



FCC TEST REPORT

FCC ID: 2A3MU-F8L

On Behalf of

Shanghai EFIX Geomatics Co.,Ltd.

Geodetic GNSS Receiver

Model No.: F8L

Prepared for : Shanghai EFIX Geomatics Co.,Ltd.
Address : Room 1137, Area D, 11th Floor, Building 1, No. 158, Shuanglian
Road, Qingpu District, Shanghai

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 : A2507136-C04-R04
Date of Receipt : July 9, 2025
Date of Test : July 9, 2025 – September 9, 2025
Date of Report : September 9, 2025
Version Number : V0
Result **Pass**

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TEST REPORT DECLARATION

Applicant : Shanghai EFIX Geomatics Co.,Ltd.
Address : Room 1137, Area D, 11th Floor, Building 1, No. 158, Shuanglian Road, Qingpu District, Shanghai
Manufacturer : Shanghai EFIX Geomatics Co.,Ltd.
Address : Room 1137, Area D, 11th Floor, Building 1, No. 158, Shuanglian Road, Qingpu District, Shanghai
EUT Description : Geodetic GNSS Receiver
(A) Model No. : F8L
(B) Trademark : 

Measurement Standard Used:

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

ANSI C63.26-2015

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 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).....: Yanniss Wen
Project Engineer



Approved by (name + signature).....: Jack Xu
Project Manager



Date of issue..... : September 9, 2025

Revision History

Revision	Issue Date	Revisions	Revised By
V0	September 9, 2025	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
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 : F8L
DIFF. : N/A
Test Voltage : DC 7.2V from battery and DC 5V form adapter

UHF

Operation frequency : 410MHz-470MHz
Conducted Power : 0.5W(26.99±1dBm), 1W(30.00±1dBm)
Channel spacing : 12.5KHz, 25KHz
Modulation type : GMSK
Antenna Type : Whip Antenna, Maximum Gain is -3.95dBi.
(Antenna information is provided by applicant.)
Software version : V1.0
Hardware version : V1.1.0
Intend use environment : Residential, commercial and light industrial environment

Note: All Conducted Power have been tested, and recorded the worst case 1W(30.00±1dBm) results in this report.

2.2. Accessories of Device (EUT)

Accessories	:	AC Adapter
Manufacturer	:	Yisheng Electronics Co., LTD
Model	:	EA1012AVRU-050
Ratings	:	AC Input: 100-240Vac, 1.0A, 50~60Hz DC Output: 5.0V=2.4A 12.0W

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	Notebook PC	Lenovo	ThinkPad L14	/	/

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

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

Description Operation Frequency

GMSK		
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	98kPa

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

SHENZHEN STS TEST SERVICES CO., LTD

101, Building B, Zhouke Science Park, No. 190 Chongqing Road, Zhancheng Shequ, Fuhai Sub-District,
Ban'an District, Shenzhen, Guangdong, China

FCC Registration No.: 625569; A2LA Certificate No.:4338.01.

Note: Except for the Transient Frequency Behavior projects that were completed in SHENZHEN STS TEST SERVICES CO., LTD, all other projects were completed in Shenzhen Alpha Product Testing Co., Ltd

2.8. Measurement Uncertainty

(95% confidence levels, k=2)

Item	Uncertainty
Uncertainty for Power point Conducted Emissions Test	1.63dB
Uncertainty for Radiation Emission test in 3m chamber (below 30MHz)	3.5dB
Uncertainty for Radiation Emission test in 3m chamber (30MHz to 1GHz)	3.74dB(Polarize: V)
	3.76dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (1GHz to 25GHz)	3.77dB(Polarize: V)
	3.80dB(Polarize: H)
Uncertainty for Radiation Emission test in 3m chamber (18GHz to 40GHz)	4.31 dB(Polarize: V)
	4.30 dB(Polarize: H)
Uncertainty for radio frequency	5.06×10^{-8} GHz
Uncertainty for conducted RF Power	0.40dB
Uncertainty for temperature	0.2°C
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.9. Test Equipment List

Shenzhen Alpha Product Testing Co., Ltd

Equipment	Manufacturer	Model No.	Firmware version	Serial No.	Last Cal.	Cal. Due day
9*6*6 anechoic chamber	CHENYU	9*6*6	/	N/A	2025.03.09	4Year
4*4*3 Shielded room	CHENYU	4*4*3	/	N/A	2025.03.09	4Year
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	2.3	102137	2025.08.04	1Year
Spectrum analyzer	Agilent	N9020A	A.14.16	MY499100060	2025.08.04	1Year
Test Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-102082-Wa	2025.08.04	1Year
Test Receiver	ROHDE&SCHWARZ	ESCI	4.42 SP1	101165	2025.08.04	1Year
Bilog Antenna	SCHWARZBECK	VULB 9168	/	VULB 9168#627	2023.08.28	2Year
Horn Antenna	SCHWARZBECK	BBHA 9120 D	/	2106	2023.08.19	2Year
Loop Antenna	SCHWARZBECK	FMZB 1519B	/	00128	2023.08.19	2Year
RF Cable	Resenberger	Cable 1	/	RE1	2025.08.04	1Year
RF Cable	Resenberger	Cable 2	/	RE2	2025.08.04	1Year
RF Cable	Resenberger	Cable 3	/	CE1	2025.08.04	1Year
Amplifier	HP	HP8347A	/	2834A00455	2025.08.04	1Year
Amplifier	Agilent	8449B	/	3008A02664	2025.08.04	1Year
L.I.S.N.#1	SCHWARZBECK	NSLK8126	/	8126-466	2025.08.04	1Year
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	/	101043	2025.08.04	1Year
Horn Antenna	SCHWARZBECK	BBHA 9170	/	00946	2023.08.19	2Year
Preamplifier	SKET	LNPA_1840-50	/	SK2018101801	2025.08.04	1 Year
Power Meter	Agilent	E4419B	/	GB40202122	2025.08.04	1 Year
Power Sensor	Agilent	E9300A	/	MY41496628	2025.08.04	1 Year
Power Sensor	Agilent	E9304A	/	MY41496815	2025.08.04	1 Year
Temp. & Humid. Chamber	Teelong	TL-HW408S	/	TL-20191205-01	2025.07.14	1 Year
Electronic Thermo-Hygrometer	S.H.Qixiang	HTC-1	/	N/A	2025.08.04	1 Year
Switching Mode Power Supply	JUNKE	JK12010S	/	20140927-6	2025.08.04	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

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RF Radiation Test Equipment						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
1	Temperature & Humidity	SW-108	SuWei	N/A	2025.02.24	2026.02.23
2	Wireless Communications Test Set	R&S	CMW 500	117239	2024.09.23	2025.09.22
3	Pre-Amplifier(0.1 M-3GHz)	EM	EM330	060665	2025.02.22	2026.02.21
4	Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018 G-45	SK2018080901	2024.09.23	2025.09.22
5	Positioning Controller	MF	MF-7802	MF-780208587	N/A	N/A
6	Signal Analyzer	R&S	FSV 40-N	101823	2024.09.23	2025.09.22
7	Switch Control Box	N/A	N/A	N/A	N/A	N/A
8	Filter Box	BALUN Technology	SU319E	BL-SZ1530051	N/A	N/A
9	Video Controller	SKET	FCS C-3	N/A	N/A	N/A
10	Bilog Antenna	TESEQ	CBL6111D	34678	2024.09.30	2025.09.29
11	Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2024.09.25	2025.09.24
12	Antenna Mast	MF	MFA-440H	N/A	N/A	N/A
13	Turn Table	MF	N/A	N/A	N/A	N/A
14	AC Power Source	APC	KDF-11010G	F214050035	N/A	N/A
15	DC Power Supply	Zhaoxin	RXN 605D	20R605D11010081	N/A	N/A
16	Test SW	EMC Test Software	15.2.0.339			

SHENZHEN STS TEST SERVICES CO., LTD

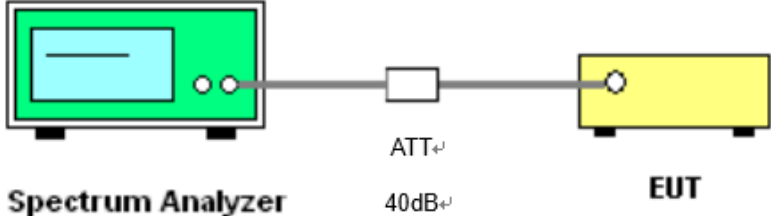
RF Connected Test Equipment						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
1	Temperature & Humidity	SW-108	SuWei	N/A	2025.02.24	2026.02.23
2	Universal Radio Communication Tester	R&S	CMU200	119907	2025.02.22	2026.02.21
3	MXG Vector Signal Generator	Keysight	N5182B	MY57301448	2024.09.23	2025.09.22
4	Signal Analyzer	Keysight	N9020A	MY52440124	2025.02.22	2026.02.21
5	Intercom comprehensive tester	HP	8920A	348A05658	2025.02.22	2026.02.21
6	Temperature& Humidity test chamber	Safety test	AG80L	171200018	2025.02.22	2026.02.21
7	Attenuator	HP	8494B	DC-18G	2025.02.25	2026.02.24
8	AC Power Source	APC	KDF-11010G	F214050035	N/A	N/A
9	DC Power Supply	Agilent	E3642A	MY40002025	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, ANSI C63.26-2015 Section 5.2
Limits:	Please refer section FCC Part 90.205
Test Setup:	 The diagram illustrates the test setup for measuring conducted transmitter power. It shows a green Spectrum Analyzer connected to a yellow Equipment Under Test (EUT) via a white attenuator (ATT) labeled 40dB. The Spectrum Analyzer is on the left, the ATT is in the middle, and the EUT is on the right. All three components are connected in a series line.
Test Procedure:	a) Connect the equipment as illustrated. b) Turn on the Spectrum Analyzer c) Record value
Test Result:	PASS

3.1.2. Test Results

GMSK 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	26.577	20.477	21.00	26.99±1	PASS
25	410.050	26.480	20.380	21.00	26.99±1	PASS
12.5	440.000	26.651	20.551	21.00	26.99±1	PASS
25	440.000	26.804	20.704	21.00	26.99±1	PASS
12.5	469.950	26.332	20.232	21.00	26.99±1	PASS
25	469.950	26.488	20.388	21.00	26.99±1	PASS

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

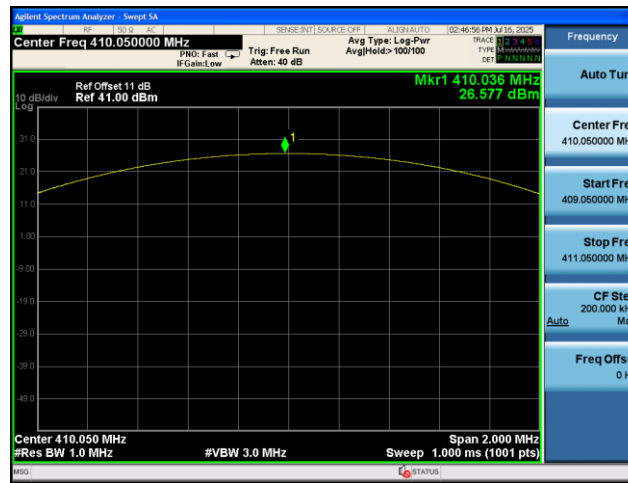
GMSK mode (1W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
12.5	410.050	29.204	23.104	34.00	30±1	PASS
25	410.050	29.424	23.324	34.00	30±1	PASS
12.5	440.000	29.262	23.162	34.00	30±1	PASS
25	440.000	29.122	23.022	34.00	30±1	PASS
12.5	469.950	29.653	23.553	34.00	30±1	PASS
25	469.950	29.413	23.313	34.00	30±1	PASS

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

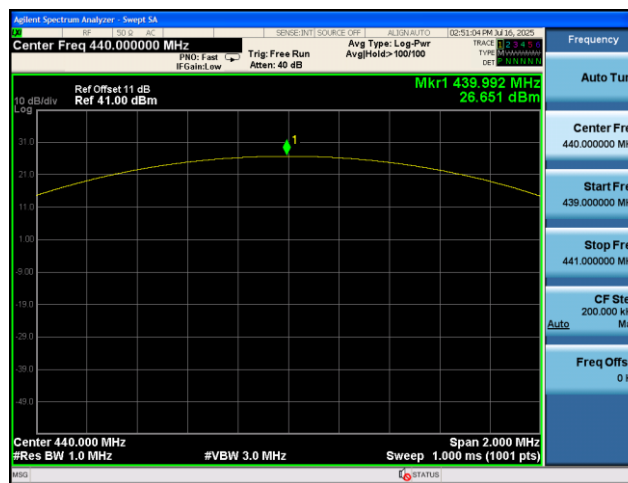
Test plots as follows:

GMSK 0.5W 12.5KHz Channel Spacing: Transmitter Power

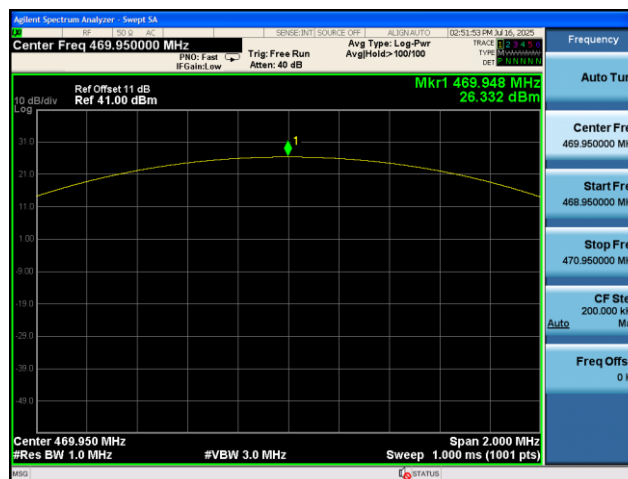
Low: 410.050MHz



Mid: 440.000MHz

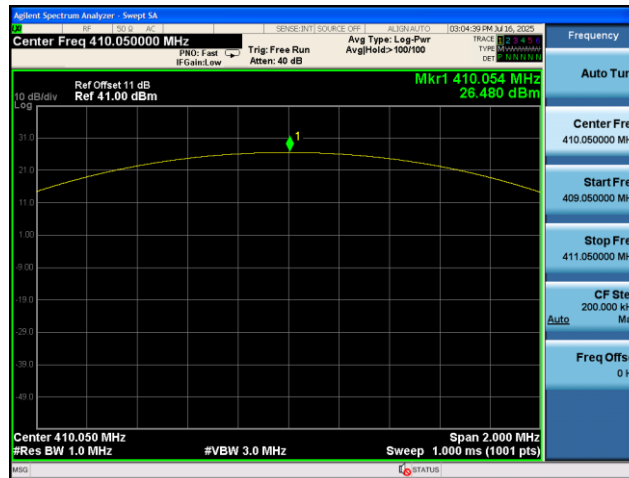


High: 470.00MHz

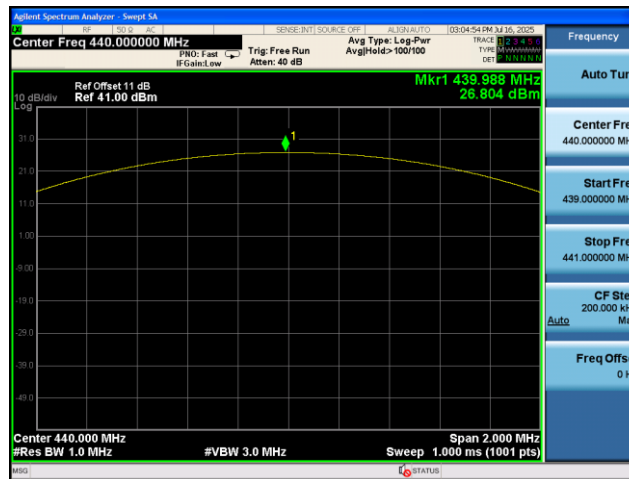


GMSK 0.5W 25KHz Channel Spacing: Transmitter Power

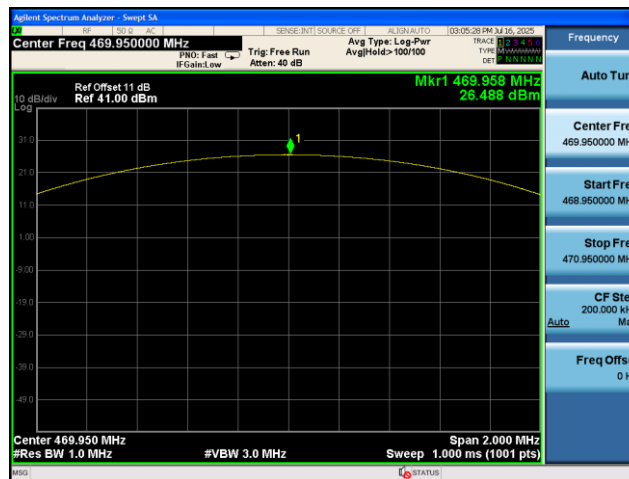
Low: 410.050MHz



Mid: 440.000MHz

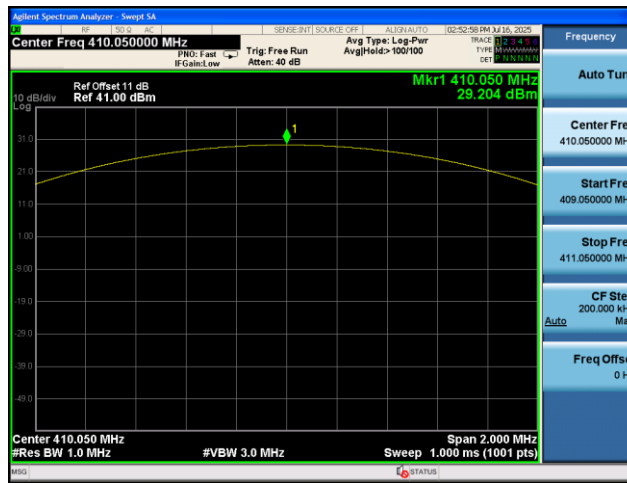


High: 470.00MHz

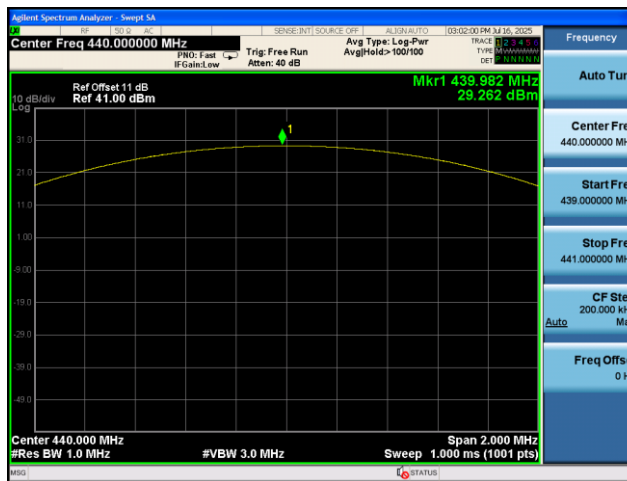


GMSK 1W 12.5KHz Channel Spacing: Transmitter Power

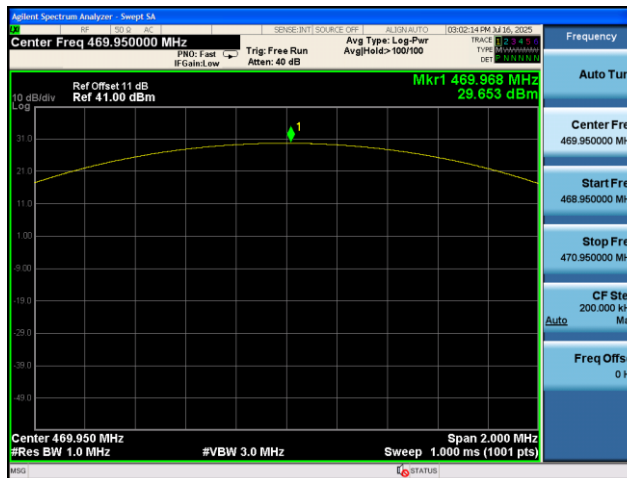
Low: 410.050MHz



Mid: 440.000MHz

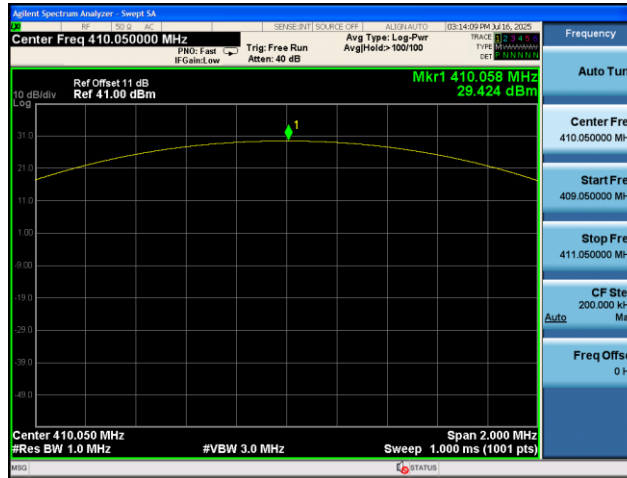


High: 470.00MHz

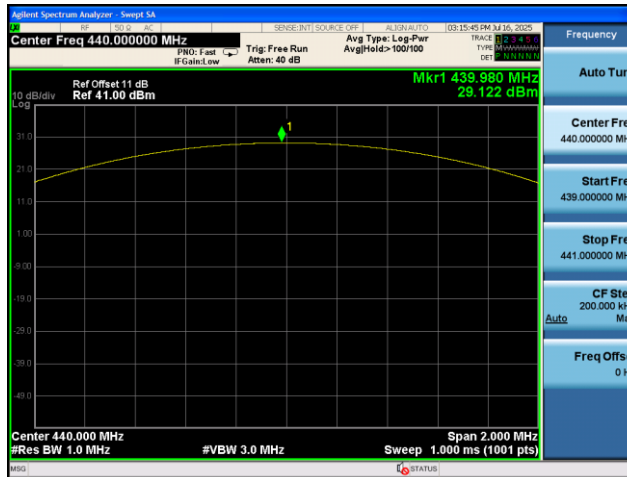


GMSK 1W 25KHz Channel Spacing: Transmitter Power

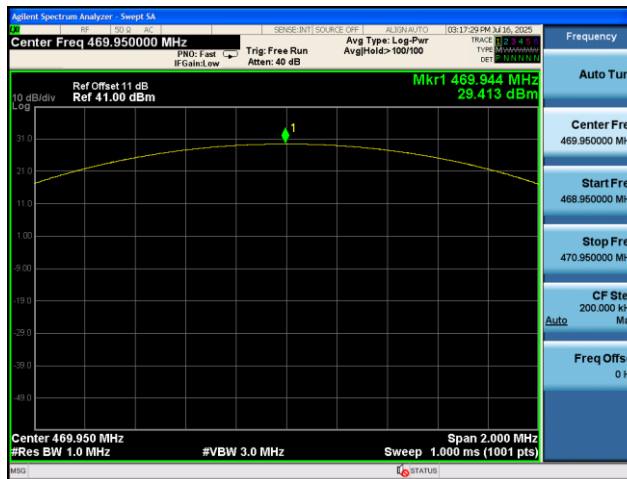
Low: 410.050MHz



Mid: 440.000MHz



High: 470.00MHz



3.2. Occupied Bandwidth and Emission Mask

3.2.1. Test Specification

Test Requirement:	FCC Part 90.209, FCC Part 90.210
Test Method:	FCC part 2.1049, ANSI C63.26-2015 Section 5.4
Test Setup:	 The diagram illustrates the test setup. On the left is a green box representing the Spectrum Analyzer, with a blue screen and two small circles representing ports. A grey cable connects this to a small white box, which then connects to a yellow box on the right representing the EUT (Equipment Under Test). Below the green box is the label 'Spectrum Analyzer' and below the yellow box is the label 'EUT'.
Test Procedure:	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.
Test Result:	PASS

3.2.2.Test Data

Occupied Bandwidth:

GMSK mode (0.5W) 12.5KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	6.472	5.938	11.25	PASS
Mid	440.000	6.525	5.953	11.25	PASS
High	469.950	6.597	5.925	11.25	PASS

GMSK mode (0.5W) 25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	12.07	11.185	20	PASS
Mid	440.000	11.95	11.240	20	PASS
High	469.950	12.07	11.157	20	PASS

GMSK mode (1W) 12.5KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	6.595	5.925	11.25	PASS
Mid	440.000	6.505	5.945	11.25	PASS
High	469.950	6.425	5.946	11.25	PASS

GMSK mode (1W) 25KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	12.00	11.214	20	PASS
Mid	440.000	11.94	11.167	20	PASS
High	469.950	12.07	11.199	20	PASS

Emission Mask:

GMSK mode (1W) 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 mode (1W) 25KHz Channel Spacing:				
Channel	Frequency (MHz)	Applicable Mask	RBW	Result
Low	410.050	C	300Hz	PASS
Mid	440.000	C	300Hz	PASS
High	469.950	C	300Hz	PASS

Test plots as follows:

GMSK mode (0.5W) 12.5KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz



Mid: 440.000MHz

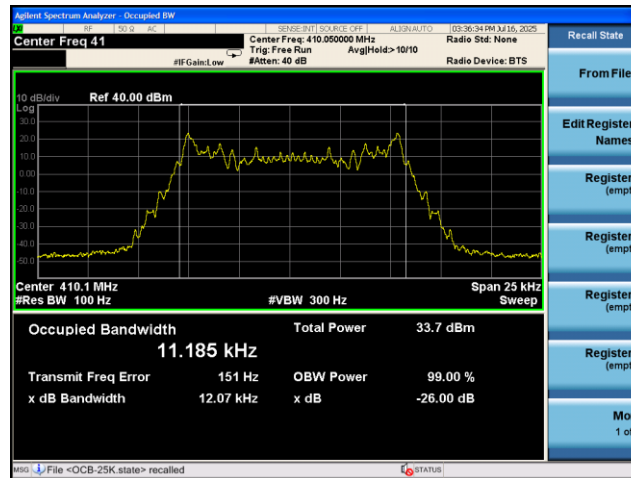


High: 470.00MHz

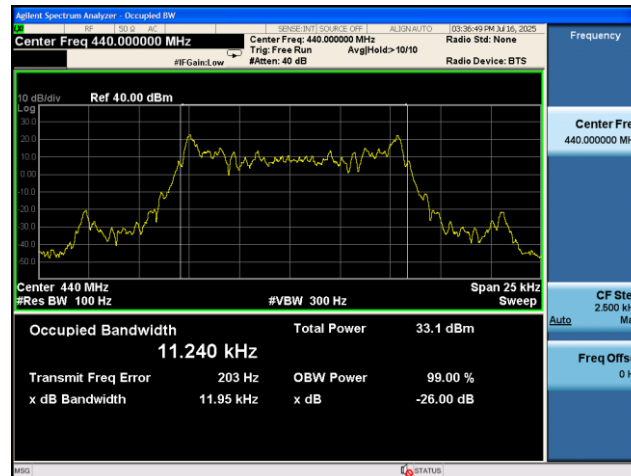


GMSK mode (0.5W) 25KHz Channel Spacing: Occupied Bandwidth

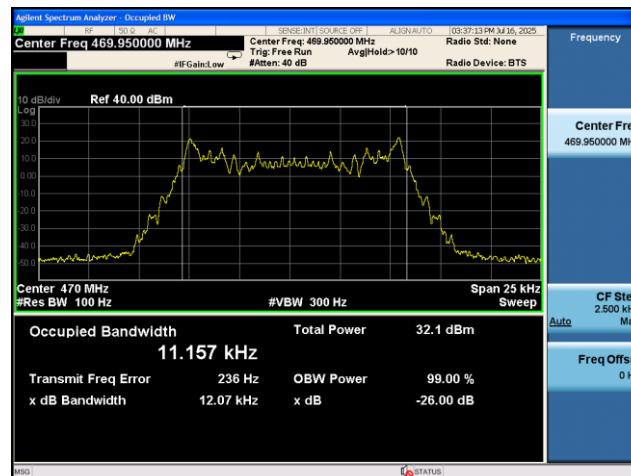
Low: 410.050MHz



Mid: 440.000MHz



High: 469.850MHz

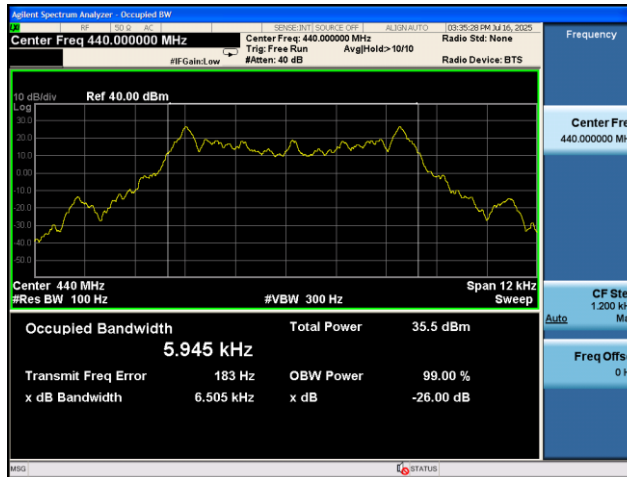


GMSK mode (1W) 12.5KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz



Mid: 440.000MHz

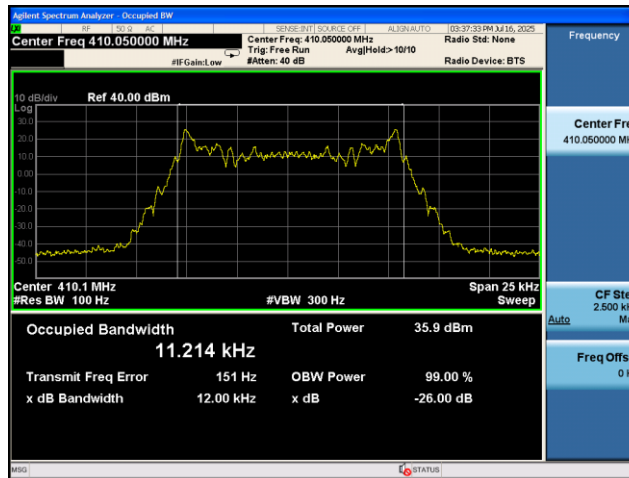


High: 470.00MHz

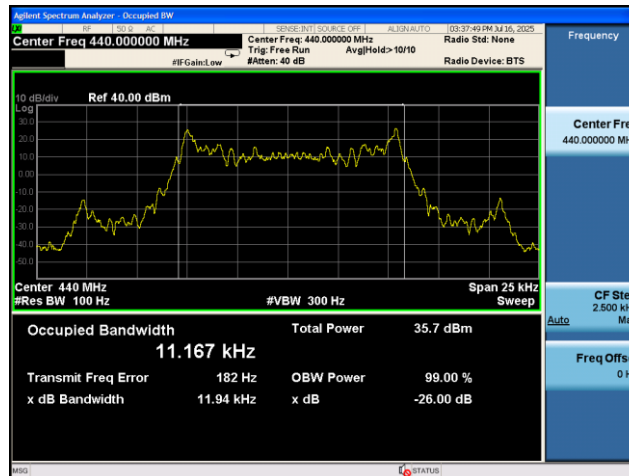


GMSK mode (1W) 25KHz Channel Spacing: Occupied Bandwidth

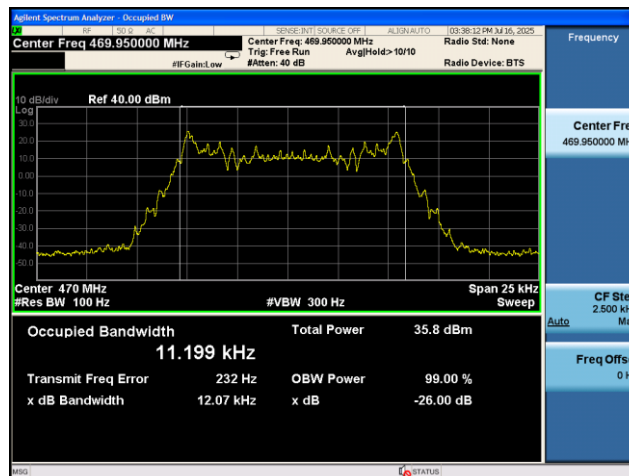
Low: 410.050MHz



Mid: 440.000MHz

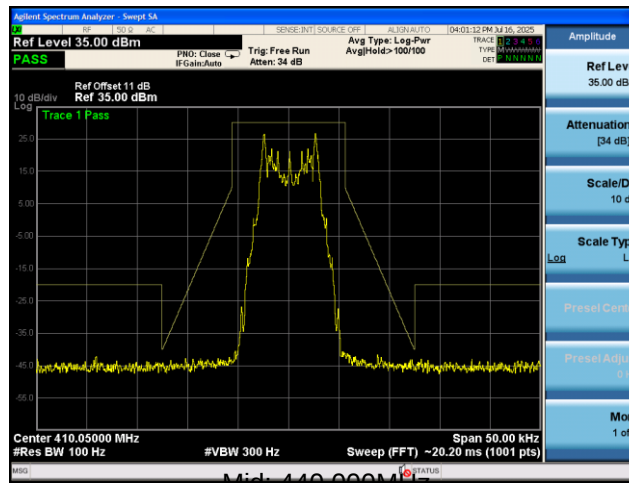


High: 469.850MHz

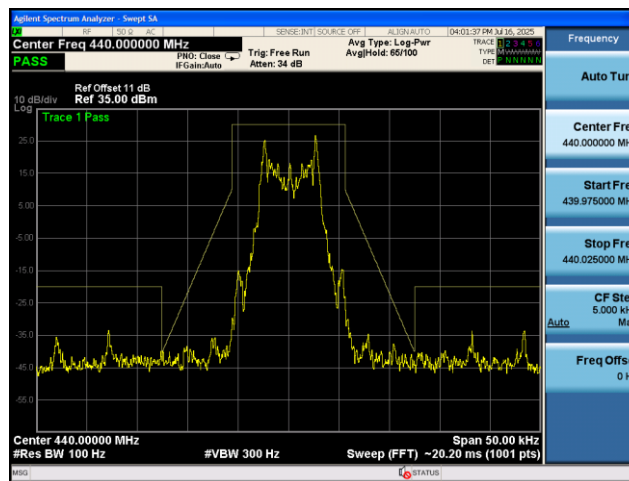


GMSK mode (1W) 12.5KHz Channel Spacing: Emission Mask

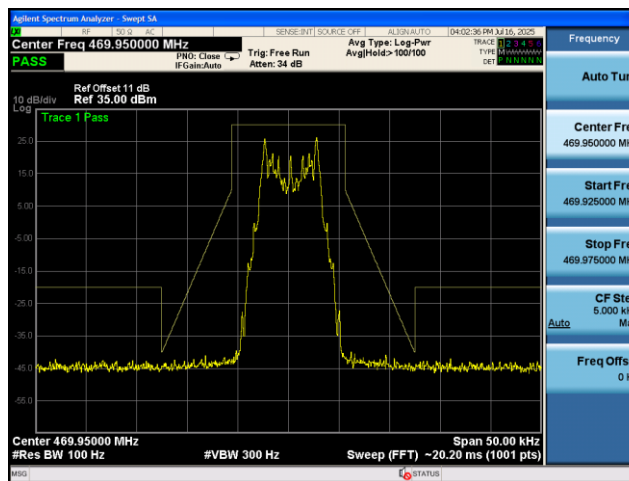
Low: 410.050MHz



Mid: 440.000MHz

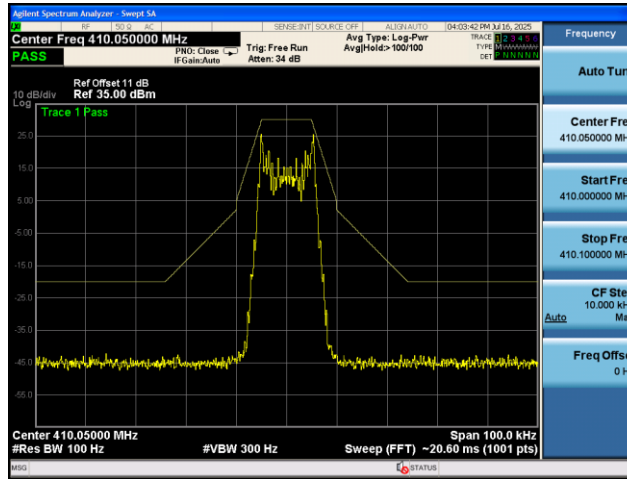


High: 469.950MHz

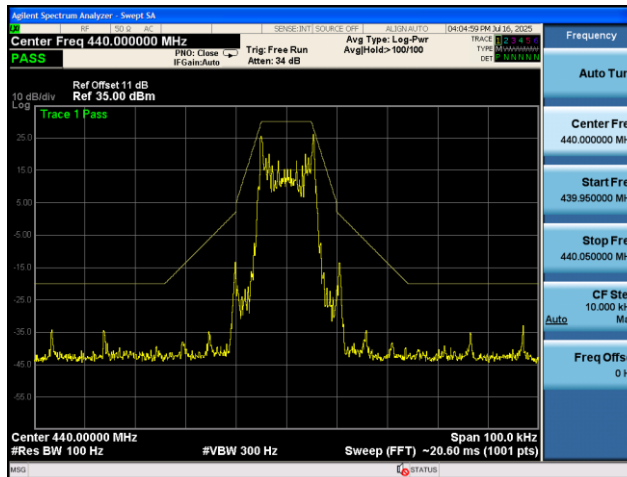


GMSK mode (1W) 25KHz Channel Spacing: Emission Mask

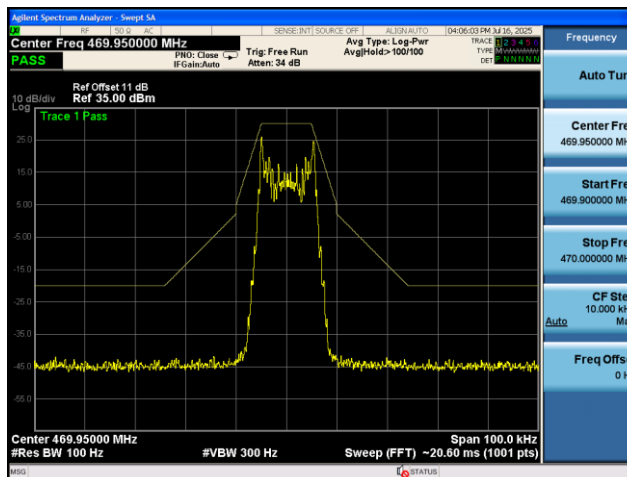
Low: 410.050MHz



Mid: 440.000MHz

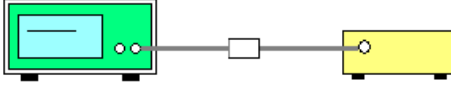


High: 469.950MHz



3.3. Spurious Emissions(conducted)

3.3.1. Test Specification

Test Requirement:	FCC Part 90.210
Test Method:	FCC part 2.1051, ANSI C63.26-2015 Section 5.7
Test Setup:	 Spectrum Analyzer EUT
Test Limit:	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 (f_d in kHz) of more than 4.6 kHz at least: $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation. Calculation: Limit (dBm) = $EL - 55 - 10 \log_{10} (TP)$ Notes: EL is the emission level of the Output Power expressed in dBm, For 12.5 bandwidth: 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. $50 + 10 \log (P \text{ watts}) = 50 + 10 \log (2) = 50 \text{ dB}$ Note: In general, the worst case attenuation requirement shown above was applied. Calculation: Limit (dBm) = $EL - 50 - 10 \log_{10} (TP)$ 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) = $30 - 50 - 10 \log (2) = -20 \text{ dBm}$ For 25 kHz bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 62.5 kHz at least: $43 + 10 \log (P \text{ watts}) = 43 + 10 \log (2) = 43 \text{ dB}$ Note: In general, the worst case attenuation requirement shown above was applied. Calculation: Limit (dBm) = $EL - 43 - 10 \log_{10} (TP)$ In this application, the EL is 30 dBm for High rated power. Limit (dBm) = $30 - 43 - 10 \log (2) = -13 \text{ dBm}$ 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 (f_d 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.

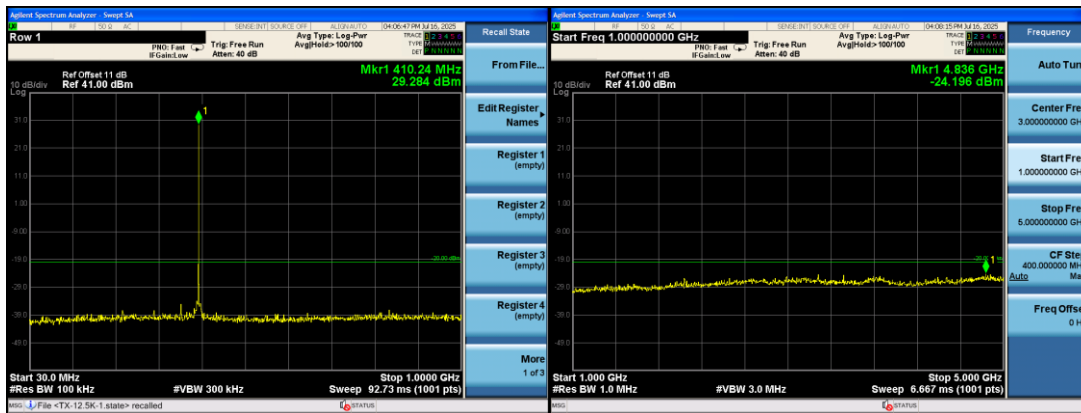
Test Result:**PASS**

3.3.2. Test Data

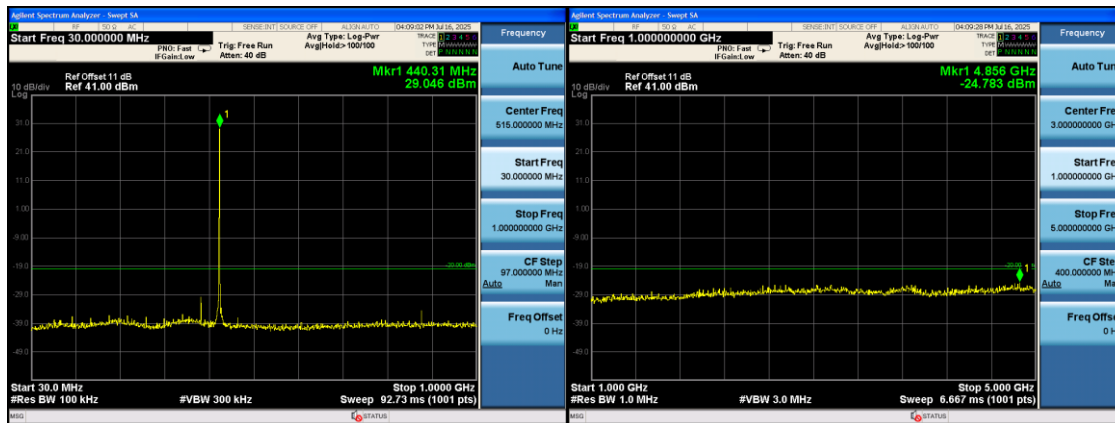
Test plots as follows:

GMSK 12.5KHz Channel Spacing:

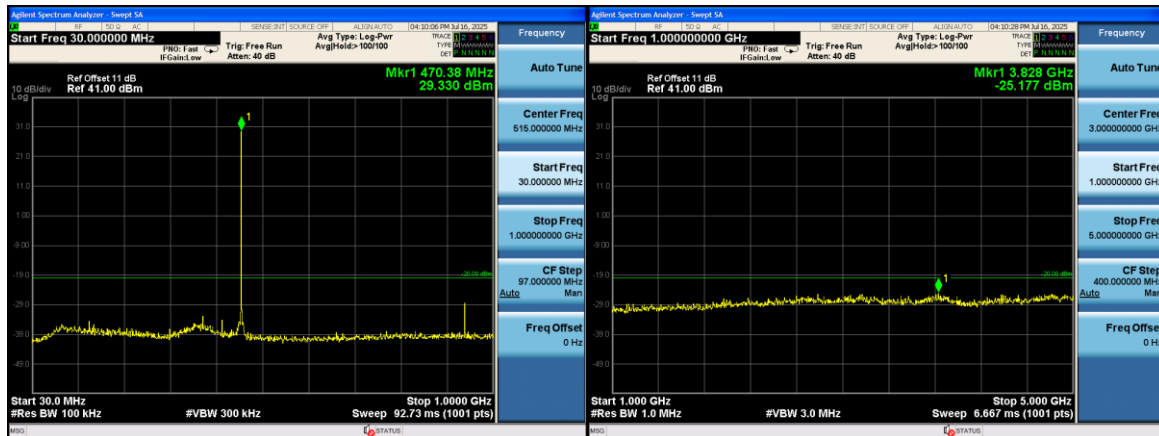
Low: 410.050MHz



Mid: 440.000MHz

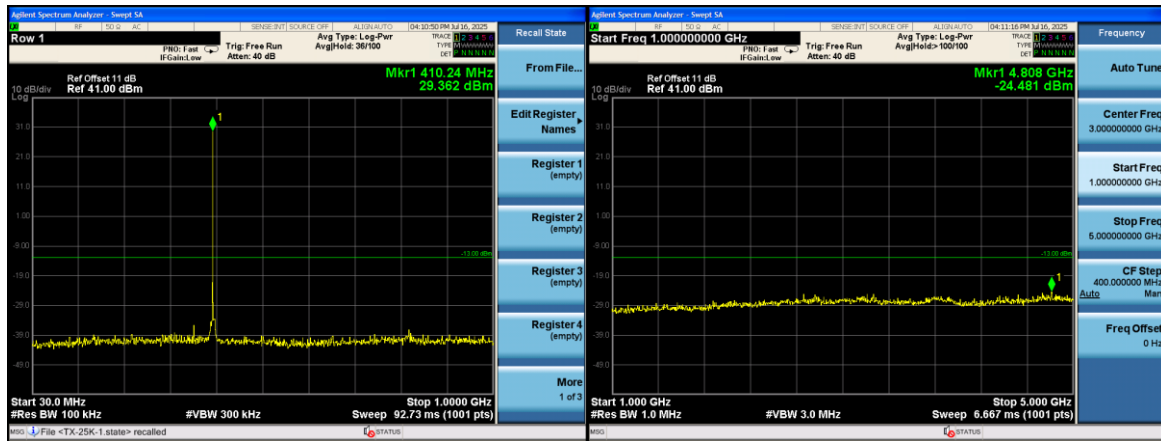


High: 469.950MHz

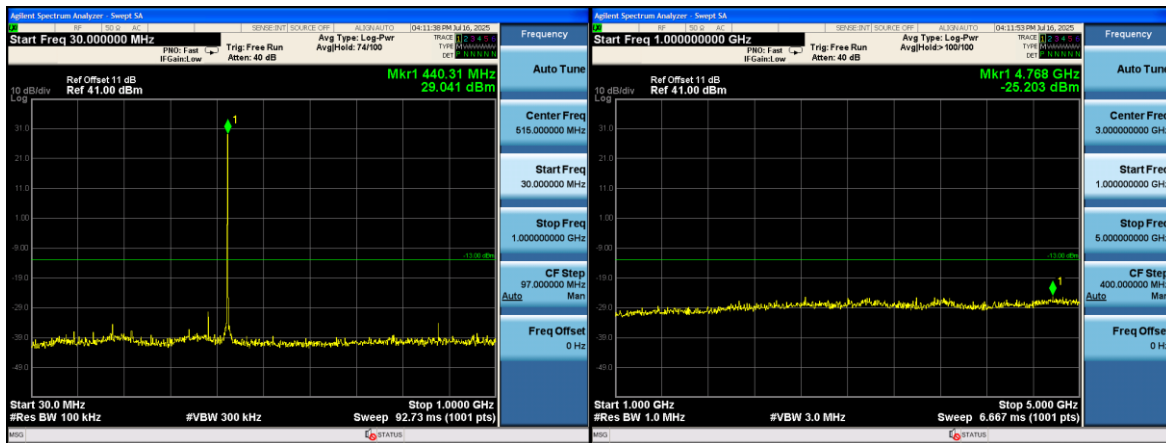


GMSK 25KHz Channel Spacing:

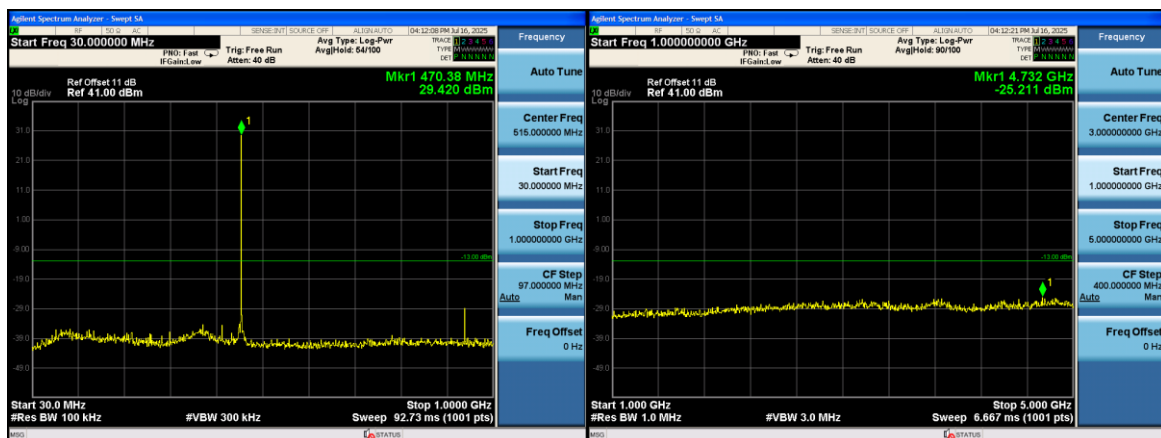
Low: 410.050MHz



Mid: 440.000MHz

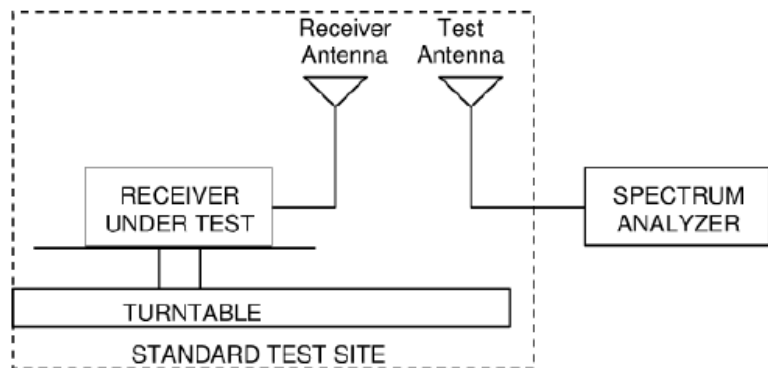


High: 469.950MHz



3.4. Radiated Spurious Emission

3.4.1. Test Specification

Test Requirement:	FCC Part 90.210															
Test Method:	FCC part 2.1051, ANSI C63.26-2015 Section 5.5															
Measurement Distance:	3 m															
Antenna Polarization:	Horizontal & Vertical															
Operation mode:	Refer to item 4.1															
Receiver Setup:	<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>	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:	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. 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. For equipment using 6.25 kHz channel spacing, On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.															
Test setup:	 The diagram illustrates the test setup within a 'STANDARD TEST SITE'. A 'RECEIVER UNDER TEST' is positioned on a 'TURNTABLE'. A 'Receiver Antenna' is connected to the receiver, and a 'Test Antenna' is connected to a 'SPECTRUM ANALYZER'. The entire setup is enclosed in a dashed box representing the test site.															
Test Procedure:	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 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
Test results:	PASS

3.4.2.Test Data

GMSK:

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)
153.028	-88.690	V	0.24	31.35	-57.580	-20	-37.580
360.196	-92.145	V	0.26	31.34	-61.065	-20	-41.065
673.701	-98.559	V	0.42	31.24	-67.739	-20	-47.739
818.672	-97.444	V	0.58	30.71	-67.314	-20	-47.314
1228.436	-81.426	V	1.23	26.38	-56.276	-20	-36.276
3863.880	-82.356	V	1.68	25.47	-58.566	-20	-38.566
283.939	-92.060	H	0.43	31.24	-61.250	-20	-41.250
399.324	-91.196	H	0.45	30.68	-60.966	-20	-40.966
677.365	-96.434	H	0.64	30.85	-66.224	-20	-46.224
821.598	-95.753	H	0.79	31.12	-65.423	-20	-45.423
1228.151	-85.860	H	1.29	26.12	-61.030	-20	-41.030
3258.027	-80.500	H	1.62	25.41	-56.710	-20	-36.710

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)
156.217	-97.495	V	0.24	31.35	-66.385	-20	-46.385
362.047	-91.004	V	0.26	31.34	-59.924	-20	-39.924
668.685	-100.734	V	0.42	31.24	-69.914	-20	-49.914
882.700	-98.488	V	0.58	30.71	-68.358	-20	-48.358
1321.249	-83.081	V	1.23	26.38	-57.931	-20	-37.931
3857.918	-77.884	V	1.68	25.47	-54.094	-20	-34.094
291.227	-98.904	H	0.43	31.24	-68.094	-20	-48.094
396.808	-93.466	H	0.45	30.68	-63.236	-20	-43.236
682.673	-98.196	H	0.64	30.85	-67.986	-20	-47.986
882.751	-99.296	H	0.79	31.12	-68.966	-20	-48.966
1322.115	-80.892	H	1.29	26.12	-56.062	-20	-36.062
3262.627	-84.171	H	1.62	25.41	-60.381	-20	-40.381

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)
150.609	-95.454	V	0.24	31.35	-64.344	-20	-44.344
366.385	-93.845	V	0.26	31.34	-62.765	-20	-42.765
673.483	-98.054	V	0.42	31.24	-67.234	-20	-47.234
940.561	-97.857	V	0.58	30.71	-67.727	-20	-47.727
1409.719	-85.338	V	1.23	26.38	-60.188	-20	-40.188
3860.440	-81.185	V	1.68	25.47	-57.395	-20	-37.395
292.315	-98.053	H	0.43	31.24	-67.243	-20	-47.243
404.439	-93.793	H	0.45	30.68	-63.563	-20	-43.563
679.646	-94.884	H	0.64	30.85	-64.674	-20	-44.674
942.838	-98.943	H	0.79	31.12	-68.613	-20	-48.613
1409.654	-84.963	H	1.29	26.12	-60.133	-20	-40.133
3264.487	-82.300	H	1.62	25.41	-58.510	-20	-38.510

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)
151.085	-94.775	V	0.24	31.35	-63.665	-13	-50.665
358.278	-91.714	V	0.26	31.34	-60.634	-13	-47.634
671.734	-90.779	V	0.42	31.24	-59.959	-13	-46.959
817.359	-95.915	V	0.58	30.71	-65.785	-13	-52.785
1229.993	-80.924	V	1.23	26.38	-55.774	-13	-42.774
3856.136	-79.409	V	1.68	25.47	-55.619	-13	-42.619
286.847	-91.135	H	0.43	31.24	-60.325	-13	-47.325
400.679	-96.856	H	0.45	30.68	-66.626	-13	-53.626
681.598	-94.588	H	0.64	30.85	-64.378	-13	-51.378
817.895	-94.833	H	0.79	31.12	-64.503	-13	-51.503
1231.205	-84.922	H	1.29	26.12	-60.092	-13	-47.092
3255.987	-79.864	H	1.62	25.41	-56.074	-13	-43.074

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)
159.828	-94.945	V	0.24	31.35	-63.835	-13	-50.835
362.281	-91.760	V	0.26	31.34	-60.680	-13	-47.680
671.488	-94.787	V	0.42	31.24	-63.967	-13	-50.967
881.750	-96.795	V	0.58	30.71	-66.665	-13	-53.665
1322.138	-83.392	V	1.23	26.38	-58.242	-13	-45.242
3859.239	-80.077	V	1.68	25.47	-56.287	-13	-43.287
287.842	-97.655	H	0.43	31.24	-66.845	-13	-53.845
403.275	-99.342	H	0.45	30.68	-69.112	-13	-56.112
683.857	-98.751	H	0.64	30.85	-68.541	-13	-55.541
882.140	-93.938	H	0.79	31.12	-63.608	-13	-50.608
1322.444	-83.926	H	1.29	26.12	-59.096	-13	-46.096
3260.537	-79.169	H	1.62	25.41	-55.379	-13	-42.260

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)
153.174	-97.733	V	0.24	31.35	-66.623	-13	-53.623
363.136	-95.779	V	0.26	31.34	-64.699	-13	-51.699
670.278	-98.128	V	0.42	31.24	-67.308	-13	-54.308
938.539	-95.512	V	0.58	30.71	-65.382	-13	-52.382
1407.845	-80.881	V	1.23	26.38	-55.731	-13	-42.731
3855.529	-81.329	V	1.68	25.47	-57.539	-13	-44.539
291.192	-99.746	H	0.43	31.24	-68.936	-13	-55.936
398.689	-93.836	H	0.45	30.68	-63.606	-13	-50.606
676.322	-97.547	H	0.64	30.85	-67.337	-13	-54.337
936.045	-99.197	H	0.79	31.12	-68.867	-13	-55.867
1407.080	-80.552	H	1.29	26.12	-55.722	-13	-42.722
3262.465	-75.428	H	1.62	25.41	-51.638	-13	-38.638

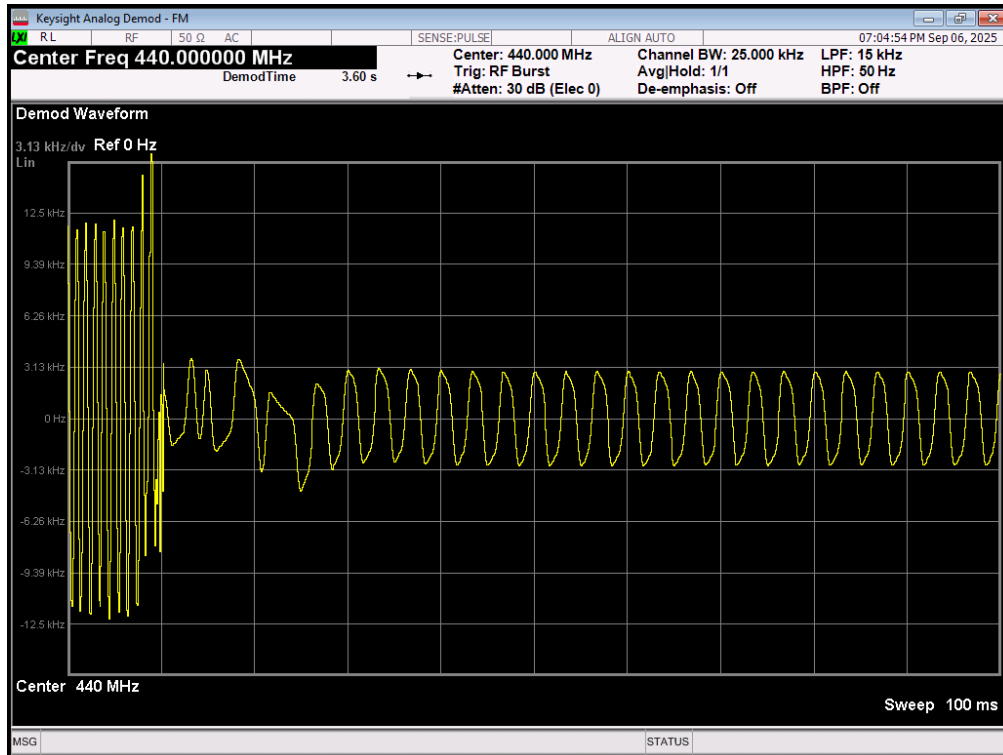
3.5. Transient Frequency Behavior

3.5.1. Test Specification

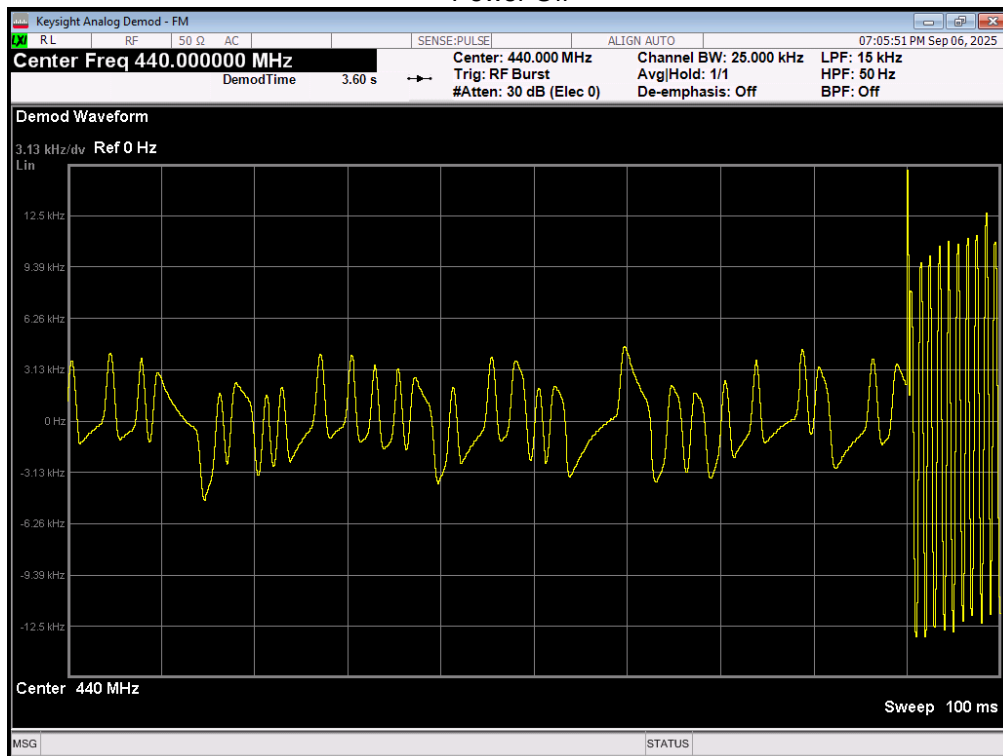
Test Requirement:	FCC Part 90.214				
Test Setup:	 Oscilloscope EUT				
Test Limit	Channel Bandwidth (kHz)	Time Intervals (Notes 1, 2)	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
				138-174 MHz	406.1-512 MHz
25	t ₁		±25	5	10
		t ₂	±12.5	20	25
		t ₃	±25	5	10
	12.5	t ₁	±12.5	5	10
		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

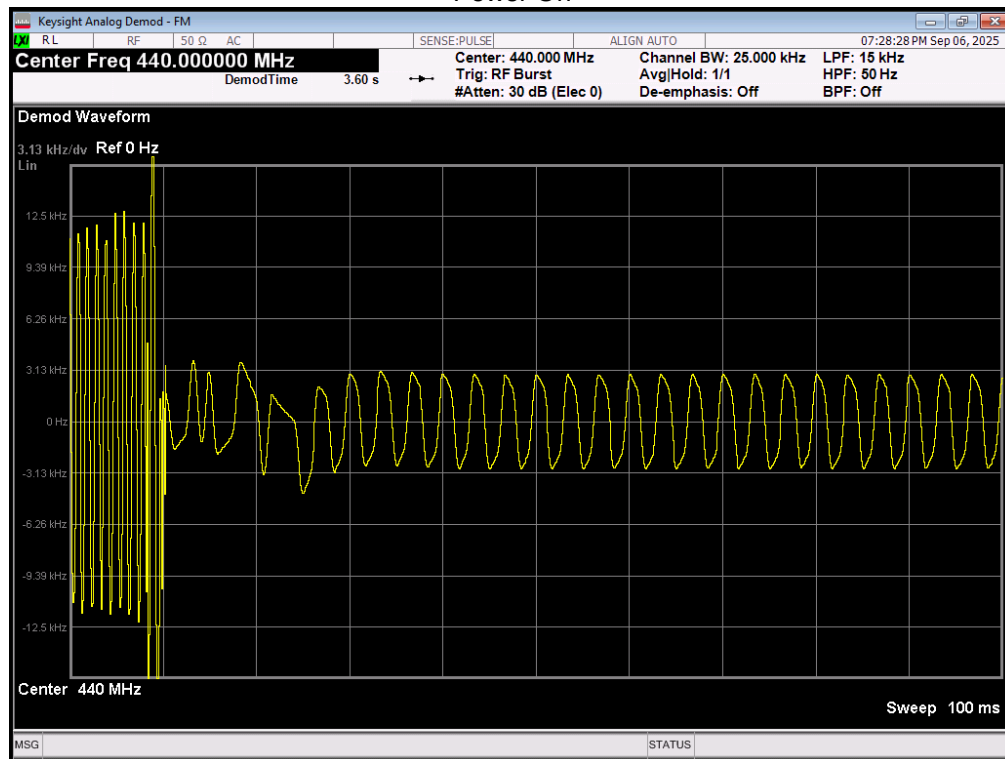
Test Plots for channel spacing 12.5KHz, EUT power setting: Maximum.
Power On



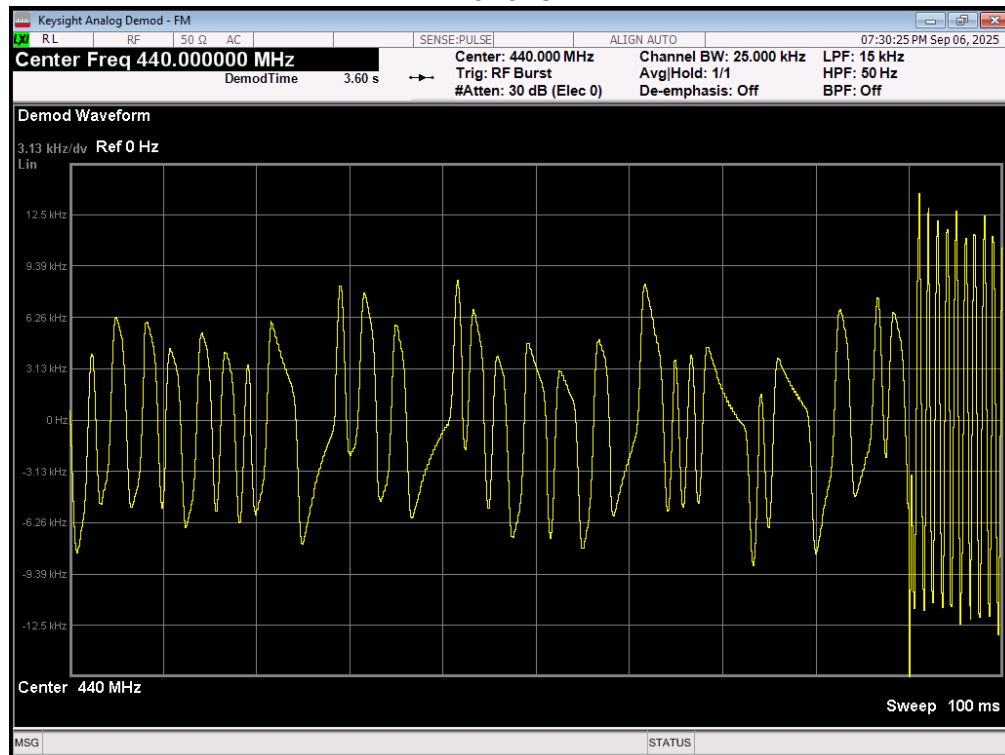
Power Off



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



Power Off



3.6. Behavior Frequency Stability

3.6.1. Test Specification

Test Requirement:	FCC Part 90.213
Test Method:	FCC part 2.1055, ANSI C63.26-2015 Section 5.6
Test Setup:	<pre> graph LR Laptop[Laptop] --- EUT[Equipment Under Test] EUT --- ACDC[AC/DC Adapter] EUT --- Att[Attenuator(s)] Att --- MC[Mini-Circuit Combiner] RFTS[RF Communication Test Set] --- MC MC --- RFDR[RF Detector] RFDR --- MA[Modulation Analyzer] MA --- HPO[Hewlett Packard Infinium Digitizing Oscilloscope] </pre>
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	5	13.48	0.031
	6	-8.97	-0.020
	7	-1.89	-0.004
	8	4.59	0.010
	9	2.67	0.006
	10	-5.90	-0.013
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	5	-3.08	-0.007
	6	-7.61	-0.017
	7	25.74	0.058
	8	-4.84	-0.011
	9	23.59	0.054
	10	6.51	0.015
Limit	5ppm		

Mode	Temperature (°C)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 12.5KHz Channel Spacing	-30	3.34	0.008
	-20	19.37	0.044
	-10	5.98	0.014
	0	0.20	0.000
	10	12.39	0.028
	20	15.82	0.036
	30	9.77	0.022
	40	19.60	0.045
	50	27.80	0.063
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	-30	-8.51	-0.019
	-20	20.96	0.048
	-10	7.77	0.018
	0	-3.43	-0.008
	10	24.67	0.056
	20	-9.07	-0.021
	30	10.48	0.024
	40	21.69	0.049
	50	26.49	0.060
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.

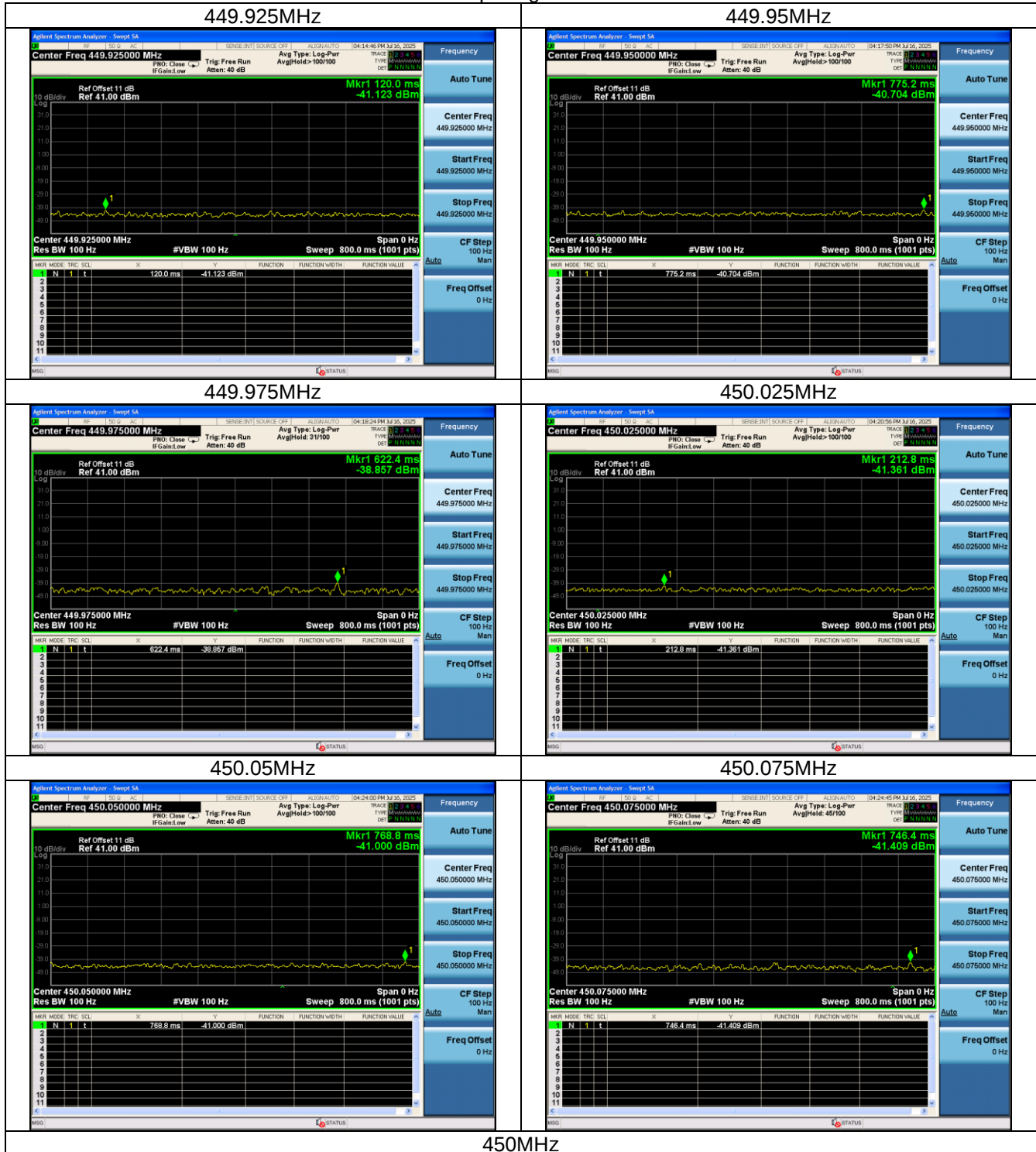
3.8. Adjacent Channel Power

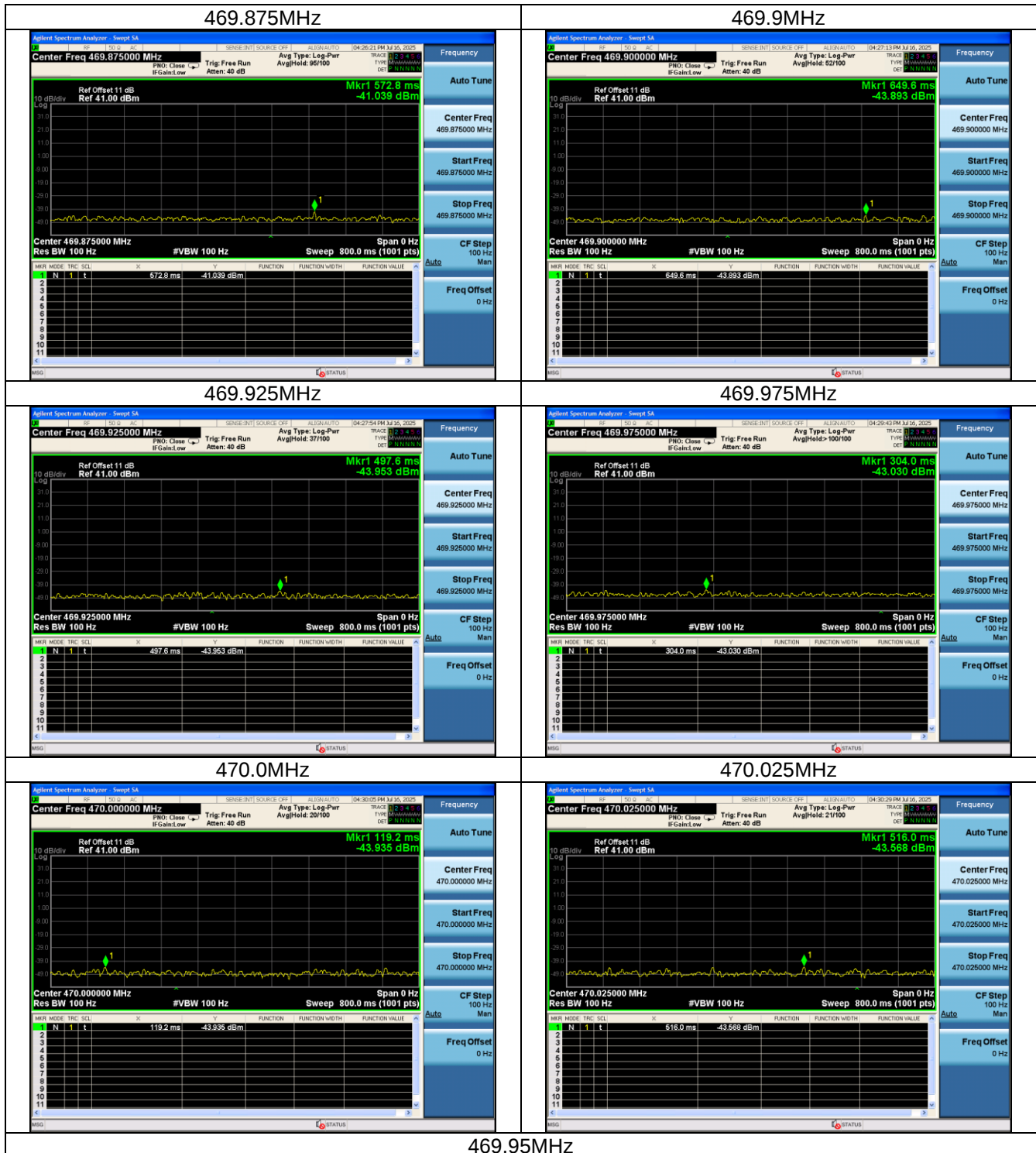
Test Requirement:	FCC Part 90.221												
Test Setup:	 Spectrum Analyzer EUT												
Test Limit:	Maximum adjacent power levels for frequencies in the 450–470 MHz band, no need compliance with below -36dBm: <table><tr><th>Frequency offset</th><th>Maximum ACP (dBc) for devices 1 watt and less</th><th>Maximum ACP (dBc) for devices above 1 watt</th></tr><tr><td>25 kHz</td><td>– 55 dBc</td><td>– 60 dBc</td></tr><tr><td>50 kHz</td><td>– 70 dBc</td><td>– 70 dBc</td></tr><tr><td>75 kHz</td><td>– 70 dBc</td><td>– 70 dBc</td></tr></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	-41.123	44-70=-26	PASS
	449.95	-40.704	44-70=-26	PASS
	449.975	-38.857	44-60=-16	PASS
	450.025	-41.361	44-60=-16	PASS
	450.05	-41.000	44-70=-26	PASS
	450.075	-41.409	44-70=-26	PASS
469.950	469.875	-41.039	44-70=-26	PASS
	469.900	-43.893	44-70=-26	PASS
	469.925	-43.953	44-60=-16	PASS
	469.975	-43.030	44-60=-16	PASS
	470.000	-43.935	44-70=-26	PASS
	470.025	-43.568	44-70=-26	PASS

GMSK 25KHz spacing 450MHz-470MHz

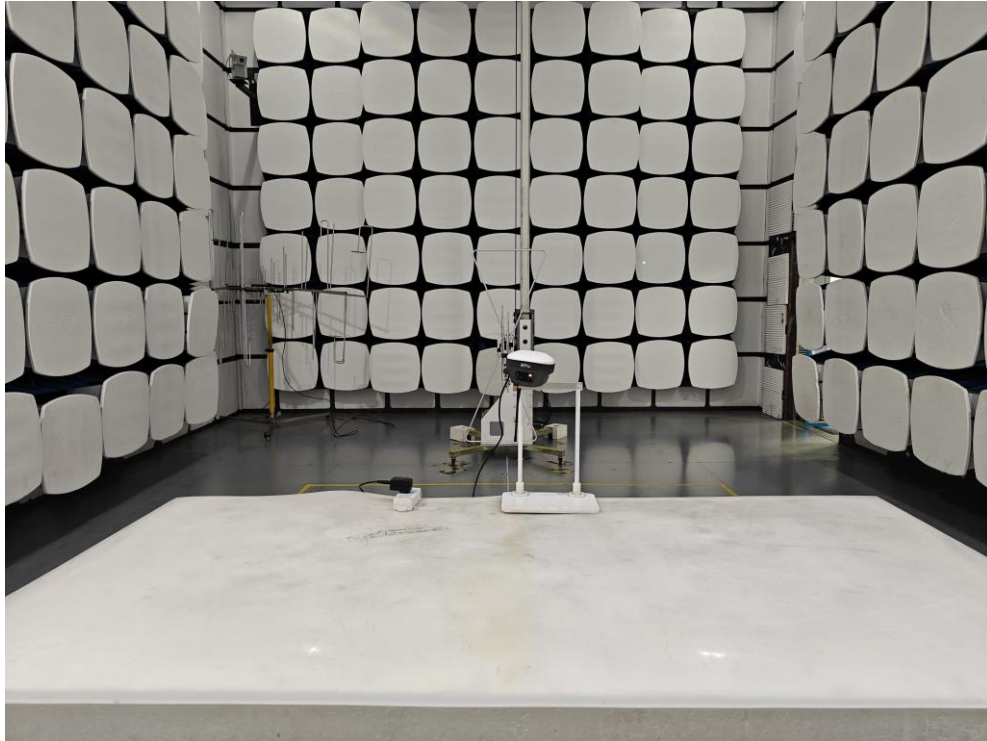




469.95MHz

4. Test Setup Photo

4.1. Photos of Radiated Emission



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