FCC Part 90 Rules
Test Report

Report No.: AGC06326201001FE10

FCC ID	:	2ARTCRR-5
PRODUCT DESIGNATION	:	Two-way radio
BRAND NAME	:	Arcshell
MODEL NAME	:	AR-5, AR-6
APPLICANT	:	Henan Aofeng Industrial Co., Ltd.
DATE OF ISSUE	:	Oct. 19, 2020
STANDARD(S)	:	FCC Part 90 Rules
REPORT VERSION	:	V 1.0

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

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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Oct. 19, 2020	Valid	Initial Release

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1. VERIFICATION OF COMPLIANCE

Applicant:	Henan Aofeng Industrial Co., Ltd.
Address	Zhongyuanqu Jianshexilu 92 Hao 1 Haolou 2 Danyuan 5 Ceng 44 Hao, Zhengzhou, Henan, China 450007
Manufacturer:	Henan Aofeng Industrial Co., Ltd.
Address	Zhongyuanqu Jianshexilu 92 Hao 1 Haolou 2 Danyuan 5 Ceng 44 Hao, Zhengzhou, Henan, China 450007
Factory	Henan Aofeng Industrial Co., Ltd.
Address	Zhongyuanqu Jianshexilu 92 Hao 1 Haolou 2 Danyuan 5 Ceng 44 Hao, Zhengzhou, Henan, China 450007
Product Designation:	Two-way radio
Brand Name:	Arcshell
Test Model	AR-5
Serial Model	AR-6
Difference Description	1.AR-5 and AR-6 have different face shell styles, different battery shells, different charger shells and different models. 2. AR-5 & AR-6 PCB boards & specifications are the same. 3. AR-6 has different colors.
Measurement Procedure	TIA/EIA 603-E-2016
Deviation	No any deviation from the test method.
Date of Test:	Oct. 13, 2020~Oct.19, 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

Donjon Huang
(Project Engineer)

Oct. 19, 2020

Reviewed By

Max Zhang
(Reviewer)

Oct. 19, 2020

Approved By

Forrest Lei
Authorized Officer

Oct. 19, 2020

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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 modulation achieves the system operating.

A major technical description of EUT is described as following:

Communication Type	Voice/ Tone only
Hardware Version	V2.4
Software Version	200/2W【1】【K】
Modulation	FM
Emission Type	11K0F3E
Emission Bandwidth	10.20KHz
Peak Frequency Deviation	1.69KHz
Audio Frequency Response	5.42dB
Maximum Transmitter Power	32.98dBm
Output power Modification	2W (It was fixed by the manufacturer, any individual can't arbitrarily change it.)
Data Rate	12.5KHz(Channel Spacing)
Antenna Designation	Detachable
Antenna Gain	2.15dBi
Power Supply	DC 3.7V,1500mAh by battery, charging for DC4.2V
Limiting Voltage	DC 3.15V-4.26V
Operation Frequency Range and Channel	Frequency Range: 400 MHz to 470 MHz (UHF) Channel Separation: 12.5KHz(Analog)
	Bottom Channel: 400.025MHz Middle Channel: 435.025MHz Middle Channel: 454.025MHz High Channel: 469.975MHz
Frequency Tolerance	1.076ppm

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Frequency Range (MHz)	Rated Transmit Power(W)(Conducted)	Transmit Mode/Emission Designator
400-470	2W	11K0F3E(Analog Vioce;NB)

Channel No. (6.25KHz)	Channel No. (12.5KHz)	12.5KHz Channel Spaced 400MHz Band Plan(MHz)
1	1-2	400.025
2		
3	3-4	455.025
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.

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2.2RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for FCC ID: **2ARTCRR-5 ,** filing to comply with Part 2, 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.

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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

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3.4 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

- Uncertainty of Conducted Emission, Uc = ±3.2 dB
- Uncertainty of Radiated Emission below 1GHz, Uc = ±3.9 dB
- Uncertainty of Radiated Emission above 1GHz, Uc = ±4.8 dB
- Uncertainty of total RF power, conducted, Uc = ±0.8dB
- Uncertainty of spurious emissions, conducted, Uc = ±2.7dB
- Uncertainty of Occupied Channel Bandwidth: Uc = ±2 %
- Uncertainty of Frequency: Uc = ±2 %
- Uncertainty of FM deviation: Uc=±2 %
- Uncertainty of Audio Level: Uc=±0.98dB
- Uncertainty of Modulation Limiting: Uc=0.42 %
- Uncertainty of Transient Frequency Behavior: Uc=6.8%

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3.5 CONFIGURATION 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	AR-5	FCC ID: 2ARTCRR-5	EUT
3	Charger	KS-36	Input: DC 5.0V 1A Output: DC 4.2V 0.5A	Accessory
4	Battery	BL-1	DC 3.7V 1500mAh	Accessory
5	Back clip	N/A	N/A	Accessory

Note：The battery is full-charged during the test

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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
§2.1047	Audio Low Pass Filter Response	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

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LIST OF EQUIPMENTS USED

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	May 15, 2020	May 14, 2021
EXA Signal Analyzer	Aglient	N9020A	W1312-60196	Aug. 21, 2020	Aug. 20, 2021
EXA Signal Analyzer	Aglient	N9020A	MY52090123	Sep. 03, 2020	Sep. 02, 2021
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. 20, 2019	Sep. 19, 2021
Modulation Domain Analyzer	HP	53310A	3121A02467	Jul. 03, 2020	Jul. 02, 2022
Small environmental tester	ESPEC	SH-242	--	Sep. 03, 2020	Sep. 02, 2022
RF Communication Test Set	HP	8920B	--	Sep. 03, 2020	Sep. 02, 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
Fliter-VHF	Microwave	N26460M1	498703	May. 11, 2020	May. 10, 2021

NOTE: 8920B can generate audio modulation frequency.

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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.

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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.

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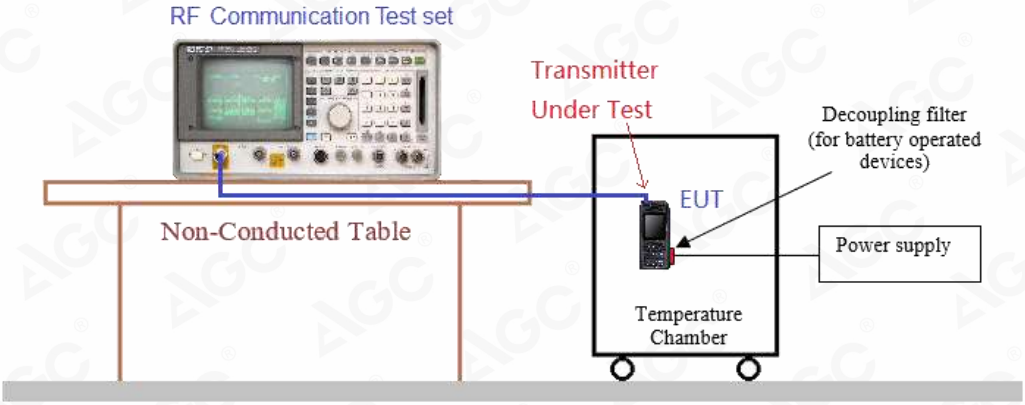
6.3 TEST SETUP BLOCK DIAGRAM



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6.4 TEST RESULTS

(1) Frequency stability versus input voltage (Supply nominal voltage is 3.70V)**-2W-12.5KHz**

Environment Temperature(℃)	Power Supply (V)	Reference Frequency 400.025MHz	435.025MHz	454.025MHz	469.975MHz	Limit: ppm
50	DC 3.70 V	0.793	0.653	0.795	0.628	2.5
40	DC 3.70 V	1.032	0.652	0.868	0.955	
30	DC 3.70 V	0.719	0.562	0.837	0.575	
20	DC 3.70 V	0.738	0.875	0.757	0.361	
10	DC 3.70 V	0.670	1.033	0.855	0.720	
0	DC 3.70 V	0.661	0.776	0.853	0.390	
-10	DC 3.70 V	0.703	0.729	1.014	0.309	
-20	DC 3.70 V	0.567	0.547	1.000	0.394	
-30	DC 3.70 V	1.020	0.665	0.558	0.471	
Result	Pass					

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

Environment Temperature(℃)	Power Supply (V)	Reference Frequency 400.025MHz	435.025MHz	454.025MHz	469.975MHz	Limit: ppm
50	DC 3.15 V	0.651	0.738	0.966	0.414	2.5
40	DC 3.15 V	1.076	0.538	0.878	0.403	
30	DC 3.15 V	0.756	0.617	1.008	0.788	
20	DC 3.15 V	0.910	0.607	0.606	0.660	
10	DC 3.15 V	0.668	0.847	0.559	0.516	
0	DC 3.15 V	1.004	0.627	0.918	0.481	
-10	DC 3.15 V	0.583	0.781	0.668	0.672	
-20	DC 3.15 V	0.953	0.855	0.929	0.370	
-30	DC 3.15 V	0.925	0.895	0.929	0.460	
Result	Pass					

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

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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).

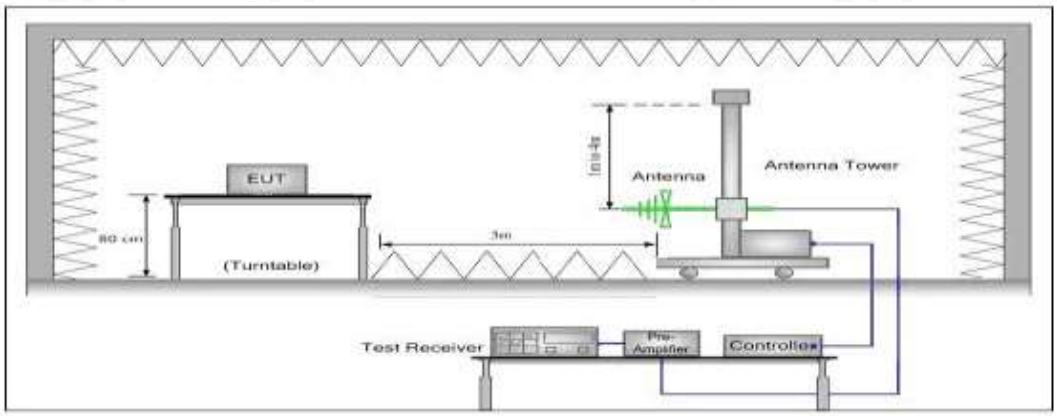
3). Set SPA Center Frequency = fundamental frequency, RBW=100Hz.VBW= 300 Hz, Span =50 KHz.

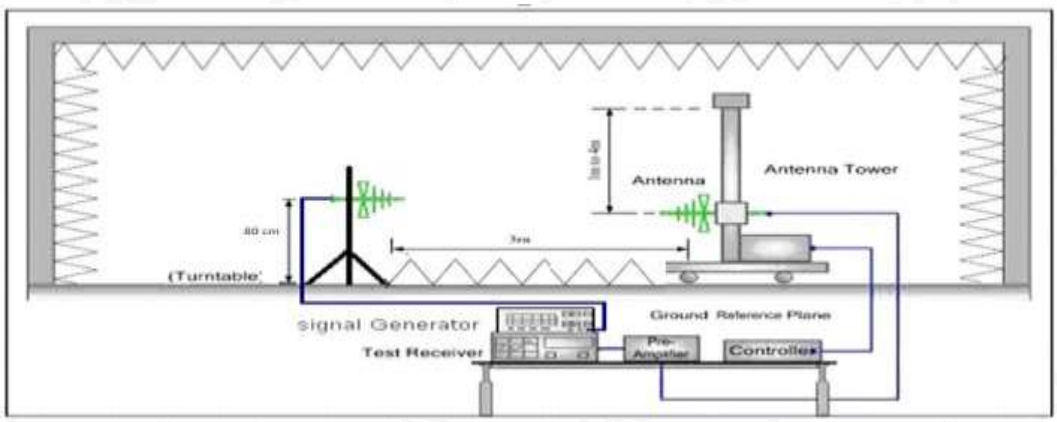
4). Set SPA Max hold. Mark peak, -26 dB.

7.3 TEST SETUP BLOCK DIAGRAM

Radiation method:

Radiated Below1GHz





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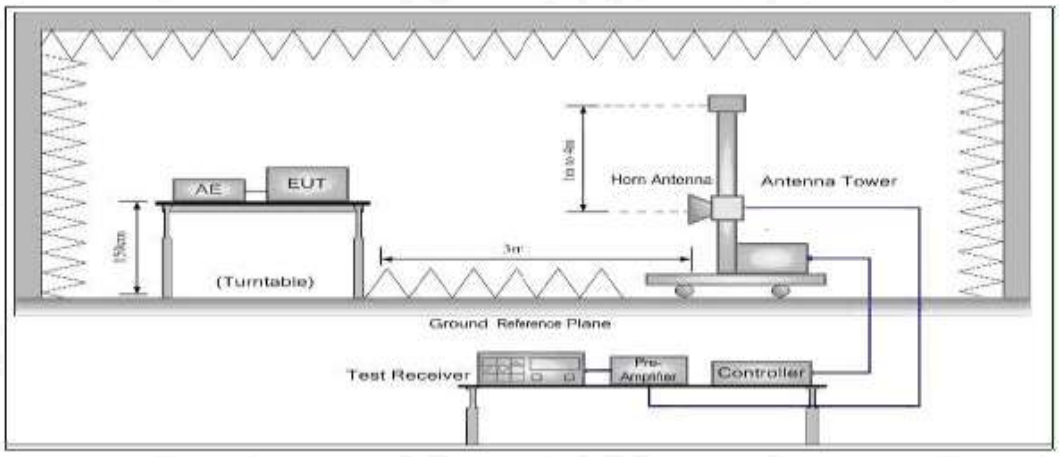
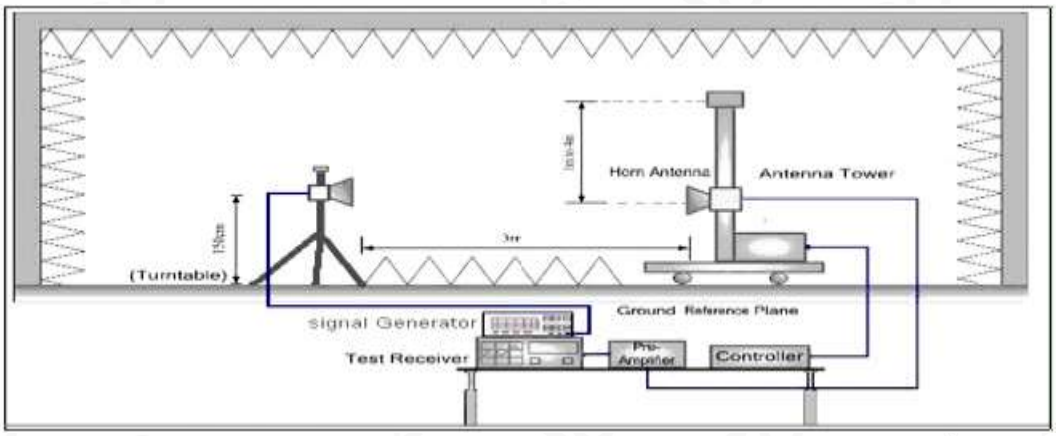
Radiated Above 1 GHz





Conduction method:

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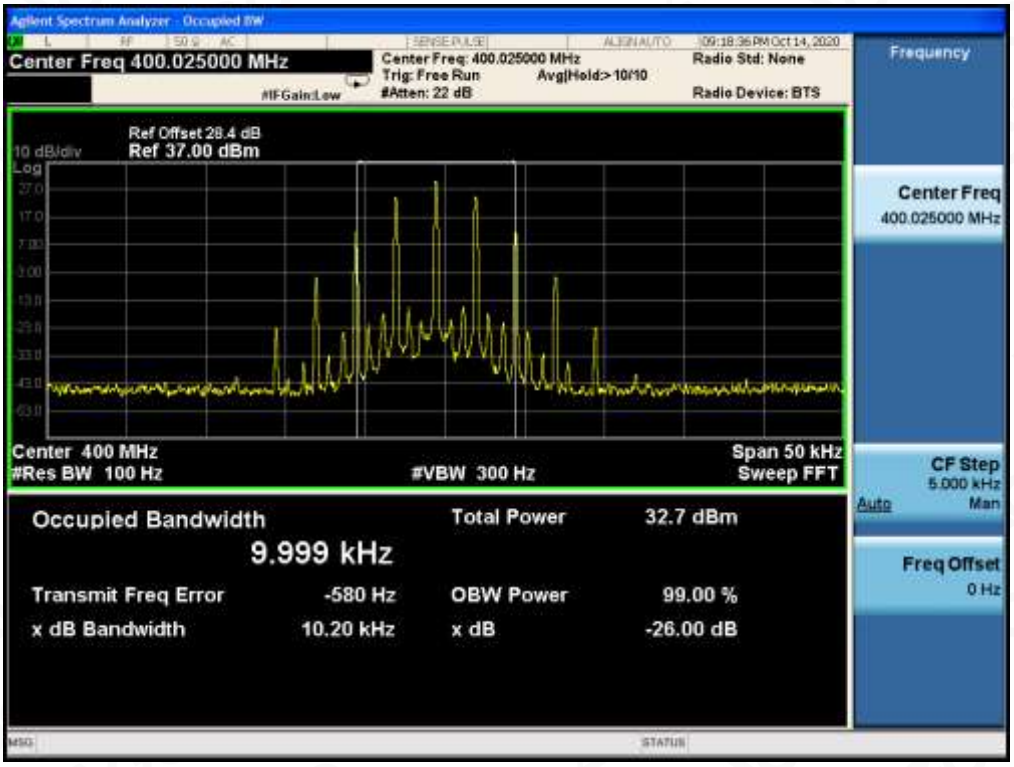
7.4 MEASUREMENT RESULT

Emission Bandwidth Measurement Result				
Operating Frequency	12.5 KHz Channel Separation			
	Occupied Bandwidth (KHz)	Emission Bandwidth (KHz)	Limits	Result
400.025MHz	9.999 KHz	10.20 KHz	11.25 KHz	Pass
435.025MHz	9.999 KHz	10.18 KHz	11.25 KHz	Pass
454.025MHz	9.998 KHz	10.19 KHz	11.25 KHz	Pass
469.975MHz	9.999 KHz	10.19 KHz	11.25 KHz	Pass

Occupied bandwidth of Bottom Channel (400.025MHz)-2W



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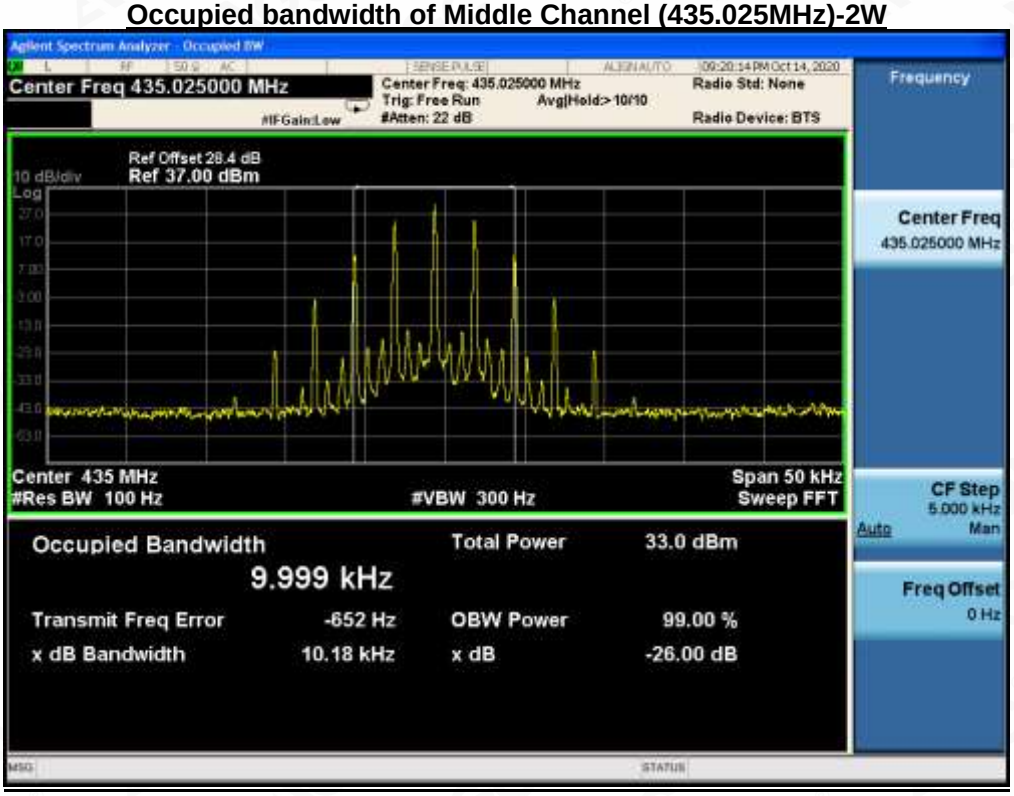
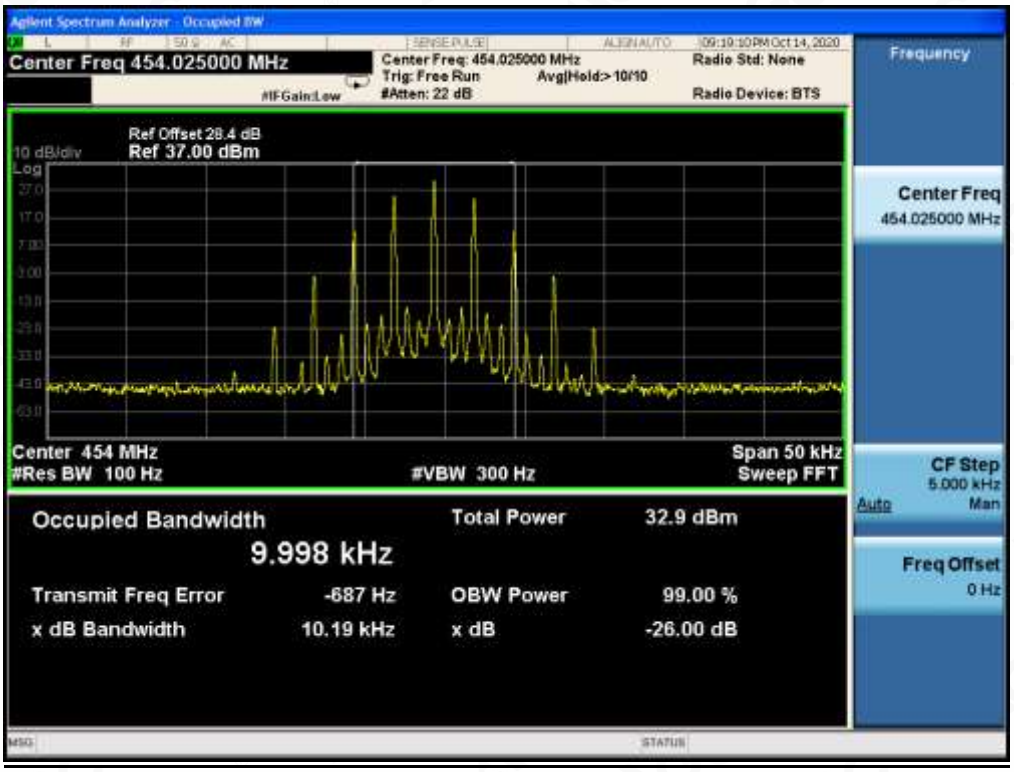
Occupied bandwidth of Middle Channel (435.025MHz)-2W



Occupied bandwidth of Middle Channel (454.025MHz)-2W



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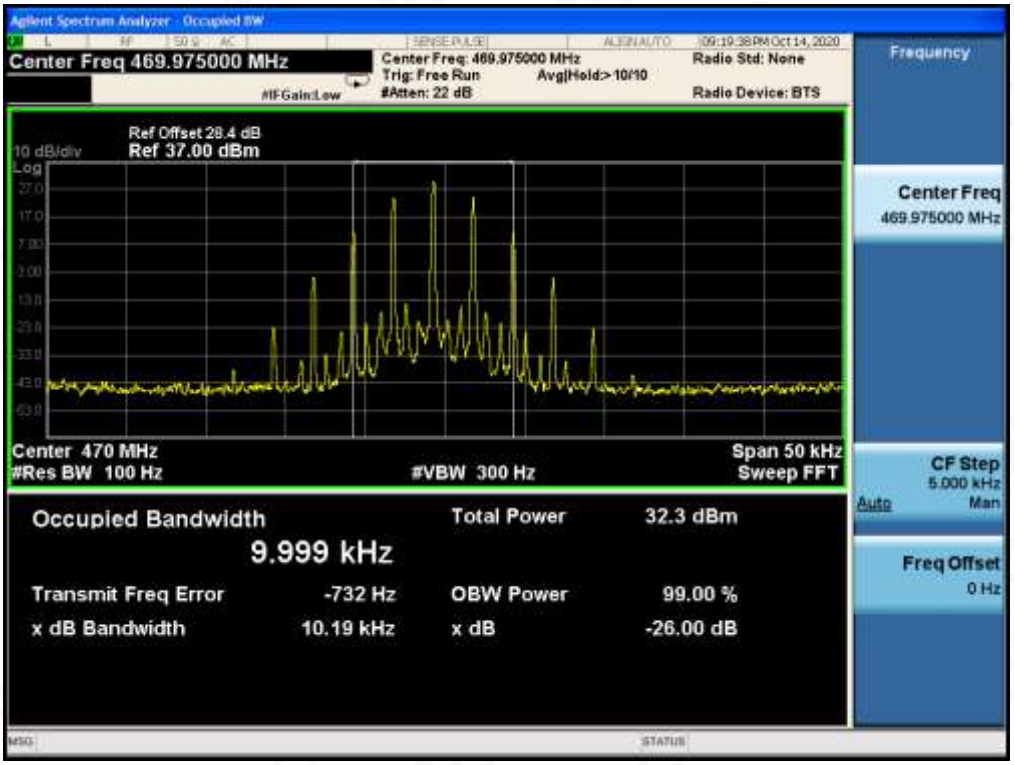
Occupied bandwidth of Top Channel (469.975MHz)-2W



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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.

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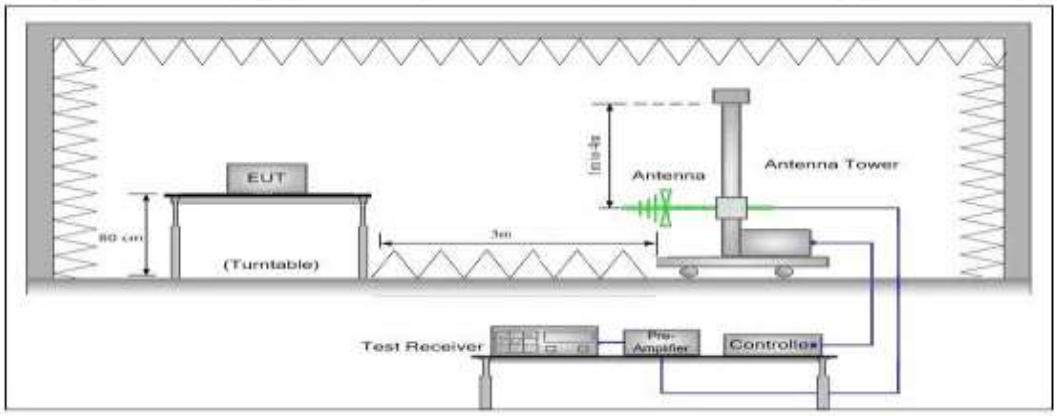
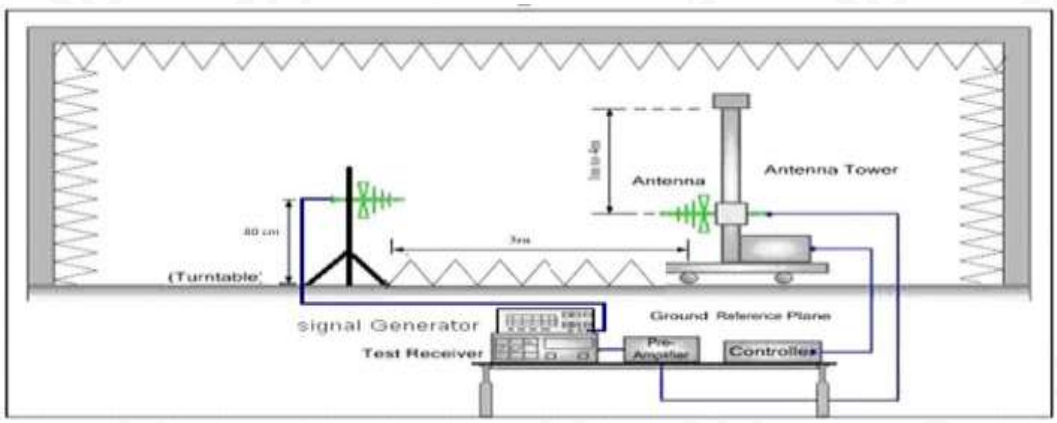
8.3 TEST SETUP BLOCK DIAGRAM

SUBSTITUTION METHOD: (Radiated Emissions)

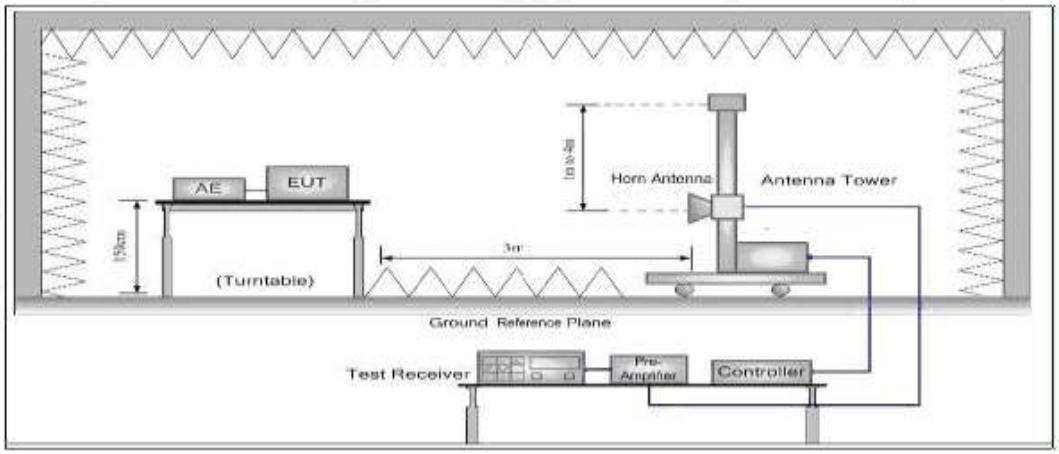
Radiation method:

Radiated Below1GHz





Radiated Above 1 GHz



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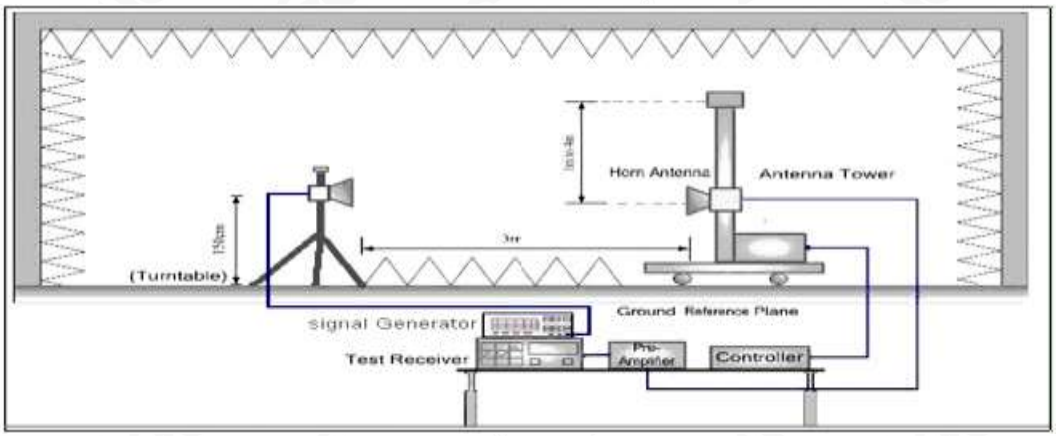

8.4 MEASUREMENT RESULTS:

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 (2) =53.01 (dB)—2W 33.01-53.01=-20dBm

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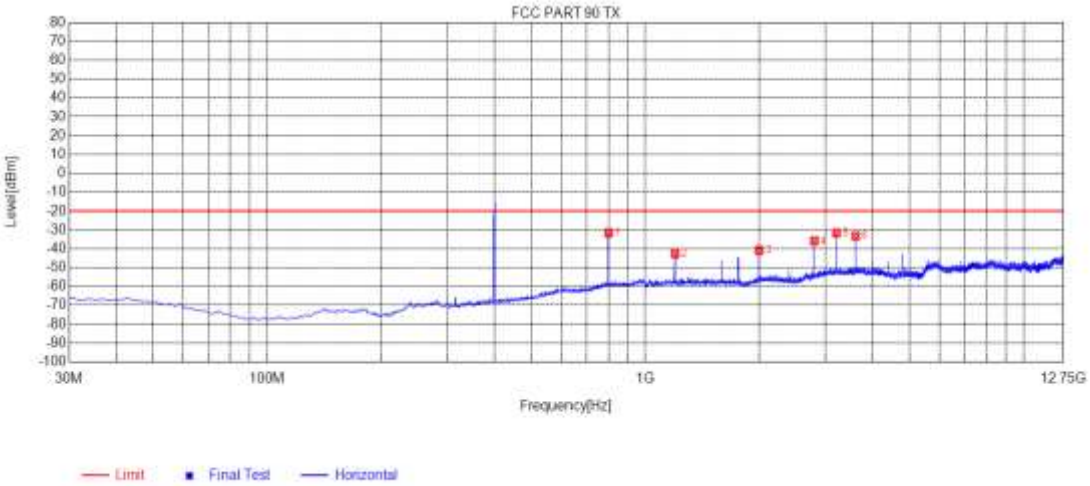
Measurement Result for 12.5 KHz Channel Separation @ 400.025MHz-2W-Horizontal



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	800.1800	-75.00	-31.58	-20.00	11.58	43.42	9	Horizontal
2	1199.7700	-38.84	-42.68	-20.00	22.68	-3.84	239	Horizontal
3	2000.0250	-41.34	-40.81	-20.00	20.81	0.53	342	Horizontal
4	2800.2800	-37.17	-35.77	-20.00	15.77	1.40	359	Horizontal
5	3200.9951	-35.27	-31.62	-20.00	11.62	3.65	9	Horizontal
6	3600.5351	-37.57	-33.28	-20.00	13.28	4.29	360	Horizontal

Note:
1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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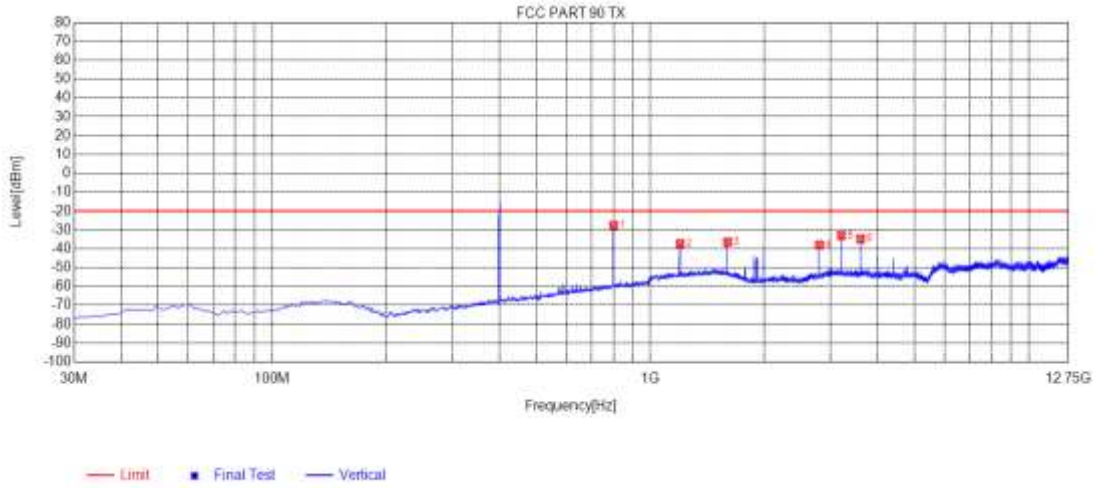
Measurement Result for 12.5 KHz Channel Separation @ 400.025MHz-2W-Vertical



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	800.1800	-70.00	-27.63	-20.00	7.63	42.37	15	Vertical
2	1199.7700	-37.49	-37.32	-20.00	17.32	0.17	0	Vertical
3	1600.4850	-38.28	-36.47	-20.00	16.47	1.81	0	Vertical
4	2800.2800	-39.46	-37.97	-20.00	17.97	1.49	359	Vertical
5	3200.9951	-36.18	-33.03	-20.00	13.03	3.15	328	Vertical
6	3600.5351	-37.89	-34.78	-20.00	14.78	3.11	328	Vertical

Note:
1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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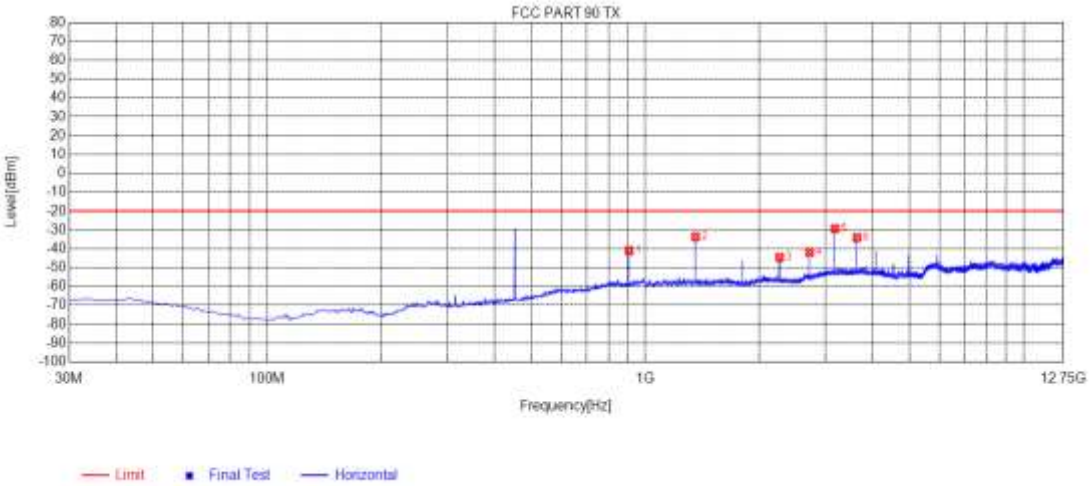
Measurement Result for 12.5 KHz Channel Separation @ 435.025MHz-2W-Horizontal



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	906.8800	-84.16	-41.07	-20.00	21.07	43.09	1	Horizontal
2	1359.5860	-30.16	-33.66	-20.00	13.66	-3.50	146	Horizontal
3	2266.7767	-44.10	-44.62	-20.00	24.62	-0.52	341	Horizontal
4	2719.1969	-42.45	-41.82	-20.00	21.82	0.63	341	Horizontal
5	3172.7923	-32.96	-29.36	-20.00	9.36	3.60	1	Horizontal
6	3626.3876	-38.42	-34.10	-20.00	14.10	4.32	0	Horizontal

Note:

1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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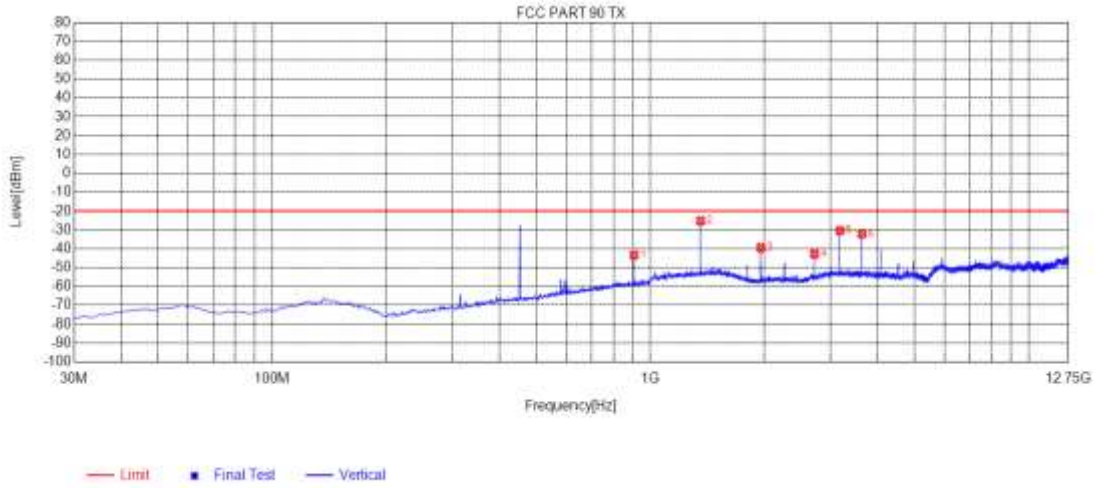
Measurement Result for 12.5 KHz Channel Separation @ 435.025MHz-2W-Vertical



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	906.8800	-86.74	-43.36	-20.00	23.36	43.38	19	Vertical
2	1359.5860	-26.43	-25.20	-20.00	5.20	1.23	19	Vertical
3	1962.4212	-40.02	-39.48	-20.00	19.48	0.54	162	Vertical
4	2719.1969	-43.53	-42.73	-20.00	22.73	0.80	19	Vertical
5	3172.7923	-33.51	-30.35	-20.00	10.35	3.16	351	Vertical
6	3626.3876	-35.23	-32.11	-20.00	12.11	3.12	351	Vertical

Note:
1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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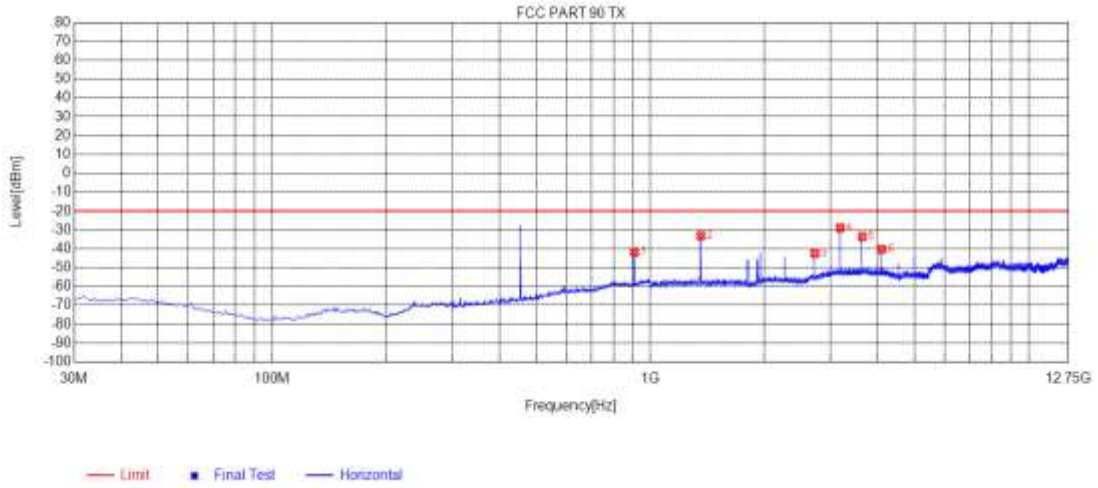
Measurement Result for 12.5 KHz Channel Separation @ 454.025MHz-2W-Horizontal



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	908.8200	-84.92	-41.79	-20.00	21.79	43.13	237	Horizontal
2	1361.9362	-29.63	-33.13	-20.00	13.13	-3.50	147	Horizontal
3	2723.8974	-43.11	-42.43	-20.00	22.43	0.68	341	Horizontal
4	3178.6679	-32.57	-28.96	-20.00	8.96	3.61	1	Horizontal
5	3632.2632	-37.93	-33.60	-20.00	13.60	4.33	359	Horizontal
6	4087.0337	-44.86	-40.33	-20.00	20.33	4.53	359	Horizontal

Note:

1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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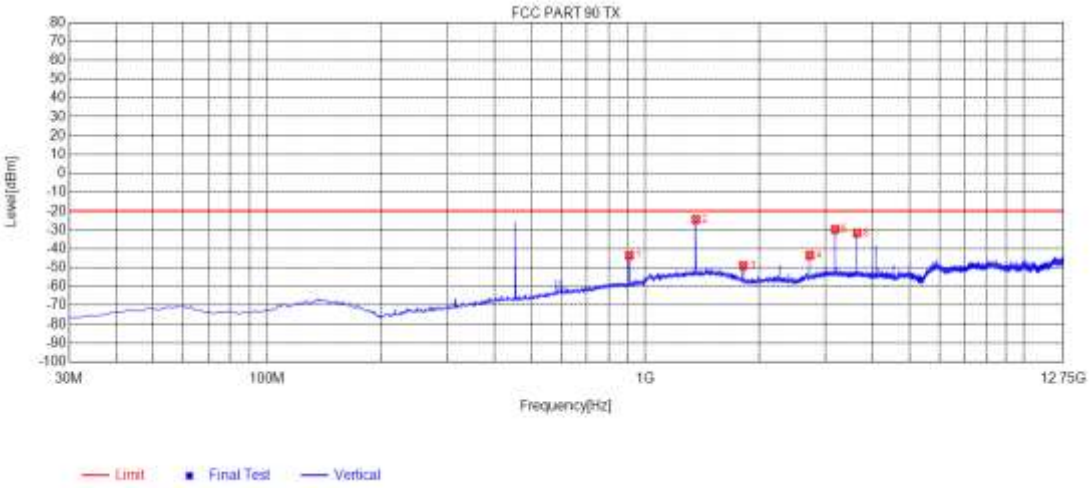
Measurement Result for 12.5 KHz Channel Separation @ 454.025MHz-2W-Vertical



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	908.8200	-86.98	-43.58	-20.00	23.58	43.40	1	Vertical
2	1361.9362	-25.70	-24.46	-20.00	4.46	1.24	28	Vertical
3	1816.7067	-50.06	-49.01	-20.00	29.01	1.05	93	Vertical
4	2723.8974	-44.37	-43.53	-20.00	23.53	0.84	9	Vertical
5	3178.6679	-32.93	-29.77	-20.00	9.77	3.16	357	Vertical
6	3632.2632	-34.77	-31.65	-20.00	11.65	3.12	9	Vertical

Note:
1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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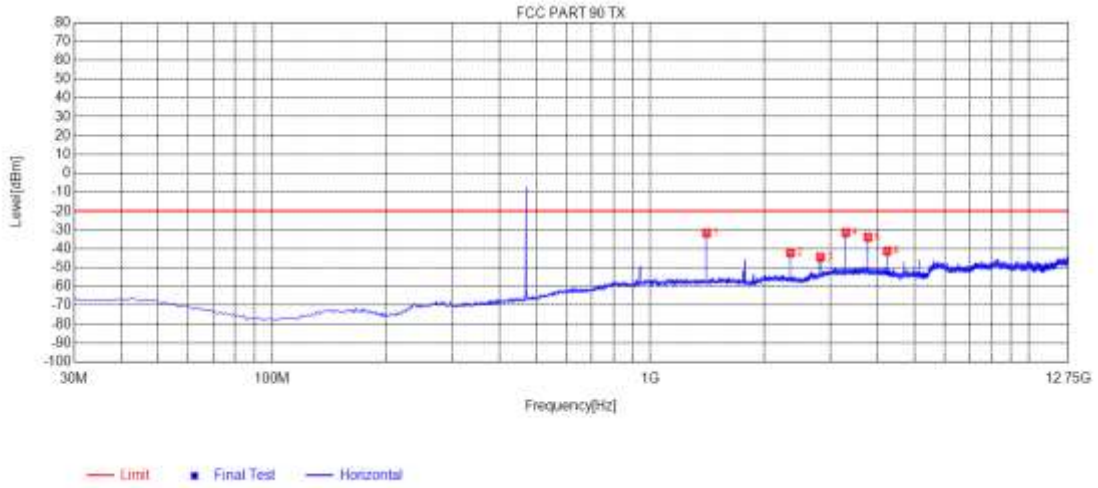
Measurement Result for 12.5 KHz Channel Separation @ 469.975MHz-2W-Horizontal



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	1410.1160	-28.21	-31.61	-20.00	11.61	-3.40	136	Horizontal
2	2350.2100	-41.35	-42.20	-20.00	22.20	-0.85	331	Horizontal
3	2820.2570	-46.04	-44.45	-20.00	24.45	1.59	351	Horizontal
4	3290.3040	-35.29	-31.48	-20.00	11.48	3.81	351	Horizontal
5	3760.3510	-38.41	-33.93	-20.00	13.93	4.48	351	Horizontal
6	4230.3980	-45.41	-41.25	-20.00	21.25	4.16	0	Horizontal

Note:

1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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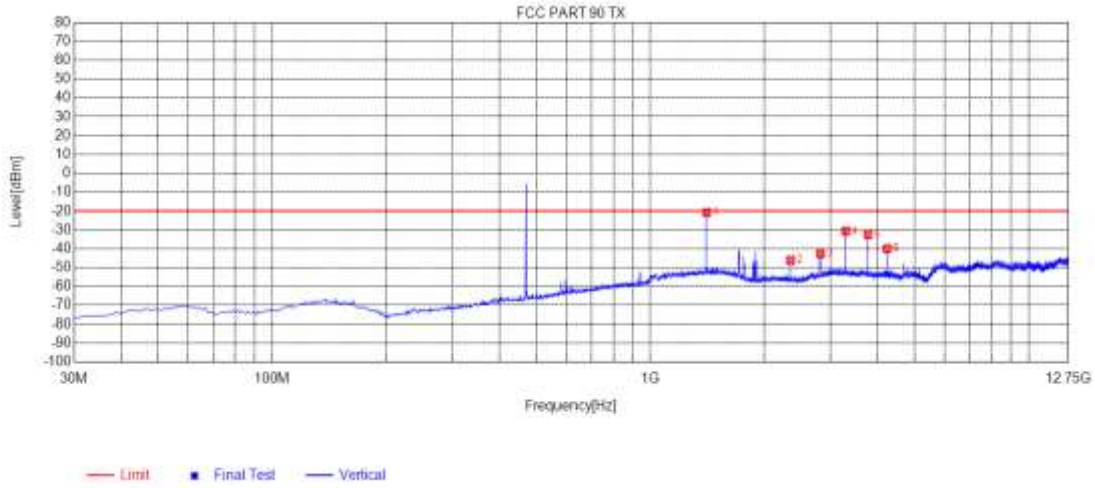
Measurement Result for 12.5 KHz Channel Separation @ 469.975MHz-2W-Vertical



NO.	Freq. [MHz]	Reading [dBm]	Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Angle [°]	Polarity
1	1410.1160	-22.38	-20.82	-20.00	0.82	1.56	9	Vertical
2	2350.2100	-45.42	-46.06	-20.00	26.06	-0.64	330	Vertical
3	2820.2570	-44.29	-42.63	-20.00	22.63	1.66	1	Vertical
4	3290.3040	-33.86	-30.74	-20.00	10.74	3.12	351	Vertical
5	3760.3510	-35.69	-32.51	-20.00	12.51	3.18	1	Vertical
6	4230.3980	-43.14	-39.96	-20.00	19.96	3.18	330	Vertical

Note:
1. Factor=Antenna Factor + Cable loss. (Below 1GHz)
2. Factor=Antenna Factor+ Cable loss-Pre-amplifier.(Above 1 GHz)
3. Margin=Limit- Level

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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.

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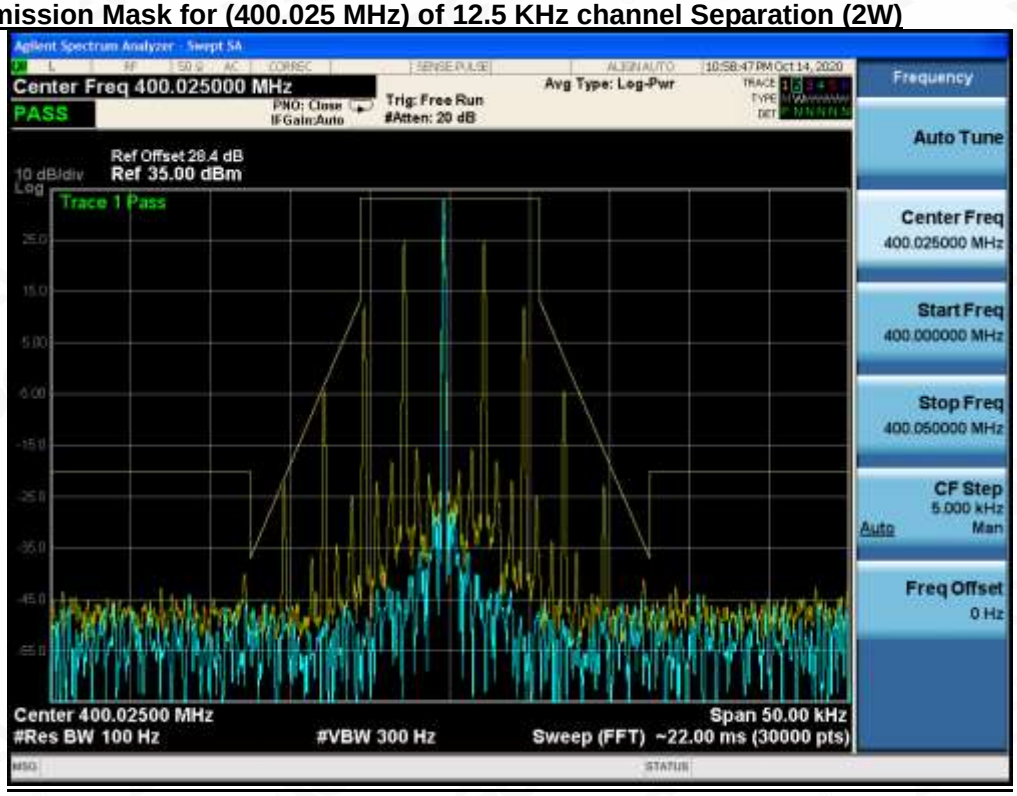
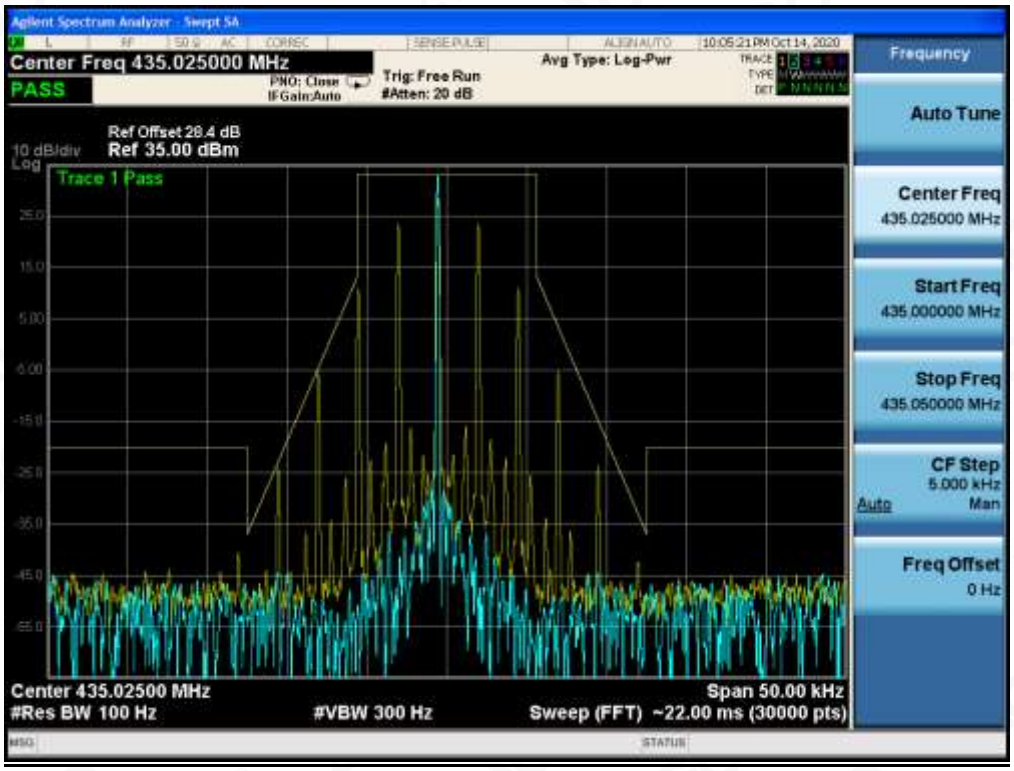
The Worst Emission Mask for (400.025 MHz) of 12.5 KHz channel Separation (2W)



The Worst Emission Mask for (435.025 MHz) of 12.5 KHz channel Separation (2W)



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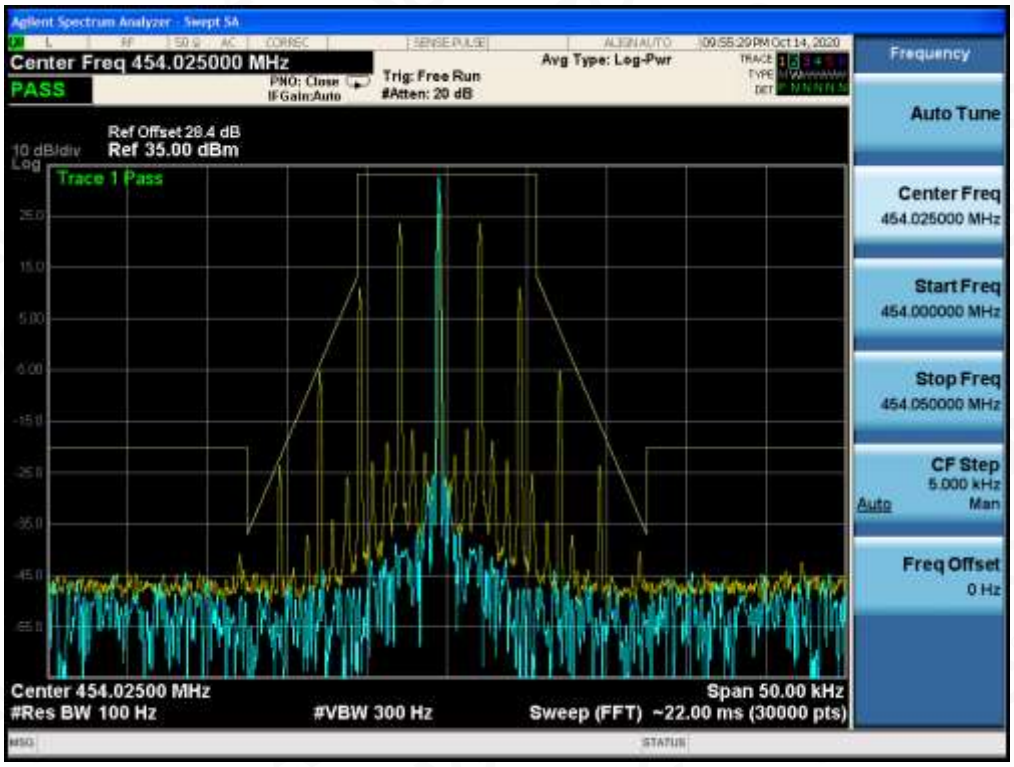
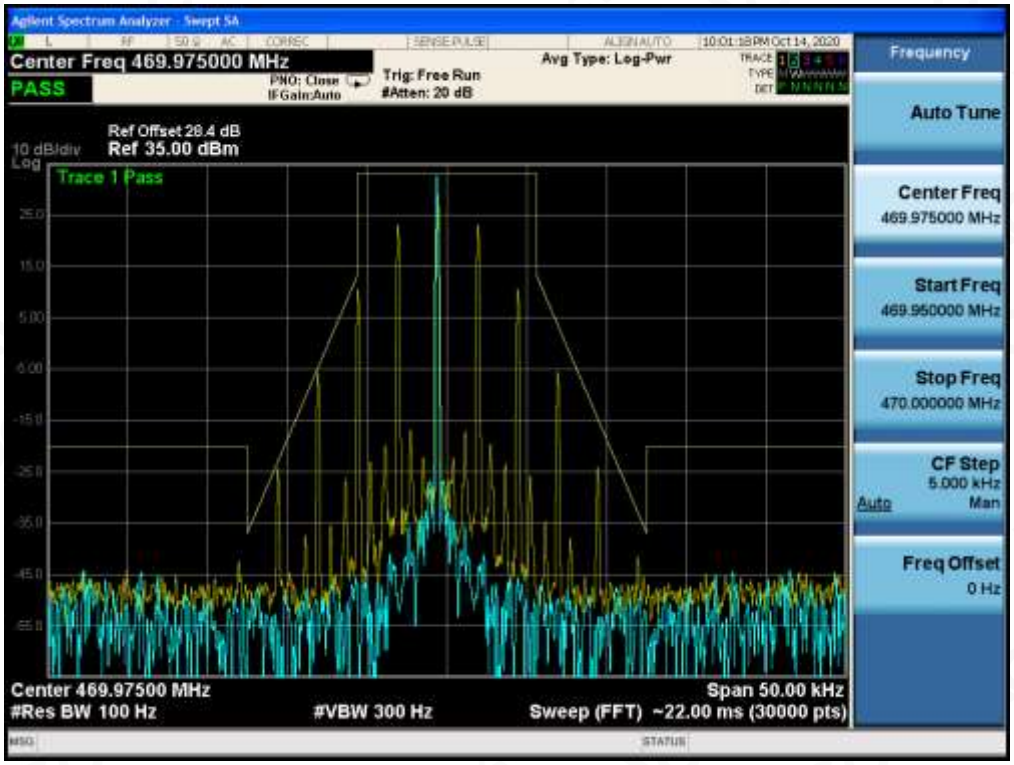
The Worst Emission Mask for (454.025 MHz) of 12.5 KHz channel Separation (2W)



The Worst Emission Mask for (469.975 MHz) of 12.5 KHz channel Separation (2W)



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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).

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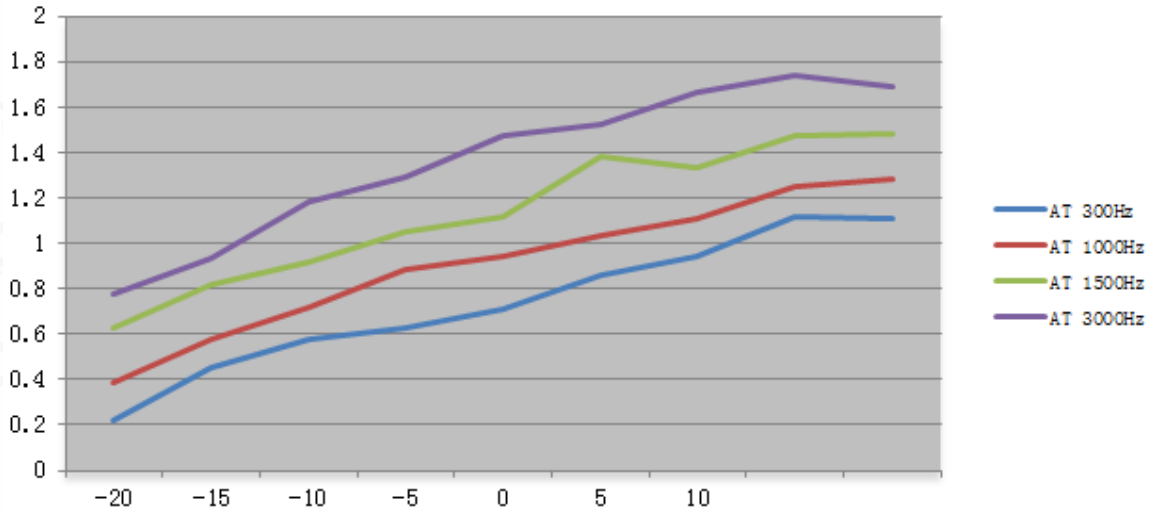
9.3 MEASUREMENT RESULT

TEST RESULT TS FOR 2W

(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	0.22	0.39	0.63	0.78
-15	0.45	0.58	0.82	0.93
-10	0.58	0.72	0.92	1.18
-5	0.63	0.88	1.05	1.29
0	0.71	0.94	1.12	1.47
+5	0.86	1.03	1.38	1.52
+10	0.94	1.11	1.33	1.66
+15	1.12	1.25	1.47	1.74
+20	1.11	1.28	1.48	1.69



Note: 1. All the modes had been tested, but only the worst data recorded in the report.
2. The data unit evaluated in this report is "KHz"

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(B). AUDIO FREQUENCY RESPONSE:

Bottom Channel @ 12.5 KHz Channel Separations

Frequency (Hz)	Deviation (KHz)	Audio Frequency Response(dB)
100	--	--
200	--	--
300	0.25	-13.10
400	0.36	-9.94
500	0.47	-7.62
600	0.58	-5.79
700	0.85	-2.47
800	0.93	-1.69
900	1.05	-0.64
1000	1.13	0.00
1200	1.33	1.42
1400	1.58	2.91
1600	1.69	3.50
1800	1.74	3.75
2000	1.88	4.42
2400	1.97	4.83
2500	2.22	5.87
2800	2.35	6.36
3000	2.24	5.94
3200	2.19	5.75
3600	1.97	4.83
4000	1.83	4.19
4500	1.47	2.28
5000	1.39	1.80
5500	1.25	0.88
6000	1.11	-0.16
6500	0.74	-3.68
7000	0.52	-6.74
7500	0.21	-14.62
9000	--	--
10000	--	--
14000	--	--
18000	--	--
20000	--	--
30000	--	--

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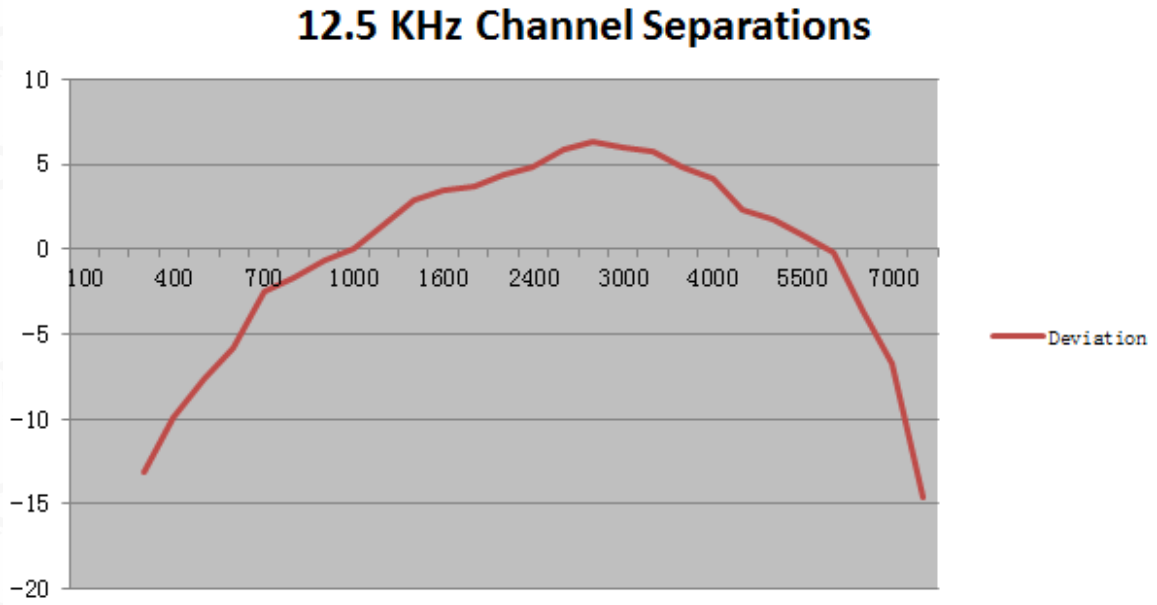
Frequency Response of Bottom Channel



Note: 1. All the modes had been tested, but only the worst data recorded in the report.

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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.

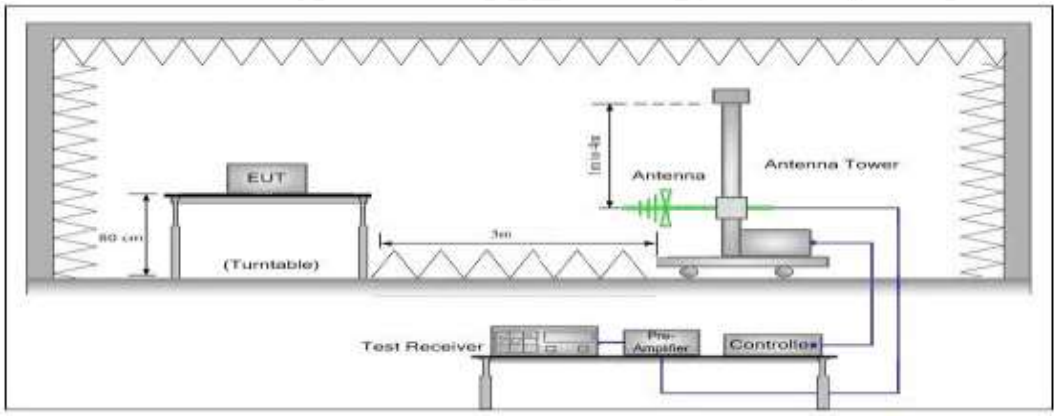
EIRP = "Read Value" + Measured substitution value + 2.15.

10.3 TEST CONFIGURATION

Conducted Output Power:

Effective Radiated Power

Radiated Below1GHz



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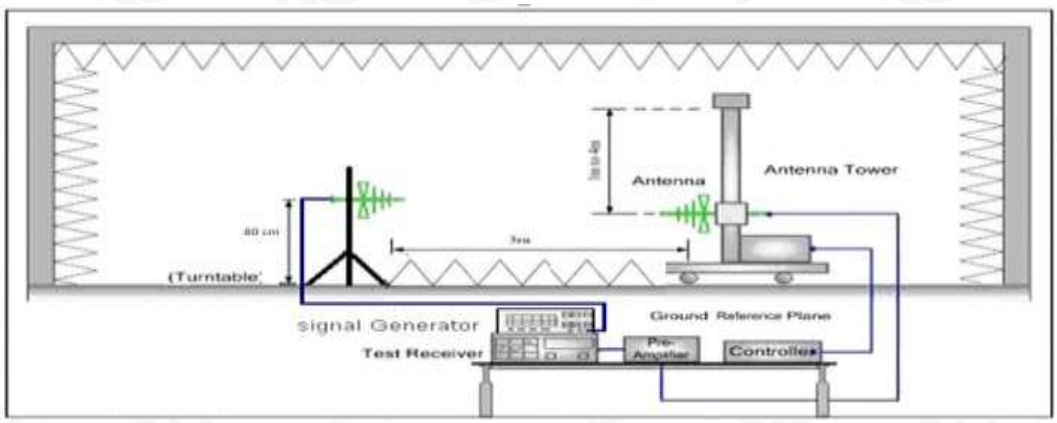
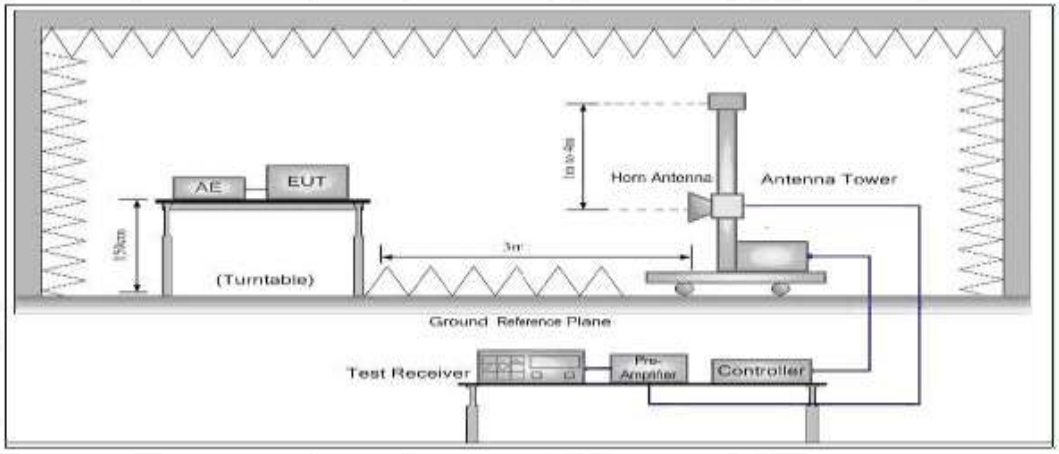
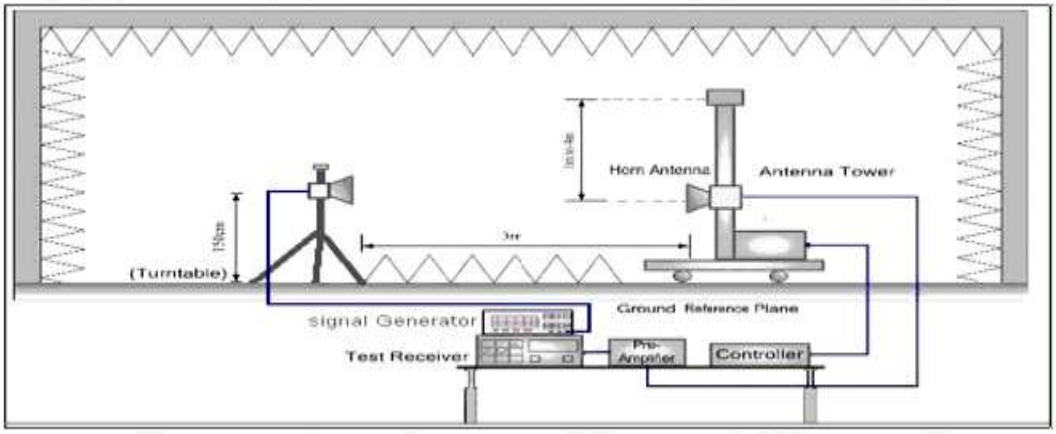


Radiated Above 1 GHz





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10.4 TEST RESULT

The maximum Conducted Power (CP) for UHF is

Analog: 2W for 12.5 KHz Channel Separation UHF

Calculation Formula: CP = R + A + L

Note:

(1) CP: The final Conducted Power

(2) R : The reading value from spectrum analyzer

(3) A : The attenuation value of the used attenuator

(4) L : The loss of all connection cables

(5) Measurement Result=Peak Power(Max)

(6) Both vertical and horizontal has been tested.

Conducted Power Measurement Results-2W		
Channel Separation	**Channel**	**Measurement Result (dBm)**
		For 33.01dBm(2W)
12.5 KHz	Bottom(400.025MHz)	32.50
	Middle(435.025MHz)	32.74
	Middle (454.025MHz)	**32.98**
	Top(469.975Hz)	32.34

Radiated Power Measurement Results-2W		
Channel Separation	**Channel**	**Measurement Result (dBm)**
		For 33.01dBm(2W)
12.5 KHz	Bottom(400.025MHz)	32.46
	Middle(435.025MHz)	32.69
	Middle (454.025MHz)	32.82
	Top(469.975Hz)	32.27

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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

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11.4 TEST RESULT

Conducted Spurious Emission (worst) @ 400.025MHz With 12.5 KHz Channel Separation-2W

30MHz-1GHz

Conducted Spurious Emission (worst) @ 400.025MHz With 12.5 KHz Channel Separation-2W

1GHz-12.75GHz

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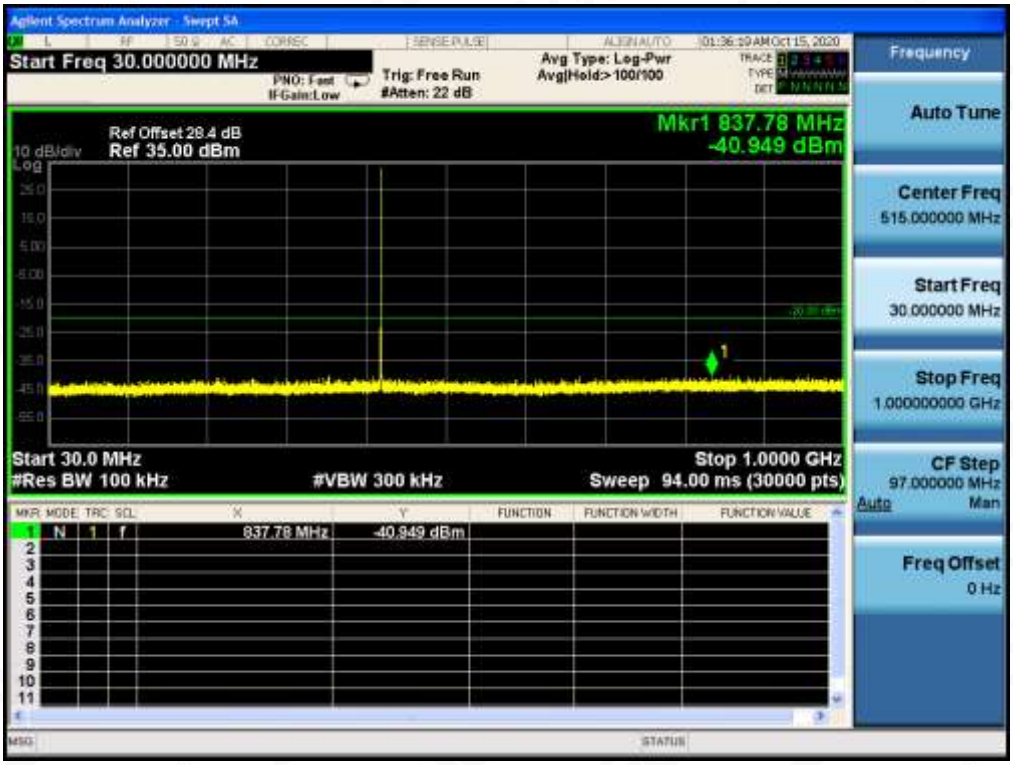
Conducted Spurious Emission (worst) @ 435.025 MHz With 12.5 KHz Channel Separation-2W

30MHz-1GHz



Conducted Spurious Emission (worst) @ 435.025 MHz With 12.5 KHz Channel Separation-2W

1GHz-12.75GHz

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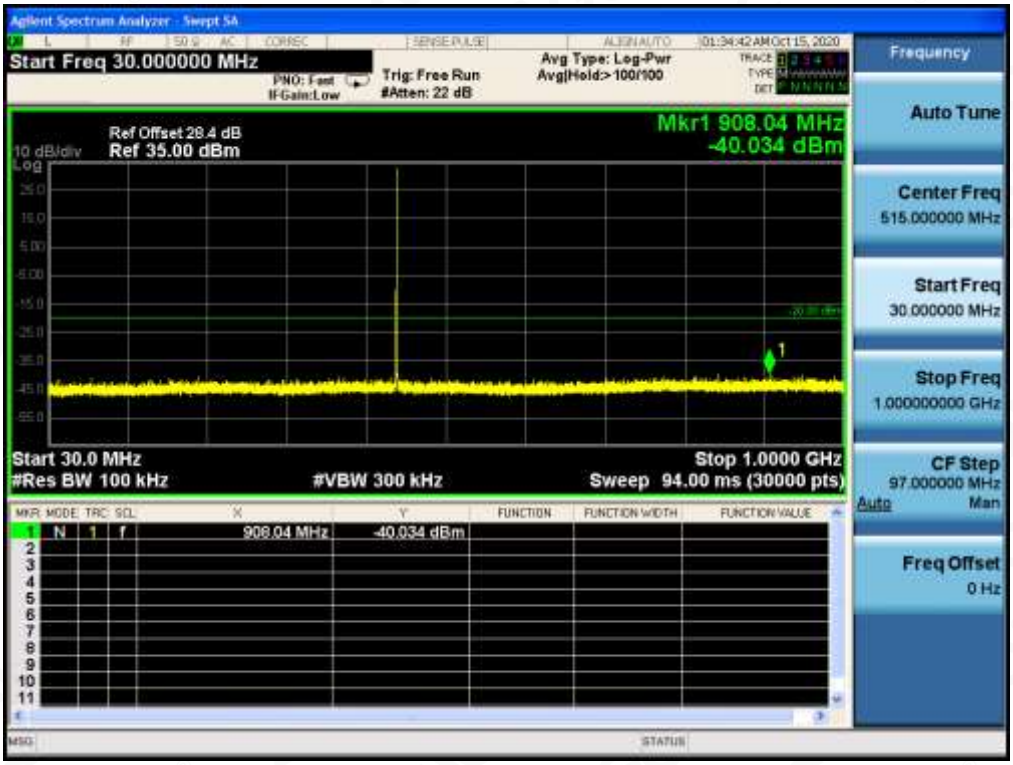
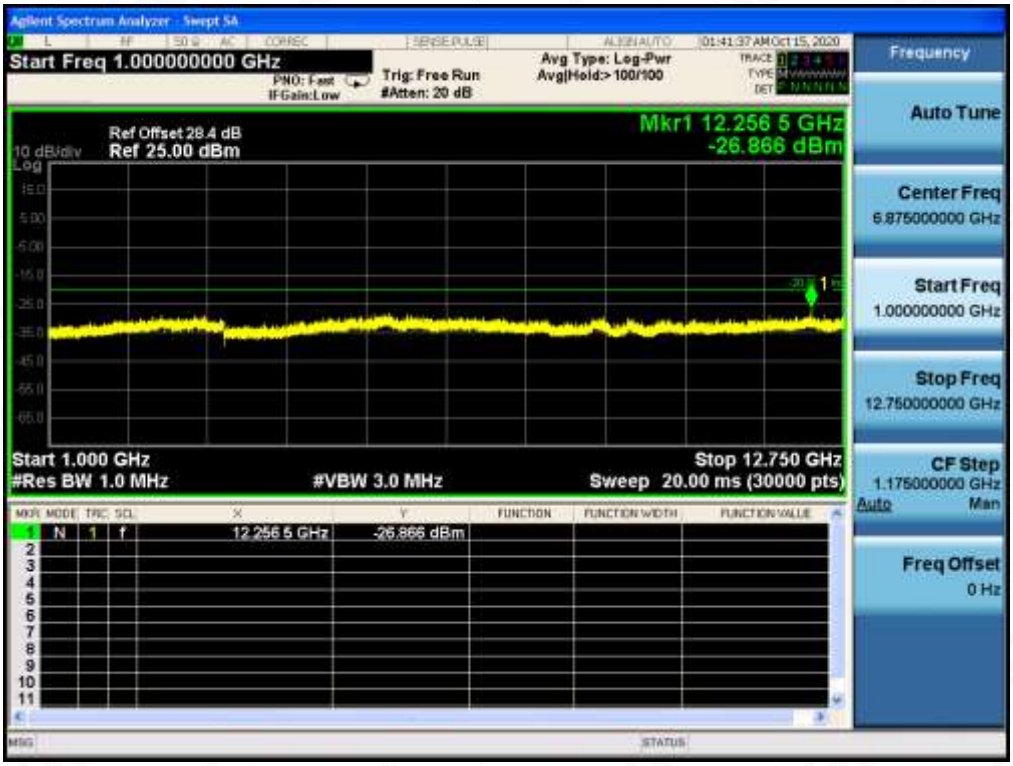
Conducted Spurious Emission (worst) @ 454.025MHz With 12.5 KHz Channel Separation-2W

30MHz-1GHz



Conducted Spurious Emission (worst) @ 454.025MHz With 12.5 KHz Channel Separation-2W

1GHz-12.75GHz



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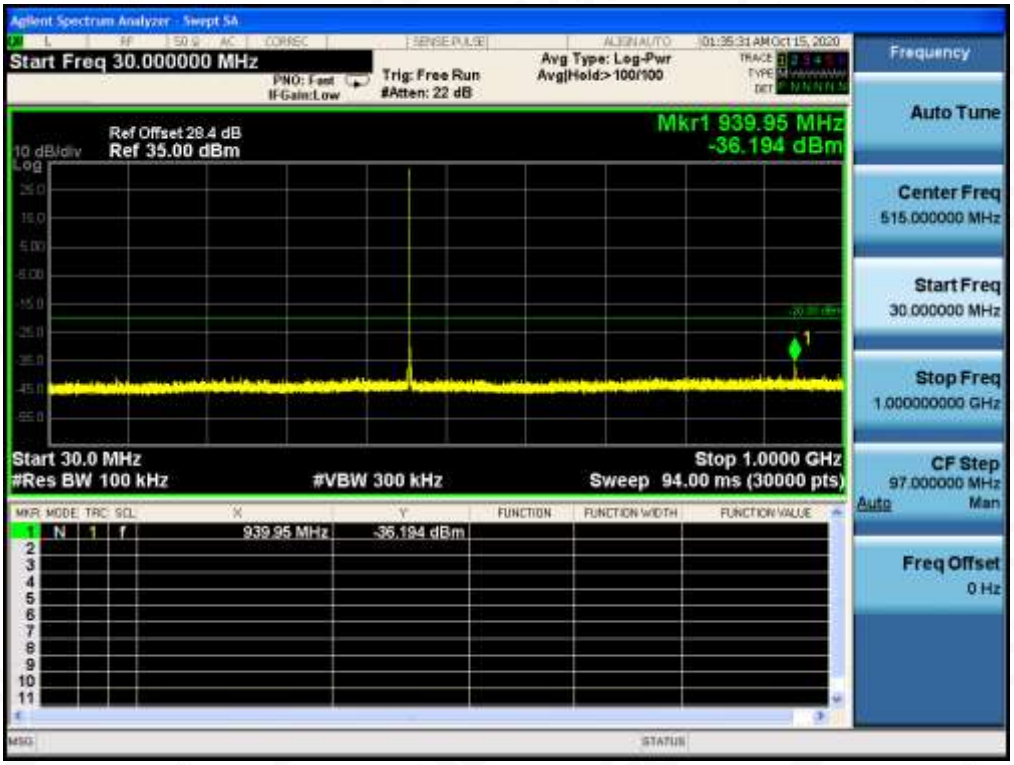
Conducted Spurious Emission (worst) @ 469.975MHz With 12.5 KHz Channel Separation-2W

30MHz-1GHz



Conducted Spurious Emission (worst) @ 469.975MHz With 12.5 KHz Channel Separation-2W

1GHz-12.75GHz

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

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12.TRANSMITTER FREQUENCY BEHAVIOR

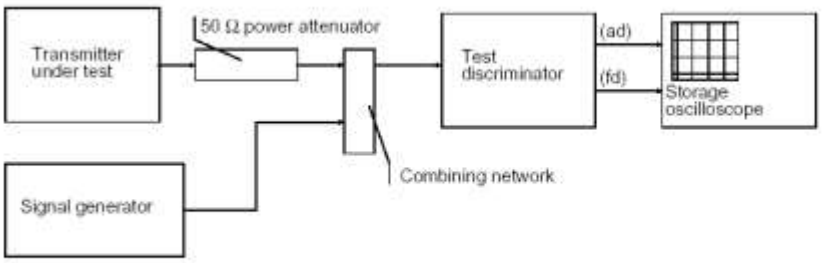
12.1PROVISIONS APPLICABLE

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



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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.

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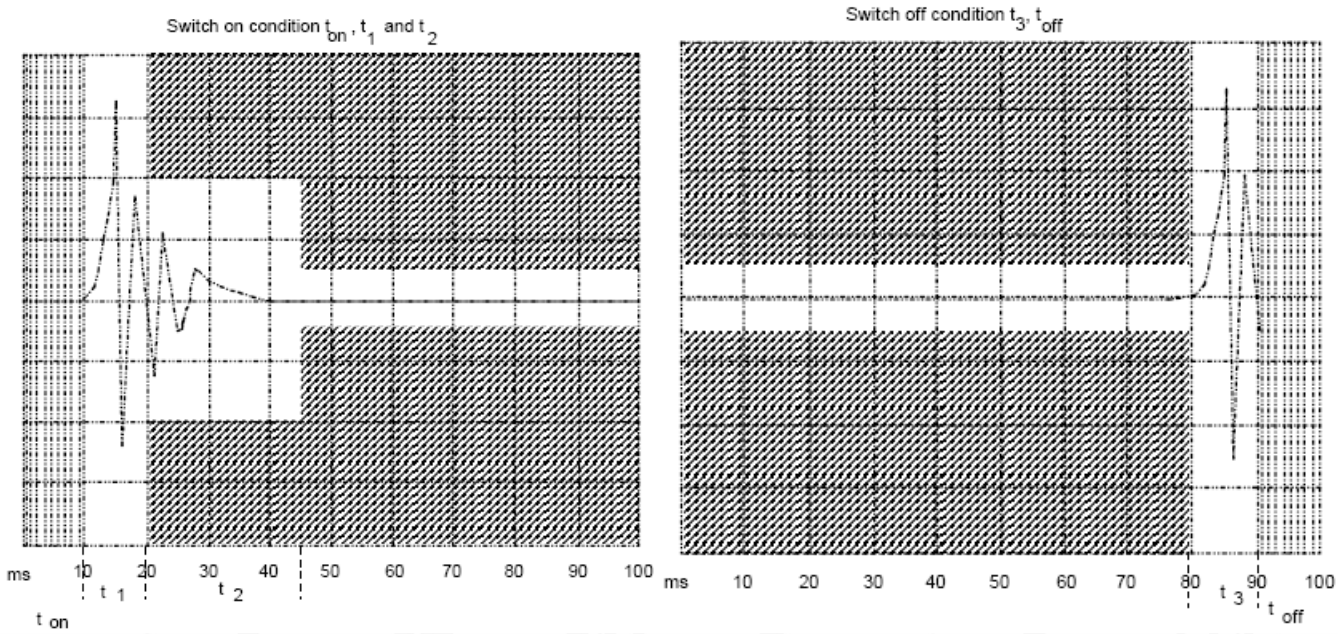
12.4 DESCRIBE LIMIT LINE OF RANSMITTER FREQUENCY BEHAVIOR

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



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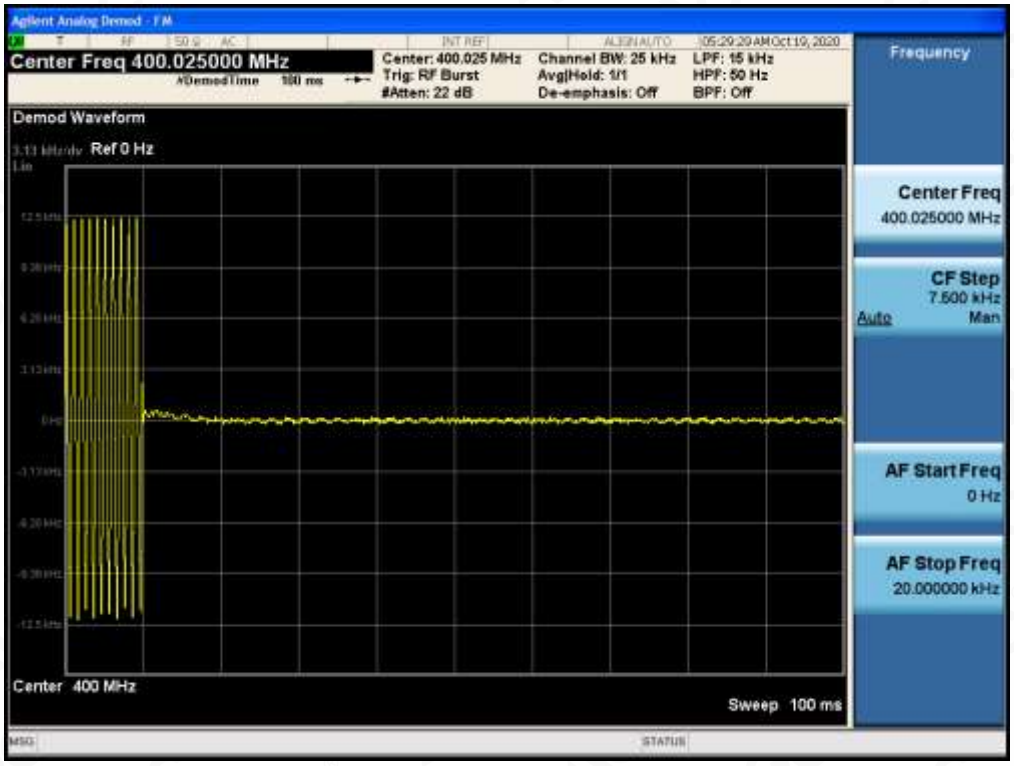
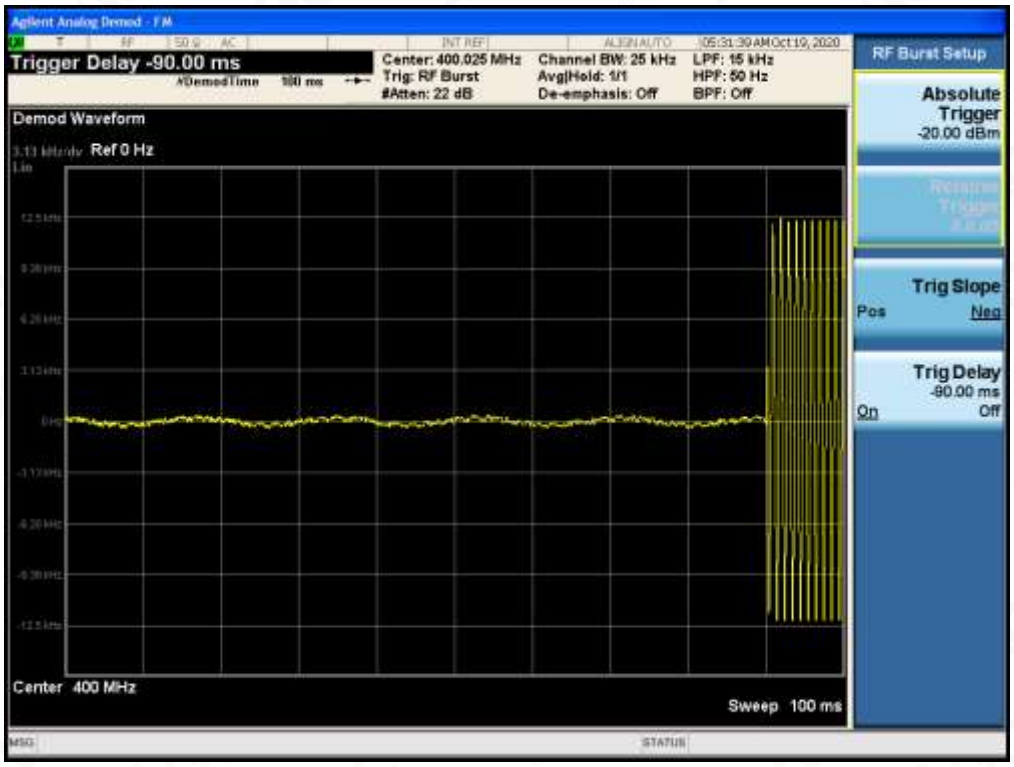
12.5 MEASURE RESULT

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



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



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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

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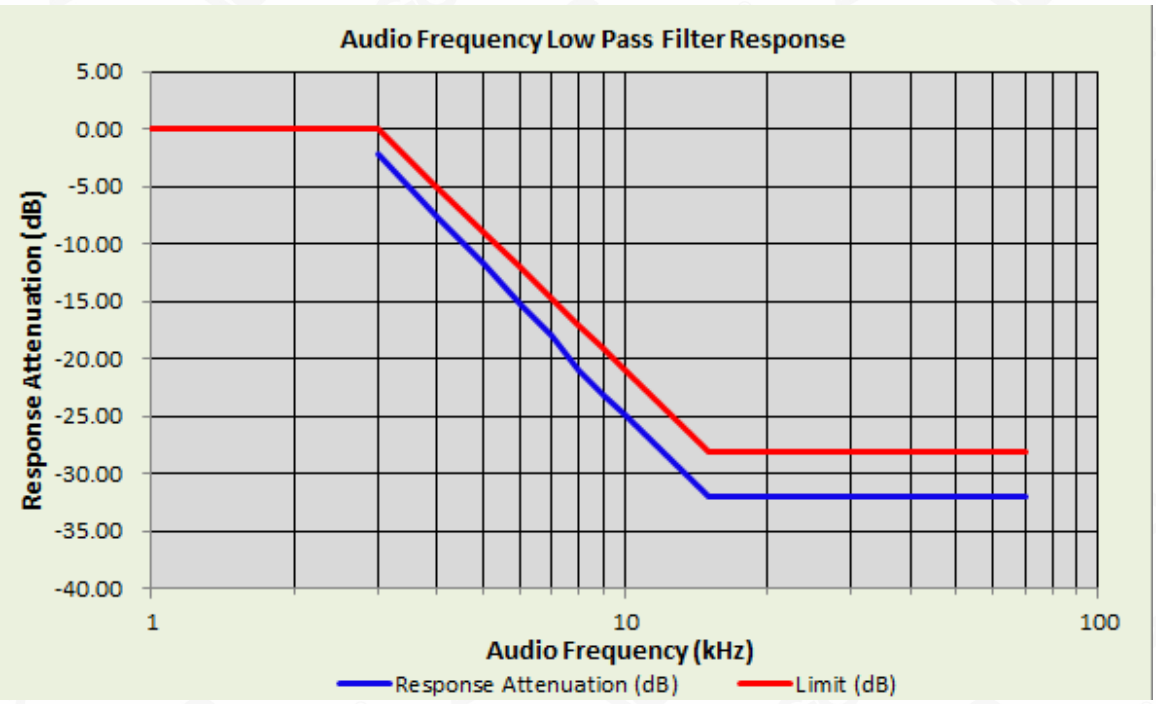
13.4.TEST RESULT

BOTTOM CHANNEL @ 12.5 KHZ CHANNEL SPACING, F3E, FREQUENCY OF ALL MODULATION STATES (TEST RESULT FOR UHF)-2W

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1	0	/
3	-2.19	0.00
4	-7.52	-5.00
5	-11.72	-8.87
6	-15.19	-12.04
7	-17.97	-14.72
8	-21.04	-17.04
9	-23.08	-19.08
10	-24.95	-20.92
15	-32.03	-28.00
20	-32.05	-28.00
30	-32.05	-28.00
50	-32.05	-28.00
70	-32.05	-28.00



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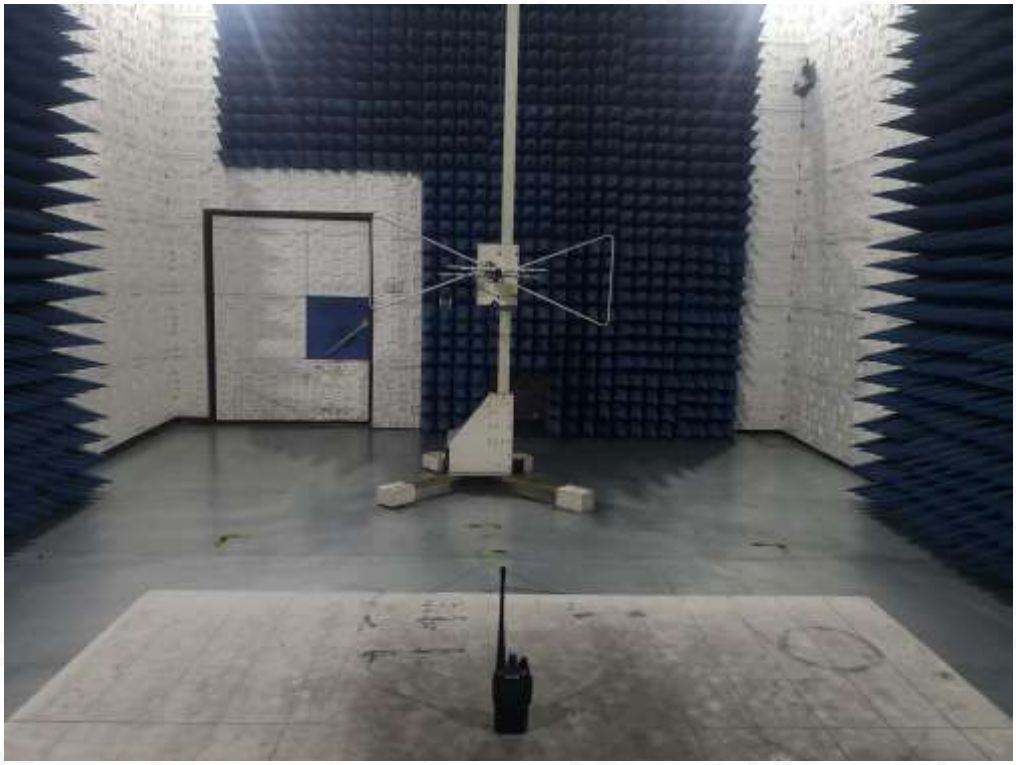
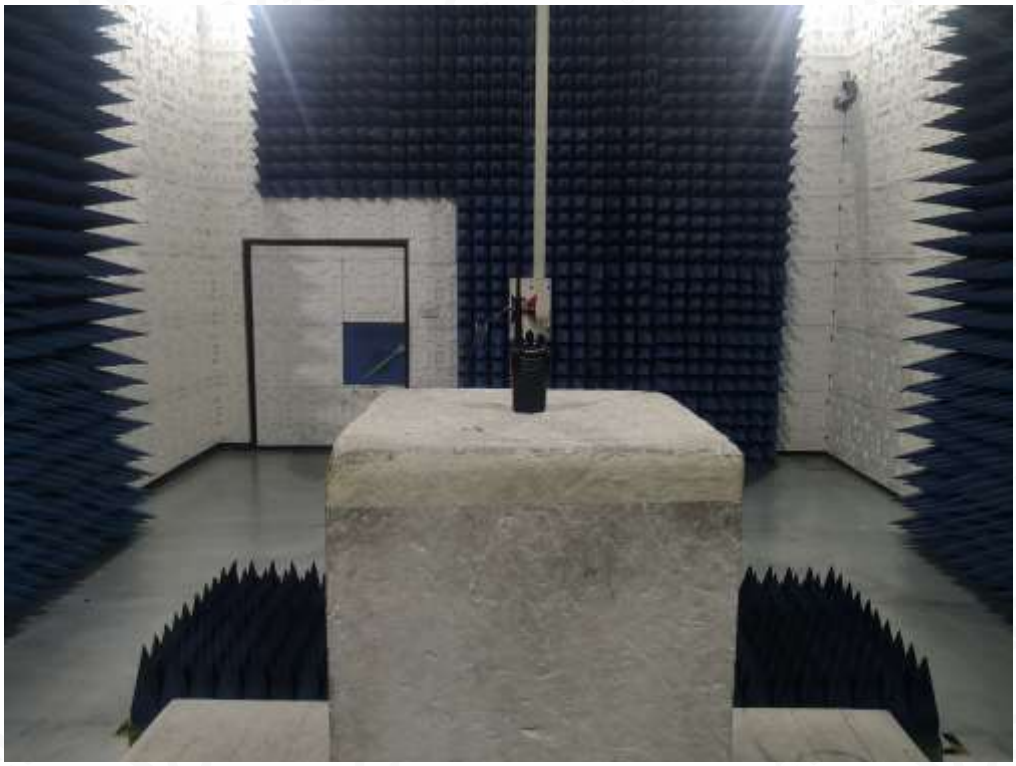
APPENDIX I: PHOTOGRAPHS OF SETUP

RADIATED EMISSION BELOW 1G TEST SETUP



RADIATED EMISSION ABOVE 1G TEST SETUP



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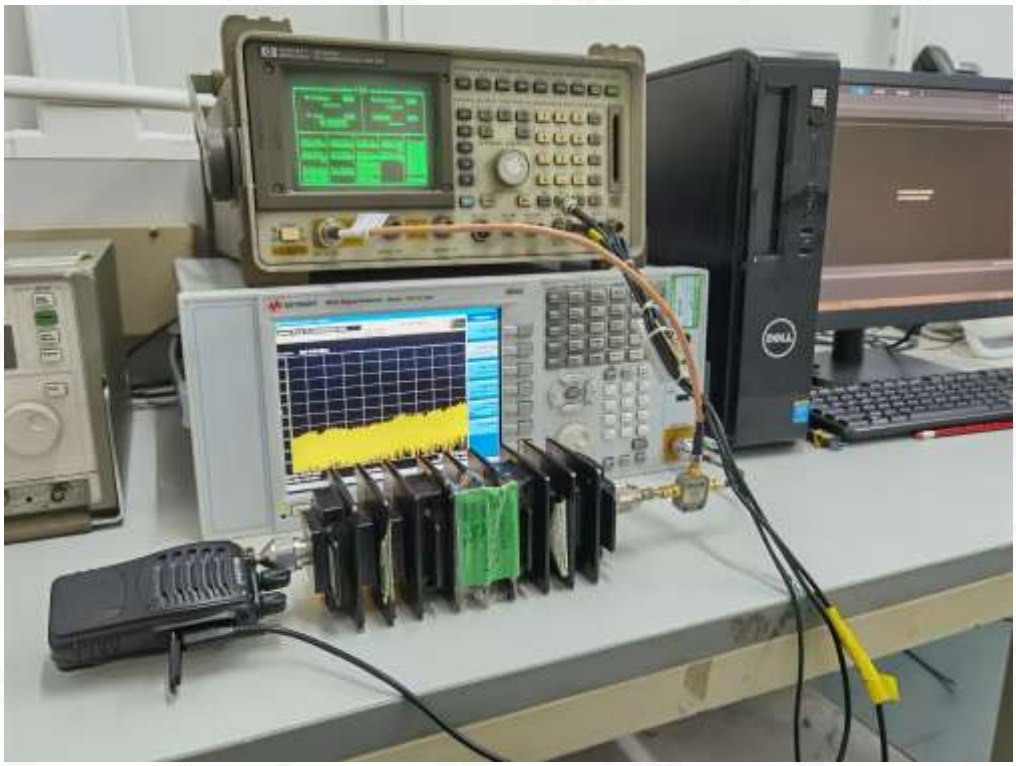
CONDUCTED TEST SETUP



----END OF REPORT----

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Conditions of Issuance of Test Reports

1. All samples and goods are accepted by the Attestation of Global Compliance (Shenzhen) Co., Ltd (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The company provides its services on the basis that such terms and conditions constitute express agreement between the company and any person, firm or company requesting its services (the "Clients").

2. Any report issued by Company as a result of this application for testing services (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to its customer, supplier or other persons directly concerned. The Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.

3.The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.

4. The non-CMA report issued by AGC is only permitted to be used by the client as internal reference use and shall not be used for public demonstration purpose.

5. In the event of the improper use of the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.

6. Samples submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.

7. The Company will not be liable for or accept responsibility for any loss or damage however arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.

8.Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.

9. The Company is not responsible for recalling the electronic version of the original report when any revision is made to them. The Client assumes the responsibility to providing the revised version to any interested party who uses them.

10. Subject to the variable length of retention time for test data and report stored hereinto as otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of the test report for a period of six years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after retention period. Under no circumstances shall we be liable for damage of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

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