FCC TEST REPORT

FCC ID: SY4-A02039

On Behalf of

Shanghai Huace Navigation Technology Ltd.

Geodetic GNSS Receiver

Model No.: i93

Prepared for	:	Shanghai Huace Navigation Technology Ltd.
Address	:	577 Songying Road, Qingpu District, 201706 Shanghai, China

Prepared By	:	Shenzhen Alpha Product Testing Co., Ltd.
Address	:	Building i, No.2, Lixin Road, Fuyong Street, Bao'an District, 518103, Shenzhen, Guangdong, China

Report Number	:	A2303056-C01-R05
Date of Receipt	:	March 14, 2023
Date of Test	:	March 14, 2023-April 8, 2023
Date of Report	:	April 18, 2023
Version Number	:	V0

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TEST REPORT DECLARATION

Applicant	:	Shanghai Huace Navigation Technology Ltd.
Address	:	577 Songying Road, Qingpu District, 201706 Shanghai, China
Manufacturer	:	Shanghai Huace Navigation Technology Ltd.
Address	:	577 Songying Road, Qingpu District, 201706 Shanghai, China
EUT Description	:	Geodetic GNSS Receiver
(A) Model No.	:	i93
(B) Trademark	:	CHCNAV

Measurement Standard Used:

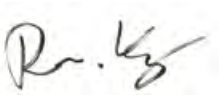
FCC CFR Title 47 Part 90, FCC CFR Title 47 Part 2,

ANSI TIA-603-E:2016

The device described above is tested by Shenzhen Alpha Product Testing Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 2, Part 90, RSS-119, RSS-Gen limits both conducted and radiated emissions. The test results are contained in this test report and Shenzhen Alpha Product Testing Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After the test, our opinion is that EUT compliance with the requirement of the above standards.

This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Shenzhen Alpha Product Testing Co., Ltd.

Tested by (name + signature).....…..:	Lucas Pang Project Engineer	
Approved by (name + signature)…....:	Reak Yang Project Manager	
Date of issue……..:	April 18, 2023	

Revision History

Revision	Issue Date	Revisions	Revised By
V0	April 18, 2023	Initial released Issue	Lucas Pang

1. Summary Of Standards And Results

1.1. Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Test Item	Test Requirement	Standards Paragraph	Result
Transmitter Power(Conducted)	FCC PART 90	§90.205,	P
Occupied Bandwidth & Emission Mask	FCC PART 90	§90.209, §90.210	P
Spurious Emissions(conducted)	FCC PART 90	§90.210,	P
Spurious Emissions(Radiated)	FCC PART 90	§90.210,	P
Transient Frequency Behavior	FCC PART 90	§90.214,	P
Frequency Stability	FCC PART 90	§90.213,	P
Modulation Characteristics - Audio Frequency Response	FCC PART 2 FCC PART 90	§2.1047(a), §90.207	N/A
Modulation Characteristics - Modulation Limiting	FCC PART 2 FCC PART 90	§2.1047(b), §90.207	N/A
Adjacent channel power	FCC PART 90	§90.221	P

Note: 1. P is an abbreviation for Pass.

2. F is an abbreviation for Fail.

3. N/A is an abbreviation for Not Applicable.

4. The conclusion of this test report is judged by actual test data without considering measurement uncertainty.

2. General Information

2.1. Description of Device (EUT)

Description	:	Geodetic GNSS Receiver
Model Number	:	i93
DIFF.	:	N/A
Test Voltage	:	DC 5V from USB with DC 7.2V from Battery
UHF		
Operation frequency	:	410MHz-470MHz
Conducted Power	:	0.5W(27dBm), 1W(30dBm), 2W(33dBm)
Channel spacing	:	12.5KHz, 25KHz
Modulation type	:	4-FSK
Antenna Type	:	Rod Antenna, Maximum Gain is 4.0dBi
Software version	:	1.0.7
Hardware version	:	V1.0.1

Note: All Conducted Power have been tested, and recorded the worst case 2W(33dBm) results in this report.

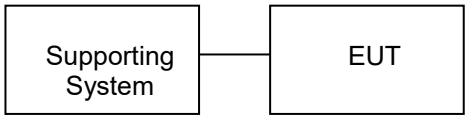
2.2. Accessories of Device (EUT)

Accessories	:	/
Manufacturer	:	/
Model	:	/
Ratings	:	/

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	Notebook PC	Lenovo	ThinkPad E14	N/A	N/A

2.4. Block Diagram of connection between EUT and simulators



The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

2.5. Test Mode

All modes and data rates and positions were investigated.
Test modes are chosen to be reported as the worst case configuration below:

Test Mode		
Item	**Description of operation mode**	**Note**
1	4-FSK+CS12.5KHz+TX	at maximum rated power for transmitter
2	4-FSK+CS25KHz+TX	at maximum rated power for transmitter

Note: The worst case modes for all test are the item 1 and item 3.

Description Operation Frequency

4-FSK		
Test Channel	Channel spacing (KHz)	Frequency(MHz)
Low	12.5	410.050
	25	410.050
Mid	12.5	440.000
	25	440.000
High	12.5	469.950
	25	469.950

2.6. Test Conditions

Items	Required	Actual
Temperature range:	15-35℃	24℃
Humidity range:	25-75%	56%
Pressure range:	86-106kPa	980kPa

2.7. Test Facility

Shenzhen Alpha Product Testing Co., Ltd

Building i, No.2, Lixin Road, Fuyong Street, Bao'an District,
518103, Shenzhen, Guangdong, China

June 21, 2018 File on Federal Communication Commission
Registration Number: 293631

July 15, 2019 Certificated by IC
Registration Number: CN0085

2.8. Measurement Uncertainty

(95% confidence levels, k=2)

Item	Uncertainty
Uncertainty for Power point Conducted Emissions Test	2.74dB
Uncertainty for Radiation Emission test in 3m chamber (below 30MHz)	2.13 dB(Polarize: V)
	2.57dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.77dB(Polarize: V)
	3.80dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	4.16dB(Polarize: H)
	4.13dB(Polarize: V)
Uncertainty for radio frequency	5.4×10-8
Uncertainty for conducted RF Power	0.37dB
Uncertainty for temperature	0.2℃
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.9. Test Equipment List

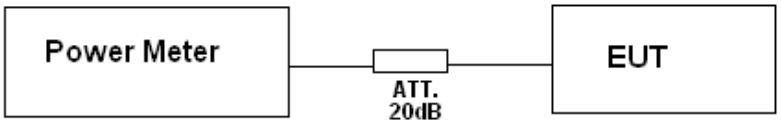
Equipment	Manufacturer	Model No.	Firmware version	Serial No.	Last cal.	Cal. Due day
Test Receiver	ROHDE&SCHWARZ	ESCI	4.42 SP1	101165	2022.08.22	2023.08.21
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	2.3	102137	2022.08.22	2023.08.21
Horn Antenna	SCHWARZBECK	BBHA 9120 D	/	2106	2021.08.30	2023.08.29
Filter	KANGMAI	ZLPF-LDC-100 0- 1959	/	1209002075	2022.08.22	2023.08.21
Filter	WAINWRIGHT	WHKX2.80 /18G- 12SS	/	SN1	2022.08.22	2023.08.21
RF Cable	Resenberger	Cable 4	/	PE1	2022.08.22	2023.08.21
CMU200	ROHDE&SCHWARZ	CMU200	V5.21	116785	2022.08.22	2023.08.21
Signal Analyzer	Agilent	N9020A	A.14.16	MY499100060	2022.08.22	2023.08.21
vector Signal	Agilent	N5182A	/	MY49060042	2022.08.22	2023.08.21
vector Signal	Agilent	E4438C	/	US44271917	2022.08.22	2023.08.21
Amplifier	HP	HP8347A	/	2834A00455	2022.08.22	2023.08.21
Amplifier	Agilent	8449B	/	3008A02664	2022.08.22	2023.08.21
Filter	SKET	HPF_1-18G-55 dB	/	N/A	2022.08.22	2023.08.21
Test Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-102082-Wa	2022.08.22	2023.08.21
Bilog Antenna	SCHWARZBECK	VULB 9168	/	9168-627	2021.08.30	2023.08.29
9*6*6 anechoic	CHENYU	9*6*6	/	N/A	2022.05.17	2025.05.16
RF Cable	Resenberger	Cable 1	/	RE1	2022.08.22	2023.08.21
RF Cable	Resenberger	Cable 2	/	RE2	2022.08.22	2023.08.21
RF Cable	Resenberger	Cable 3	/	CE1	2022.08.22	2023.08.21
Power Sensor	DARE	RPR3006W	/	15100041SNO 91	2022.08.22	2023.08.21
Power Sensor	DARE	RPR3006W	/	15100041SNO 92	2022.08.22	2023.08.21
CMW500	ROHDE&SCHWARZ	CMW500	V 3.7.22	1201.0002K50-117239-sM	2022.08.22	2023.08.21
Loop Antenna	SCHWARZBECK	FMZB 1519B	/	00128	2021.08.30	2023.08.29
Temp. & Humid. Chamber	Weihuang	WHTH-1000-40 -880	/	100631	2022.04.21	2023.04.20
Adjustable attenuator	MWRFtest	N/A	/	N/A	N/A	N/A
10dB Attenuator	Mini-Circuits	DC-6G	/	N/A	N/A	N/A

Software Information			
Test Item	Software Name	Manufacturer	Version
RE	EZ-EMC	farad	Alpha-3A1
CE	EZ-EMC	farad	Alpha-3A1
RF-CE	MTS 8310	MW	V2.0.0.0

3. Test Results and Measurement Data

3.1. Transmitter Power (Conducted)

3.1.1.Test Specification

Test Requirement:	Part 90.205, RSS-119(5.4)
Test Method:	FCC part 2.1046
Limits:	Please refer section FCC Part 90.205 and , RSS-119(5.4)
Test Setup:	
Test Procedure:	a) Connect the equipment as illustrated. b) Turn on the power meter c) Record value
Test Result:	PASS

3.1.2. Test Results

4-FSK mode (2W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
12.5	410.050	32.781	34.631	35	33±1	PASS
25	410.050	32.793	34.643	35	33±1	PASS
12.5	440.000	**32.921**	34.771	35	33±1	PASS
25	440.000	32.885	34.735	35	33±1	PASS
12.5	469.950	32.863	34.713	35	33±1	PASS
25	469.950	32.912	34.762	35	33±1	PASS

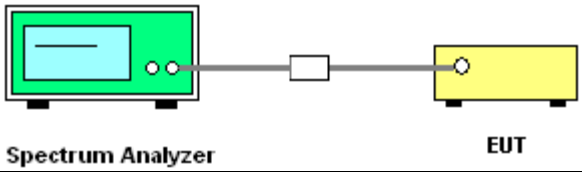
4-FSK mode (1W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
12.5	410.050	29.452	31.302	32	30±1	PASS
25	410.050	29.668	31.518	32	30±1	PASS
12.5	440.000	29.913	31.763	32	30±1	PASS
25	440.000	29.825	31.675	32	30±1	PASS
12.5	469.950	29.874	31.724	32	30±1	PASS
25	469.950	29.694	31.544	32	30±1	PASS

4-FSK mode (0.5W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
12.5	410.050	26.812	28.662	29	27±1	PASS
25	410.050	26.746	28.596	29	27±1	PASS
12.5	440.000	26.569	28.419	29	27±1	PASS
25	440.000	26.817	28.667	29	27±1	PASS
12.5	469.950	26.822	28.672	29	27±1	PASS
25	469.950	26.691	28.541	29	27±1	PASS

Note: 1. ERP= Maximum Conducted Output Power(Peak) + Antenna Gain – 2.15dB

3.2. Occupied Bandwidth and Emission Mask

3.2.1.Test Specification

Test Requirement:	FCC Part 90.209, FCC Part 90.210, RSS-119(5.5)
Test Setup:	
Test Procedure:	The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the Frequency band ± 50KHz from the carrier frequency for Occupied Bandwidth, the resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the Frequency band ± 100KHz from the carrier frequency for Emission Mask.
Test Result:	PASS

3.2.2.Test data

Occupied Bandwidth:

4-FSK 12.5KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	10.13	7.082	11.25	PASS
Mid	440.000	9.273	7.987	11.25	PASS
High	469.950	9.792	7.152	11.25	PASS

4-FSK 25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	14.76	10.471	20	PASS
Mid	440.000	14.78	10.305	20	PASS
High	469.950	14.79	10.177	20	PASS

Emission Mask:

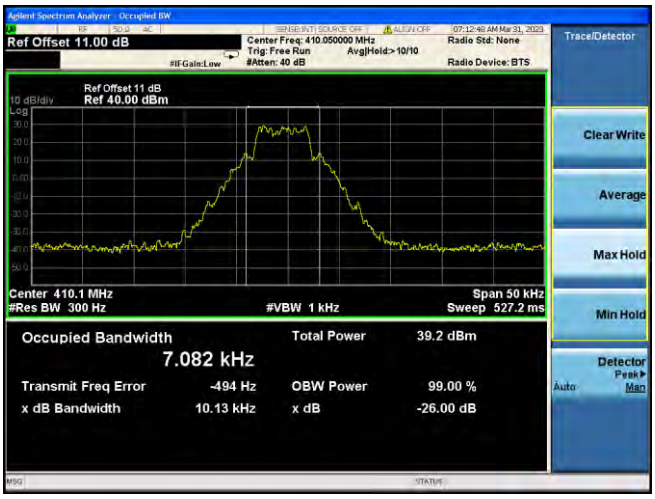
4-FSK 12.5KHz Channel Spacing:				
Channel	Frequency (MHz)	Applicable Mask	RBW	Result
Low	410.050	D	100Hz	PASS
Mid	440.000	D	100Hz	PASS
High	469.950	D	100Hz	PASS

4-FSK 25KHz Channel Spacing:				
Channel	Frequency (MHz)	Applicable Mask	RBW	Result
Low	410.050	C	100Hz	PASS
Mid	440.000	C	100Hz	PASS
High	469.950	C	100Hz	PASS

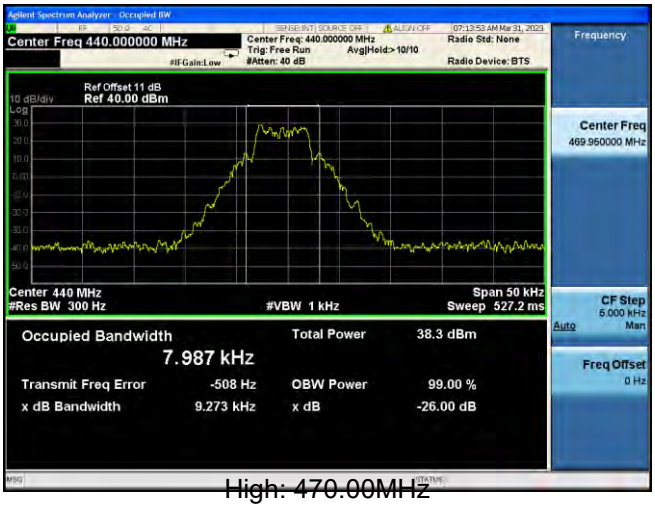
Test plots as follows:

4-FSK 12.5KHz Channel Spacing: Occupied Bandwidth

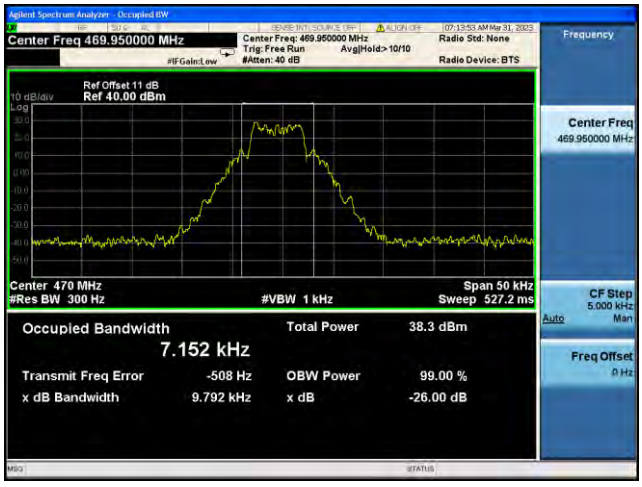
Low: 410.050MHz



Mid: 440.000MHz

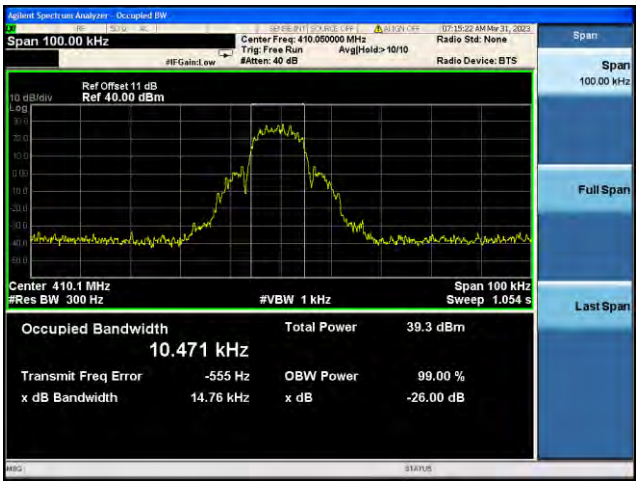


High: 470.00MHz



4-FSK 25KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz

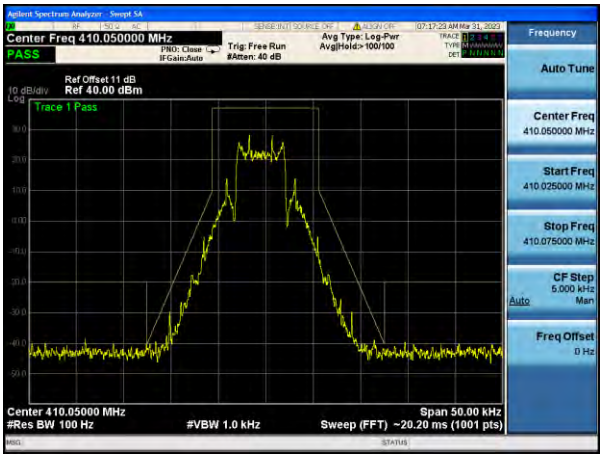


Mid: 440.000MHz

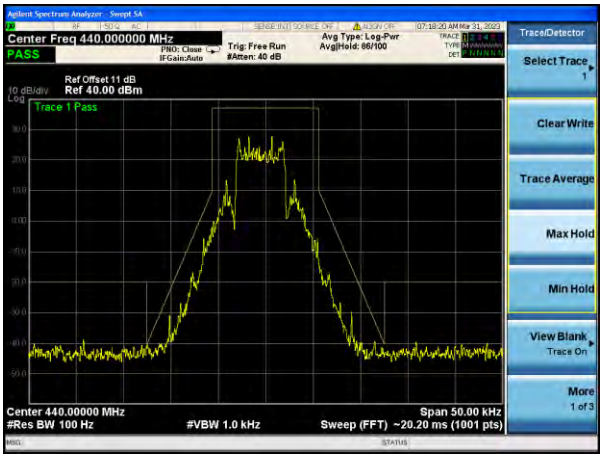
High: 469.850MHz

4-FSK 12.5KHz Channel Spacing: **Emission Mask**

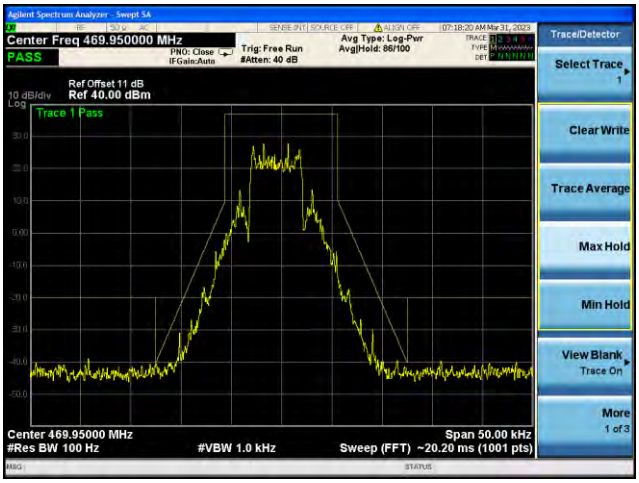
Low: 410.050MHz



Mid: 440.000MHz

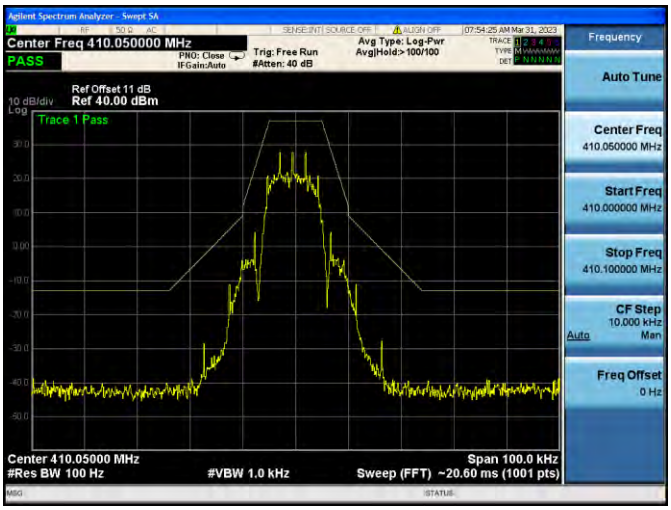


High: 469.950MHz

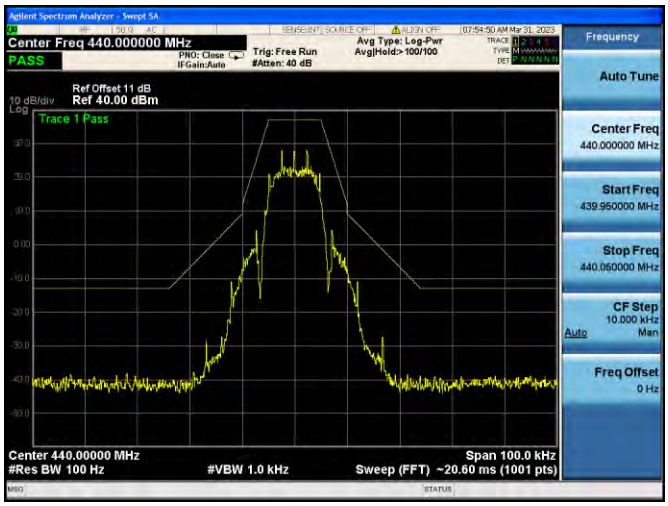


4-FSK 25KHz Channel Spacing: **Emission Mask**

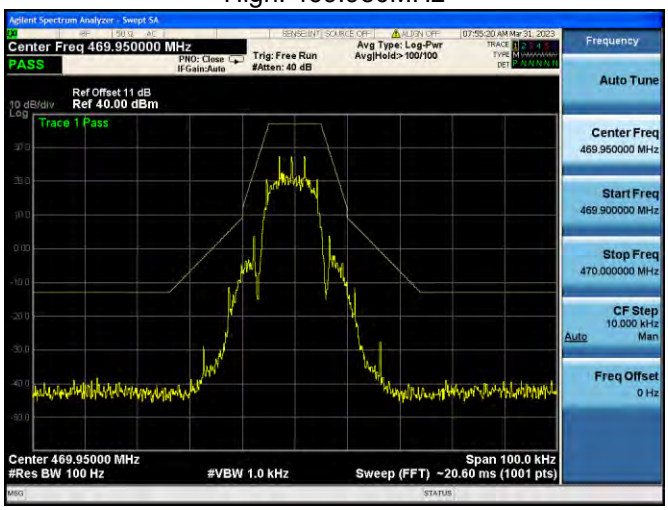
Low: 410.050MHz



Mid: 440.000MHz

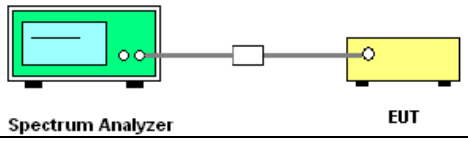


High: 469.950MHz



3.3. Spurious Emissions(conducted)

3.3.1.Test Specification

Test Requirement:	FCC Part 90.210, RSS-119(5.8)
Test Setup:	
Test Limit:	Modulation Type: 4-FSK FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 12: For 6.25 bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 6.25 kHz at least: 55 + 10 log (Pwatts) = 55 + 10 log (1.0) =55.00 dB Calculation: Limit (dBm) =EL-55-10log10 (TP) Notes: EL is the emission level of the Output Power expressed in dBm, In this application, the EL is 30 dBm for High rated power. High: Limit (dBm) = 30 – 55 – 10log (3.0) = -25 dBm For 12.5 bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz at least: 50 + 10 log (Pwatts) = 50 + 10 log (1.0) =50.00 dB Note: In general, the worst case attenuation requirement shown above was applied. Calculation: Limit (dBm) =EL-50-10log10 (TP) Notes: EL is the emission level of the Output Power expressed in dBm, In this application, the EL is 30 dBm for High rated power. Limit (dBm) = 30.00 – 50 – 10log (1.0) = -20 dBm For 25 kHz bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 62.5 kHz at least: 43 + 10 log (Pwatts) = 43 + 10 log (1.0) = 43.00 dB Note: In general, the worst case attenuation requirement shown above was applied. Calculation: Limit (dBm) =EL-43-10log10 (TP) In this application, the EL is 30 dBm for High rated power. Limit (dBm) = 30.00 – 43 – 10log (1.0) = -13 dBm Note: 1. In general, the worst case attenuation requirement shown above was applied. For emission inside from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of channel spacing, emission mask limit should be compliant. 2. The measurement frequency range from 9 KHz to 5 GHz. 3. *** means that the emission level is too low to be measured or at least 20 dB down than the limit. 4. ERP for below 1GHz and EIRP above 1GHz.

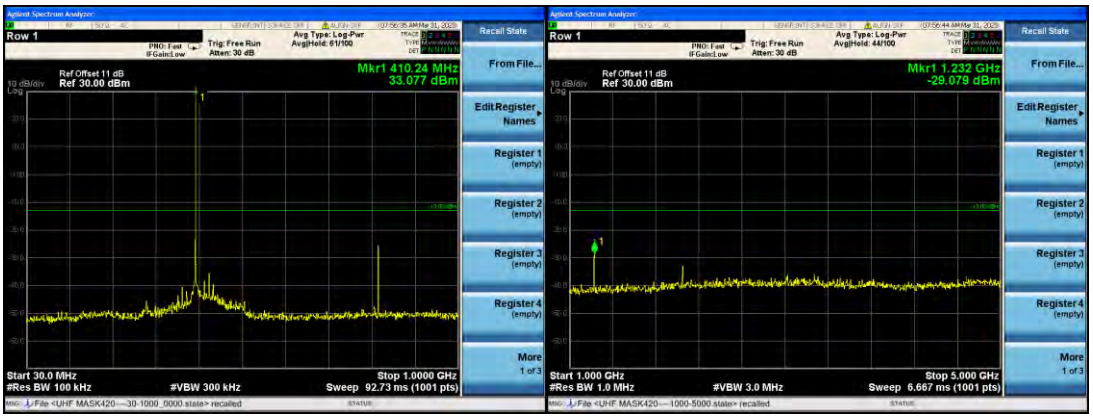
Test Result:	PASS

3.3.2.Test data

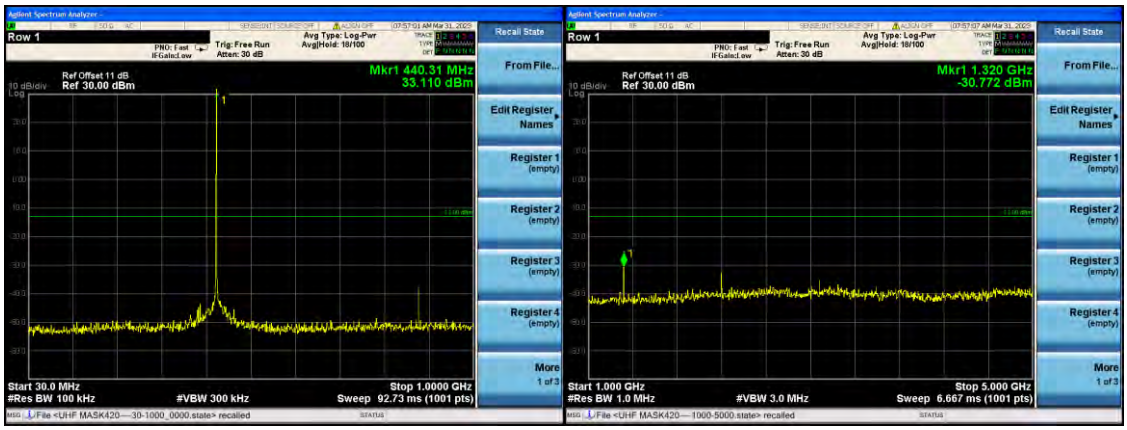
Test plots as follows:

4-FSK 12.5KHz Channel Spacing:

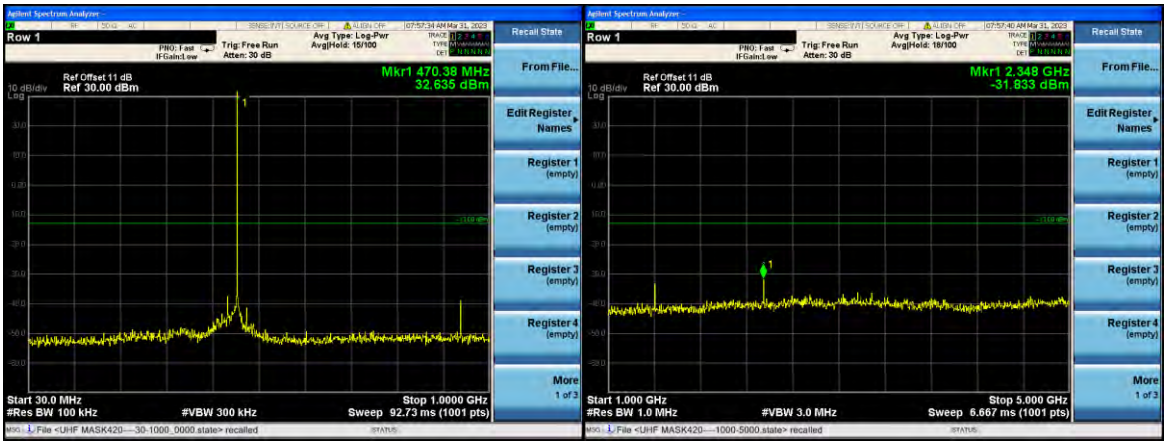
Low: 410.050MHz



Mid: 440.000MHz

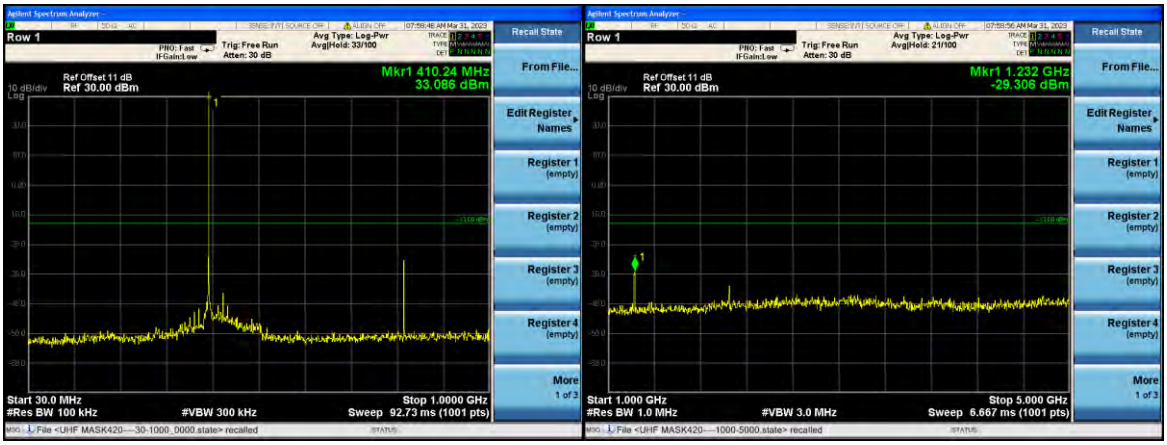


High: 469.950MHz

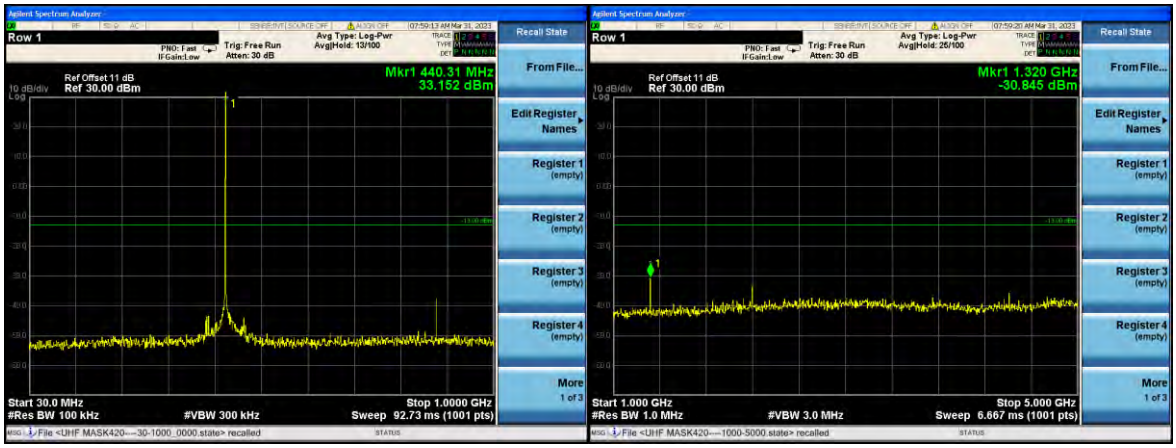


4-FSK 25KHz Channel Spacing:

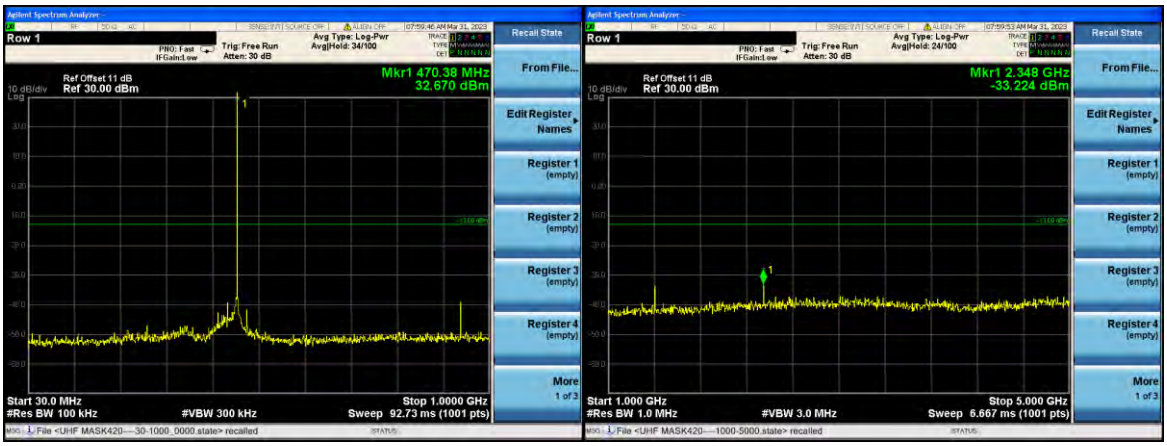
Low: 410.050MHz



Mid: 440.000MHz

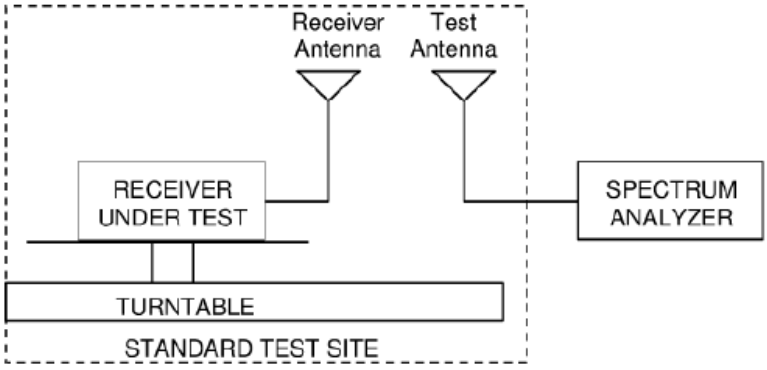


High: 469.950MHz



3.4. Radiated Spurious Emission

3.4.1.Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part 90.210, RSS-119(5.8)</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.26</td></tr>
<tr><td>Measurement Distance:</td><td>3 m</td></tr>
<tr><td>Antenna Polarization:</td><td>Horizontal & Vertical</td></tr>
<tr><td>Operation mode:</td><td>Refer to item 4.1</td></tr>
<tr><td>Receiver Setup:</td><td>
<table>
<tr><td>Frequency</td><td>RBW</td><td>VBW</td></tr>
<tr><td>9kHz- 150kHz</td><td>200Hz</td><td>1kHz</td></tr>
<tr><td>150kHz-30MHz</td><td>9kHz</td><td>30kHz</td></tr>
<tr><td>30MHz-1GHz</td><td>100KHz</td><td>300KHz</td></tr>
<tr><td>Above 1GHz</td><td>1MHz</td><td>3MHz</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>For equipment using 25 kHz channel spacing, on any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10log (P) dB.
For equipment using 12.5 kHz channel spacing, on any frequency removed from the center of
The authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log(P) dB or 70 dB, whichever is the lesser attenuation.</td></tr>
<tr><td>Test setup:</td><td> 
</td></tr>
<tr><td>Test Procedure:</td><td>The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.
The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT .The test was performed by placing the EUT on 3-orthogonal axis.
The frequency range up to teeth harmonic of the fundamental frequency was investigated.
Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a</td></tr>
</table>

	non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution. Spurious emissions in dB =10, 1g (TXpwr in Watts/0.001)-the absolute level Spurious attenuation limit in dB =50+10 Log10 (power out in Watts) for EUT with a 12.5 kHz and 25KHz channel bandwidth.
Test results:	PASS

3.4.2.Test Data

4-FSK:

Test Mode: Low: 410.050MHz, Channel Spacing 12.5KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
150.753	-93.90	V	0.24	31.35	-62.79	-20	-42.79
359.807	-90.79	V	0.26	31.34	-59.71	-20	-39.71
671.423	-93.21	V	0.42	31.24	-62.39	-20	-42.39
862.653	-93.76	V	0.58	30.71	-63.63	-20	-43.63
1263.815	-78.84	V	1.23	26.38	-53.69	-20	-33.69
3863.073	-77.93	V	1.68	25.47	-54.14	-20	-34.14
287.133	-94.96	H	0.43	31.24	-64.15	-20	-44.15
400.204	-95.50	H	0.45	30.68	-65.27	-20	-45.27
478.017	-94.21	H	0.64	30.85	-64.00	-20	-44.00
676.575	-97.66	H	0.79	31.12	-67.33	-20	-47.33
1369.176	-82.52	H	1.29	26.12	-57.69	-20	-37.69
3258.122	-77.40	H	1.62	25.41	-53.61	-20	-33.61

Test Mode: Mid: 440.000MHz, Channel Spacing 12.5KHz

Frequency (MHz)	**Reading level (dBm)**	**Antenna Polarization**	**Cable loss (dB)**	**Ant.Gain (dBi)**	**Emission level (dBm)**	**Limit (dBm)**	**Margin (dB)**
157.911	-93.89	V	0.24	31.35	-62.78	-20	-42.78
362.588	-90.21	V	0.26	31.34	-59.13	-20	-39.13
669.972	-92.94	V	0.42	31.24	-62.12	-20	-42.12
862.586	-93.40	V	0.58	30.71	-63.27	-20	-43.27
1263.083	-78.31	V	1.23	26.38	-53.16	-20	-33.16
3857.439	-78.16	V	1.68	25.47	-54.37	-20	-34.37
292.620	-95.06	H	0.43	31.24	-64.25	-20	-44.25
397.340	-95.71	H	0.45	30.68	-65.48	-20	-45.48
477.536	-94.73	H	0.64	30.85	-64.52	-20	-44.52
682.949	-97.25	H	0.79	31.12	-66.92	-20	-46.92
1366.759	-81.86	H	1.29	26.12	-57.03	-20	-37.03
3262.627	-77.77	H	1.62	25.41	-53.98	-20	-33.98

Test Mode: High: 469.950MHz, Channel Spacing 12.5KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
149.819	-93.75	V	0.24	31.35	-62.64	-20	-42.64
366.378	-90.50	V	0.26	31.34	-59.42	-20	-39.42
671.133	-93.44	V	0.42	31.24	-62.62	-20	-42.62
866.455	-93.79	V	0.58	30.71	-63.66	-20	-43.66
1259.762	-78.51	V	1.23	26.38	-53.36	-20	-33.36
3860.704	-78.22	V	1.68	25.47	-54.43	-20	-34.43
292.127	-94.75	H	0.43	31.24	-63.94	-20	-43.94
407.252	-96.08	H	0.45	30.68	-65.85	-20	-45.85
476.193	-94.81	H	0.64	30.85	-64.60	-20	-44.60
679.120	-97.34	H	0.79	31.12	-67.01	-20	-47.01
1371.936	-82.52	H	1.29	26.12	-57.69	-20	-37.69
3265.395	-77.56	H	1.62	25.41	-53.77	-20	-33.77

Test Mode: Low: 410.050MHz, Channel Spacing 25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
146.884	-94.42	V	0.24	31.35	-63.31	-20	-43.31
361.661	-90.45	V	0.26	31.34	-59.37	-20	-39.37
672.403	-93.43	V	0.42	31.24	-62.61	-20	-42.61
869.253	-93.74	V	0.58	30.71	-63.61	-20	-43.61
1260.906	-78.75	V	1.23	26.38	-53.60	-20	-33.60
3859.099	-78.46	V	1.68	25.47	-54.67	-20	-34.67
289.522	-95.03	H	0.43	31.24	-64.22	-20	-44.22
400.914	-95.70	H	0.45	30.68	-65.47	-20	-45.47
476.804	-94.43	H	0.64	30.85	-64.22	-20	-44.22
681.363	-97.37	H	0.79	31.12	-67.04	-20	-47.04
1370.675	-81.97	H	1.29	26.12	-57.14	-20	-37.14
3261.429	-77.93	H	1.62	25.41	-54.14	-20	-34.14

Test Mode; Mid: 440.000MHz, Channel Spacing 25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
157.631	-94.40	V	0.24	31.35	-63.29	-20	-43.29
364.164	-90.79	V	0.26	31.34	-59.71	-20	-39.71
672.658	-92.84	V	0.42	31.24	-62.02	-20	-42.02
857.656	-93.85	V	0.58	30.71	-63.72	-20	-43.72
1261.789	-78.26	V	1.23	26.38	-53.11	-20	-33.11
3860.792	-78.54	V	1.68	25.47	-54.75	-20	-34.75
286.101	-95.19	H	0.43	31.24	-64.38	-20	-44.38
404.305	-95.64	H	0.45	30.68	-65.41	-20	-45.41
472.706	-94.65	H	0.64	30.85	-64.44	-20	-44.44
684.044	-97.44	H	0.79	31.12	-67.11	-20	-47.11
1372.293	-82.31	H	1.29	26.12	-57.48	-20	-37.48
3261.991	-77.44	H	1.62	25.41	-53.65	-20	-33.65

Test Mode: High: 469.950MHz, Channel Spacing 25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
150.444	-94.03	V	0.24	31.35	-62.92	-20	-42.92
360.103	-90.36	V	0.26	31.34	-59.28	-20	-39.28
671.514	-93.08	V	0.42	31.24	-62.26	-20	-42.26
863.778	-93.56	V	0.58	30.71	-63.43	-20	-43.43
1256.913	-78.54	V	1.23	26.38	-53.39	-20	-33.39
3854.891	-78.55	V	1.68	25.47	-54.76	-20	-34.76
288.493	-95.34	H	0.43	31.24	-64.53	-20	-44.53
398.954	-95.53	H	0.45	30.68	-65.30	-20	-45.30
474.968	-94.81	H	0.64	30.85	-64.60	-20	-44.60
681.111	-97.37	H	0.79	31.12	-67.04	-20	-47.04
1372.828	-82.53	H	1.29	26.12	-57.70	-20	-37.70
3265.247	-77.96	H	1.62	25.41	-54.17	-20	-34.17

3.5. Transient Frequency Behavior

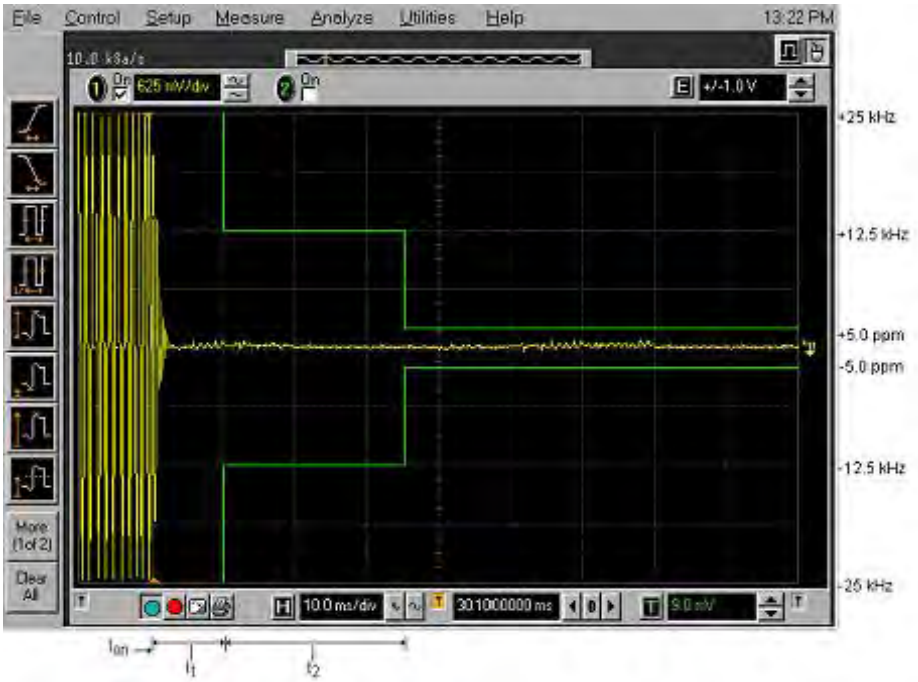
3.5.1.Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part 90.214, RSS-119(5.9)</td></tr>
<tr><td>Test Setup:</td><td> 
</td></tr>
<tr><td>Test Limit</td><td>
<table>
<tr><th rowspan="2">Channel Bandwidth (kHz)</th><th rowspan="2">Time Intervals (Notes 1, 2)</th><th rowspan="2">Maximum Frequency Difference (kHz)</th><th colspan="2">Transient Duration Limit (ms)</th></tr>
<tr><th>138-174 MHz</th><th>406.1-512 MHz</th></tr>
<tr><td rowspan="3">25</td><td>t_1</td><td>±25</td><td>5</td><td>10</td></tr>
<tr><td>t_2</td><td>±12.5</td><td>20</td><td>25</td></tr>
<tr><td>t_3</td><td>±25</td><td>5</td><td>10</td></tr>
<tr><td rowspan="3">12.5</td><td>t_1</td><td>±12.5</td><td>5</td><td>10</td></tr>
<tr><td>t_2</td><td>±6.25</td><td>20</td><td>25</td></tr>
<tr><td>t_3</td><td>±12.5</td><td>5</td><td>10</td></tr>
<tr><td rowspan="3">6.25</td><td>t_1</td><td>±6.25</td><td>5</td><td>10</td></tr>
<tr><td>t_2</td><td>±3.125</td><td>20</td><td>25</td></tr>
<tr><td>t_3</td><td>±6.25</td><td>5</td><td>10</td></tr>
</table>
</td></tr>
<tr><td>Test Procedure:</td><td>The EUT was set in the climate chamber and connected to an external DC power supply and AC power supply. The RF output was directly connected to Oscilloscope. The coupling loss of the additional cables was recorded and taken in account for all the measurements. The result was recorded.</td></tr>
<tr><td>Test Result:</td><td>PASS</td></tr>
</table>

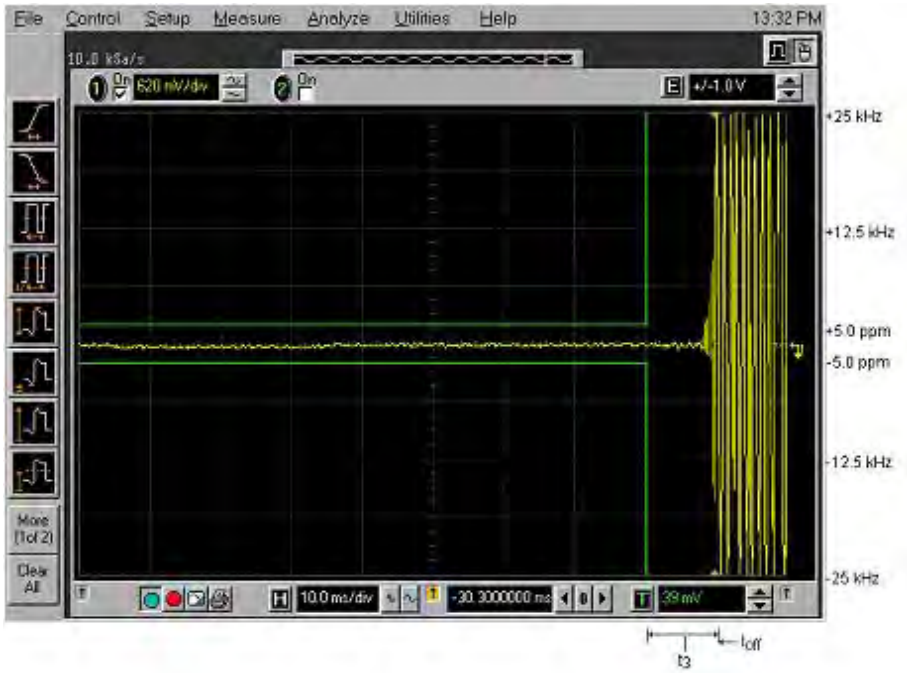
3.5.2.Test data

Test Plots for channel spacing 25KHz, EUT power setting: Maximum.

Power On



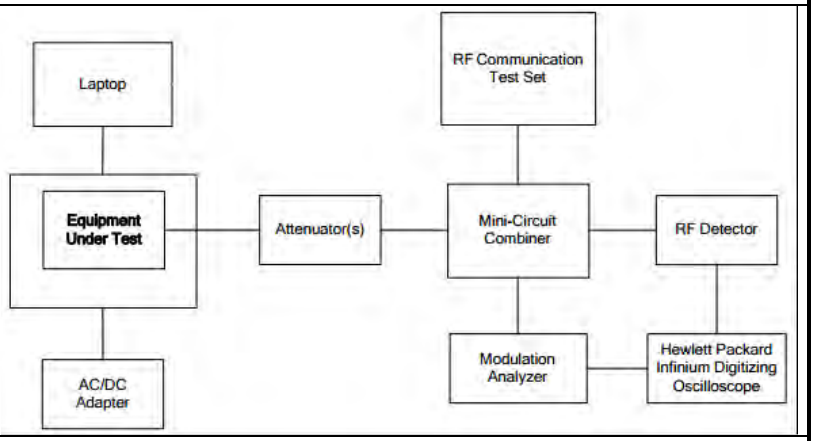
Power Off



Remark: Only list the worst data for channel spacing 25KHz, modulation 4-FSK.

3.6. Behavior Frequency Stability

3.6.1.Test Specification

Test Requirement:	FCC Part 90.213, RSS-119(5.3)
Test Method:	ANSI C63.26, RSS-Gen
Test Setup:	
Test Procedure:	Method of Measurement: After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply or AC power supply and the voltage was adjusted in the required ranges.
Test Result:	PASS

3.6.2. Test data

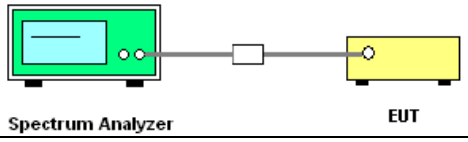
Conclusion: PASS			
Mode	Voltage (V)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 12.5KHz Channel Spacing	3.6	12	0.0010
	3.5	16	0.0189
	3.4	16	0.0185
	3.3	14	0.0163
	3.2	9	0.0108
	3.1	11	0.0128
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	3.6	18	0.0014
	3.5	14	0.0163
	3.4	10	0.0114
	3.3	17	0.0202
	3.2	9	0.0109
	3.1	18	0.0210
Limit	5ppm		

Mode	Temperature (℃)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 12.5KHz Channel Spacing	-20	15	0.0012
	-10	19	0.0229
	0	14	0.0164
	10	13	0.0158
	20	11	0.0136
	30	17	0.0198
	40	16	0.0194
	50	13	0.0152
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	-20	17	0.0013
	-10	14	0.0169
	0	10	0.0122
	10	12	0.0148
	20	12	0.0139
	30	11	0.0130
	40	17	0.0204
	50	17	0.0199
Limit	5ppm		

3.7. Modulation Characteristic

Test Requirement:	FCC Part 90.207
Test Result:	According to FCC § 2.1047(d), Part 22, 74, 90 there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

3.8. Adjacent channel power

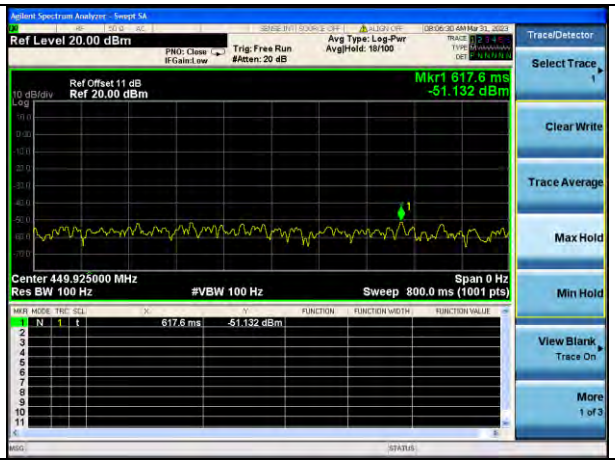
Test Requirement:	FCC Part 90.221
Test Setup:	
Test Limit:	Maximum adjacent power levels for frequencies in the 450–470 MHz band, no need compliance with below -36dBm: Frequency offset / Maximum ACP (dBc) for devices 1 watt and less / Maximum ACP (dBc) for devices above 1 watt 25 kHz ..... – 55 dBc – 60 dBc 50 kHz ..... – 70 dBc – 70 dBc 75 kHz ..... – 70 dBc – 70 dBc
Test method:	The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the Frequency band 0Kz from the wanted frequency
Test result:	Pass.

4-FSK 25KHz spacing 450MHz-470MHz

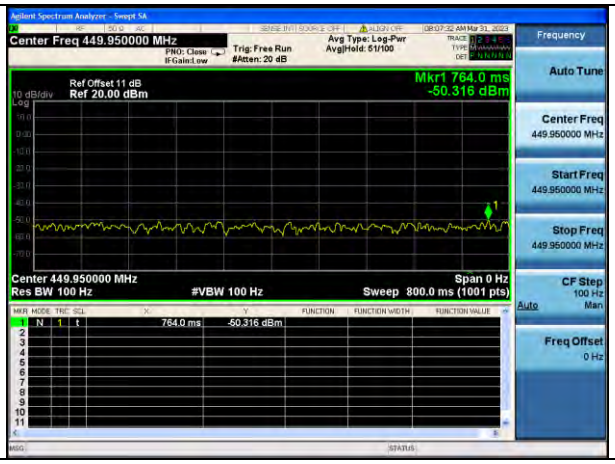
Carrier frequency (MHz)	Test Frequency (MHz)	Test Value (dBm)	Limit (dBm)	Result
450.000	449.925	-51.132	30-70=-40	PASS
	449.95	-50.316	30-70=-40	PASS
	449.975	-48.027	30-55=-25	PASS
	450.025	-45.982	30-55=-25	PASS
	450.05	-44.595	30-70=-40	PASS
	450.075	-42.051	30-70=-40	PASS
469.950	469.875	-42.477	30-70=-40	PASS
	469.900	-40.409	30-70=-40	PASS
	469.925	-40.727	30-55=-25	PASS
	469.975	-42.132	30-55=-25	PASS
	470.000	-40.868	30-70=-40	PASS
	470.025	-42.787	30-70=-40	PASS

4-FSK 25KHz spacing 450MHz-470MHz

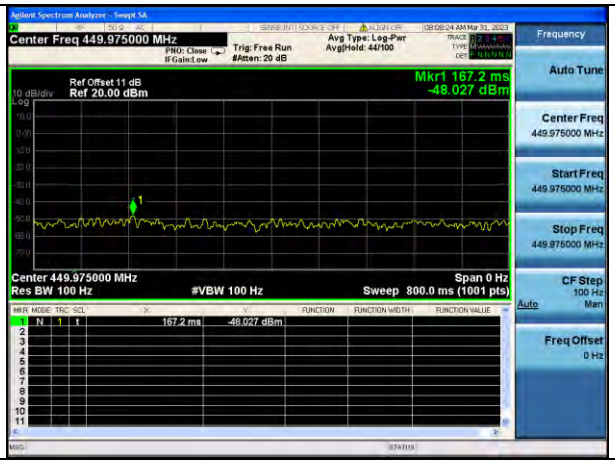
449.925MHz



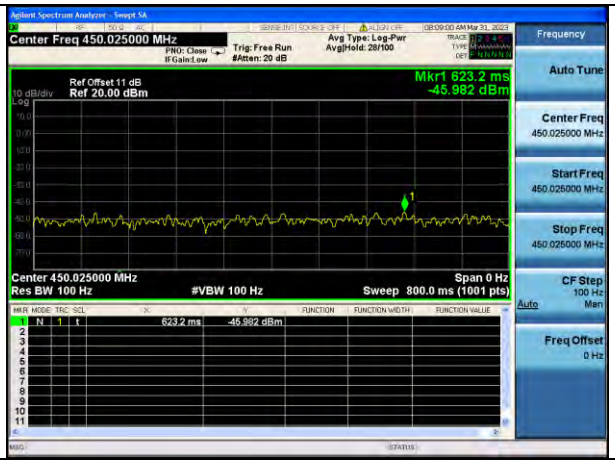
449.95MHz



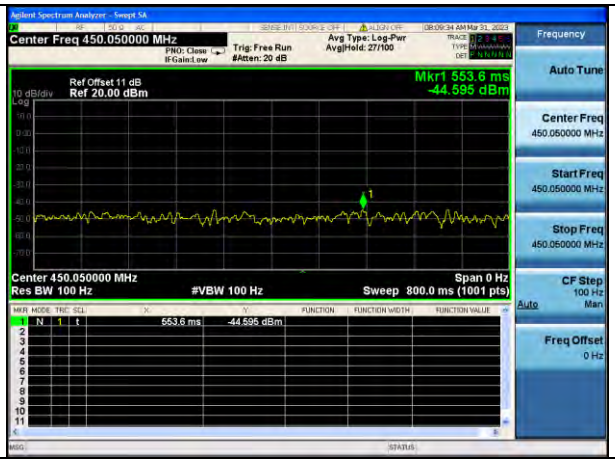
449.975MHz



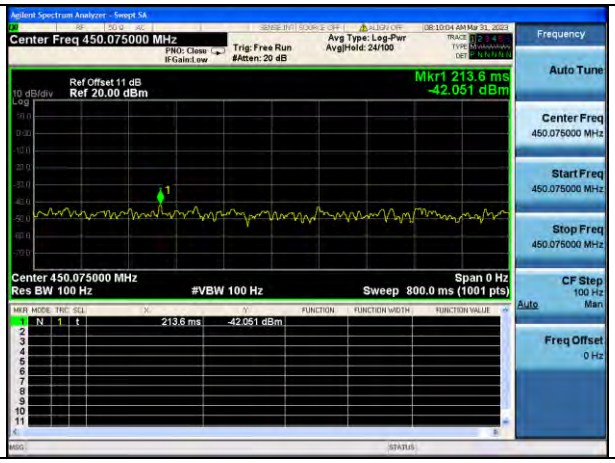
450.025MHz



450.05MHz

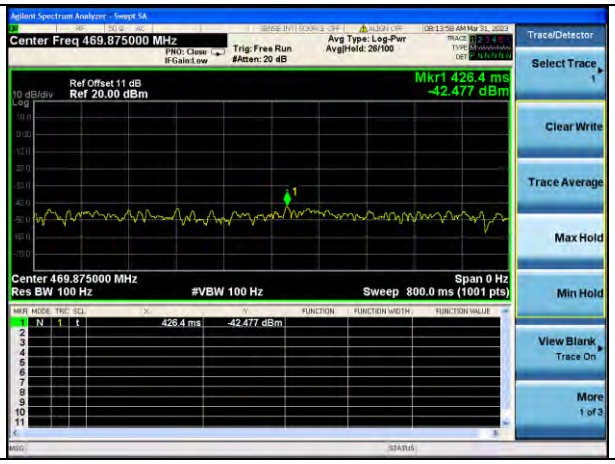


450.075MHz

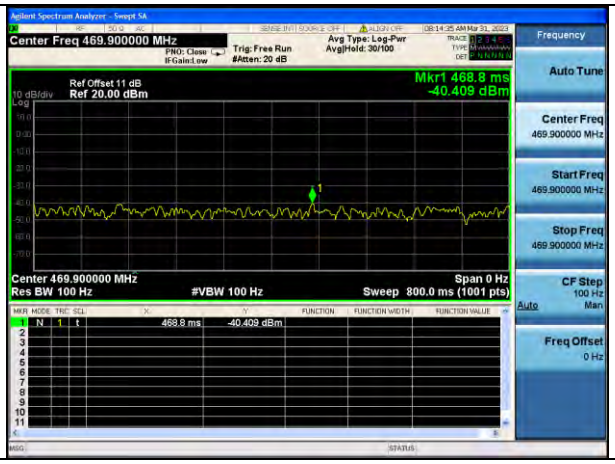


450MHz

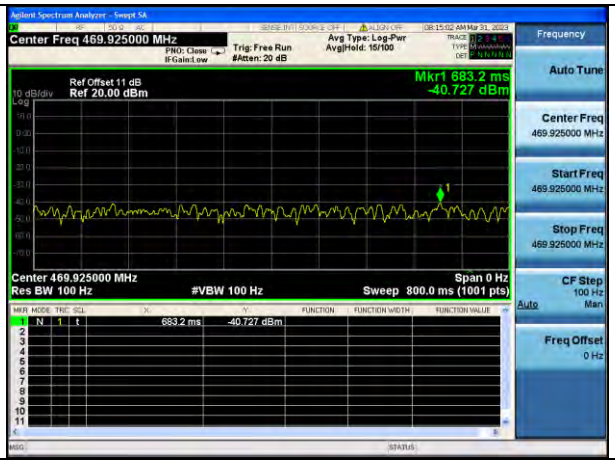
469.875MHz



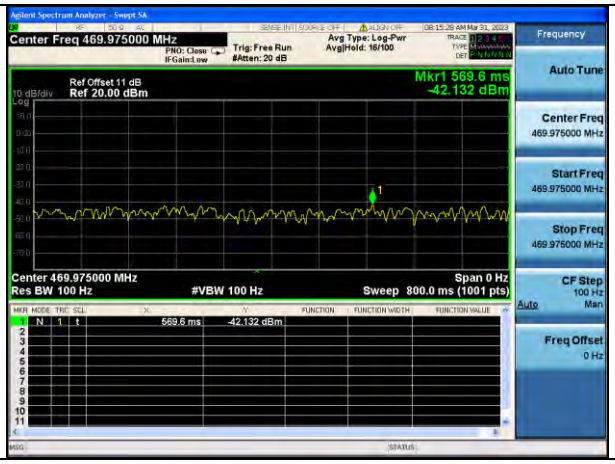
469.9MHz



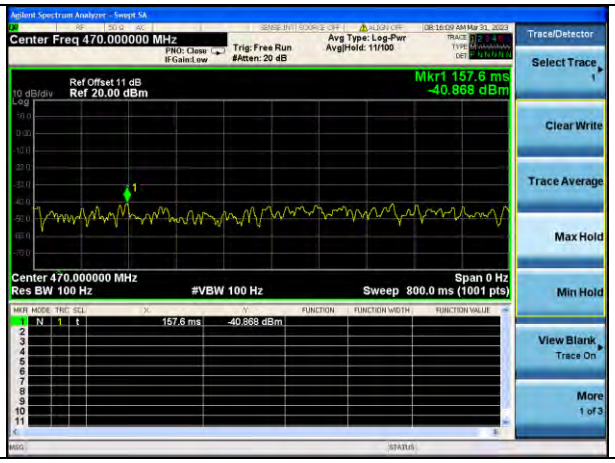
469.925MHz



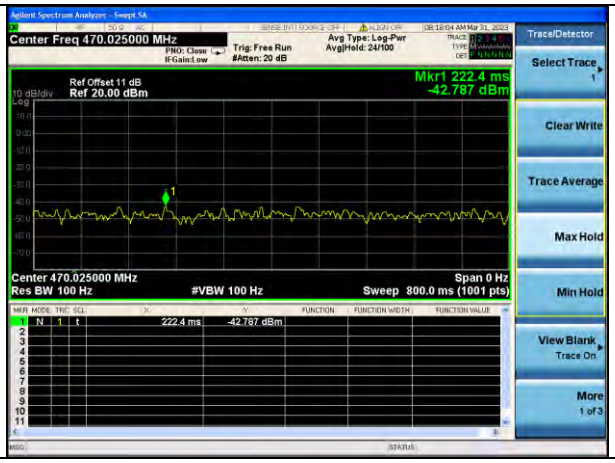
469.975MHz



470.0MHz



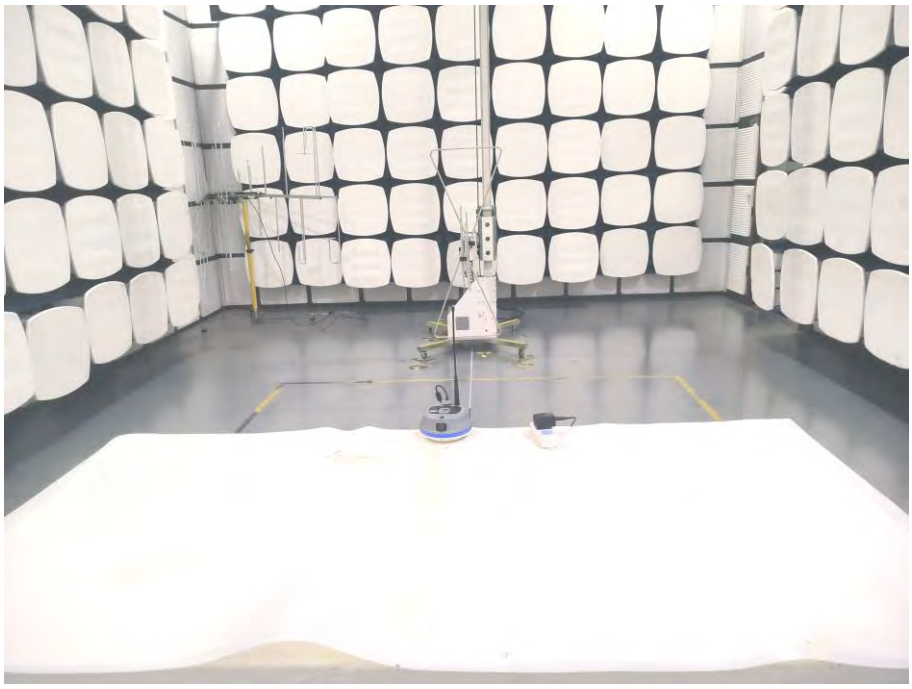
470.025MHz

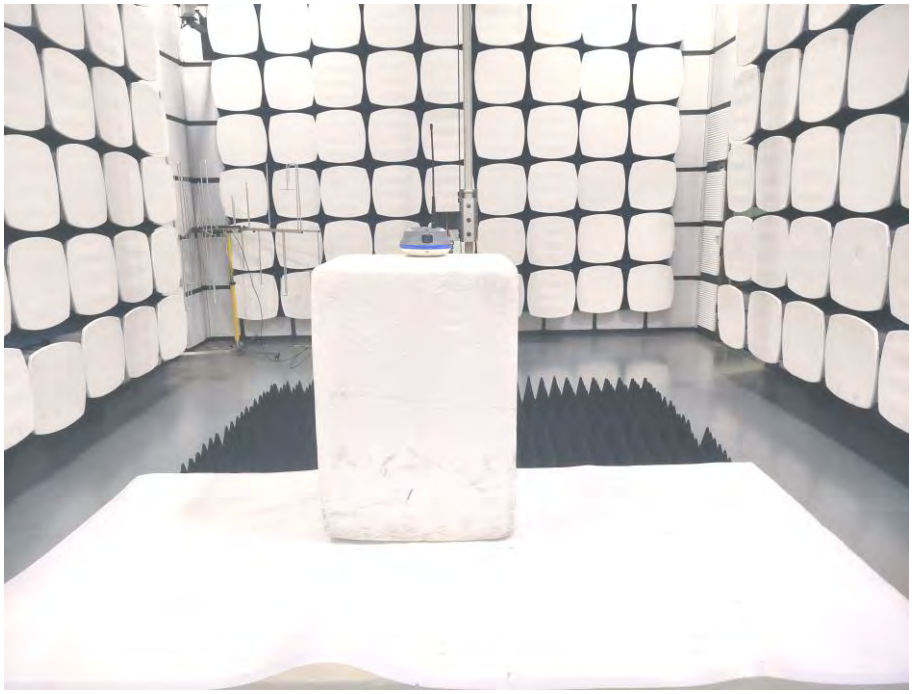


469.95MHz

4. Test Setup Photo

4.1. Photos of Radiated emission





5. EUT Photo

Please refer to the report A2303056-C01-R01.

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