



UHF TEST REPORT

FCC ID: 2ABNA-TRM201

On Behalf of

Guangzhou Geoelectron Science & Technology Company Ltd.

Wireless Data Transceiver Module

Model No.: TRM201

Prepared for : Guangzhou Geoelectron Science & Technology Company Ltd.
No.704/702, No.7, Cai Pin Road, Science City, Guangzhou
Address : High-Tech Industrial Development Zone, Guangzhou, Guangdong
Province, 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 : A2311132-C01-R04
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Date of Test : November 16, 2023 - February 23, 2024
Date of Report : February 23, 2024
Version Number : V0
Result Pass

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TEST REPORT DECLARATION

Applicant : Guangzhou Geoelectron Science & Technology Company Ltd.
 Address : No.704/702, No.7, Cai Pin Road, Science City, Guangzhou High-Tech Industrial Development Zone, Guangzhou, Guangdong Province, China.
 Manufacturer : Guangzhou Geoelectron Science & Technology Company Ltd.
 Address : No.704/702, No.7, Cai Pin Road, Science City, Guangzhou High-Tech Industrial Development Zone, Guangzhou, Guangdong Province, China.
 EUT Description : Wireless Data Transceiver Module
 (A) Model No. : TRM201
 (B) Trademark : 


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).....: Yannis Wen
 Project Engineer 

Approved by (name + signature).....: Reak Yang
 Project Manager 

Date of issue..... : February 23, 2024

Revision History

Revision	Issue Date	Revisions	Revised By
V0	February 23, 2024	Initial released Issue	Yannis Wen

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
<p>Note: 1. P is an abbreviation for Pass.</p> <p>2. F is an abbreviation for Fail.</p> <p>3. N/A is an abbreviation for Not Applicable.</p> <p>4. The conclusion of this test report is judged by actual test data without considering measurement uncertainty.</p>			

2. General Information

2.1. Description of Device (EUT)

Description : Wireless Data Transceiver Module
Model Number : TRM201
DIFF. : N/A
Test Voltage : DC 3.6V from DC power.

UHF

Operation frequency : 410MHz-470MHz
Conducted Power : 2W(33±1dBm)
Channel spacing : 6.25KHz, 12.5KHz, 25KHz
Modulation type : GMSK
Antenna Type : Rod antenna, Maximum Gain is 4dBi.
(Antenna information is provided by applicant.)
Software version : V1.0
Hardware version : V1.0

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

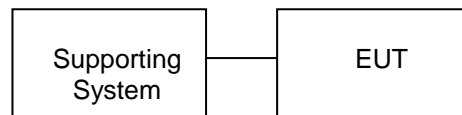
2.2. Accessories of Device (EUT)

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

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	Notebook PC	Lenovo	T430	/	/
2	DC Power	JUNKE	JK12010S	/	/

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	GMSK+CS6.25KHz+TX	at maximum rated power for transmitter
2	GMSK+CS12.5KHz+TX	at maximum rated power for transmitter
3	GMSK+CS25KHz+TX	at maximum rated power for transmitter

Note: The worst case modes for all test are the item 1 and item 2 and item 3.

Description Operation Frequency

GMSK		
Test Channel	Channel spacing (KHz)	Frequency(MHz)
Low	6.25	410.050
	12.5	410.050
	25	410.050
Mid	6.25	440.000
	12.5	440.000
	25	440.000
High	6.25	469.950
	12.5	469.950
	25	469.950

2.6. Test Conditions

Items	Required	Actual
Temperature range:	15-35°C	24°C
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: 12135A

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°C
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.9. Test Equipment List

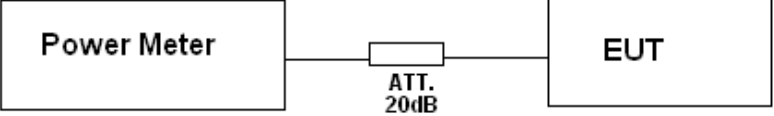
Equipment	Manufacture	Model No.	Firmware version	Serial No.	Last cal.	Cal Interval
9*6*6 anechoic chamber	CHENYU	9*6*6	/	N/A	2022.05.17	3Year
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	2.3	102137	2023.08.16	1Year
Spectrum analyzer	Agilent	N9020A	A.14.16	MY499100060	2023.08.16	1Year
Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-10 2082-Wa	2023.08.16	1Year
Receiver	R&S	ESCI	4.42 SP1	101165	2023.08.16	1Year
Bilog Antenna	Schwarzbeck	VULB 9168	/	VULB 9168#627	2023.08.28	1Year
Horn Antenna	SCHWARZBECK	BBHA 9120 D	/	2106	2023.08.19	1Year
Loop Antenna	SCHWARZBECK	FMZB 1519B	/	00128	2023.08.19	1Year
RF Cable	Resenberger	Cable 1	/	RE1	2023.08.16	1Year
RF Cable	Resenberger	Cable 2	/	RE2	2023.08.16	1Year
RF Cable	Resenberger	Cable 3	/	CE1	2023.08.16	1Year
Pre-amplifier	HP	HP8347A	/	2834A00455	2023.08.16	1Year
Pre-amplifier	Agilent	8449B	/	3008A02664	2023.08.16	1Year
L.I.S.N.#1	Schwarzbeck	NSLK8126	/	8126-466	2023.08.16	1Year
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	/	101043	2023.08.16	1Year
Horn Antenna	SCHWARZBECK	BBHA 9170	/	00946	2023.08.19	1Year
Preamplifier	SKET	LNPA_1840 -50	/	SK2018101801	2023.08.16	1 Year
Power Meter	Agilent	E9300A	/	MY41496628	2023.08.16	1 Year
Power Sensor	DARE	RPR3006W	/	15100041SNO91	2023.08.16	1 Year
Temp. & Humid. Chamber	Teelong	TL-HW408S	/	TL-20191205-01	2023.07.25	1 Year
Switching Mode Power Supply	JUNKE	JK12010S	/	20140927-6	2023.08.16	1 Year
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
Test Method:	FCC part 2.1046
Limits:	Please refer section FCC Part 90.205
Test Setup:	 <pre> graph LR PM[Power Meter] --- ATT[ATT. 20dB] ATT --- EUT[EUT] </pre>
Test Procedure:	<ul style="list-style-type: none"> a) Connect the equipment as illustrated. b) Turn on the power meter c) Record value
Test Result:	PASS


3.1.2. Test Results

GMSK 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
6.25	410.050	32.419	34.269	34.85	33±1	PASS
12.5	410.050	32.504	34.354	34.85	33±1	PASS
25	410.050	32.159	34.009	34.85	33±1	PASS
6.25	440.000	32.661	34.511	34.85	33±1	PASS
12.5	440.000	32.459	34.309	34.85	33±1	PASS
25	440.000	32.694	34.544	34.85	33±1	PASS
6.25	469.950	32.727	34.577	34.85	33±1	PASS
12.5	469.950	32.831	34.681	34.85	33±1	PASS
25	469.950	32.479	34.329	34.85	33±1	PASS

Note: 1. Maximum 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
Test Setup:	 <p style="text-align: center;"> Spectrum Analyzer EUT </p>
Test Procedure:	<p>The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the Frequency band $\pm 50\text{KHz}$ 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 $\pm 100\text{KHz}$ from the carrier frequency for Emission Mask.</p>
Test Result:	PASS

3.2.2. Test data

Occupied Bandwidth:

GMSK 6.25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	2.850	2.066	6	PASS
Mid	440.000	2.840	2.067	6	PASS
High	469.950	2.855	2.055	6	PASS

GMSK 12.5KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	10.09	3.565	11.25	PASS
Mid	440.000	8.920	3.665	11.25	PASS
High	469.950	8.812	3.545	11.25	PASS

GMSK 25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	15.67	4.782	20	PASS
Mid	440.000	17.48	4.801	20	PASS
High	469.950	19.67	4.656	20	PASS

Emission Mask:

GMSK 6.25KHz Channel Spacing:				
Channel	Frequency (MHz)	Applicable Mask	RBW	Result
Low	410.050	E	100Hz	PASS
Mid	440.000	E	100Hz	PASS
High	469.950	E	100Hz	PASS

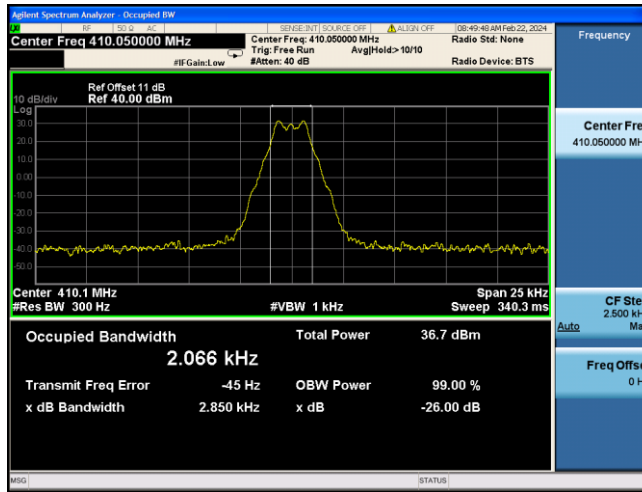
GMSK 12.5KHz Channel Spacing:				
Channel	Frequency (MHz)	Applicable Mask	RBW	Result
Low	410.050	D	100Hz	PASS
Mid	440.000	D	100Hz	PASS
High	469.950	D	100Hz	PASS

GMSK 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

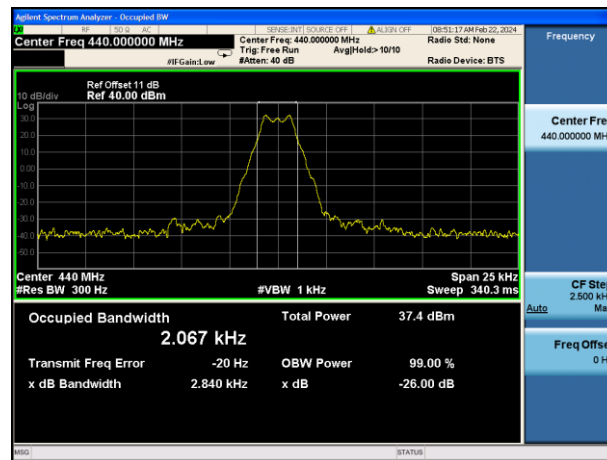
Test plots as follows:

GMSK 6.25KHz Channel Spacing: Occupied Bandwidth

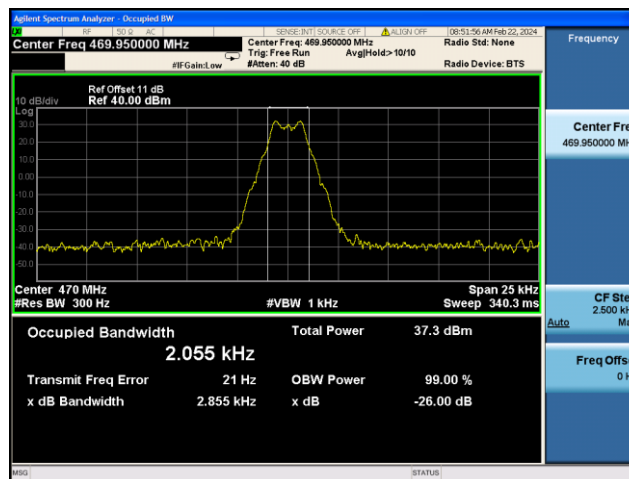
Low: 410.050MHz



Mid: 440.000MHz

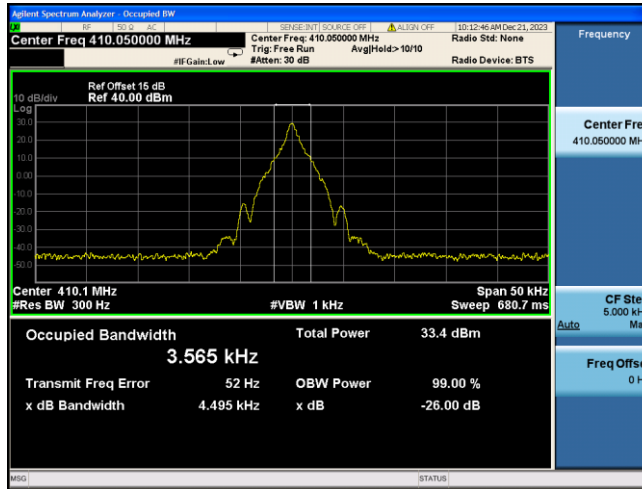


High: 470.00MHz

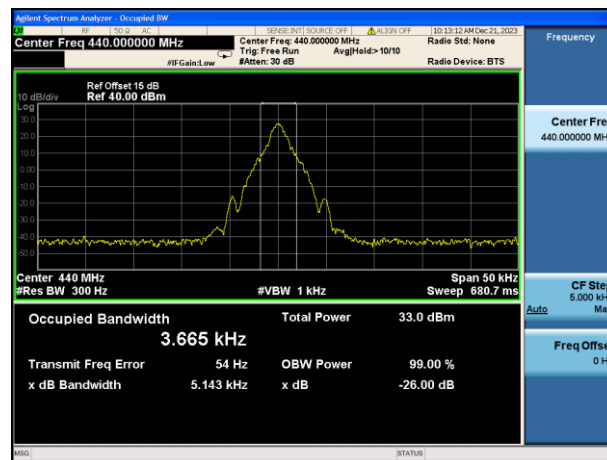


GMSK 12.5KHz Channel Spacing: Occupied Bandwidth

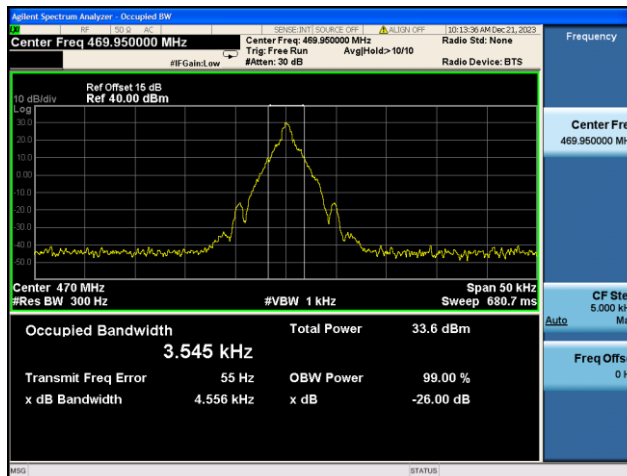
Low: 410.050MHz



Mid: 440.000MHz

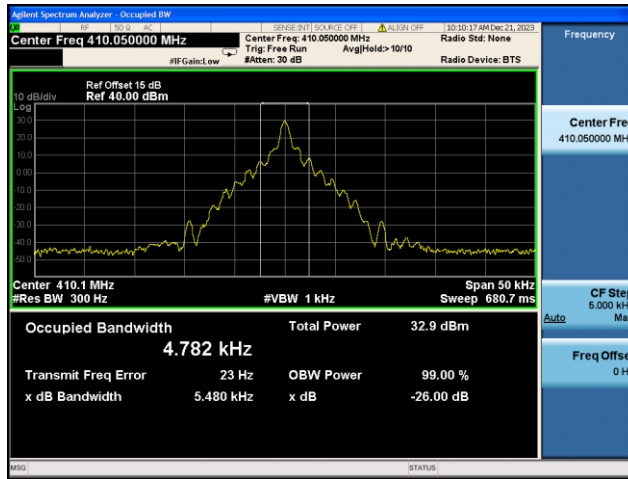


High: 470.00MHz

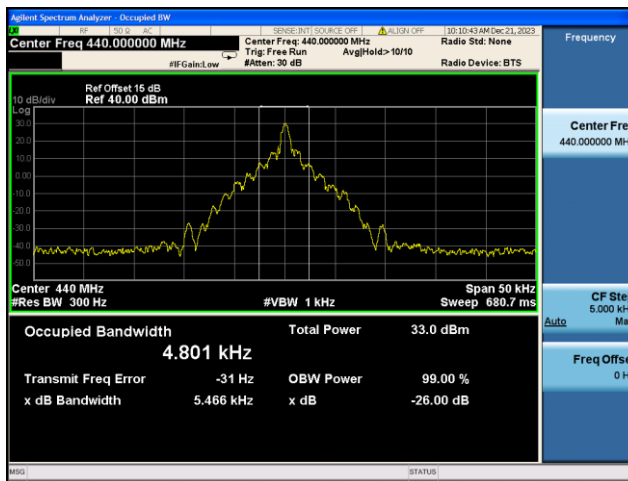


GMSK 25KHz Channel Spacing: Occupied Bandwidth

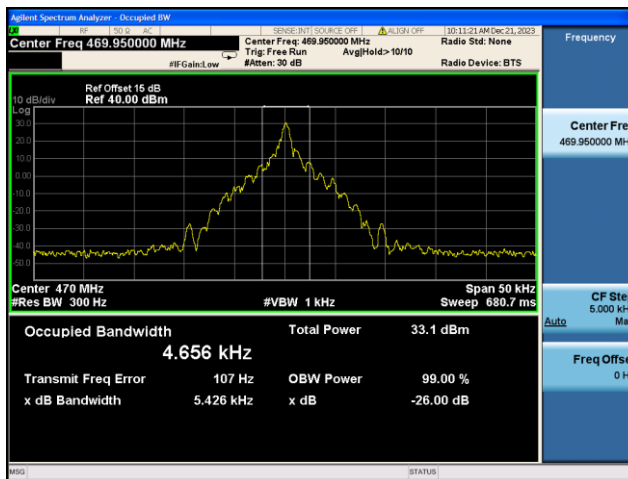
Low: 410.050MHz



Mid: 440.000MHz

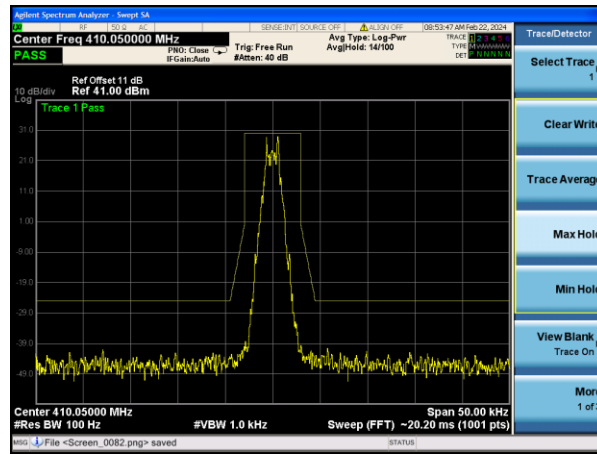


High: 469.850MHz

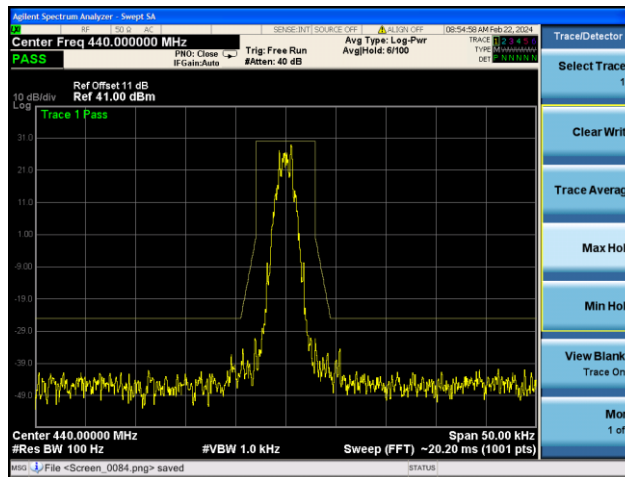


GMSK 6.25KHz Channel Spacing: Emission Mask

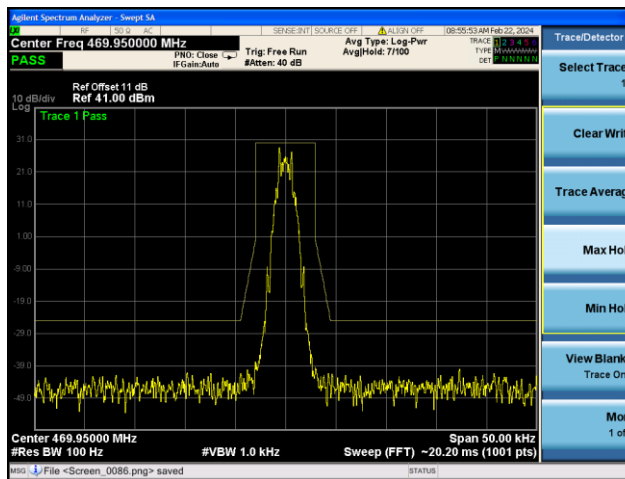
Low: 410.050MHz



Mid: 440.000MHz

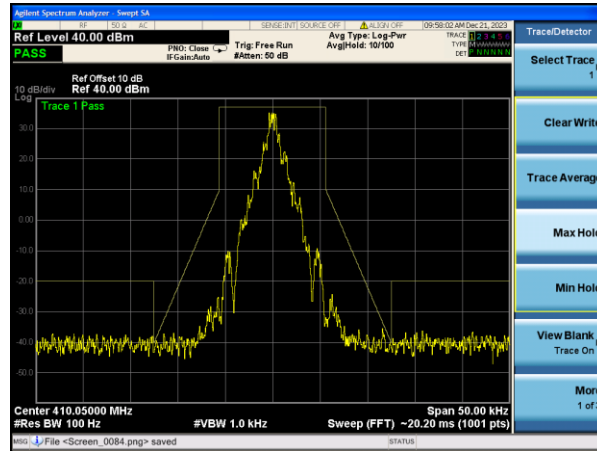


High: 469.950MHz

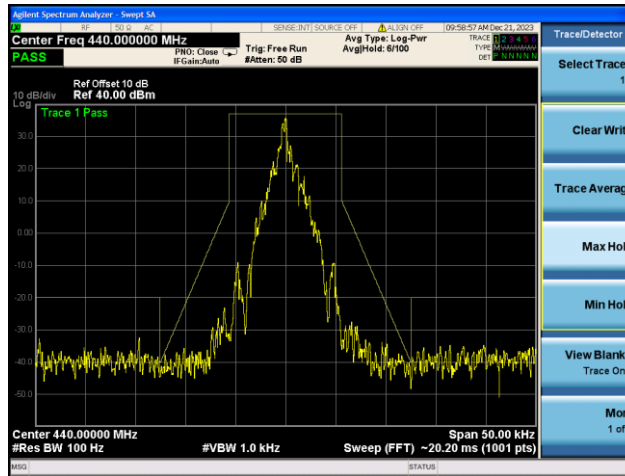


GMSK 12.5KHz Channel Spacing: Emission Mask

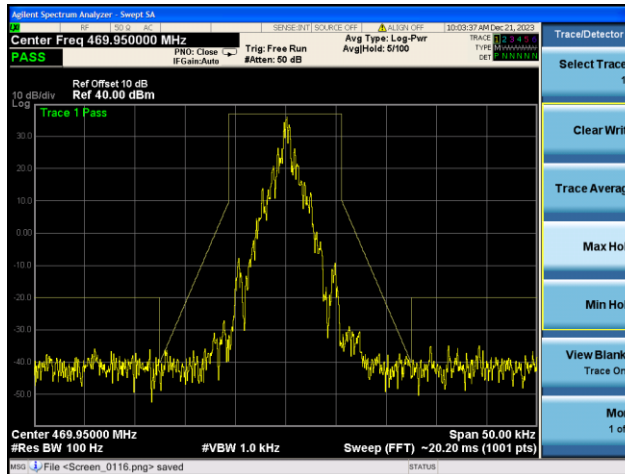
Low: 410.050MHz



Mid: 440.000MHz

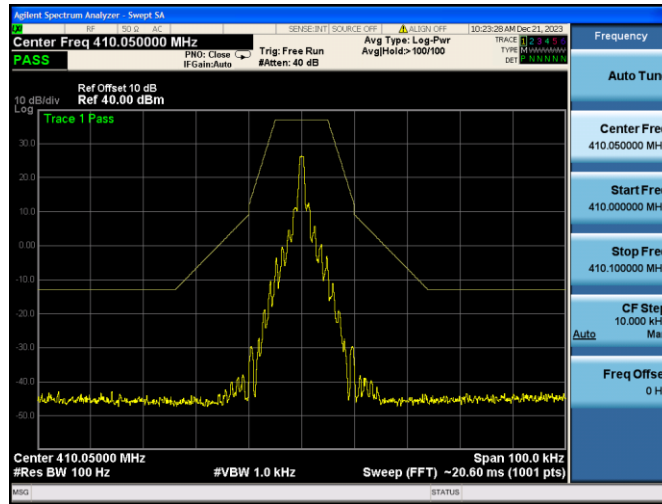


High: 469.950MHz

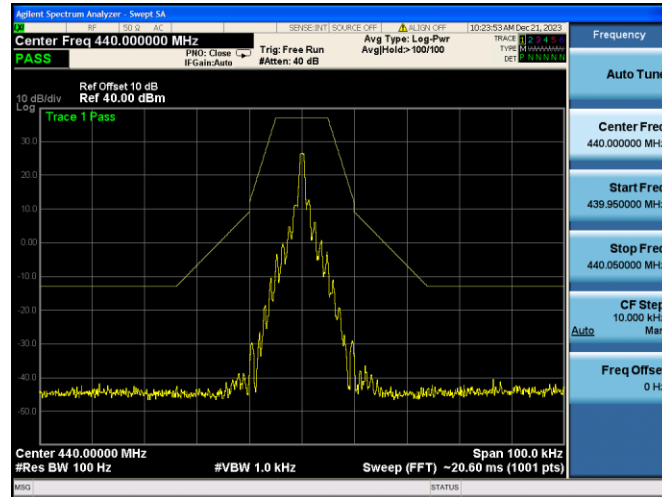


GMSK 25KHz Channel Spacing: Emission Mask

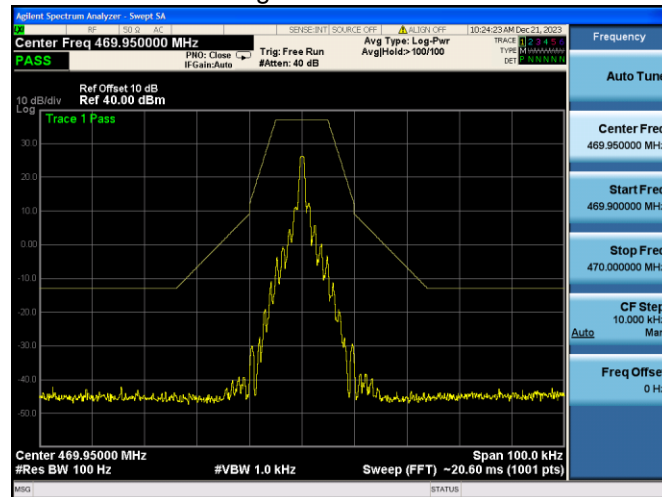
Low: 410.050MHz



Mid: 440.000MHz




High: 469.950MHz



3.3. Spurious Emissions(conducted)

3.3.1.Test Specification

Test Requirement:	FCC Part 90.210
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Limit:	<p>Modulation Type: GMSK FCC Part 22.359, 74.462, 80.211 and 90.210: 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: $55 + 10 \log (P_{\text{watts}}) = 55 + 10 \log (1.0) = 55.00 \text{ dB}$ 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: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (1.0) = 50.00 \text{ dB}$ 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: $43 + 10 \log (P_{\text{watts}}) = 43 + 10 \log (1.0) = 43.00 \text{ dB}$ 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.</p>

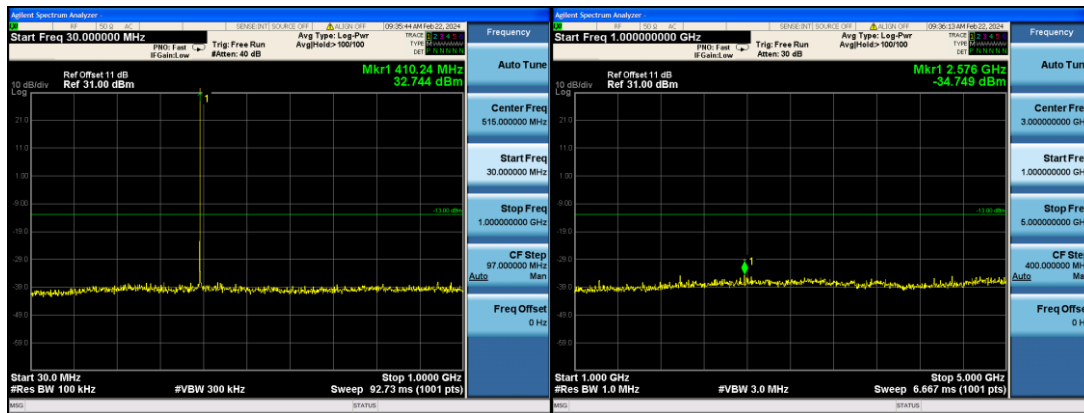
Test Result:	PASS
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3.3.2. Test data

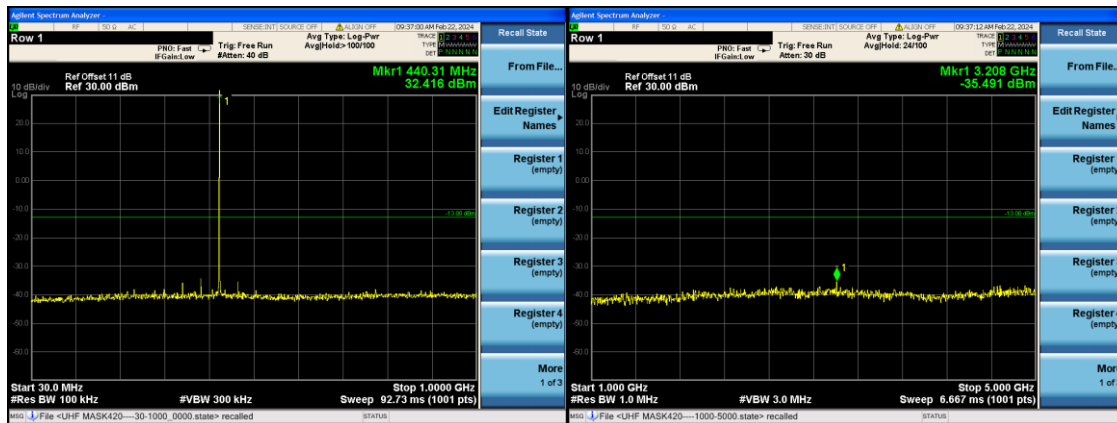
Test plots as follows:

GMSK 6.25KHz Channel Spacing:

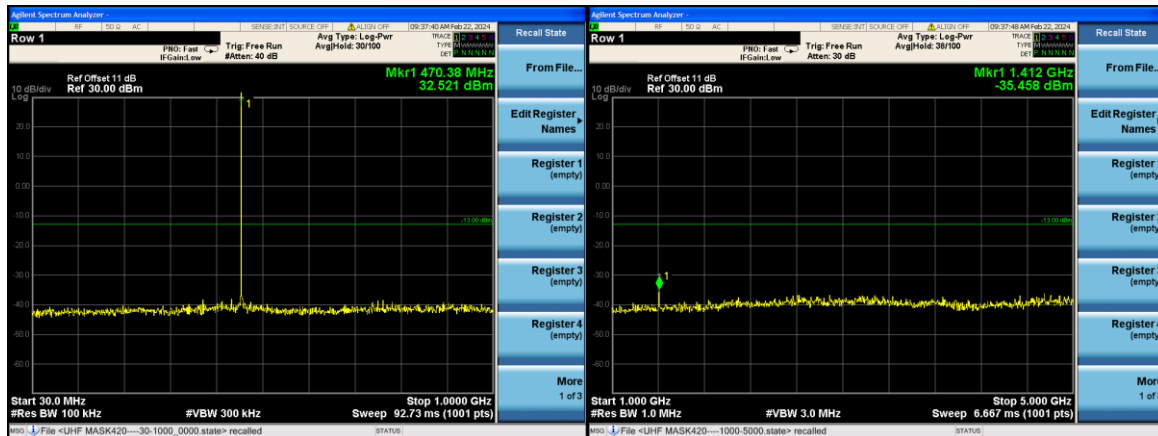
Low: 410.050MHz



Mid: 440.000MHz

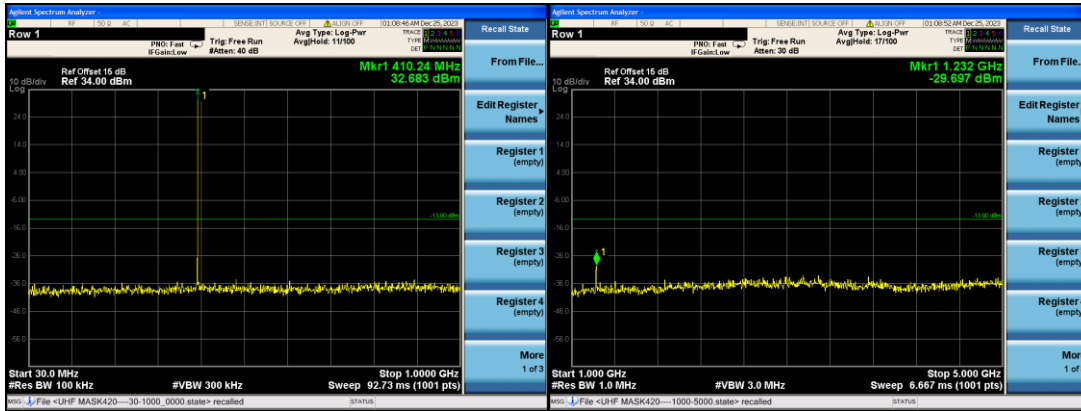


High: 469.950MHz

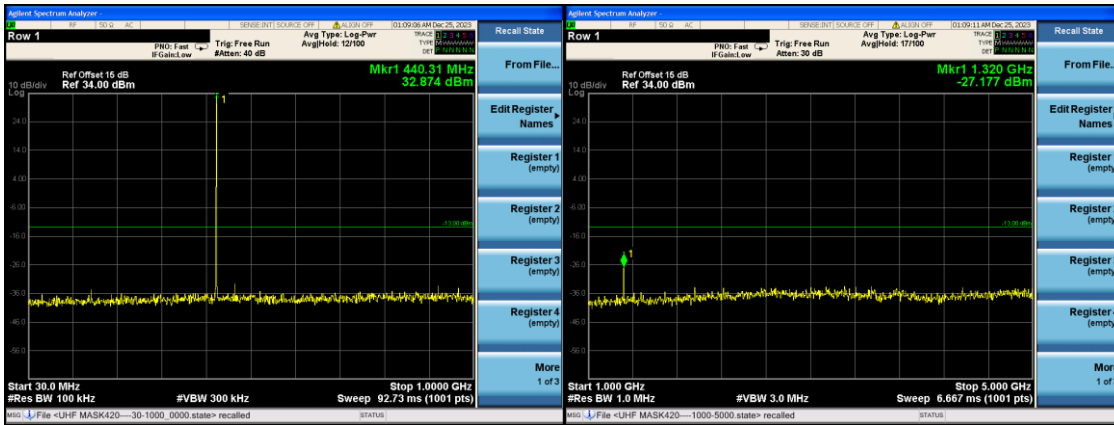


GMSK 12.5KHz Channel Spacing:

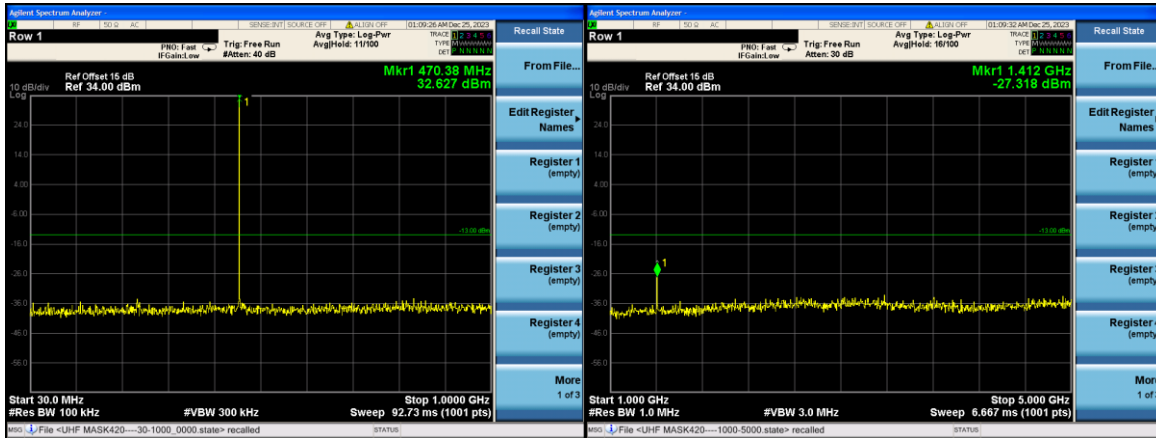
Low: 410.050MHz



Mid: 440.000MHz

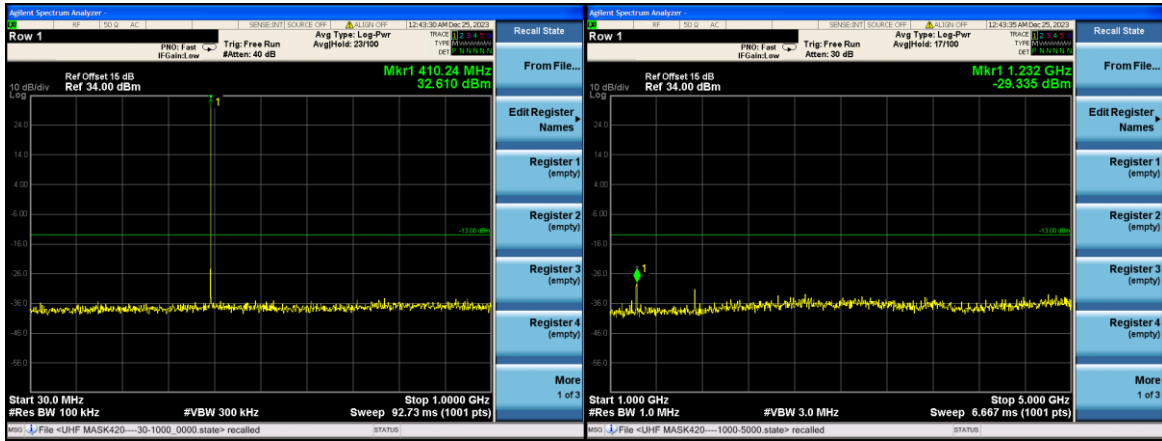


High: 469.950MHz

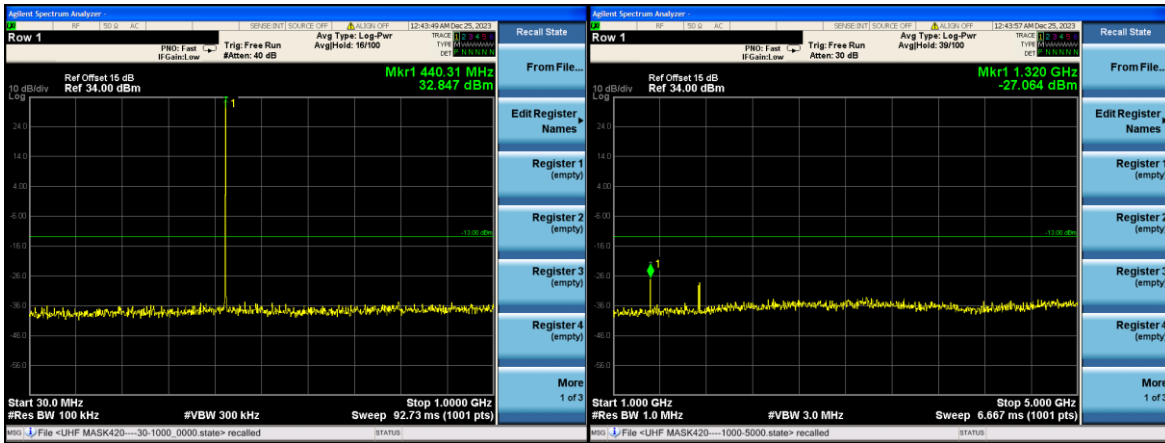


GMSK 25KHz Channel Spacing:

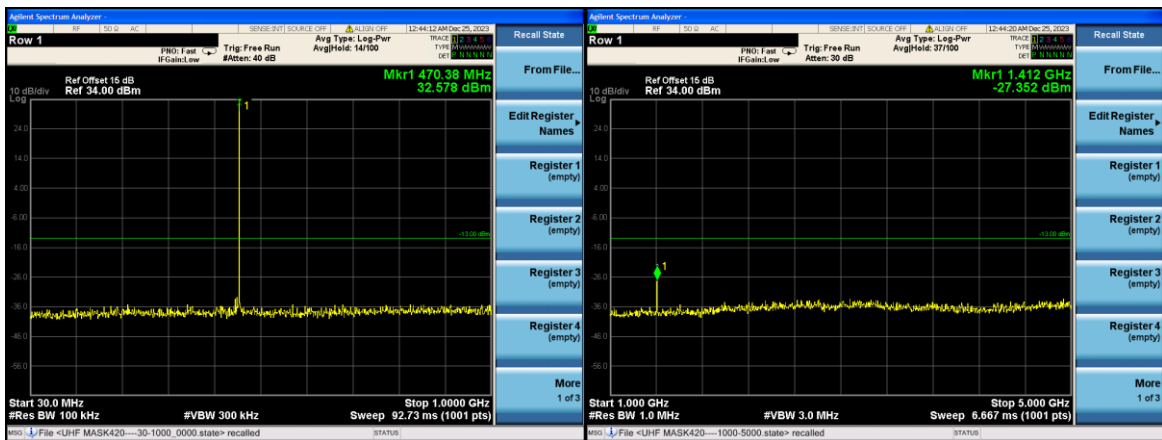
Low: 410.050MHz



Mid: 440.000MHz



High: 469.950MHz



3.4. Radiated Spurious Emission

3.4.1. Test Specification

Test Requirement:	FCC Part 90.210															
Test Method:	ANSI C63.26															
Measurement Distance:	3 m															
Antenna Polarization:	Horizontal & Vertical															
Operation mode:	Refer to item 4.1															
Receiver Setup:	<table border="1"> <thead> <tr> <th>Frequency</th> <th>RBW</th> <th>VBW</th> </tr> </thead> <tbody> <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> </tbody> </table>	Frequency	RBW	VBW	9kHz- 150kHz	200Hz	1kHz	150kHz-30MHz	9kHz	30kHz	30MHz-1GHz	100KHz	300KHz	Above 1GHz	1MHz	3MHz
Frequency	RBW	VBW														
9kHz- 150kHz	200Hz	1kHz														
150kHz-30MHz	9kHz	30kHz														
30MHz-1GHz	100KHz	300KHz														
Above 1GHz	1MHz	3MHz														
Limit:	<p>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 $43 + 10\log(P)$ dB.</p> <p>For equipment using 12.5 kHz channel spacing, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.</p>															
Test setup:	<p>The diagram shows a 'RECEIVER UNDER TEST' on a 'TURNTABLE' within a 'STANDARD TEST SITE'. A 'Receiver Antenna' is positioned above the receiver, and a 'Test Antenna' is positioned to the right. A 'SPECTRUM ANALYZER' is connected to the Test Antenna.</p>															
Test Procedure:	<p>The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.</p> <p>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.</p> <p>The frequency range up to teeth harmonic of the fundamental frequency was investigated.</p> <p>Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a</p>															

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

3.4.2.Test Data

GMSK:

Test Mode: Low: 410.050MHz, Channel Spacing 6.25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
145.293	-95.02	V	0.24	31.35	-63.91	-20	-43.91
359.909	-89.17	V	0.26	31.34	-58.09	-20	-38.09
670.021	-93.11	V	0.42	31.24	-62.29	-20	-42.29
859.315	-94.79	V	0.58	30.71	-64.66	-20	-44.66
1263.638	-80.36	V	1.23	26.38	-55.21	-20	-35.21
3860.660	-75.99	V	1.68	25.47	-52.20	-20	-32.20
290.259	-93.55	H	0.43	31.24	-62.74	-20	-42.74
396.127	-93.60	H	0.45	30.68	-63.37	-20	-43.37
480.288	-95.00	H	0.64	30.85	-64.79	-20	-44.79
680.554	-96.07	H	0.79	31.12	-65.74	-20	-45.74
1369.712	-84.01	H	1.29	26.12	-59.18	-20	-39.18
3253.983	-78.70	H	1.62	25.41	-54.91	-20	-34.91

Test Mode: Mid: 440.000MHz, Channel Spacing 6.25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
151.424	-93.23	V	0.24	31.35	-62.12	-20	-42.12
363.844	-88.71	V	0.26	31.34	-57.63	-20	-37.63
666.666	-92.73	V	0.42	31.24	-61.91	-20	-41.91
862.829	-95.29	V	0.58	30.71	-65.16	-20	-45.16
1265.379	-80.14	V	1.23	26.38	-54.99	-20	-34.99
3855.538	-76.01	V	1.68	25.47	-52.22	-20	-32.22
287.257	-96.97	H	0.43	31.24	-66.16	-20	-46.16
406.032	-96.31	H	0.45	30.68	-66.08	-20	-46.08
481.218	-93.35	H	0.64	30.85	-63.14	-20	-43.14
674.611	-99.58	H	0.79	31.12	-69.25	-20	-49.25
1370.501	-81.46	H	1.29	26.12	-56.63	-20	-36.63
3255.556	-76.57	H	1.62	25.41	-52.78	-20	-32.78

Test Mode: High: 469.950MHz, Channel Spacing 6.25KHz

Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
155.563	-93.19	V	0.24	31.35	-62.08	-20	-42.08
353.265	-88.15	V	0.26	31.34	-57.07	-20	-37.07
663.823	-94.57	V	0.42	31.24	-63.75	-20	-43.75
869.013	-92.94	V	0.58	30.71	-62.81	-20	-42.81
1261.897	-78.11	V	1.23	26.38	-52.96	-20	-32.96
3861.381	-77.75	V	1.68	25.47	-53.96	-20	-33.96
283.285	-94.58	H	0.43	31.24	-63.77	-20	-43.77
394.290	-95.80	H	0.45	30.68	-65.57	-20	-45.57
482.323	-93.58	H	0.64	30.85	-63.37	-20	-43.37
673.754	-97.81	H	0.79	31.12	-67.48	-20	-47.48
1362.423	-84.28	H	1.29	26.12	-59.45	-20	-39.45
3261.566	-76.17	H	1.62	25.41	-52.38	-20	-32.38

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)
152.266	-93.12	V	0.24	31.35	-62.01	-20	-42.01
360.408	-91.19	V	0.26	31.34	-60.11	-20	-40.11
665.358	-92.61	V	0.42	31.24	-61.79	-20	-41.79
863.309	-94.87	V	0.58	30.71	-64.74	-20	-44.74
1259.736	-80.01	V	1.23	26.38	-54.86	-20	-34.86
3862.187	-78.28	V	1.68	25.47	-54.49	-20	-34.49
288.557	-93.69	H	0.43	31.24	-62.88	-20	-42.88
399.526	-95.93	H	0.45	30.68	-65.70	-20	-45.70
476.795	-95.94	H	0.64	30.85	-65.73	-20	-45.73
674.527	-97.51	H	0.79	31.12	-67.18	-20	-47.18
1363.863	-82.18	H	1.29	26.12	-57.35	-20	-37.35
3255.009	-77.62	H	1.62	25.41	-53.83	-20	-33.83

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)
146.962	-95.78	V	0.24	31.35	-64.67	-20	-44.67
362.146	-91.19	V	0.26	31.34	-60.11	-20	-40.11
677.489	-91.71	V	0.42	31.24	-60.89	-20	-40.89
860.156	-93.24	V	0.58	30.71	-63.11	-20	-43.11
1268.534	-77.34	V	1.23	26.38	-52.19	-20	-32.19
3857.070	-79.89	V	1.68	25.47	-56.10	-20	-36.10
286.581	-96.11	H	0.43	31.24	-65.30	-20	-45.30
408.166	-96.15	H	0.45	30.68	-65.92	-20	-45.92
476.756	-93.03	H	0.64	30.85	-62.82	-20	-42.82
669.228	-97.16	H	0.79	31.12	-66.83	-20	-46.83
1370.313	-83.90	H	1.29	26.12	-59.07	-20	-39.07
3261.831	-79.05	H	1.62	25.41	-55.26	-20	-35.26

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)
143.766	-93.86	V	0.24	31.35	-62.75	-20	-42.75
362.741	-89.65	V	0.26	31.34	-58.57	-20	-38.57
669.059	-93.69	V	0.42	31.24	-62.87	-20	-42.87
857.508	-93.88	V	0.58	30.71	-63.75	-20	-43.75
1259.978	-80.44	V	1.23	26.38	-55.29	-20	-35.29
3866.726	-76.50	V	1.68	25.47	-52.71	-20	-32.71
281.512	-94.11	H	0.43	31.24	-63.30	-20	-43.30
407.264	-96.44	H	0.45	30.68	-66.21	-20	-46.21
479.238	-94.51	H	0.64	30.85	-64.30	-20	-44.30
669.979	-97.21	H	0.79	31.12	-66.88	-20	-46.88
1372.822	-83.90	H	1.29	26.12	-59.07	-20	-39.07
3252.783	-76.10	H	1.62	25.41	-52.31	-20	-32.31

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)
140.680	-95.33	V	0.24	31.35	-64.22	-25	-39.22
365.104	-91.39	V	0.26	31.34	-60.31	-25	-35.31
672.366	-93.56	V	0.42	31.24	-62.74	-25	-37.74
865.622	-92.05	V	0.58	30.71	-61.92	-25	-36.92
1255.687	-77.20	V	1.23	26.38	-52.05	-25	-27.05
3851.937	-76.58	V	1.68	25.47	-52.79	-25	-27.79
293.367	-93.84	H	0.43	31.24	-63.03	-25	-38.03
406.494	-96.67	H	0.45	30.68	-66.44	-25	-41.44
481.324	-94.22	H	0.64	30.85	-64.01	-25	-39.01
678.676	-97.39	H	0.79	31.12	-67.06	-25	-42.06
1377.701	-81.21	H	1.29	26.12	-56.38	-25	-31.38
3256.624	-77.65	H	1.62	25.41	-53.86	-25	-28.86

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

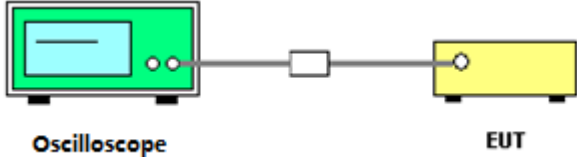
Frequency (MHz)	Reading level (dBm)	Antenna Polarization	Cable loss (dB)	Ant.Gain (dBi)	Emission level (dBm)	Limit (dBm)	Margin (dB)
146.458	-92.91	V	0.24	31.35	-61.80	-25	-36.80
367.138	-90.36	V	0.26	31.34	-59.28	-25	-34.28
667.310	-93.53	V	0.42	31.24	-62.71	-25	-37.71
867.877	-95.24	V	0.58	30.71	-65.11	-25	-40.11
1255.195	-79.93	V	1.23	26.38	-54.78	-25	-29.78
3851.773	-77.79	V	1.68	25.47	-54.00	-25	-29.00
282.095	-96.29	H	0.43	31.24	-65.48	-25	-40.48
394.203	-96.35	H	0.45	30.68	-66.12	-25	-41.12
475.297	-94.41	H	0.64	30.85	-64.20	-25	-39.20
689.350	-99.66	H	0.79	31.12	-69.33	-25	-44.33
1369.292	-81.20	H	1.29	26.12	-56.37	-25	-31.37
3261.018	-78.42	H	1.62	25.41	-54.63	-25	-29.63

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)
153.972	-95.24	V	0.24	31.35	-64.13	-25	-39.13
365.170	-89.14	V	0.26	31.34	-58.06	-25	-33.06
664.978	-92.91	V	0.42	31.24	-62.09	-25	-37.09
870.392	-91.82	V	0.58	30.71	-61.69	-25	-36.69
1254.050	-77.68	V	1.23	26.38	-52.53	-25	-27.53
3858.698	-77.17	V	1.68	25.47	-53.38	-25	-28.38
293.558	-92.91	H	0.43	31.24	-62.10	-25	-37.10
408.468	-96.34	H	0.45	30.68	-66.11	-25	-41.11
477.949	-96.07	H	0.64	30.85	-65.86	-25	-40.86
676.022	-96.66	H	0.79	31.12	-66.33	-25	-41.33
1372.973	-83.80	H	1.29	26.12	-58.97	-25	-33.97
3267.074	-78.88	H	1.62	25.41	-55.09	-25	-30.09

3.5. Transient Frequency Behavior

3.5.1. Test Specification

Test Requirement:	FCC Part 90.214																																														
Test Setup:	 <p style="text-align: center;">Oscilloscope EUT</p>																																														
Test Limit	<table border="1"> <thead> <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> </thead> <tbody> <tr> <td rowspan="3">25</td> <td>t₁</td> <td>±25</td> <td>5</td> <td>10</td> </tr> <tr> <td>t₂</td> <td>±12.5</td> <td>20</td> <td>25</td> </tr> <tr> <td>t₃</td> <td>±25</td> <td>5</td> <td>10</td> </tr> <tr> <td rowspan="3">12.5</td> <td>t₁</td> <td>±12.5</td> <td>5</td> <td>10</td> </tr> <tr> <td>t₂</td> <td>±6.25</td> <td>20</td> <td>25</td> </tr> <tr> <td>t₃</td> <td>±12.5</td> <td>5</td> <td>10</td> </tr> <tr> <td rowspan="3">6.25</td> <td>t₁</td> <td>±6.25</td> <td>5</td> <td>10</td> </tr> <tr> <td>t₂</td> <td>±3.125</td> <td>20</td> <td>25</td> </tr> <tr> <td>t₃</td> <td>±6.25</td> <td>5</td> <td>10</td> </tr> </tbody> </table>	Channel Bandwidth (kHz)	Time Intervals (Notes 1, 2)	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)		138-174 MHz	406.1-512 MHz	25	t ₁	±25	5	10	t ₂	±12.5	20	25	t ₃	±25	5	10	12.5	t ₁	±12.5	5	10	t ₂	±6.25	20	25	t ₃	±12.5	5	10	6.25	t ₁	±6.25	5	10	t ₂	±3.125	20	25	t ₃	±6.25	5	10
Channel Bandwidth (kHz)	Time Intervals (Notes 1, 2)				Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)																																									
		138-174 MHz	406.1-512 MHz																																												
25	t ₁	±25	5	10																																											
	t ₂	±12.5	20	25																																											
	t ₃	±25	5	10																																											
12.5	t ₁	±12.5	5	10																																											
	t ₂	±6.25	20	25																																											
	t ₃	±12.5	5	10																																											
6.25	t ₁	±6.25	5	10																																											
	t ₂	±3.125	20	25																																											
	t ₃	±6.25	5	10																																											
Test Procedure:	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.																																														
Test Result:	PASS																																														

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 GMSK.

3.6. Behavior Frequency Stability

3.6.1. Test Specification

Test Requirement:	FCC Part 90.213
Test Method:	ANSI C63.26
Test Setup:	<pre> graph TD Laptop[Laptop] --- EUT[Equipment Under Test] EUT --- ACDC[AC/DC Adapter] EUT --- Att[Attenuator(s)] Att --- MC[Mini-Circuit Combiner] MC --- RF[RF Detector] MC --- MA[Modulation Analyzer] RF --- HPO[Hewlett Packard Infinium Digitizing Oscilloscope] RFTS[RF Communication Test Set] --- MC </pre>
Test Procedure:	<p>Method of Measurement:</p> <p>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.</p>
Test Result:	PASS

3.6.2. Test data


Conclusion: PASS			
Mode	Voltage (V)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 6.25KHz Channel Spacing	3.6	5	0.0108
	3.5	9	0.0199
	3.4	5	0.0112
	3.3	8	0.0184
	3.2	4	0.0097
	3.1	2	0.0040
Limit	1.25ppm		
Middle Channel 12.5KHz Channel Spacing	3.6	2	0.0050
	3.5	6	0.0133
	3.4	6	0.0126
	3.3	8	0.0174
	3.2	1	0.0030
	3.1	9	0.0194
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	3.6	4	0.0096
	3.5	9	0.0197
	3.4	3	0.0078
	3.3	5	0.0107
	3.2	2	0.0043
	3.1	8	0.0179
Limit	5ppm		

Mode	Temperature (°C)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 6.25KHz Channel Spacing	-20	6	0.0139
	-10	4	0.0102
	0	4	0.0084
	10	5	0.0114
	20	1	0.0023
	30	8	0.0178
	40	7	0.0159
50	3	0.0064	
Limit	1.25ppm		
Middle Channel 12.5KHz Channel Spacing	-20	4	0.0082
	-10	7	0.0152
	0	8	0.0188
	10	4	0.0083
	20	4	0.0090
	30	4	0.0102
	40	6	0.0142
50	9	0.0193	
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	-20	4	0.0084
	-10	8	0.0182
	0	5	0.0113
	10	8	0.0181
	20	5	0.0118
	30	5	0.0124
	40	5	0.0115
50	4	0.0084	
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.

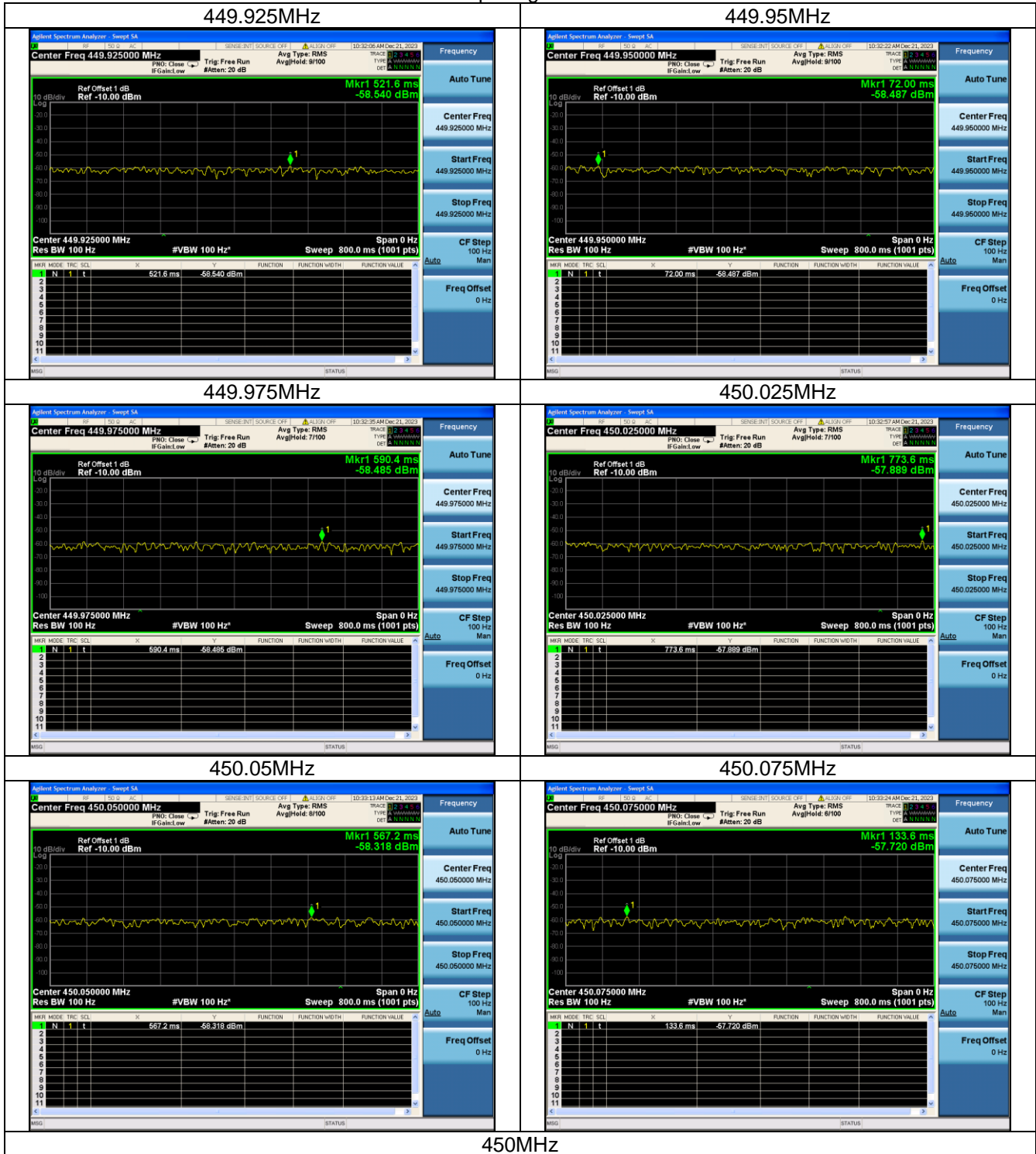
3.8. Adjacent channel power

Test Requirement:	FCC Part 90.221												
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>												
Test Limit:	<p>Maximum adjacent power levels for frequencies in the 450–470 MHz band, no need compliance with below -36dBm:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Frequency offset</th> <th style="text-align: center;">Maximum ACP (dBc) for devices 1 watt and less</th> <th style="text-align: center;">Maximum ACP (dBc) for devices above 1 watt</th> </tr> </thead> <tbody> <tr> <td>25 kHz</td> <td style="text-align: center;">- 55 dBc</td> <td style="text-align: center;">- 60 dBc</td> </tr> <tr> <td>50 kHz</td> <td style="text-align: center;">- 70 dBc</td> <td style="text-align: center;">- 70 dBc</td> </tr> <tr> <td>75 kHz</td> <td style="text-align: center;">- 70 dBc</td> <td style="text-align: center;">- 70 dBc</td> </tr> </tbody> </table>	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
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.												

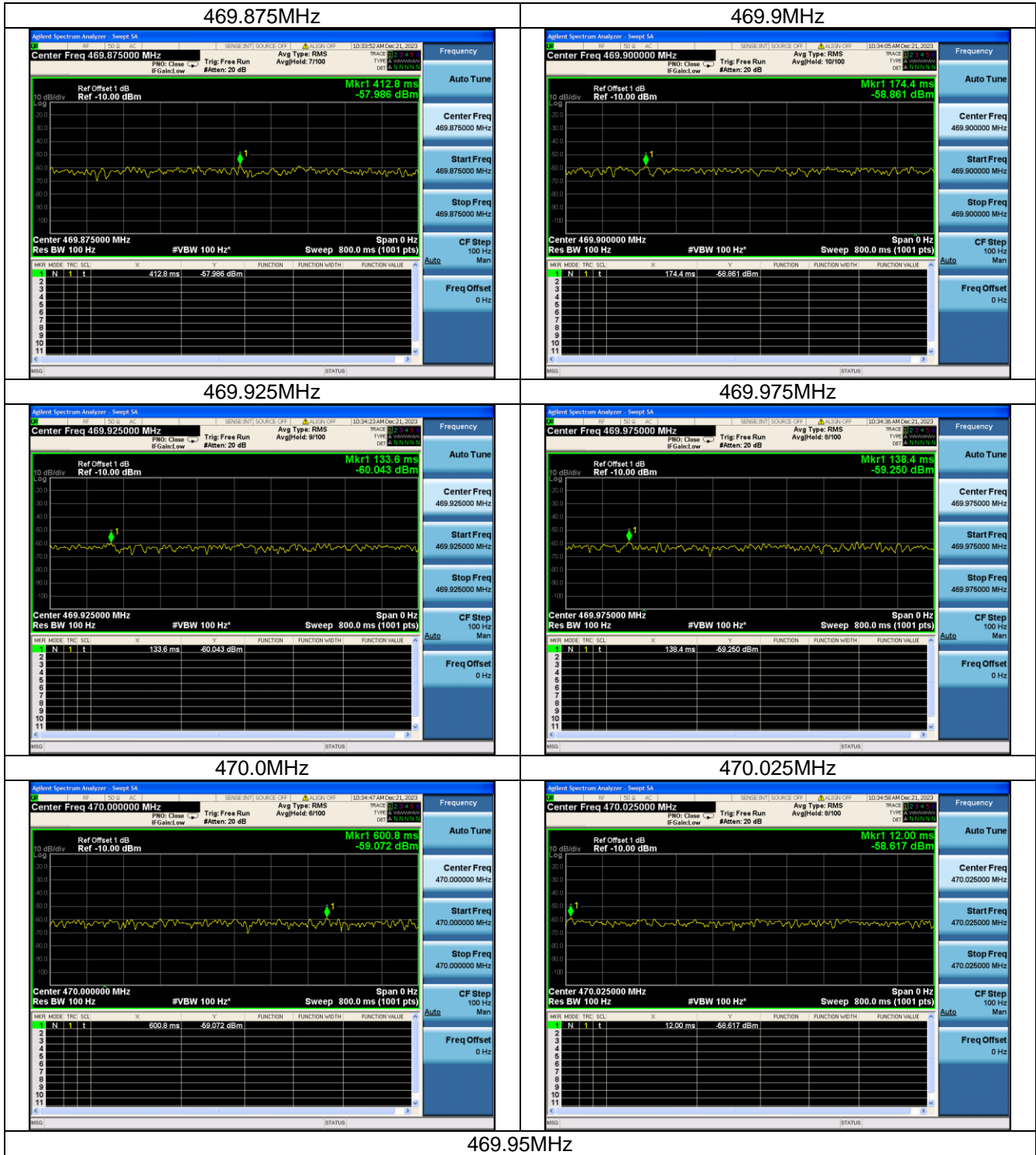
GMSK 25KHz spacing 450MHz-470MHz

Carrier frequency (MHz)	Test Frequency (MHz)	Test Value (dBm)	Limit (dBm)	Result
450.000	449.925	-58.540	30-70=-40	PASS
	449.95	-58.487	30-70=-40	PASS
	449.975	-58.485	30-55=-25	PASS
	450.025	-57.889	30-55=-25	PASS
	450.05	-58.318	30-70=-40	PASS
	450.075	-57.720	30-70=-40	PASS
469.950	469.875	-57.986	30-70=-40	PASS
	469.900	-58.861	30-70=-40	PASS
	469.925	-60.043	30-55=-25	PASS
	469.975	-59.250	30-55=-25	PASS
	470.000	-59.072	30-70=-40	PASS
	470.025	-58.617	30-70=-40	PASS

GMSK 25KHz spacing 450MHz-470MHz

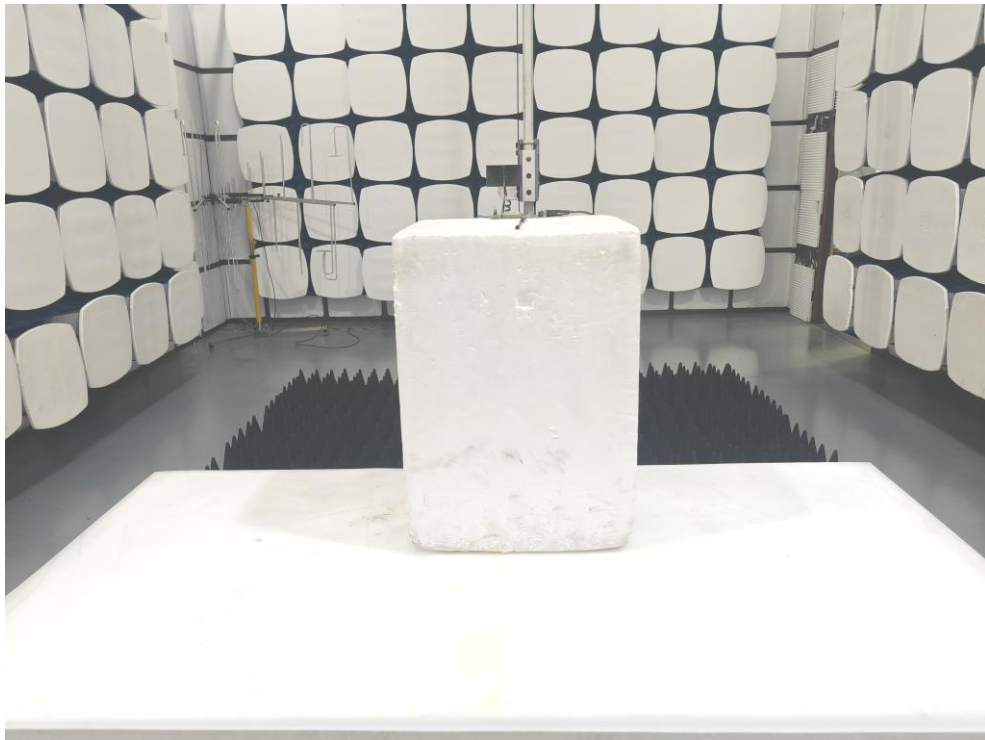
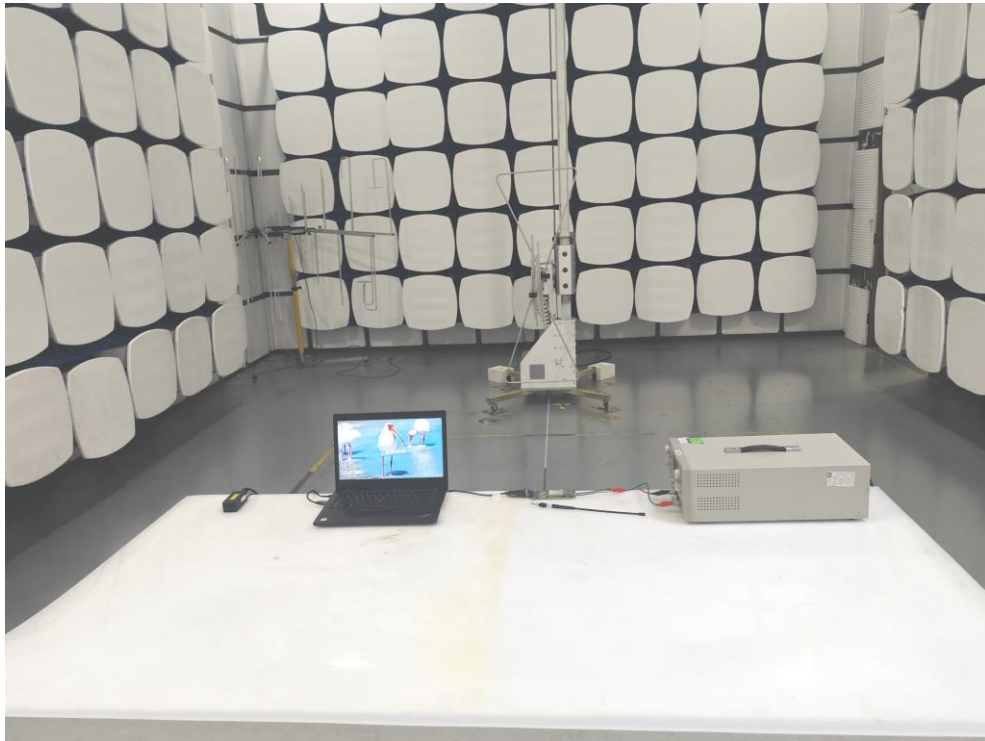


450MHz



4. Test Setup Photo

4.1. Photos of Radiated emission



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