



UHF TEST REPORT
FCC ID: 2A34K-ERTK60

On Behalf of
Shanghai eSurvey GNSS Co., Ltd.
High Precision GNSS Receiver
Model No.: eRTK60

Prepared for : Shanghai eSurvey GNSS Co., Ltd.
Address : Lianhang Rd, Pujiang Town, Minhang District, 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 : A2412321-C02-R12
Date of Receipt : December 24, 2024
Date of Test : December 24, 2024 – April 12, 2025
Date of Report : April 14, 2025
Version Number : V0
Result **Pass**

TABLE OF CONTENTS

Description	Page
1. Summary of Standards and Results -----	5
1.1. Description of Standards and Results -----	5
2. General Information -----	6
2.1. Description of Device (EUT) -----	6
2.2. Accessories of Device (EUT) -----	7
2.3. Tested Supporting System Details-----	7
2.4. Block Diagram of Connection between EUT and Simulators -----	7
2.5. Test Mode -----	8
2.6. Test Conditions-----	9
2.7. Test Facility-----	9
2.8. Measurement Uncertainty -----	10
2.9. Test Equipment List -----	11
3. Test Results and Measurement Data -----	15
3.1. Transmitter Power (Conducted)-----	15
3.2. Occupied Bandwidth and Emission Mask -----	21
3.3. Spurious Emissions(conducted) -----	31
3.4. Radiated Spurious Emission -----	34
3.5. Transient Frequency Behavior -----	40
3.6. Behavior Frequency Stability -----	43
3.7. Modulation Characteristic-----	46
3.8. Adjacent Channel Power -----	47
4. Test Setup Photo -----	50
4.1. Photos of Radiated Emission -----	50

TEST REPORT DECLARATION

Applicant : Shanghai eSurvey GNSS Co., Ltd.
Address : Lianhang Rd, Pujiang Town, Minhang District, Shanghai, China
Manufacturer : Shanghai eSurvey GNSS Co., Ltd.
Address : Lianhang Rd, Pujiang Town, Minhang District, Shanghai, China
EUT Description : High Precision GNSS Receiver
(A) Model No. : eRTK60
(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 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).....: Jack Xu
Project Manager



Date of issue.....: April 14, 2025

Revision History

Revision	Issue Date	Revisions	Revised By
V0	April 14, 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	: High Precision GNSS Receiver
Model Number	: eRTK60
DIFF.	: N/A
Test Voltage	: Rated Input: 15V DC ---2A(external power supply, 5 pin port, Voltage range: 9~28V) Battery: 7.2V/3400mAh*2(double battery)
UHF	
Operation frequency	: 410MHz-470MHz
Conducted Power	: 2W(33.01±1dBm), 1W(30.00±1dBm)
Channel spacing	: 12.5KHz, 25KHz
Modulation type	: GMSK
Antenna Type	: Whip Antenna, Maximum Gain is 4dBi. (Antenna information is provided by applicant.)
Software version	: 0.27.250210
Hardware version	: PR03-V1.01
Intend use environment	: Residential, commercial and light industrial environment

Note: All Conducted Power have been tested, and recorded the worst case 2W(33.01±1dBm) results in this report.

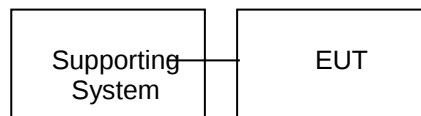
2.2. Accessories of Device (EUT)

Accessories	:	Switching Adapter
Manufacturer	:	DEE VAN ENTERPRISE CO., LTD.
Model	:	DSA-45PDH
Ratings	:	Input: 100-240V~50/60Hz 1.5A Output: 5.0V=3.0A, 15.0W; 9.0V=3.0A, 27.0W; 12.0V=3.0A, 36.0W; 15.0V=3.0A, 45.0W; 20.0V=2.25A, 45.0W

2.3. Tested Supporting System Details

No.	Description	Manufacturer	Model	Serial Number	Certification or SDOC
1.	Notebook PC	Lenovo	T430	/	/

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	Manufacture	Model No.	Firmware version	Serial No.	Last cal.	Cal Interval
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	2024.08.08	1Year
Spectrum analyzer	Agilent	N9020A	A.14.16	MY499100060	2024.08.08	1Year
Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-10 2082-Wa	2024.08.08	1Year
Receiver	R&S	ESCI	4.42 SP1	101165	2024.08.08	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	2024.08.08	1Year
RF Cable	Resenberger	Cable 2	/	RE2	2024.08.08	1Year
RF Cable	Resenberger	Cable 3	/	CE1	2024.08.08	1Year
Pre-amplifier	HP	HP8347A	/	2834A00455	2024.08.08	1Year
Pre-amplifier	Agilent	8449B	/	3008A02664	2024.08.08	1Year
L.I.S.N.#1	Schwarzbeck	NSLK8126	/	8126-466	2024.08.08	1Year
L.I.S.N.#2	ROHDE&SCHWARZ	ENV216	/	101043	2024.08.08	1Year
Horn Antenna	SCHWARZBECK	BBHA 9170	/	00946	2023.08.19	2Year
Preamplifier	SKET	LNPA_1840 -50	/	SK2018101801	2024.08.08	1 Year
Power Meter	Agilent	E9300A	/	MY41496628	2024.08.08	1 Year
Power Sensor	DARE	RPR3006W	/	15100041SNO91	2024.08.08	1 Year
Temp. & Humid. Chamber	Teelong	TL-HW408S	/	TL-20191205-01	2024.07.15	1 Year
Electronic Thermo-Hygrometer	S.H.Qixiang	HTC-1	/	N/A	2024.08.11	1 Year
Switching Mode Power Supply	JUNKE	JK12010S	/	20140927-6	2024.08.08	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

SHENZHEN STS TEST SERVICES CO., LTD

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

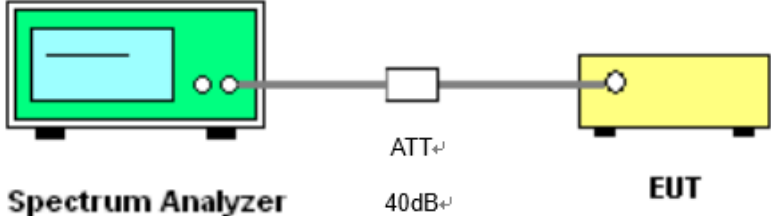
RF Connected Test Equipment						
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
1	Temperature & Humidity	SW-108	SuWei	N/A	2025.02.24	2026.02.23
2	Universal Radio Communication Tester	R&S	CMU200	119907	2025.02.22	2026.02.21
3	MXG Vector Signal Generator	Keysight	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
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 (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	32.437	34.287	35	33.01±1	PASS
25	410.050	32.580	34.430	35	33.01±1	PASS
12.5	440.000	33.079	34.929	35	33.01±1	PASS
25	440.000	33.063	34.913	35	33.01±1	PASS
12.5	469.950	32.552	34.402	35	33.01±1	PASS
25	469.950	32.740	34.590	35	33.01±1	PASS

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

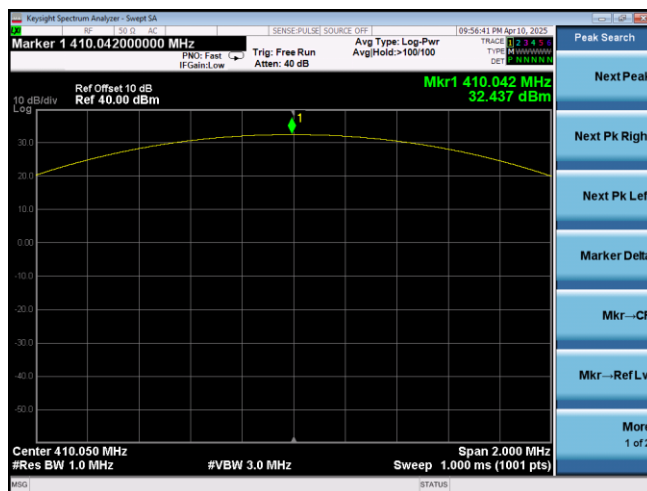
GMSK mode (1W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
12.5	410.050	30.930	32.780	33	30±1	PASS
25	410.050	30.893	32.743	33	30±1	PASS
12.5	440.000	30.807	32.657	33	30±1	PASS
25	440.000	30.879	32.729	33	30±1	PASS
12.5	469.950	29.508	31.358	33	30±1	PASS
25	469.950	29.555	31.405	33	30±1	PASS

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

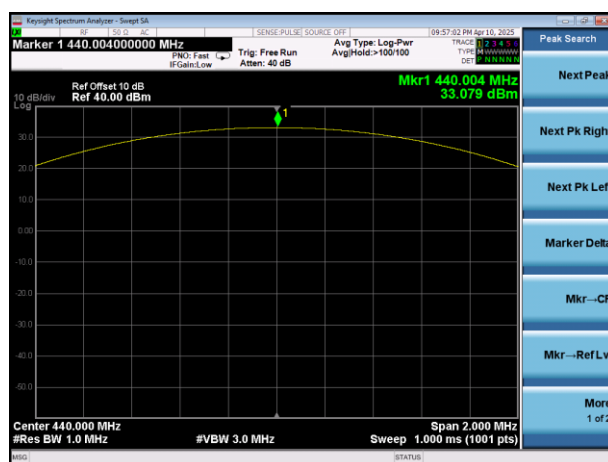
Test plots as follows:

GMSK 2W 12.5KHz Channel Spacing: Transmitter Power

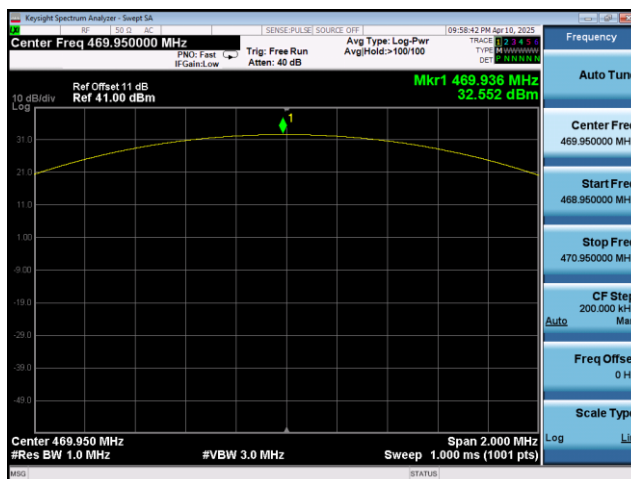
Low: 410.050MHz



Mid: 440.000MHz

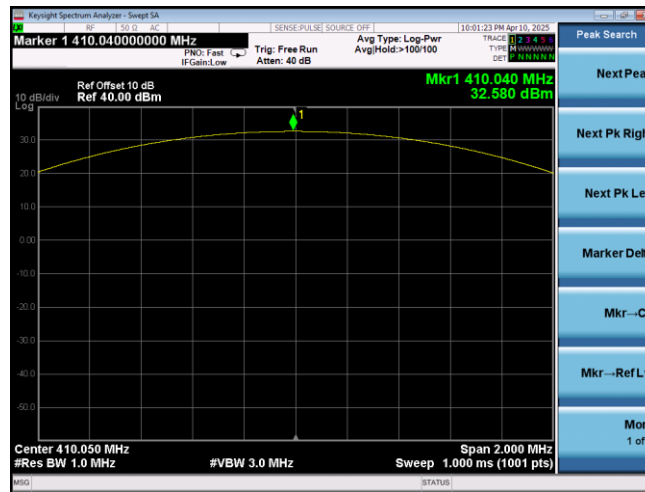


High: 470.00MHz

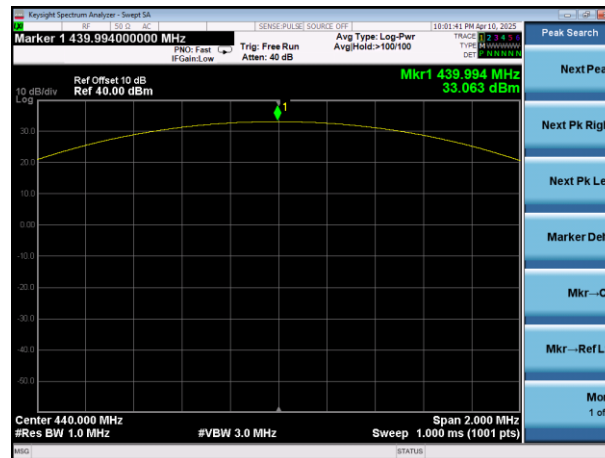


GMSK 2W 25KHz Channel Spacing: Transmitter Power

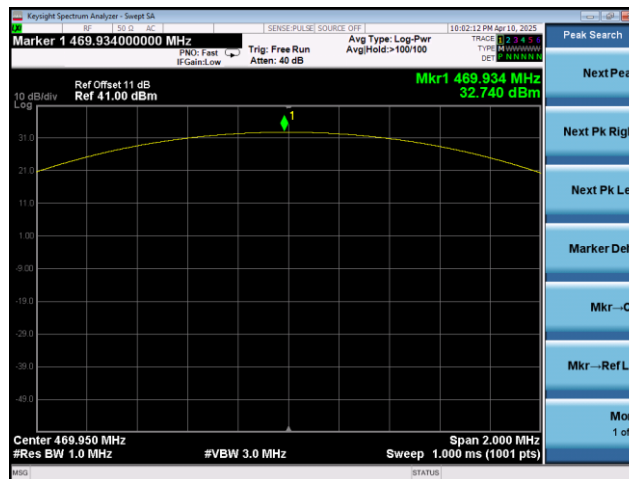
Low: 410.050MHz



Mid: 440.000MHz

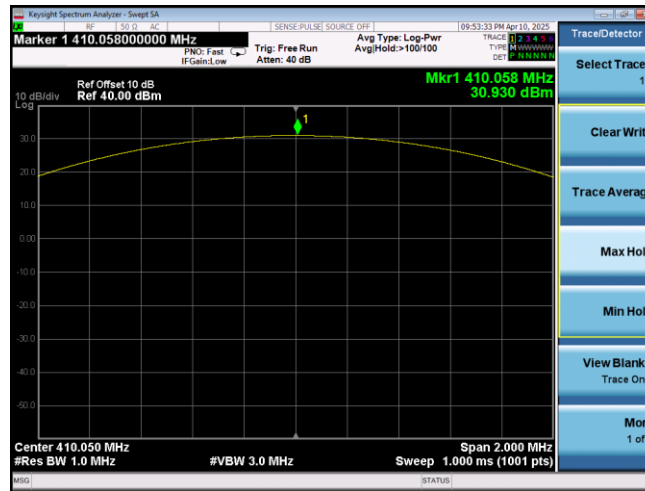


High: 470.00MHz

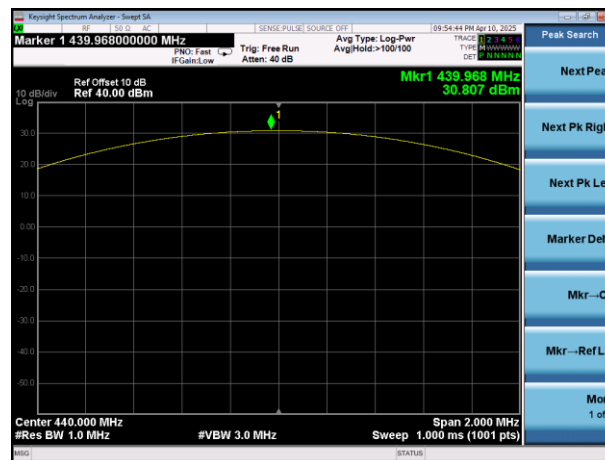


GMSK 1W 12.5KHz Channel Spacing: Transmitter Power

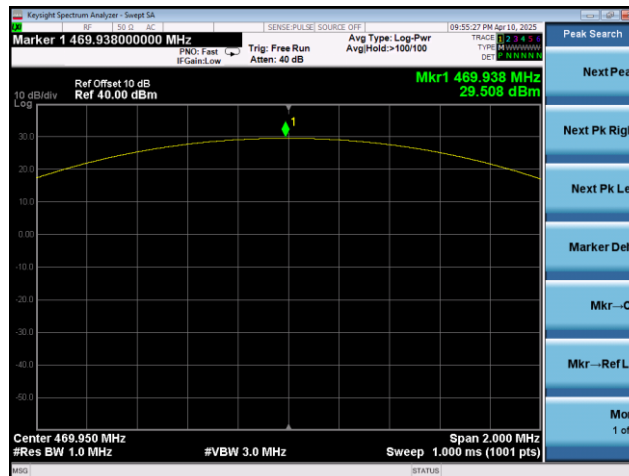
Low: 410.050MHz



Mid: 440.000MHz

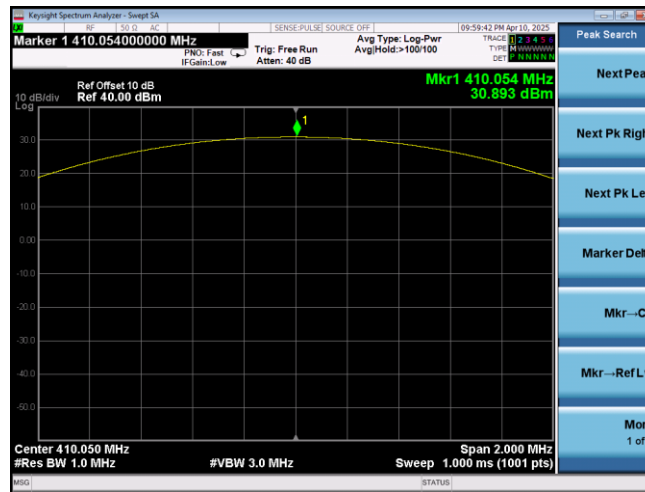


High: 470.00MHz

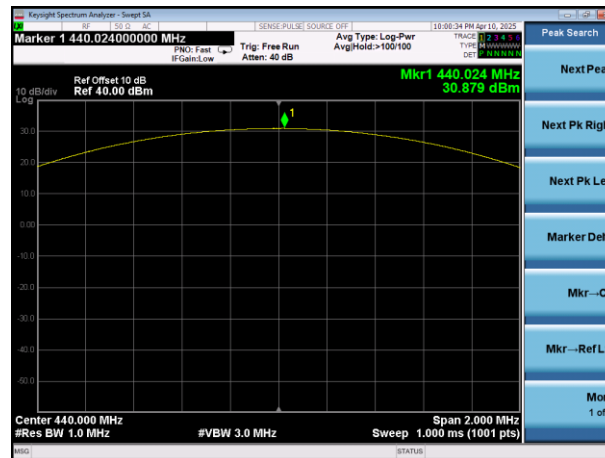


GMSK 1W 25KHz Channel Spacing: Transmitter Power

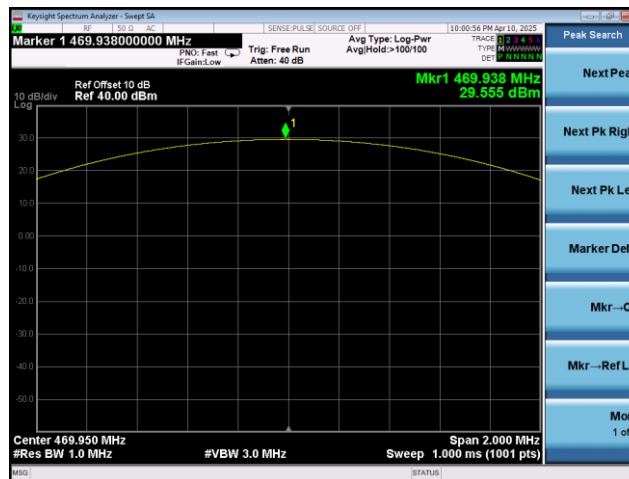
Low: 410.050MHz



Mid: 440.000MHz

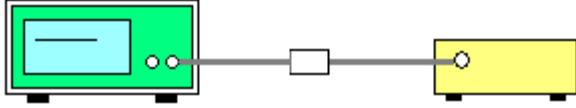


High: 470.00MHz



3.2. Occupied Bandwidth and Emission Mask

3.2.1. Test Specification

Test Requirement:	FCC Part 90.209, FCC Part 90.210
Test Setup:	 The diagram illustrates the test setup. On the left is a green rectangular box representing the Spectrum Analyzer, with a blue screen and two small circular ports. A grey cable connects these ports to a small white rectangular box in the middle. Another grey cable connects this white box to a yellow rectangular box on the right, which represents the EUT (Equipment Under Test) and has a single circular port. 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 (2W) 12.5KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	6.300	4.918	11.25	PASS
Mid	440.000	6.305	4.917	11.25	PASS
High	469.950	6.302	4.924	11.25	PASS

GMSK mode (2W) 25KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	12.61	9.866	20	PASS
Mid	440.000	12.35	9.855	20	PASS
High	469.950	12.35	9.872	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	6.300	4.917	11.25	PASS
Mid	440.000	6.293	4.917	11.25	PASS
High	469.950	6.299	4.953	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	12.22	9.883	20	PASS
Mid	440.000	12.61	9.866	20	PASS
High	469.950	12.36	9.879	20	PASS

Emission Mask:

GMSK mode (2W) 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 (2W) 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 (2W) 12.5KHz Channel Spacing: Occupied Bandwidth

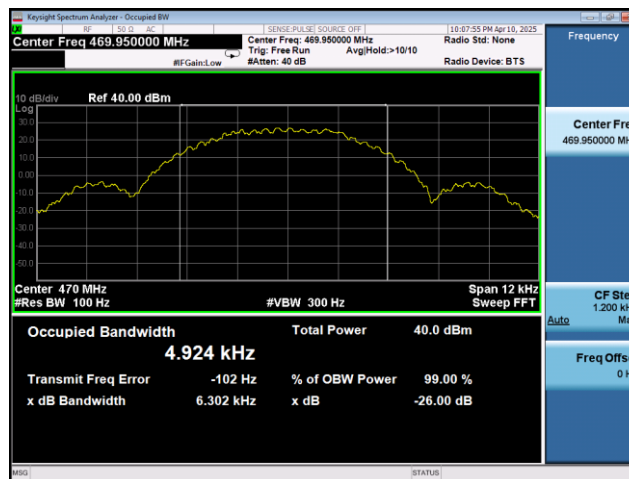
Low: 410.050MHz



Mid: 440.000MHz

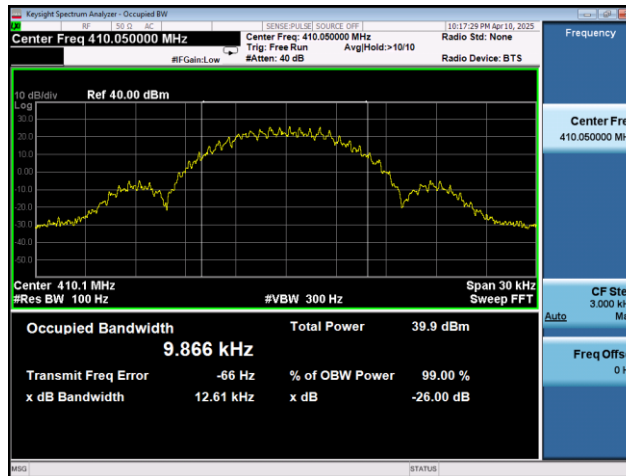


High: 470.00MHz

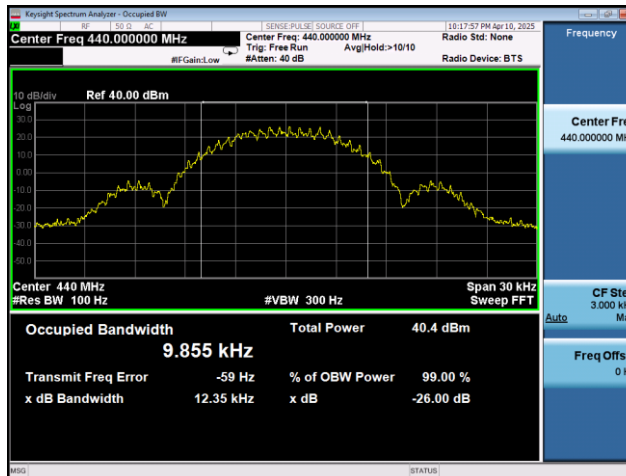


GMSK mode (2W) 25KHz Channel Spacing: Occupied Bandwidth

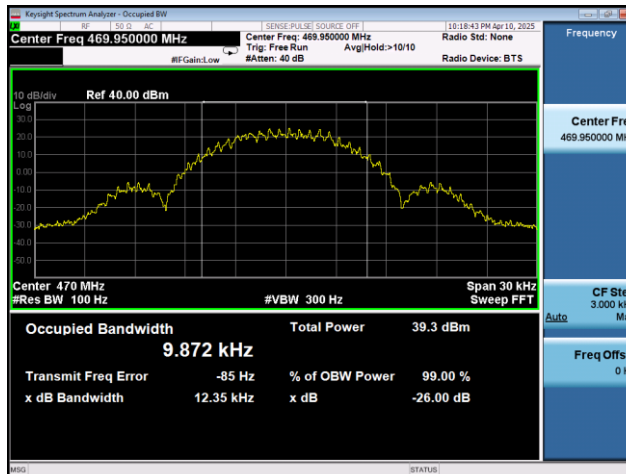
Low: 410.050MHz



Mid: 440.000MHz

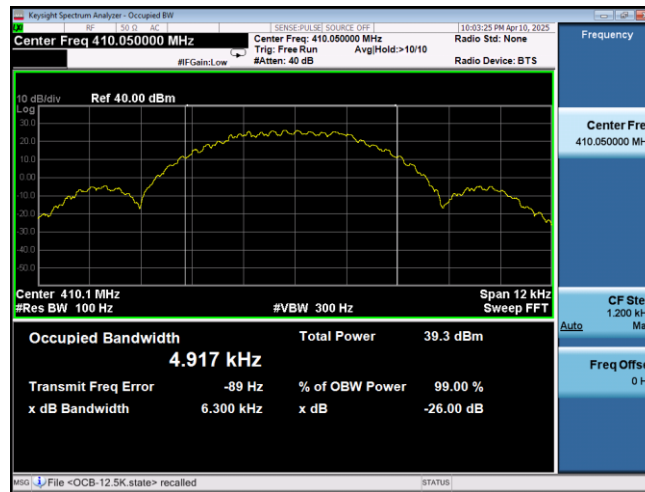


High: 469.850MHz



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

Low: 410.050MHz



Mid: 440.000MHz

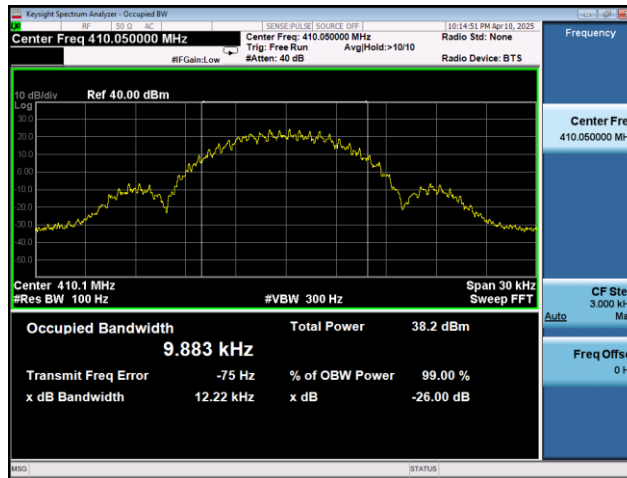


High: 470.00MHz



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

Low: 410.050MHz



Mid: 440.000MHz

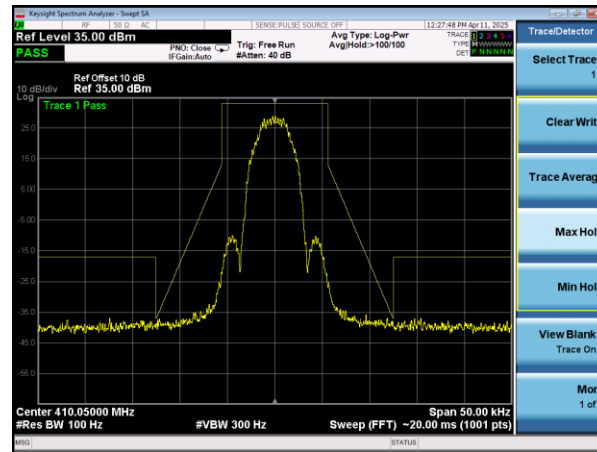


High: 469.850MHz

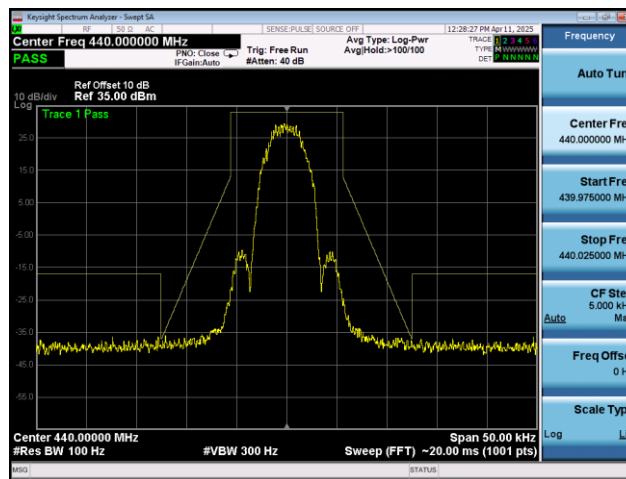


GMSK mode (2W) 12.5KHz Channel Spacing: Emission Mask

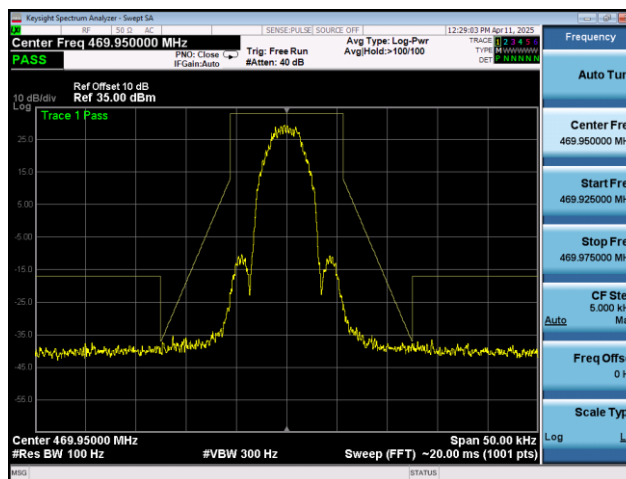
Low: 410.050MHz



Mid: 440.000MHz

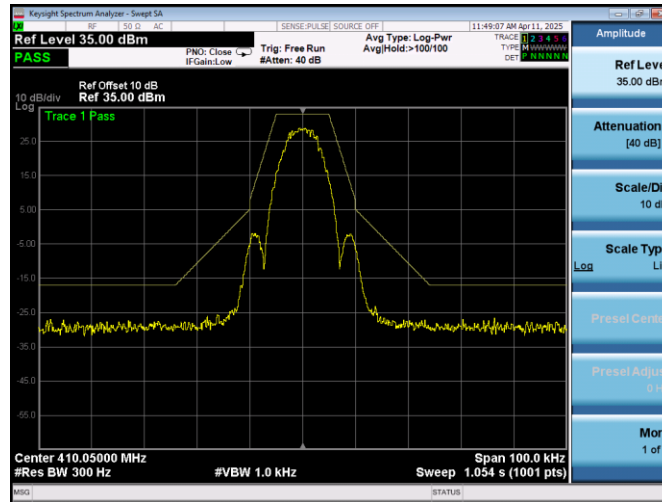


High: 469.950MHz

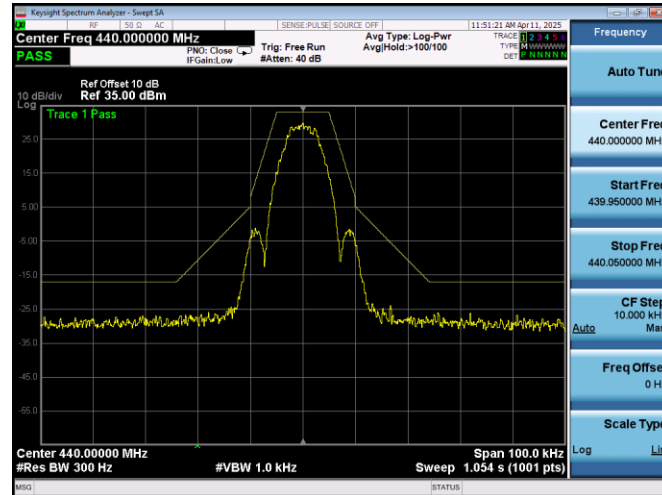


GMSK mode (2W) 25KHz Channel Spacing: Emission Mask

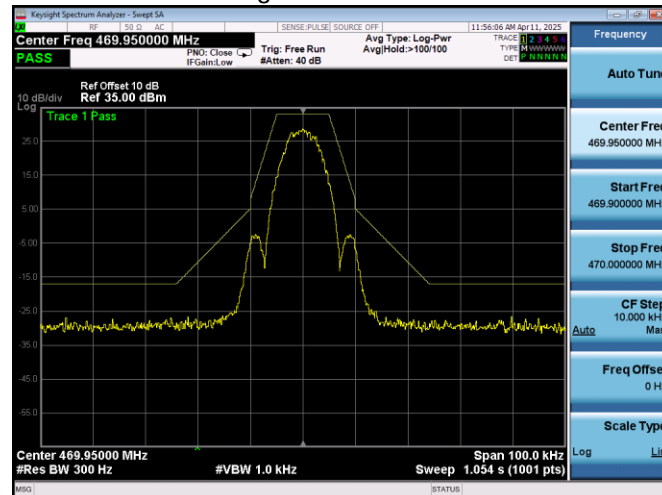
Low: 410.050MHz



Mid: 440.000MHz

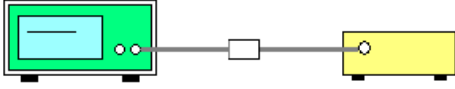


High: 469.950MHz



3.3. Spurious Emissions(conducted)

3.3.1. Test Specification

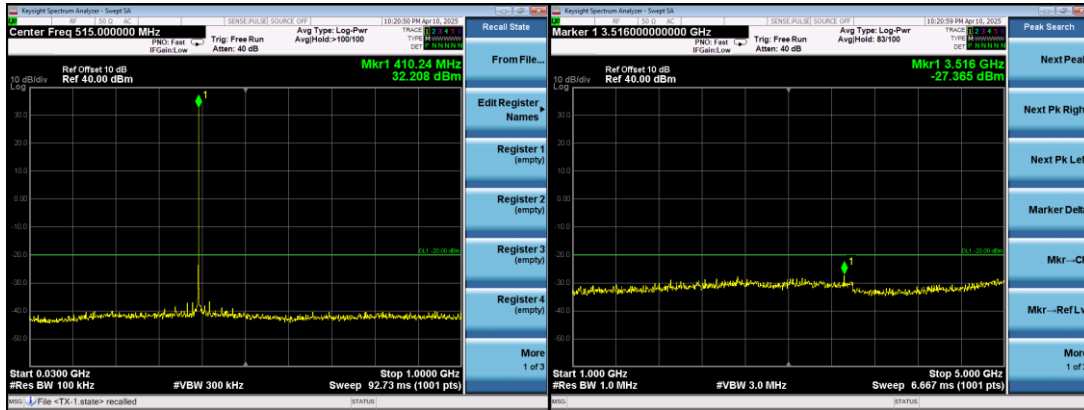
Test Requirement:	FCC Part 90.210
Test Setup:	 Spectrum Analyzer EUT
Test Limit:	Modulation Type: GMSK FCC Part 22.359, 74.462, 80.211 and 90.210: For 6.25 bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 4.6 kHz at 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. $50 + 10 \log(P \text{ watts}) = 50 + 10 \log(2) = 53.010 \text{ dB}$ 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 33.01 dBm for High rated power. Limit (dBm) = $33.01 - 50 - 10 \log(2) = -20 \text{ dBm}$ 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: $43 + 10 \log(P \text{ watts}) = 43 + 10 \log(2) = 46.010 \text{ dB}$ 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 33.01 dBm for High rated power. Limit (dBm) = $33.01 - 43 - 10 \log(2) = -13 \text{ dBm}$ 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

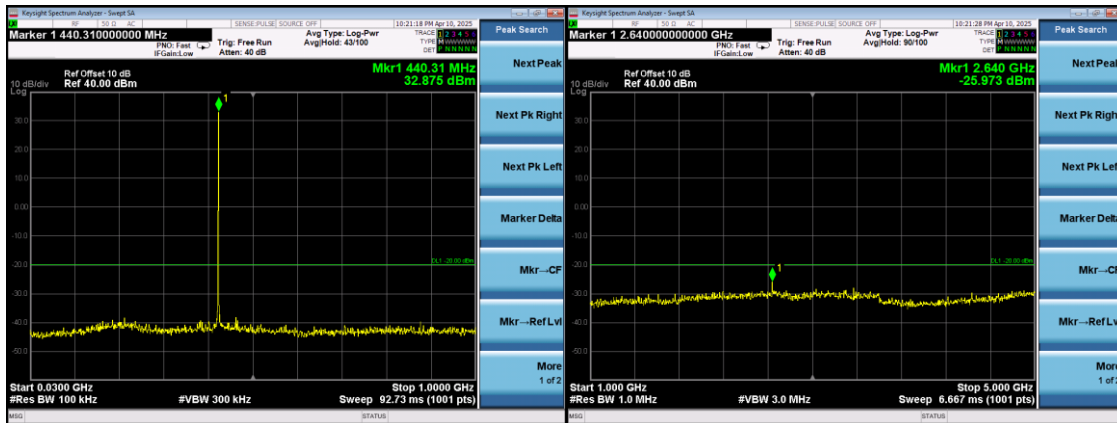
Test plots as follows:

GMSK 12.5KHz Channel Spacing:

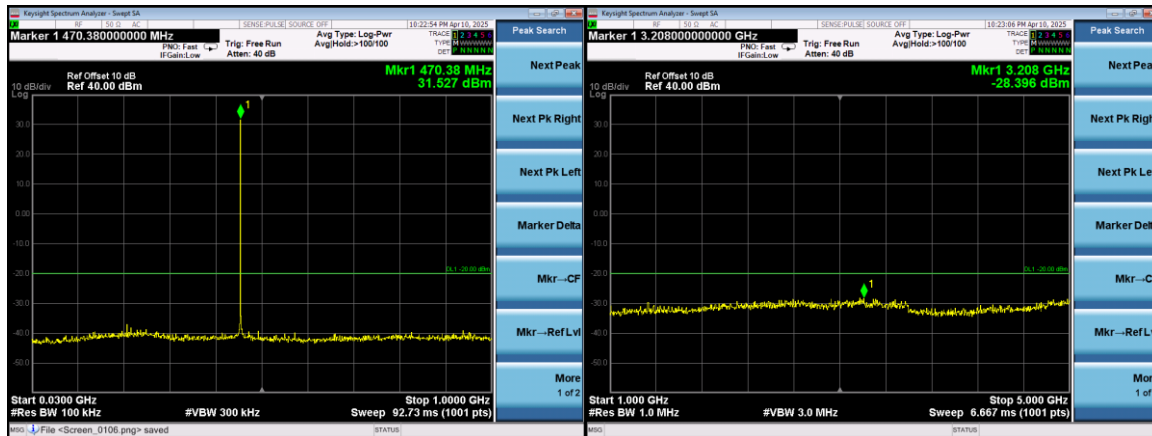
Low: 410.050MHz



Mid: 440.000MHz

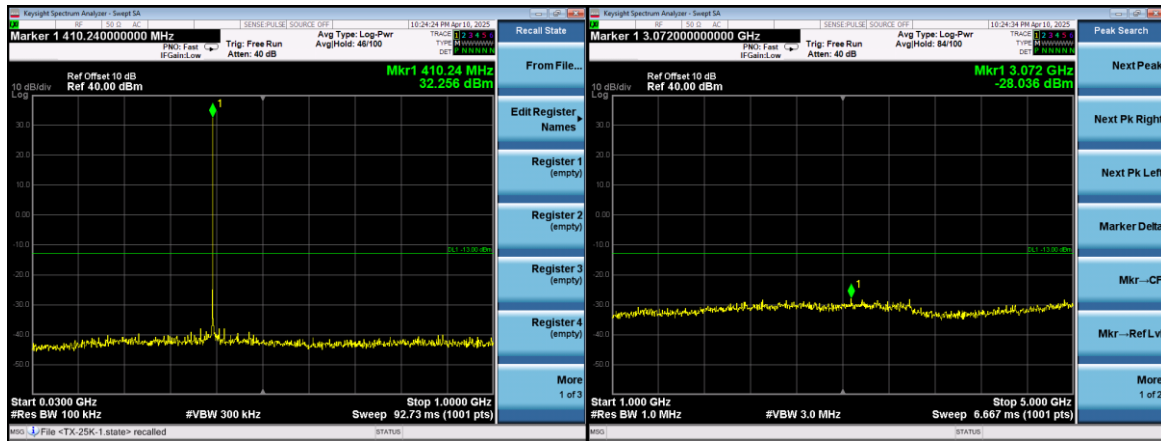


High: 469.950MHz

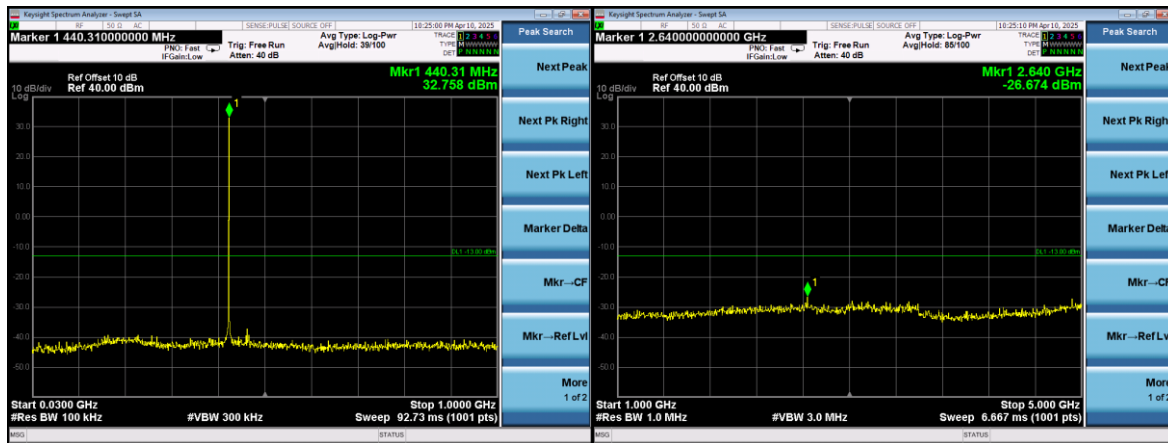


GMSK 25KHz Channel Spacing:

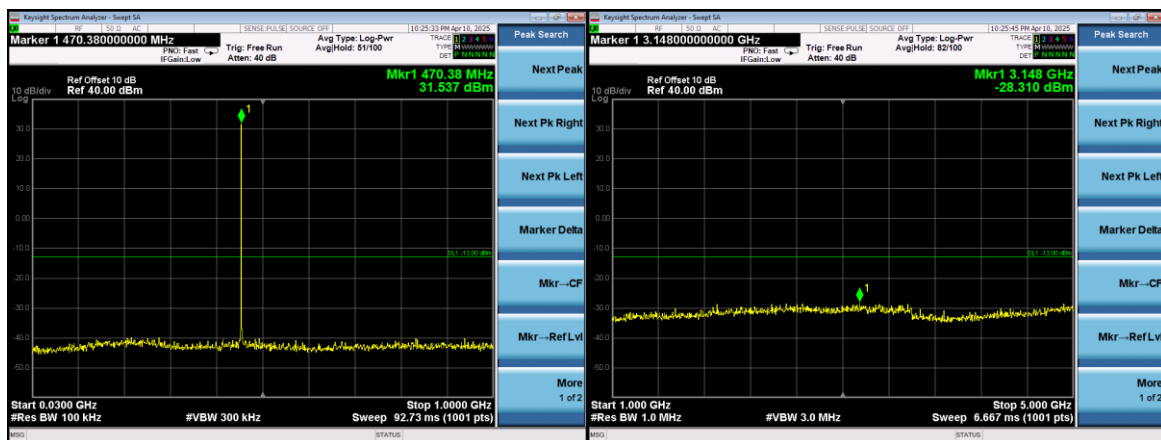
Low: 410.050MHz



Mid: 440.000MHz



High: 469.950MHz



3.4. Radiated Spurious Emission

3.4.1. Test Specification

Test Requirement:	FCC Part 90.210															
Test Method:	ANSI C63.26															
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:	Receiver Antenna Test Antenna RECEIVER UNDER TEST TURNTABLE SPECTRUM ANALYZER STANDARD 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)
151.917	-93.997	V	0.24	31.35	-62.887	-20	-42.887
361.785	-93.474	V	0.26	31.34	-62.394	-20	-42.394
672.154	-92.737	V	0.42	31.24	-61.917	-20	-41.917
821.394	-98.756	V	0.58	30.71	-68.626	-20	-48.626
1229.957	-83.915	V	1.23	26.38	-58.765	-20	-38.765
3864.767	-80.024	V	1.68	25.47	-56.234	-20	-36.234
286.364	-98.886	H	0.43	31.24	-68.076	-20	-48.076
400.619	-92.064	H	0.45	30.68	-61.834	-20	-41.834
674.595	-94.202	H	0.64	30.85	-63.992	-20	-43.992
820.661	-98.836	H	0.79	31.12	-68.506	-20	-48.506
1228.952	-80.636	H	1.29	26.12	-55.806	-20	-35.806
3256.755	-82.676	H	1.62	25.41	-58.886	-20	-38.886

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)
157.667	-96.701	V	0.24	31.35	-65.591	-20	-45.591
364.040	-92.285	V	0.26	31.34	-61.205	-20	-41.205
667.538	-98.977	V	0.42	31.24	-68.157	-20	-48.157
881.148	-94.144	V	0.58	30.71	-64.014	-20	-44.014
1322.510	-86.900	V	1.23	26.38	-61.750	-20	-41.750
3860.362	-84.631	V	1.68	25.47	-60.841	-20	-40.841
291.106	-98.025	H	0.43	31.24	-67.215	-20	-47.215
397.508	-91.981	H	0.45	30.68	-61.751	-20	-41.751
681.054	-97.000	H	0.64	30.85	-66.790	-20	-46.790
881.491	-99.675	H	0.79	31.12	-69.345	-20	-49.345
1320.932	-87.353	H	1.29	26.12	-62.523	-20	-42.523
3262.627	-83.058	H	1.62	25.41	-59.268	-20	-39.268

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)
148.133	-93.161	V	0.24	31.35	-62.051	-20	-42.051
362.786	-95.630	V	0.26	31.34	-64.550	-20	-44.550
673.461	-96.576	V	0.42	31.24	-65.756	-20	-45.756
940.387	-95.124	V	0.58	30.71	-64.994	-20	-44.994
1410.119	-87.145	V	1.23	26.38	-61.995	-20	-41.995
3857.204	-81.115	V	1.68	25.47	-57.325	-20	-37.325
292.619	-95.917	H	0.43	31.24	-65.107	-20	-45.107
404.601	-95.326	H	0.45	30.68	-65.096	-20	-45.096
677.161	-97.425	H	0.64	30.85	-67.215	-20	-47.215
940.290	-97.601	H	0.79	31.12	-67.271	-20	-47.271
1409.236	-83.611	H	1.29	26.12	-58.781	-20	-38.781
3262.144	-80.840	H	1.62	25.41	-57.050	-20	-37.050

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)
150.681	-93.962	V	0.24	31.35	-62.852	-13	-49.852
362.358	-89.911	V	0.26	31.34	-58.831	-13	-45.831
672.453	-91.427	V	0.42	31.24	-60.607	-13	-47.607
819.960	-93.081	V	0.58	30.71	-62.951	-13	-49.951
1227.855	-84.310	V	1.23	26.38	-59.160	-13	-46.160
3854.715	-81.960	V	1.68	25.47	-58.170	-13	-45.170
285.464	-96.200	H	0.43	31.24	-65.390	-13	-52.390
402.761	-96.875	H	0.45	30.68	-66.645	-13	-53.645
679.238	-93.767	H	0.64	30.85	-63.557	-13	-50.557
818.831	-94.423	H	0.79	31.12	-64.093	-13	-51.093
1233.272	-82.070	H	1.29	26.12	-57.240	-13	-44.240
3256.705	-79.703	H	1.62	25.41	-55.913	-13	-42.913

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)
156.386	-96.834	V	0.24	31.35	-65.724	-13	-52.724
360.392	-93.503	V	0.26	31.34	-62.423	-13	-49.423
670.295	-95.318	V	0.42	31.24	-64.498	-13	-51.498
881.385	-96.673	V	0.58	30.71	-66.543	-13	-53.543
1320.500	-85.083	V	1.23	26.38	-59.933	-13	-46.933
3859.622	-80.959	V	1.68	25.47	-57.169	-13	-44.169
284.497	-94.884	H	0.43	31.24	-64.074	-13	-51.074
405.164	-98.505	H	0.45	30.68	-68.275	-13	-55.275
685.411	-98.463	H	0.64	30.85	-68.253	-13	-55.253
879.689	-96.126	H	0.79	31.12	-65.796	-13	-52.796
1319.046	-83.840	H	1.29	26.12	-59.010	-13	-46.010
3262.763	-80.588	H	1.62	25.41	-56.798	-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)
150.490	-94.024	V	0.24	31.35	-62.914	-13	-49.914
361.968	-90.159	V	0.26	31.34	-59.079	-13	-46.079
666.893	-96.598	V	0.42	31.24	-65.778	-13	-52.778
938.290	-95.232	V	0.58	30.71	-65.102	-13	-52.102
1409.706	-81.111	V	1.23	26.38	-55.961	-13	-42.961
3859.639	-78.934	V	1.68	25.47	-55.144	-13	-42.144
290.667	-95.464	H	0.43	31.24	-64.654	-13	-51.654
399.862	-99.563	H	0.45	30.68	-69.333	-13	-56.333
680.103	-95.743	H	0.64	30.85	-65.533	-13	-52.533
940.524	-98.176	H	0.79	31.12	-67.846	-13	-54.846
1407.597	-85.054	H	1.29	26.12	-60.224	-13	-47.224
3262.351	-77.131	H	1.62	25.41	-53.341	-13	-40.341

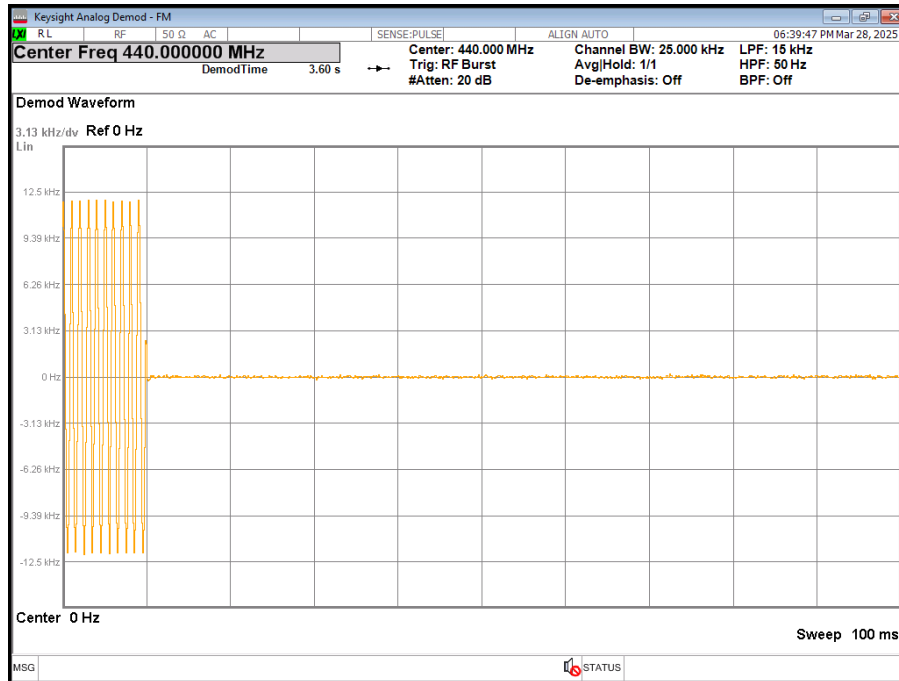
3.5. Transient Frequency Behavior

3.5.1. Test Specification

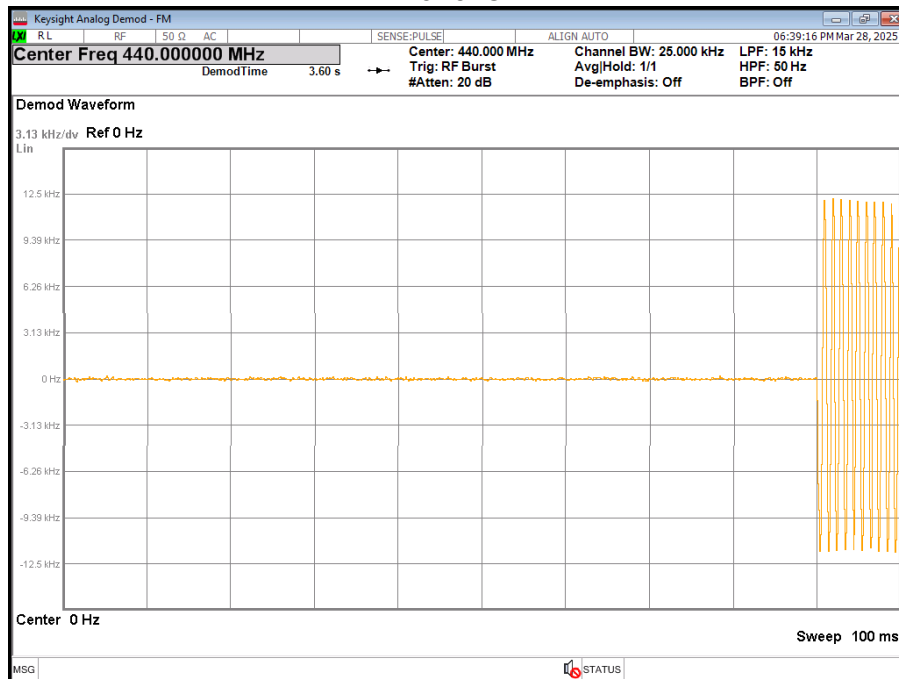
Test Requirement:	FCC Part 90.214																																																		
Test Setup:	 OscilloscopeEUT																																																		
Test Limit	<table><tr><th rowspan="2">Channel Bandwidth (kHz)</th><th rowspan="2">Time Intervals (Notes 1, 2)</th><th rowspan="2">Maximum 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>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></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

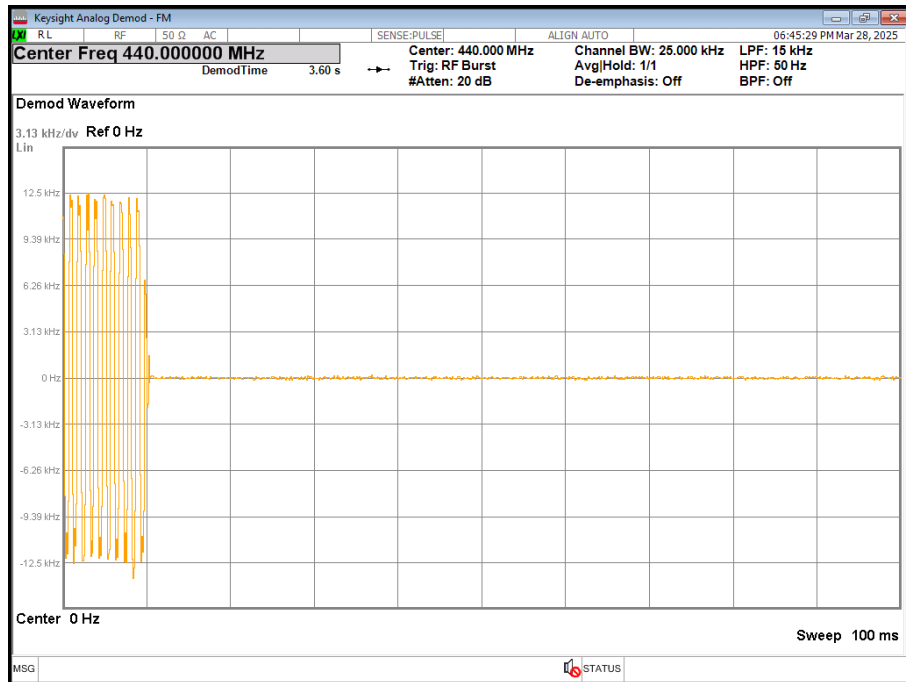
Test Plots for channel spacing 12.5KHz, EUT power setting: Maximum.
Power On



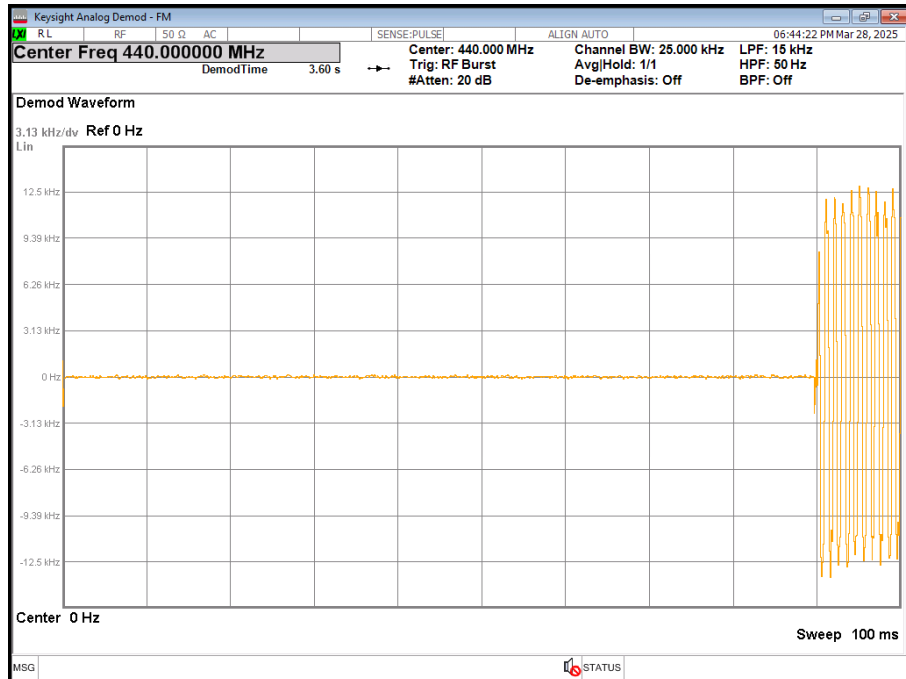
Power Off



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:	ANSI C63.26
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] MC --- RFCS[RF Communication Test Set] MC --- MA[Modulation Analyzer] RFCS --- RFD[RF Detector] RFD --- 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	10	13.97	0.032
	11	29.58	0.067
	12	3.26	0.007
	13	26.95	0.061
	14	19.41	0.044
	15	10.44	0.024
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	10	3.09	0.007
	11	6.56	0.015
	12	-9.71	-0.022
	13	-1.90	-0.004
	14	18.17	0.041
	15	3.65	0.008
Limit	5ppm		

Mode	Temperature (°C)	Frequency error (Hz)	frequency error (ppm)
Middle Channel 12.5KHz Channel Spacing	-20	18.15	0.041
	-10	26.93	0.061
	0	-0.81	-0.002
	10	6.21	0.014
	20	20.81	0.047
	30	3.43	0.008
	40	-1.12	-0.003
	50	28.00	0.064
Limit	2.5ppm		
Middle Channel 25KHz Channel Spacing	-20	26.05	0.059
	-10	-5.26	-0.012
	0	28.75	0.065
	10	23.28	0.053
	20	-8.71	-0.020
	30	-3.97	-0.009
	40	16.17	0.037
	50	23.34	0.053
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.

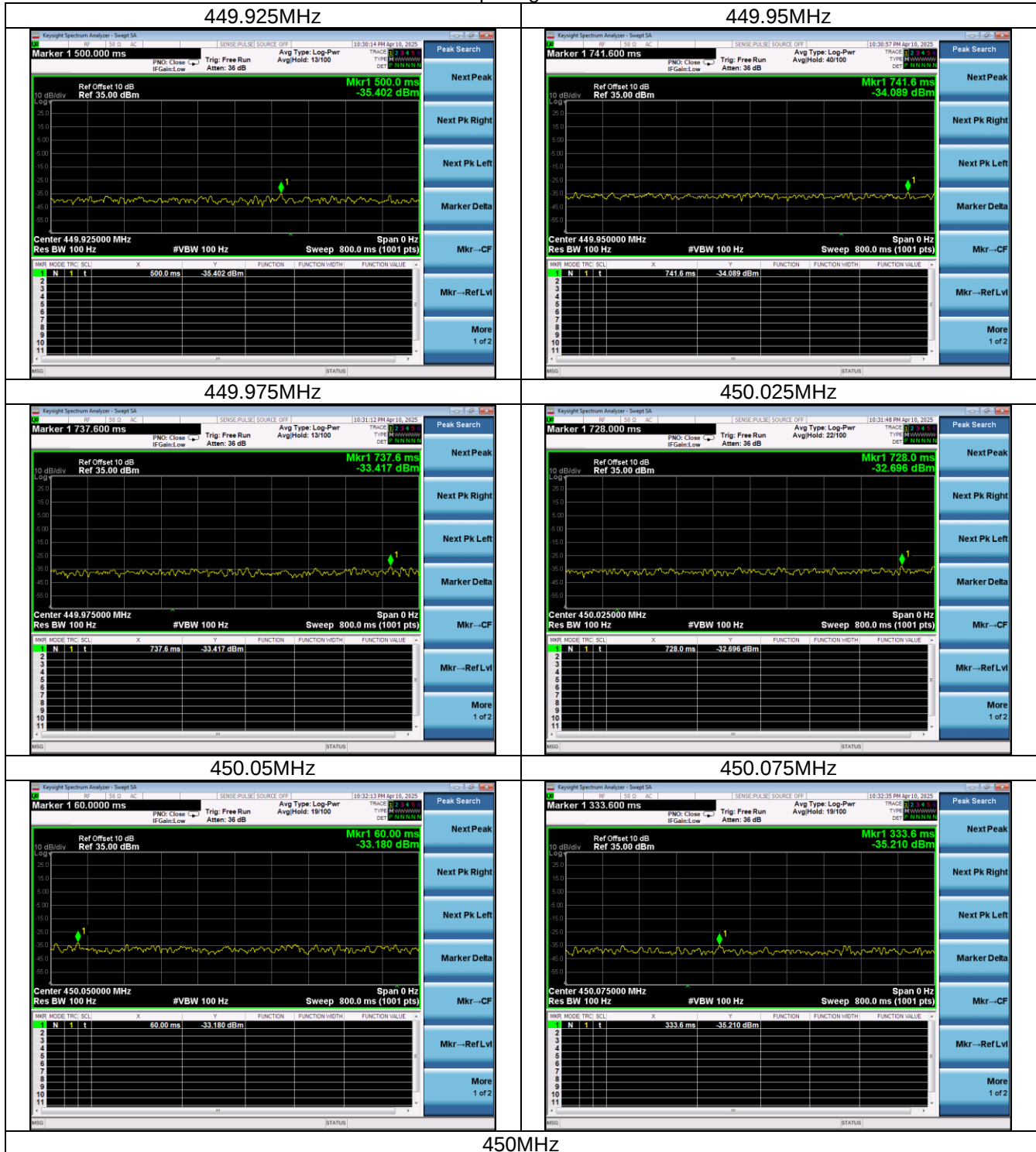
3.8. Adjacent Channel Power

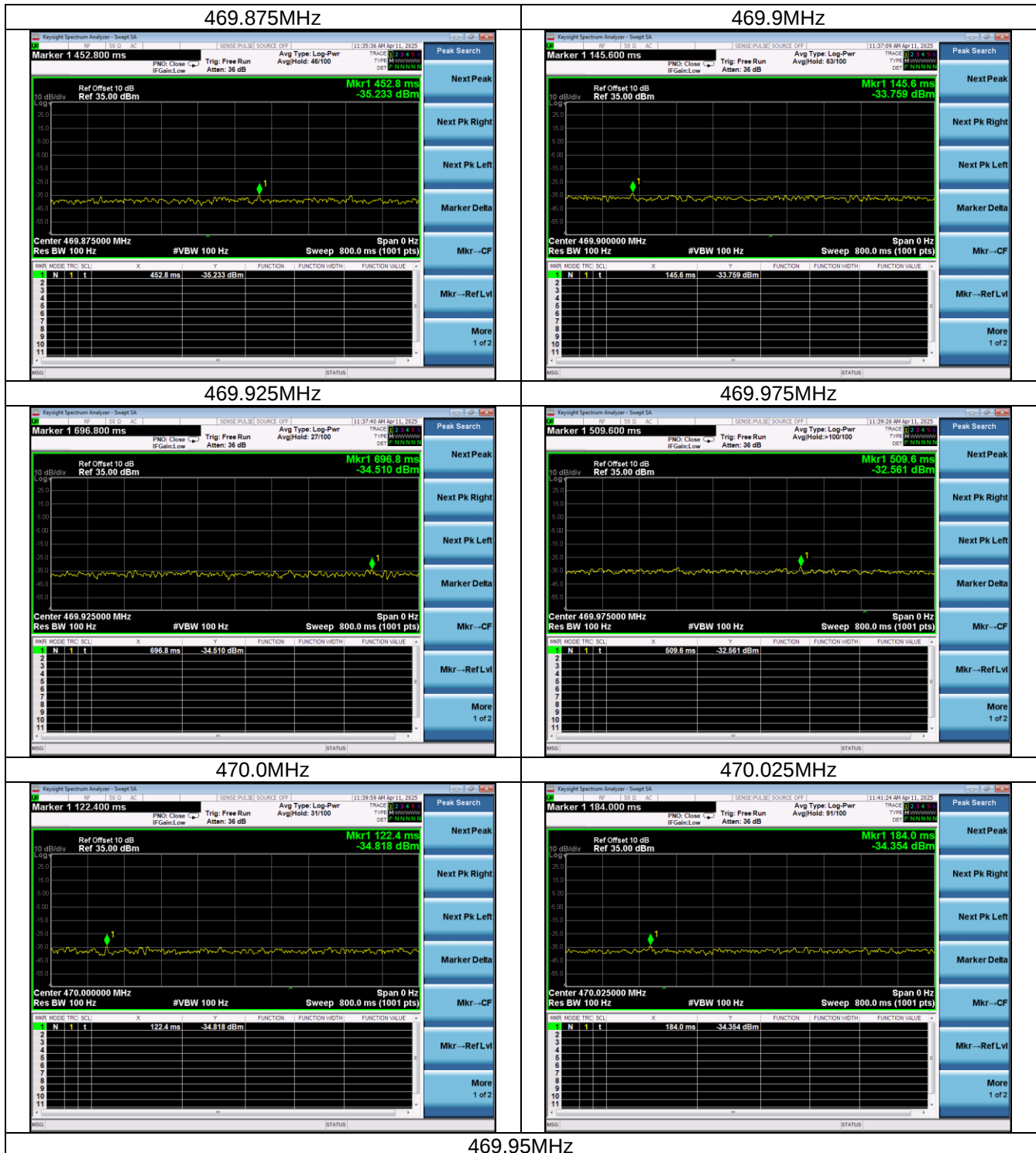
Test Requirement:	FCC Part 90.221												
Test Setup:	 Spectrum AnalyzerEUT												
Test Limit:	Maximum adjacent power levels for frequencies in the 450–470 MHz band, no need compliance with below -36dBm: <table><thead><tr><th>Frequency offset</th><th>Maximum ACP (dBc) for devices 1 watt and less</th><th>Maximum ACP (dBc) for devices above 1 watt</th></tr></thead><tbody><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></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	-35.402	44-70=-26	PASS
	449.95	-34.089	44-70=-26	PASS
	449.975	-33.417	44-60=-16	PASS
	450.025	-32.696	44-60=-16	PASS
	450.05	-33.180	44-70=-26	PASS
	450.075	-35.210	44-70=-26	PASS
469.950	469.875	-35.233	44-70=-26	PASS
	469.900	-33.759	44-70=-26	PASS
	469.925	-34.510	44-60=-16	PASS
	469.975	-32.561	44-60=-16	PASS
	470.000	-34.818	44-70=-26	PASS
	470.025	-34.354	44-70=-26	PASS

GMSK 25KHz spacing 450MHz-470MHz





4. Test Setup Photo

4.1. Photos of Radiated Emission



----- END OF REPORT-----