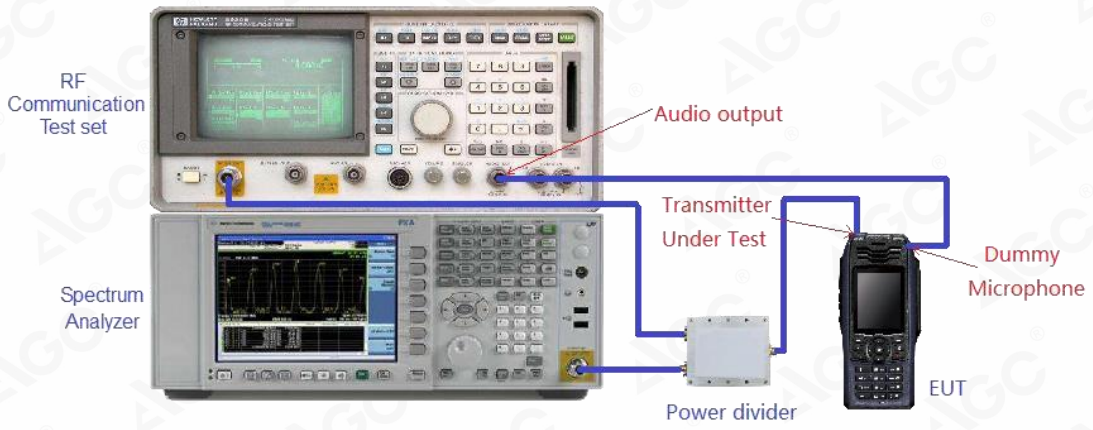
FCC Rules	Attenuation Limit (dBc)
§ 90.210	At least 50 + 10 log (P) dB

50 +10 log (Pwatts)
Note: In general, the worse case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log10 (TP)
EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is P(dBm)
Limit (dBm) = P(dBm)-50-10 log (Pwatts) = -20dBm

11.2 TEST PROCEDURE

1. The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation.
2. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th . Harmonic for the lower and the highest frequency range.
3. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic.
4. The audio input was set the unmodulated carrier, the resulting picture is print out for each channel separation.

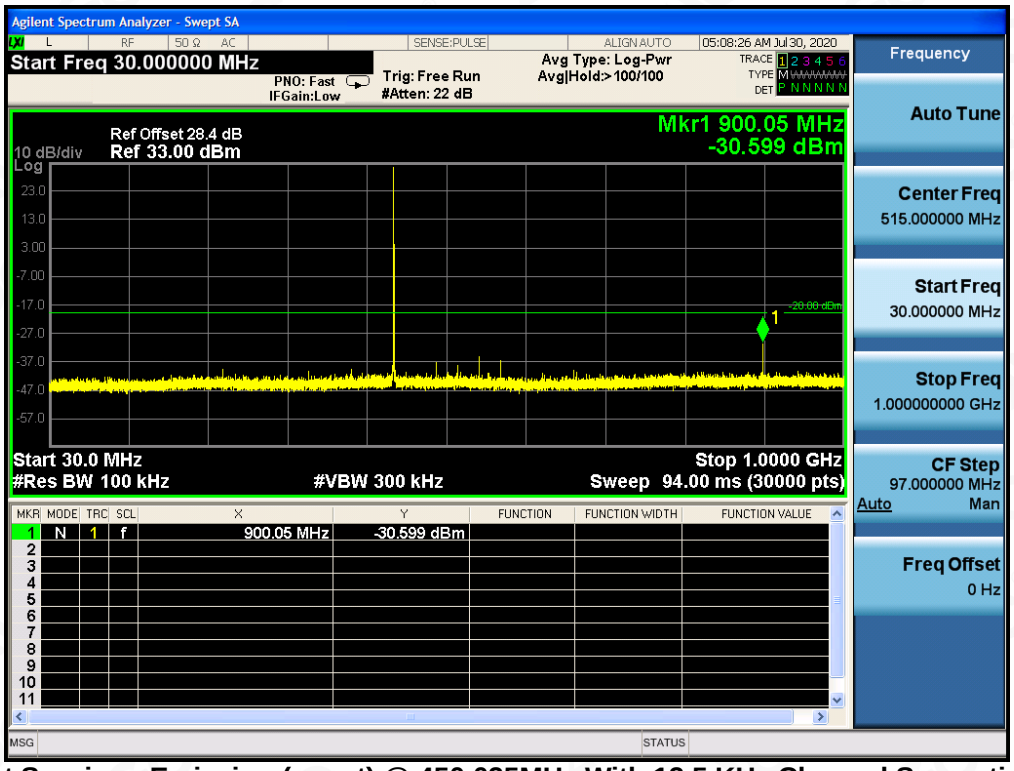
11.3 TEST CONFIGURATION



11.4 TEST RESULT

Conducted Spurious Emission (worst) @ 450.025MHz With 12.5 KHz Channel Separation-1.5W

30MHz-1GHz

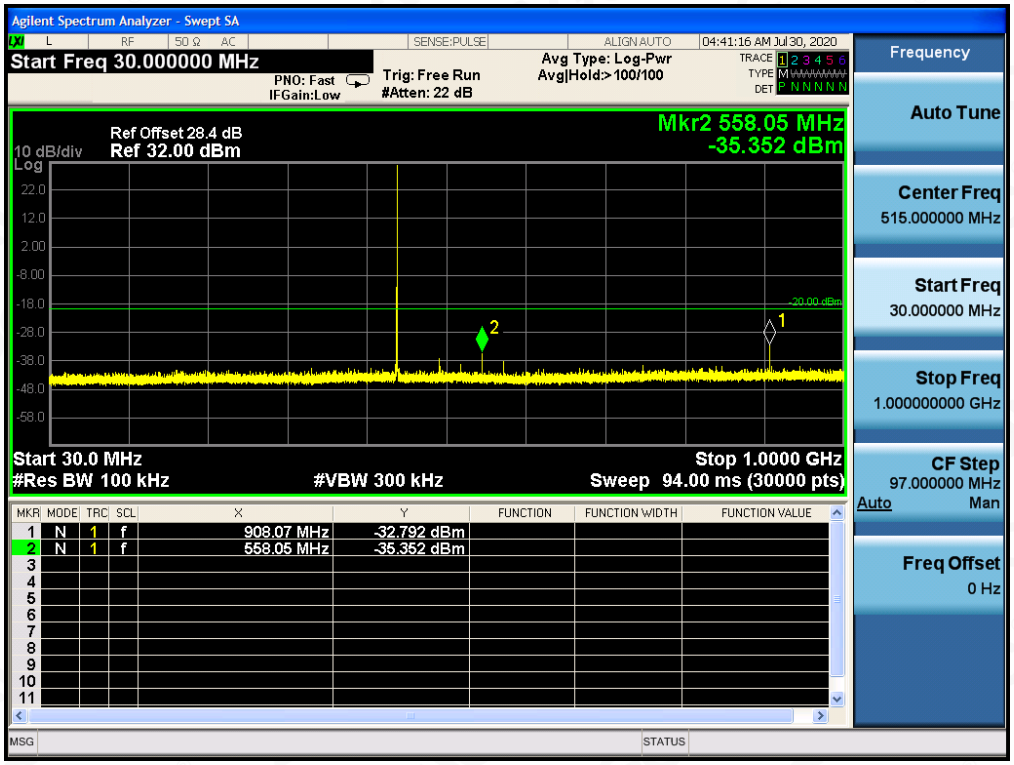


Conduct Spurious Emission (worst) @ 450.025MHz With 12.5 KHz Channel Separation-1.5W

1GHz-12.75GHz

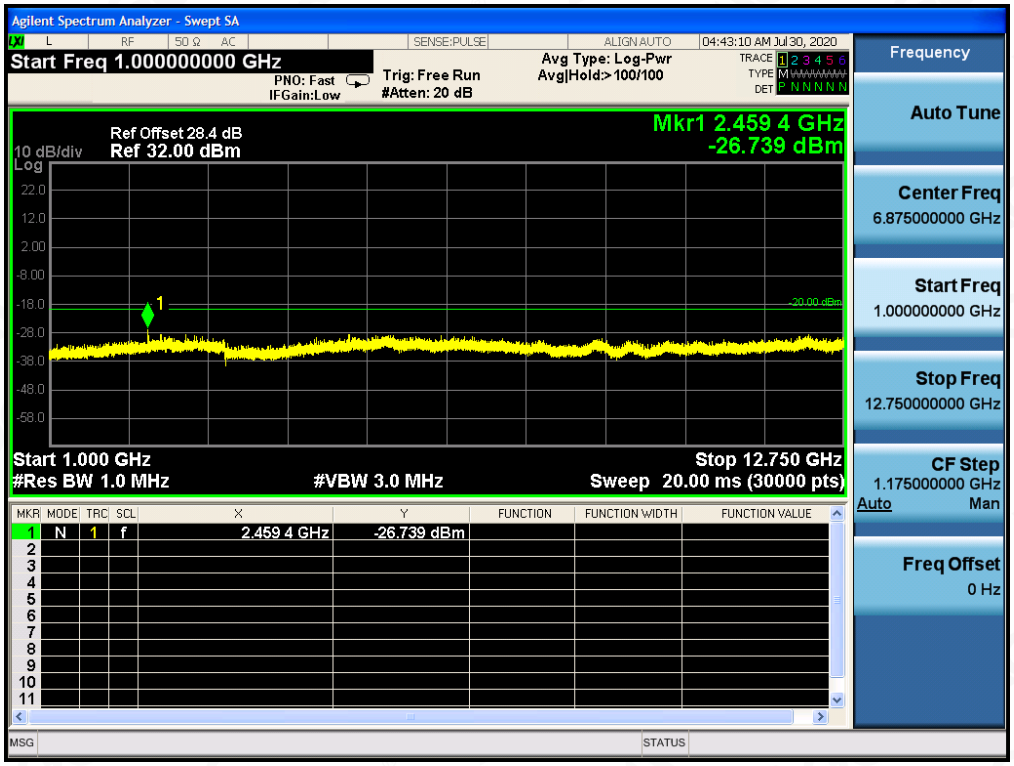
Conducted Spurious Emission (worst) @ 454.025 MHz With 12.5 KHz Channel Separation-1.5W

30MHz-1GHz



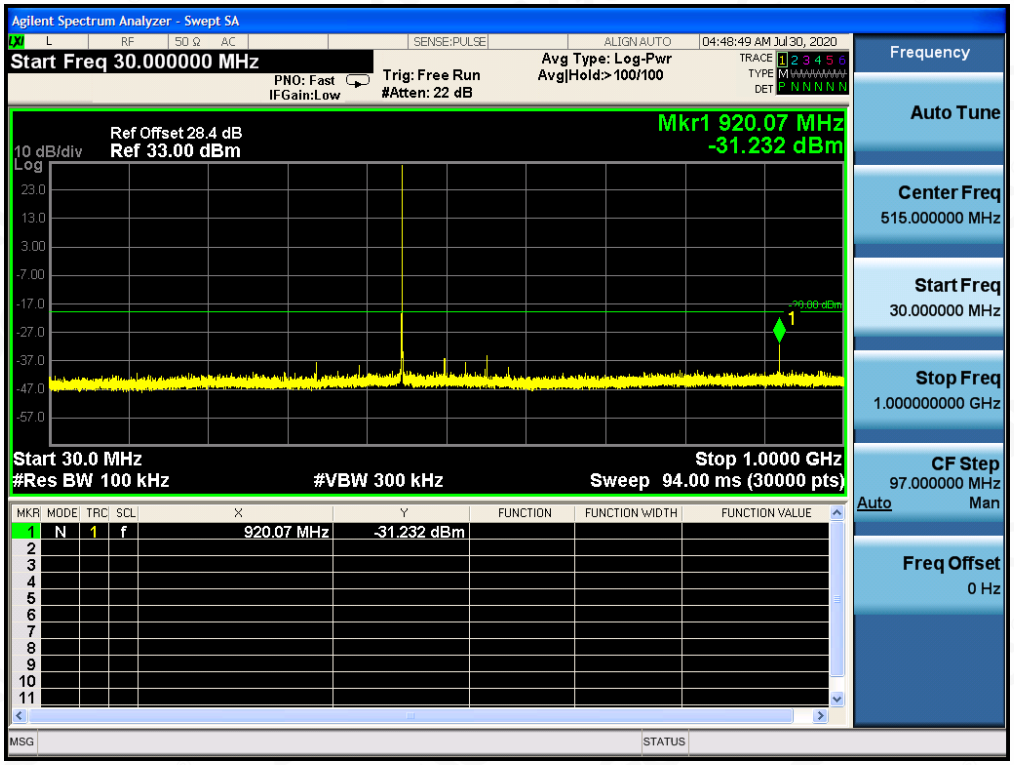
Conduct Spurious Emission (worst) @ 454.025 MHz With 12.5 KHz Channel Separation-1.5W

1GHz-12.75GHz



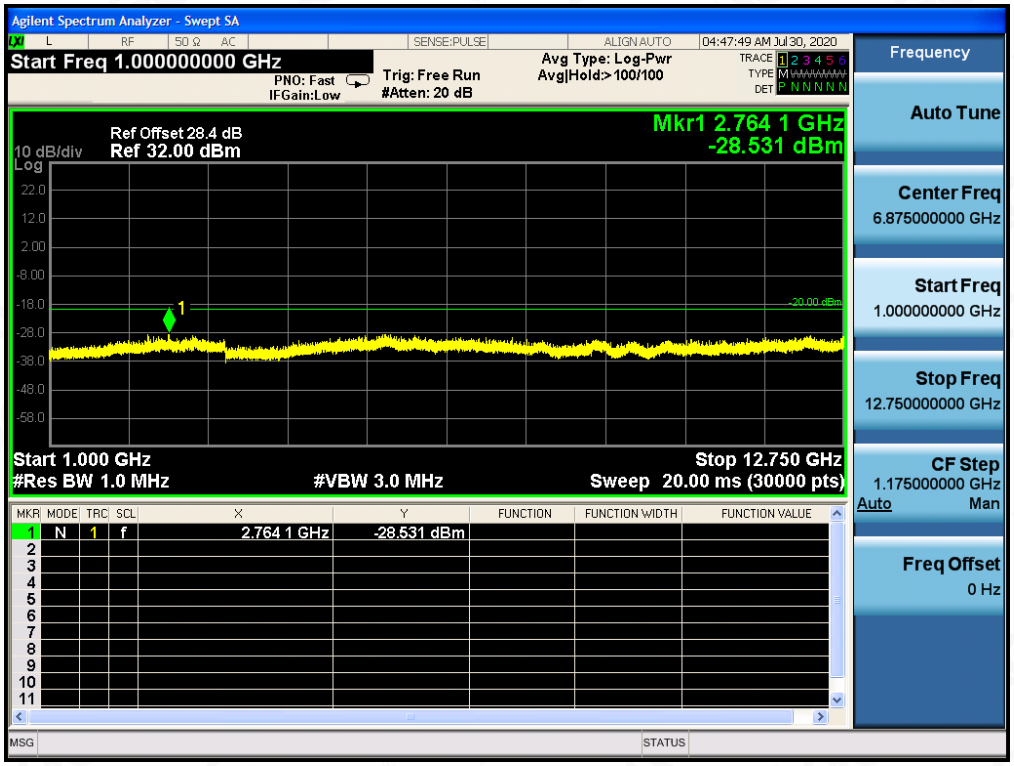
Conducted Spurious Emission (worst) @ 460.025MHz With 12.5 KHz Channel Separation-1.5W

30MHz-1GHz



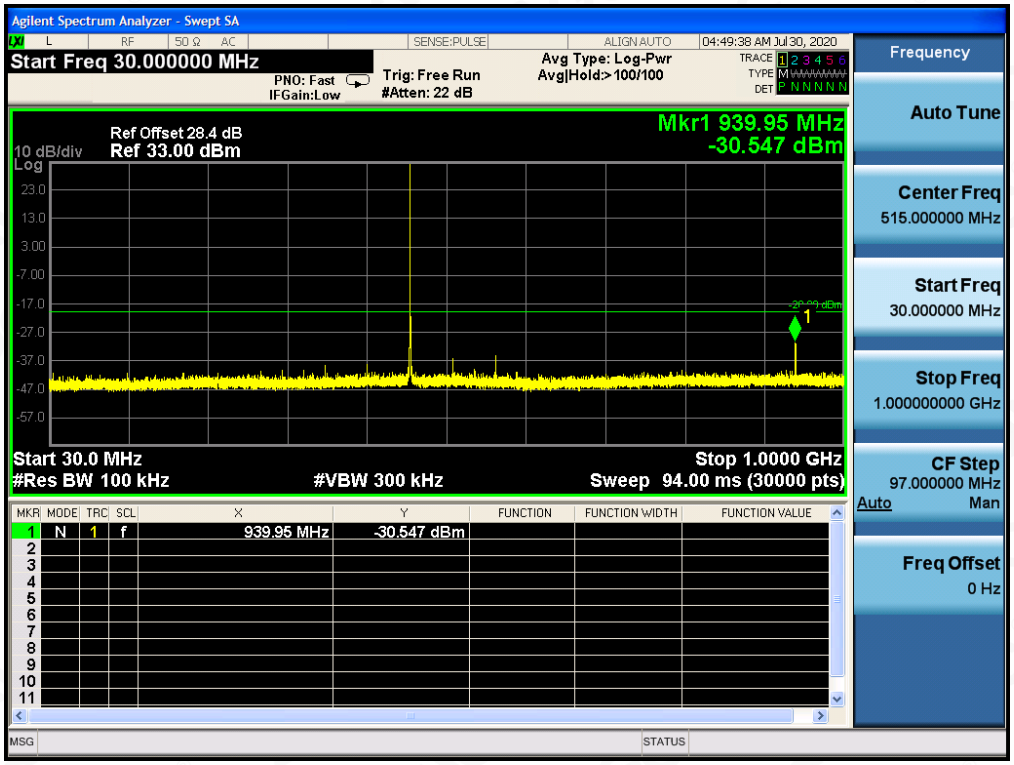
Conduct Spurious Emission (worst) @ 460.025MHz With 12.5 KHz Channel Separation-1.5W

1GHz-12.75GHz



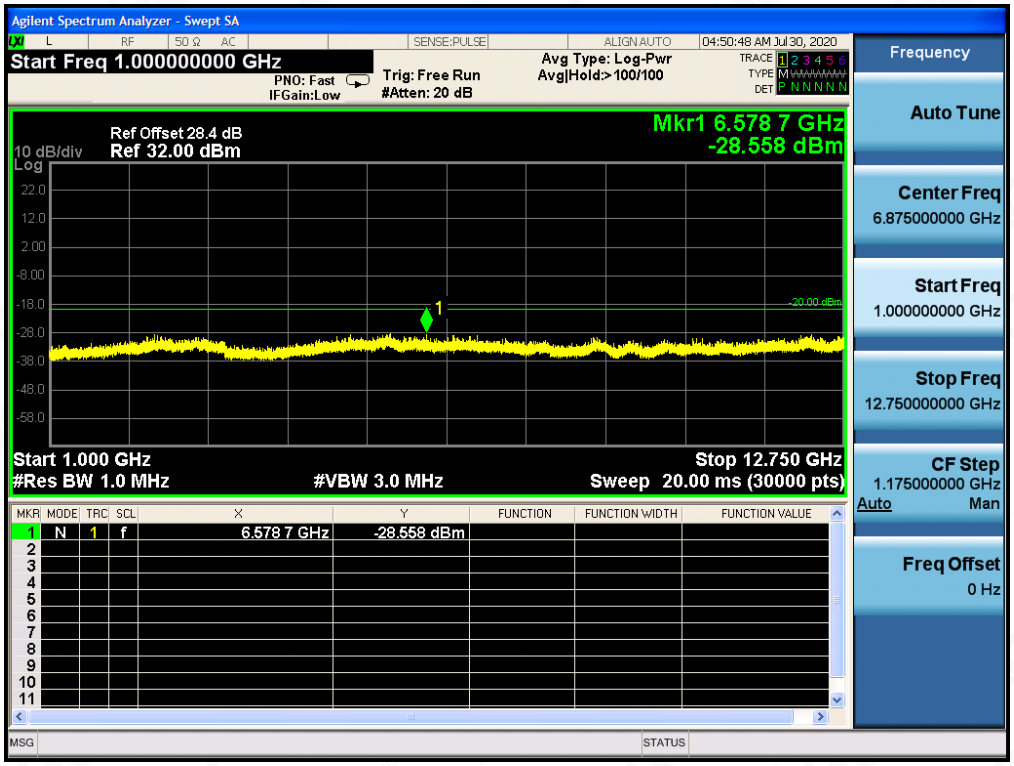
Conducted Spurious Emission (worst) @ 469.975MHz With 12.5 KHz Channel Separation-1.5W

30MHz-1GHz



Conduct Spurious Emission (worst) @ 469.975MHz With 12.5 KHz Channel Separation-1.5W

1GHz-12.75GHz



Note: All the test frequencies was tested, but only the worst data be recorded in this part.

12.TRANSMITTER FREQUENCY BEHAVIOR

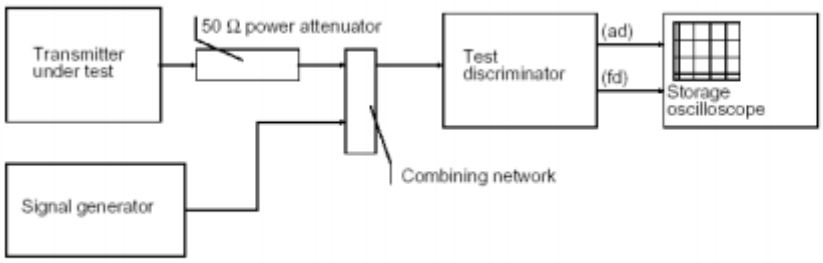
12.1PROVISIONS APPLICABLE

FCC §90.214

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1 [4]	± 25.0 kHz	5.0 ms	10.0 ms
t_2	± 12.5 kHz	20.0 ms	25.0 ms
t_3 [4]	± 25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1 [4]	± 12.5 kHz	5.0 ms	10.0 ms
t_2	± 6.25 kHz	20.0 ms	25.0 ms
t_3 [4]	± 12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1 [4]	± 6.25 kHz	5.0 ms	10.0 ms
t_2	± 3.125 kHz	20.0 ms	25.0 ms
t_3 [4]	± 6.25 kHz	5.0 ms	10.0 ms

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
t_2 is the time period immediately following t_1.
t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

12.2 TEST CONFIGURATION

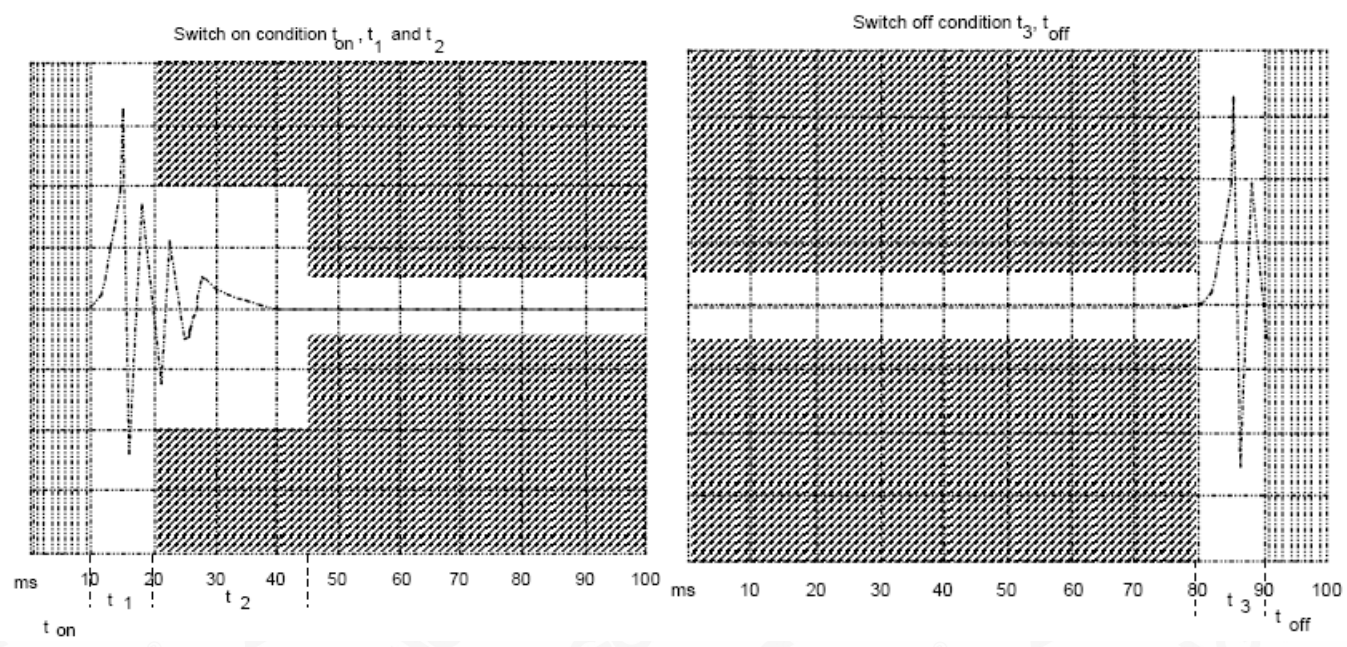


12.3 TEST METHOD

According to TIA/EIA-603 2.2.19 requirement, as for the product different from PTT, we use test steps as follows:
1. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON;
2. Input 1kHz signal into DUT;
3. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signals;
4. Keep DUT in OFF state and Key the PTT;
5. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t1 and t2,and shall also remain within limits following t2;
6. Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal.
7. Keep the digital portable radio in ON state and unkey the PTT;
8. Observe the stored oscilloscope of modulation domain analyzer, The signal trace shall be maintained within the allowable limits during the period t3.
9. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±12.5 kHz deviation and set its output level to -100dBm.
10. Turn on the transmitter.
11. Supply sufficient attenuation via the RF attenuator to provide an input level to the stored oscilloscope
12. that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the stored oscilloscope as P0.
13. Turn off the transmitter.
14. Adjust the RF level of the signal generator to provide RF power equal to P0. This signal generator RF level shall be maintained throughout the rest of the measurement.
15. Remove the attenuation, so the input power to the stored oscilloscope is increased by 30 dB when the transmitter is turned on.
16. Adjust the vertical amplitude control of the stored oscilloscope to display the 1000 Hz at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to “Video”, and tune the “trigger level” on suitable level. Then set the “tiger offset” to -10ms for turn on and -15ms for turn off.
17. Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be ton. The trace should be maintained within the allowed divisions during the period t1 and t2.
18. Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum
19. Analyzer. The trace should be maintained within the allowed divisions during the period t3.

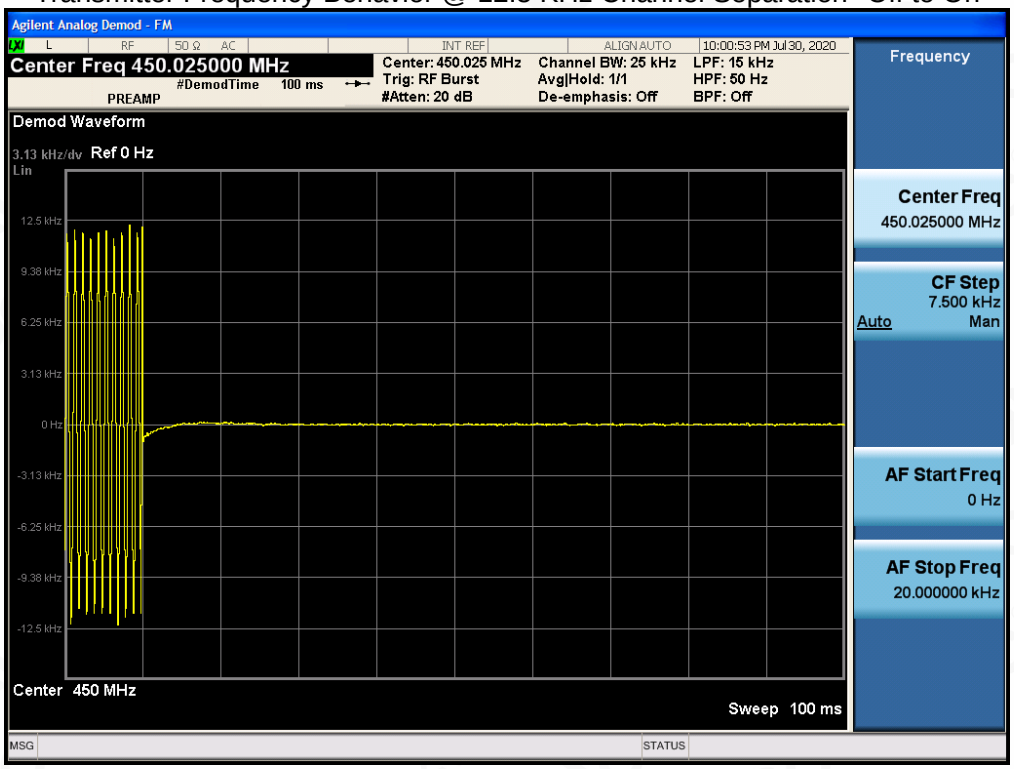
12.4 DESCRIBE LIMIT LINE OF RANSMITTER FREQUENCY BEHAVIOR

ton: The switch-on instant ton of a transmitter is defined by the condition when the output power, measured at the antenna terminal, exceeds 0,1 % of the full output power (-30 dBc).
t1: period of time starting at ton and finishing according to above 11.1
t2: period of time starting at the end of t1 and finishing according to above 11.1
toff: switch-off instant defined by the condition when the output power falls below 0,1 % of the full output power (-30 dBc).
t3: period of time that finishing at toff and starting according to above 11.1

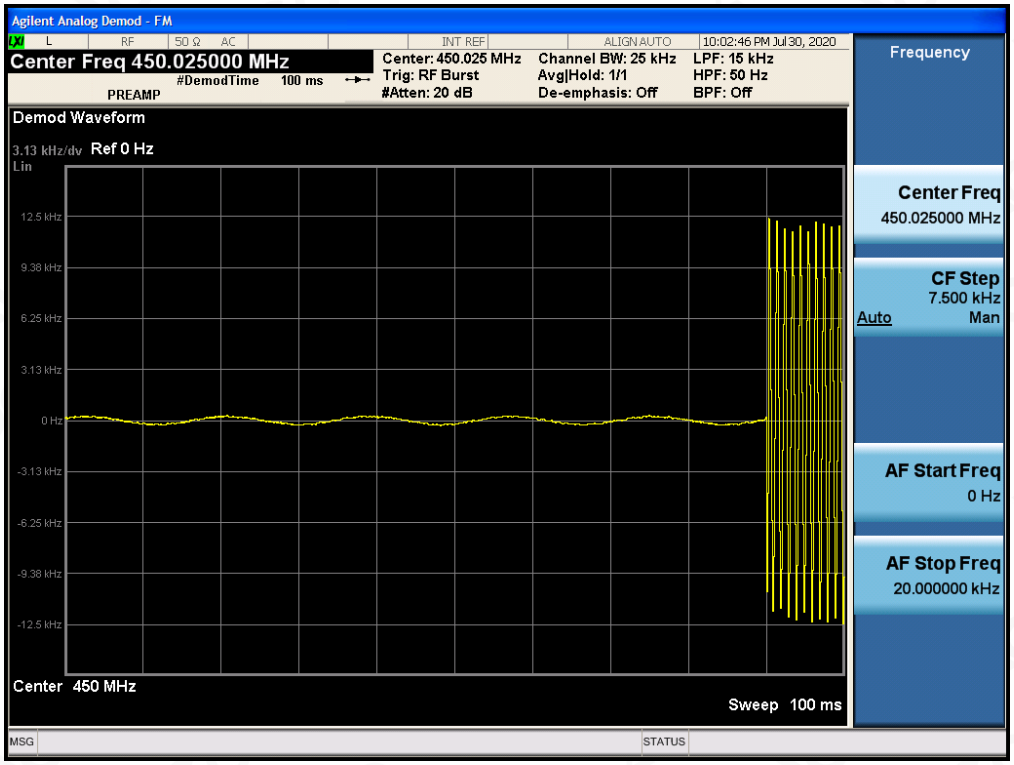


12.5 MEASURE RESULT

Transmitter Frequency Behavior @ 12.5 KHz Channel Separation--Off to On



Transmitter Frequency Behavior @ 12.5 KHz Channel Separation--On to Off



Note: All the test frequencies was tested, but only the worst data be recorded in this part.

13.AUDIO LOW PASS FILTER RESPONSE

13.1.TEST 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:

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

13.2. METHOD OF MEASUREMENTS

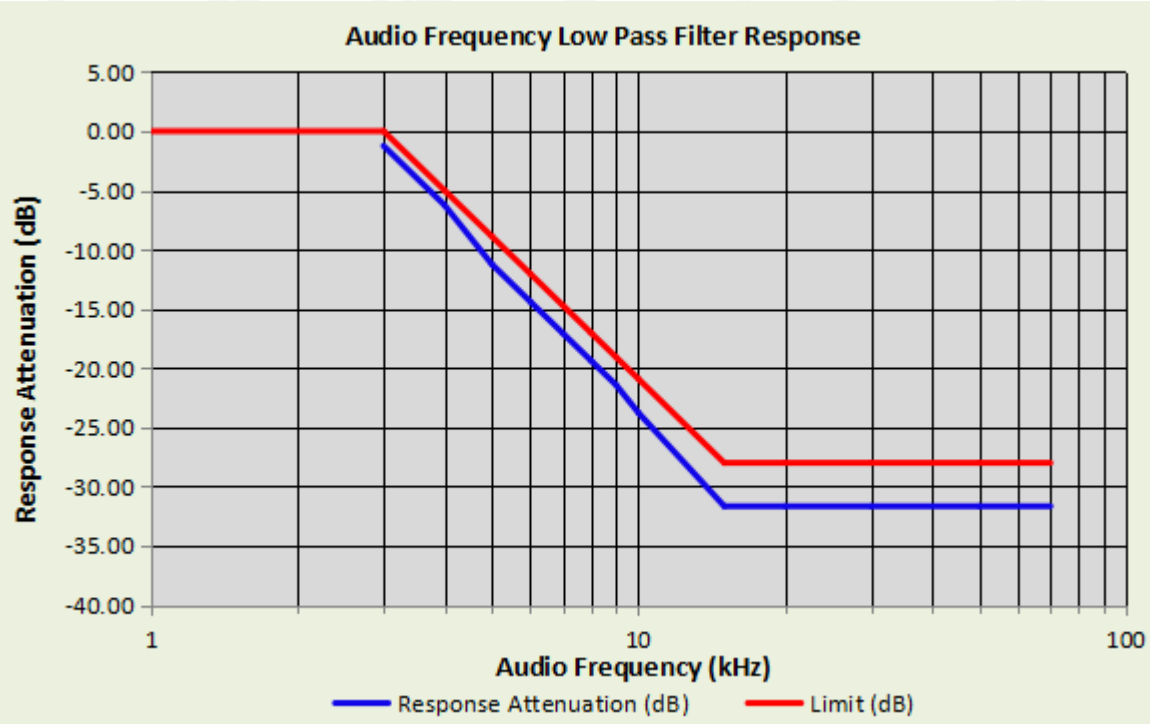
The rated audio input signal was applied to the input of the audio low-pass filter (or of all modulation stages) using an audio oscillator, this input signal level and its corresponding output signal were then measured and recorded using the FFT Digital Spectrum Analyzer. Tests were repeated at different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

13.3.TEST CONFIGURATION

13.4.TEST RESULT

BOTTOM CHANNEL @12.5 KHZ CHANNEL SPACING, F3E, FREQUENCY OF ALL MODULATION STATES (TEST RESULT FOR UHF)-1.5W

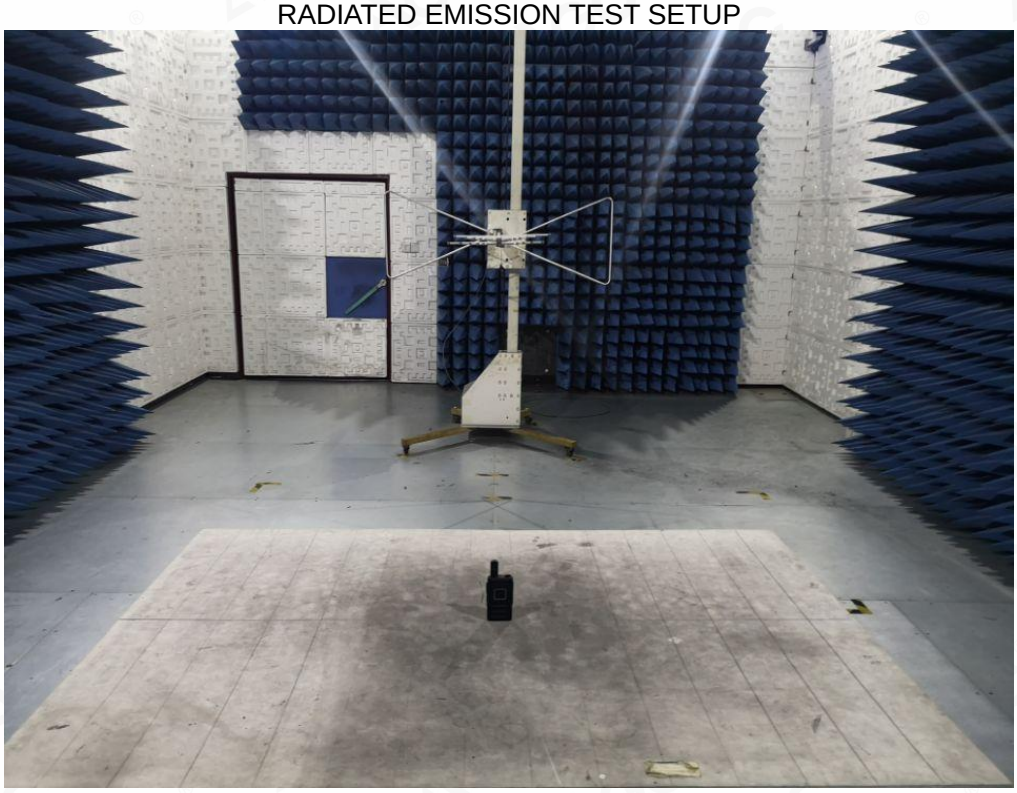
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1	0	/
3	-1.24	0.00
4	-6.24	-5.00
5	-11.22	-8.87
6	-14.39	-12.04
7	-17.07	-14.72
8	-19.39	-17.04
9	-21.43	-19.08
10	-23.78	-20.92
15	-31.66	-28.00
20	-31.66	-28.00
30	-31.66	-28.00
50	-31.66	-28.00
70	-31.66	-28.00



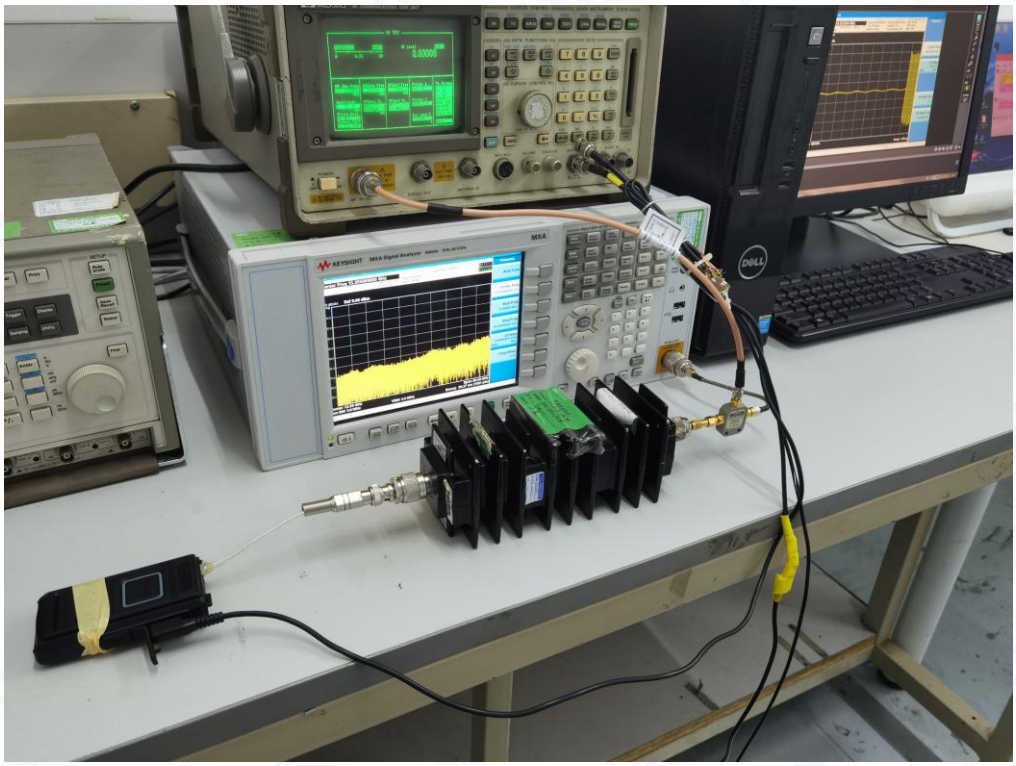
Note: All the test frequencies was tested, but only the worst data be recorded in this part.

APPENDIX I: PHOTOGRAPHS OF SETUP

RADIATED EMISSION TEST SETUP



CONDUCTED TEST SETUP



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