UHF TEST REPORT

FCC ID: 2AUW9-TRU35

On Behalf of

GeoMax AG

Wireless Data Transceiver

Model No.: TRU35

Prepared for	:	GeoMax AG
Address	:	Espenstrasse 135, CH-9443 Widnau, Switzerland

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	:	A2312227-C01-R21
Date of Receipt	:	December 25, 2023
Date of Test	:	December 25, 2023 - September 19, 2024
Date of Report	:	September 19, 2024
Version Number	:	V0
Result		**Pass**

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TEST REPORT DECLARATION

Applicant	:	GeoMax AG
Address	:	Espenstrasse 135, CH-9443 Widnau, Switzerland
Manufacturer	:	GeoMax AG
Address	:	Espenstrasse 135, CH-9443 Widnau, Switzerland
EUT Description	:	Wireless Data Transceiver
	(A) Model No.	: TRU35
	(B) Trademark	: GEOMAX

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	Yannis Wen
Approved by (name + signature)…....:	Jack Xu Project Manager	Jack Xu
Date of issue…… ……..:	September 19, 2024	

Revision History

Revision	Issue Date	Revisions	Revised By
V0	September 19, 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

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	:	Wireless Data Transceiver
Model Number	:	TRU35
DIFF.	:	N/A
Test Voltage	:	DC 10.8-15V from DC power.
UHF		
Operation frequency	:	410MHz-470MHz
Conducted Power	:	27W(44.31±1dBm), 11W(40.41±1dBm)
Channel spacing	:	6.25KHz, 12.5KHz, 25KHz
Modulation type	:	GMSK
Antenna Type	:	Rod Antenna, Maximum Gain is 5.5dBi. (Antenna information is provided by applicant.)
Software version	:	1.1.7
Hardware version	:	V1.1

Note: All Conducted Power have been tested, and recorded the worst case 27W(44.31±1dBm) re*sults in this report.*

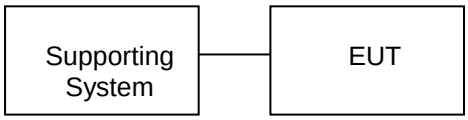
2.2. Accessories of Device (EUT)

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

2.3. Tested Supporting System Details

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

2.4. 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℃	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

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℃
Uncertainty for humidity	1%
Uncertainty for DC and low frequency voltages	0.06%

2.9. Test Equipment List

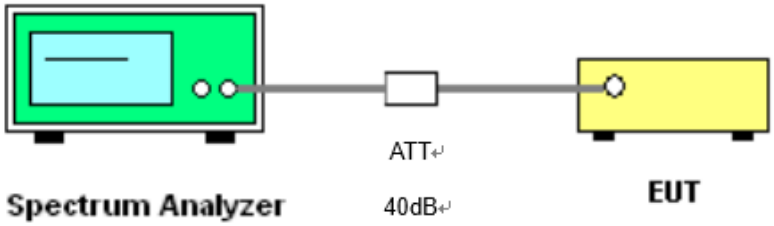
Equipment	Manufacture	Model No.	Firmware version	Serial No.	Last cal.	Cal Interval
9*6*6 anechoic chamber	CHENYU	9*6*6	/	N/A	2022.05.18	3Year
Spectrum analyzer	ROHDE&SCHWARZ	FSV40-N	2.3	102137	2024.08.08	1Year
Spectrum analyzer	Agilent	N9020A	A.14.16	MY499100060	2024.08.08	1Year
Receiver	ROHDE&SCHWARZ	ESR	2.28 SP1	1316.3003K03-102082-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
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

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:	
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 (27W):						
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	43.983	47.333	47.66	44.31±1	PASS
12.5	410.050	43.997	47.347	47.66	44.31±1	PASS
25	410.050	43.844	47.194	47.66	44.31±1	PASS
6.25	440.000	43.848	47.198	47.66	44.31±1	PASS
12.5	440.000	43.759	47.109	47.66	44.31±1	PASS
25	440.000	43.751	47.101	47.66	44.31±1	PASS
6.25	469.950	43.680	47.030	47.66	44.31±1	PASS
12.5	469.950	43.661	47.011	47.66	44.31±1	PASS
25	469.950	43.714	47.064	47.66	44.31±1	PASS

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

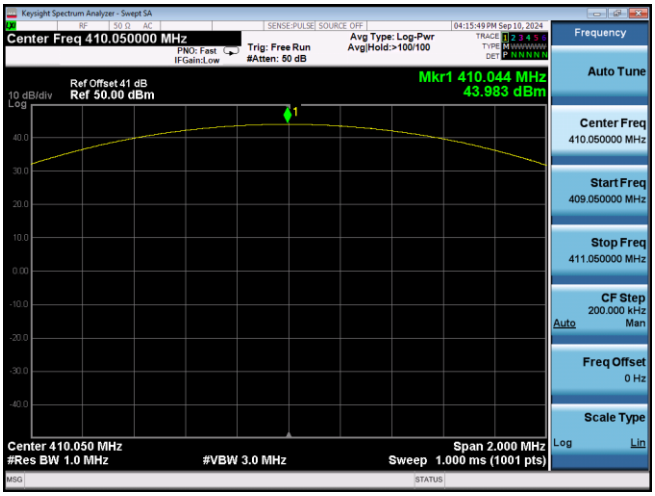
GMSK mode (11W):						
Channel spacing (KHz)	Frequency (MHz)	Maximum Conducted Output Power(Peak) (dBm)	Maximum ERP (dBm)	Stated ERP Power (dBm)	Conducted Output Power Limit (dBm)	Result
6.25	410.050	39.881	43.231	43.76	40.41±1	PASS
12.5	410.050	39.814	43.164	43.76	40.41±1	PASS
25	410.050	39.853	43.203	43.76	40.41±1	PASS
6.25	440.000	39.906	43.256	43.76	40.41±1	PASS
12.5	440.000	39.914	43.264	43.76	40.41±1	PASS
25	440.000	39.957	43.307	43.76	40.41±1	PASS
6.25	469.950	39.860	43.210	43.76	40.41±1	PASS
12.5	469.950	39.796	43.146	43.76	40.41±1	PASS
25	469.950	39.816	43.166	43.76	40.41±1	PASS

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

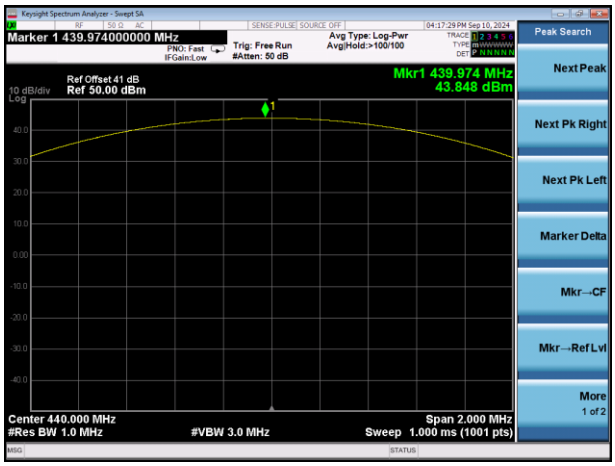
Test plots as follows:

GMSK 27W 6.25KHz Channel Spacing: Transmitter Power

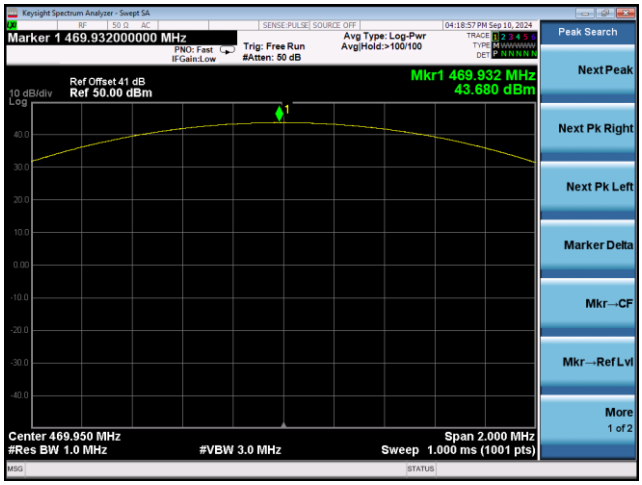
Low: 410.050MHz



Mid: 440.000MHz

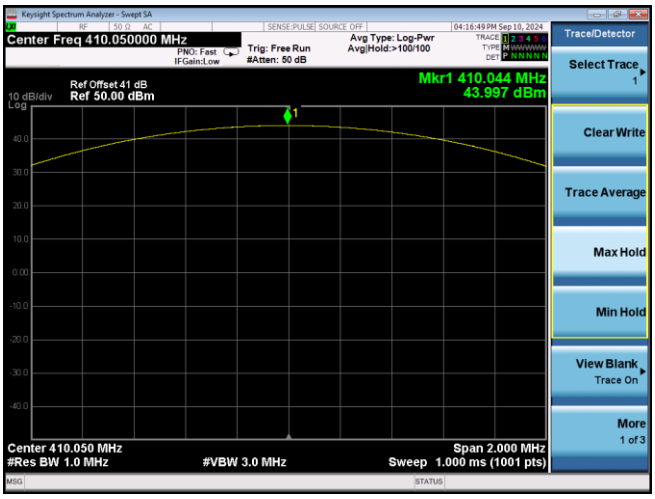


High: 470.00MHz

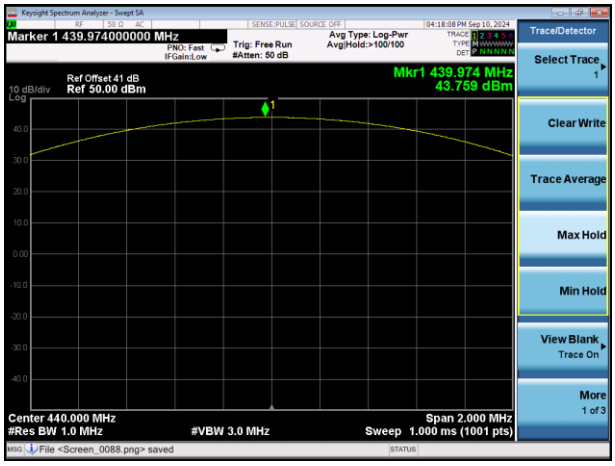


GMSK 27W 12.5KHz Channel Spacing: Transmitter Power

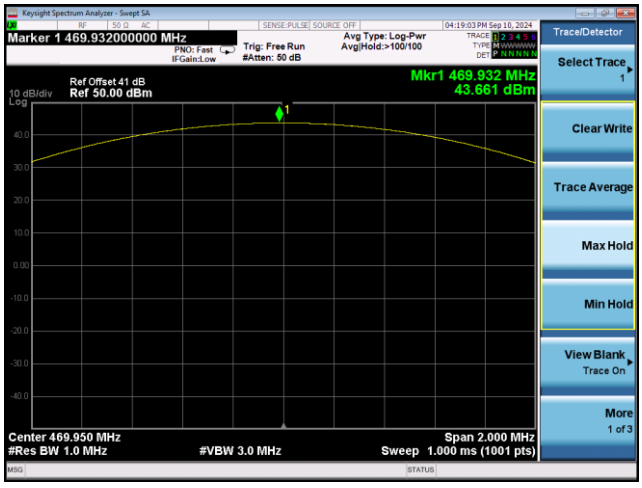
Low: 410.050MHz



Mid: 440.000MHz

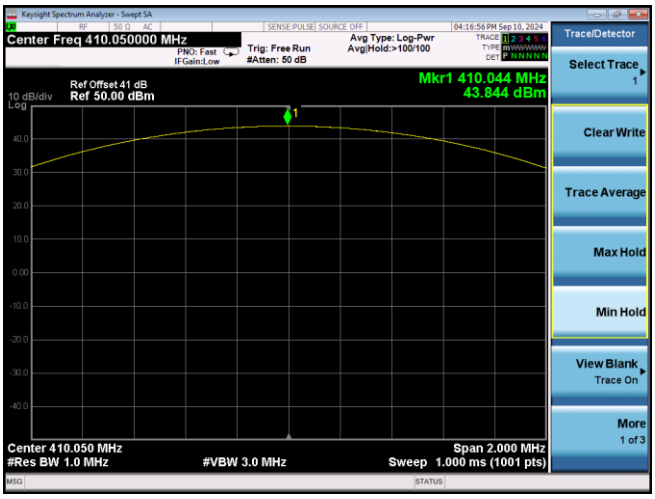


High: 470.00MHz

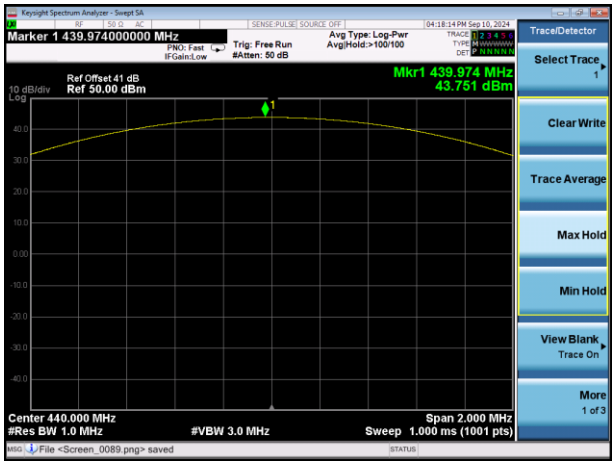


GMSK 27W 25KHz Channel Spacing: Transmitter Power

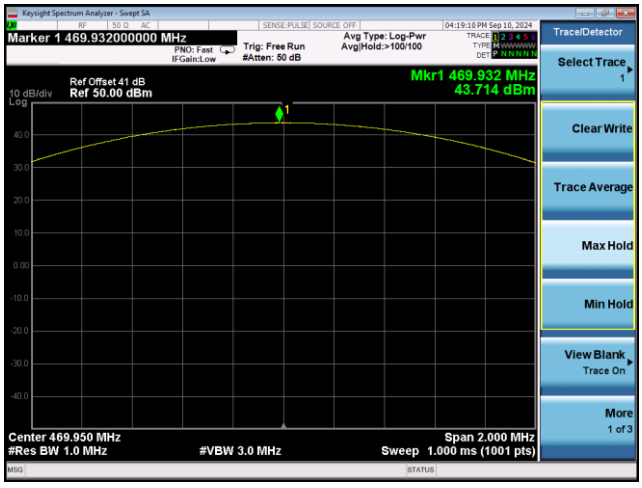
Low: 410.050MHz



Mid: 440.000MHz

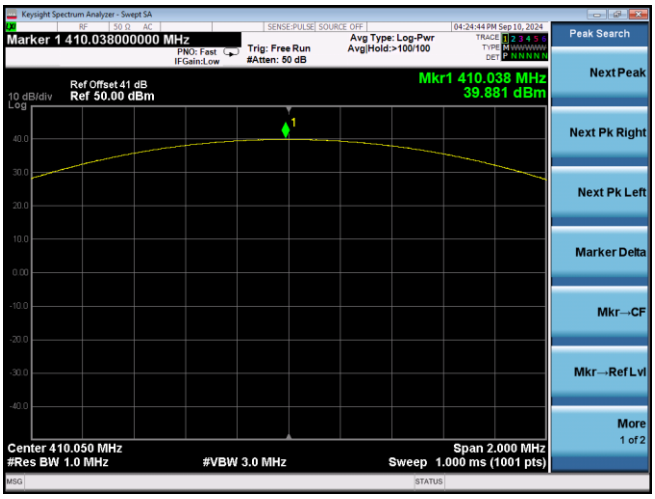


High: 470.00MHz

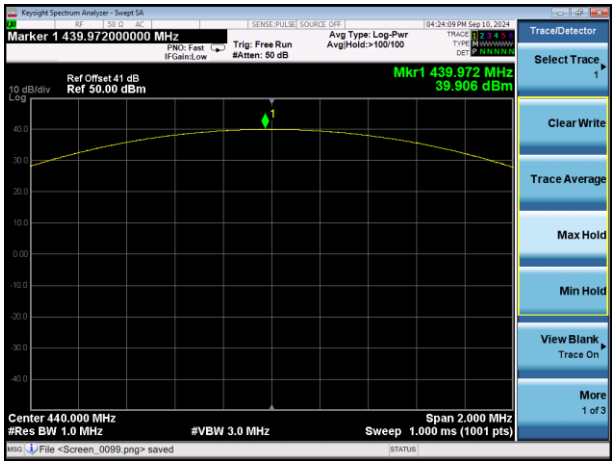


GMSK 11W 6.25KHz Channel Spacing: Transmitter Power

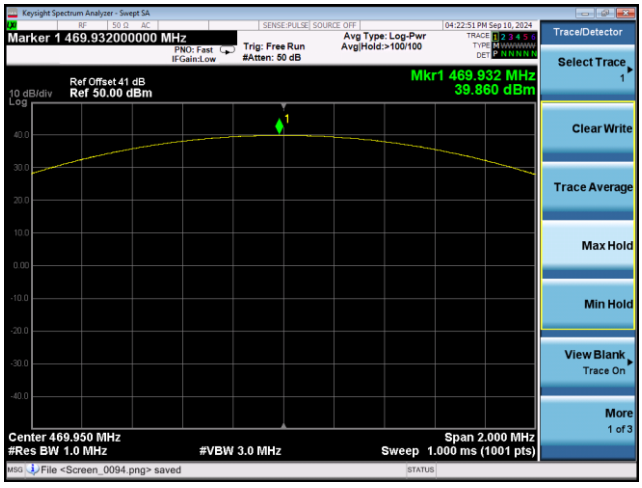
Low: 410.050MHz



Mid: 440.000MHz

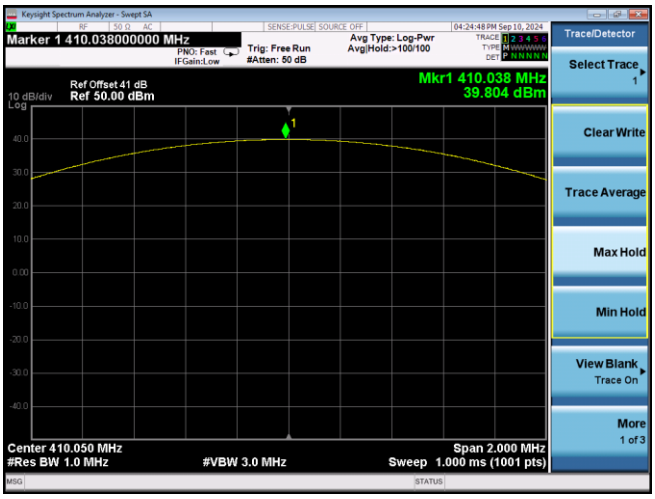


High: 470.00MHz

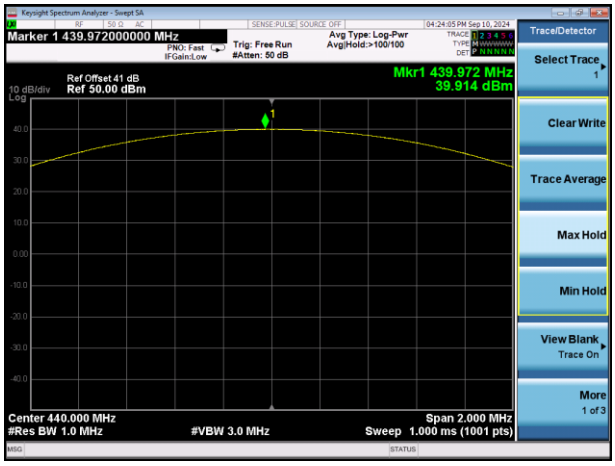


GMSK 11W 12.5KHz Channel Spacing: Transmitter Power

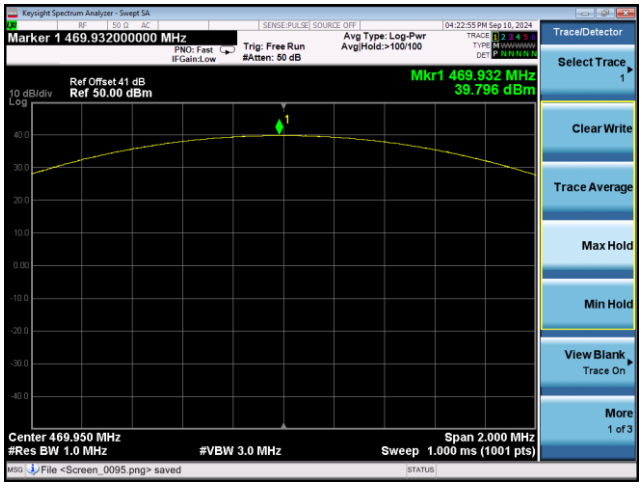
Low: 410.050MHz



Mid: 440.000MHz

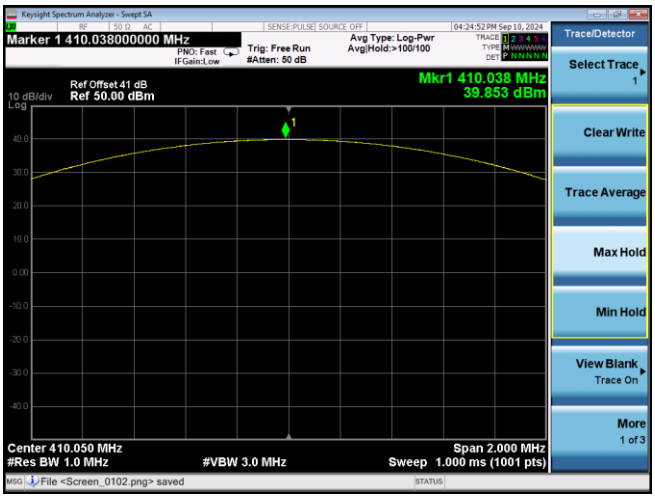


High: 470.00MHz

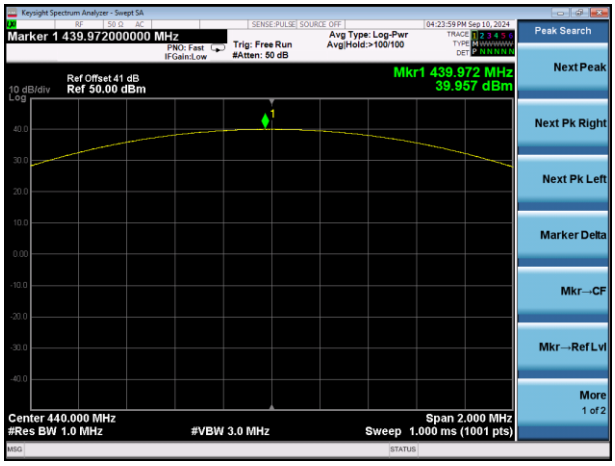


GMSK 11W 25KHz Channel Spacing: Transmitter Power

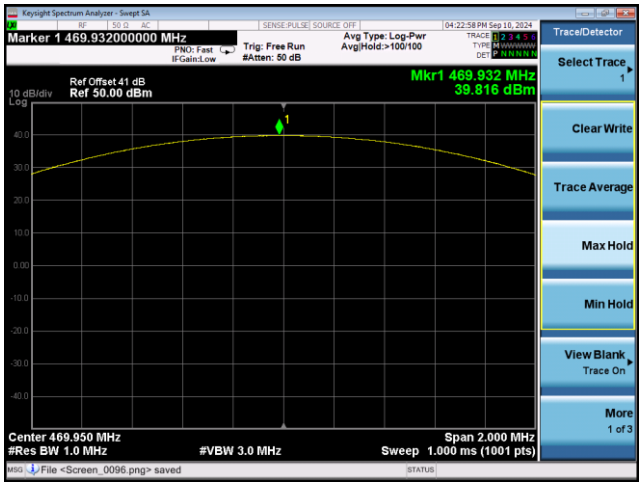
Low: 410.050MHz



Mid: 440.000MHz

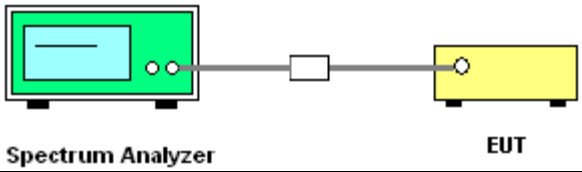


High: 470.00MHz



3.2. Occupied Bandwidth and Emission Mask

3.2.1.Test Specification

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

3.2.2.Test data

Occupied Bandwidth:

GMSK mode (27W) 6.25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	2.893	2.101	6	PASS
Mid	440.000	2.831	2.110	6	PASS
High	469.950	2.905	2.103	6	PASS

GMSK mode (27W) 12.5KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	6.150	4.934	11.25	PASS
Mid	440.000	6.081	4.924	11.25	PASS
High	469.950	6.107	4.941	11.25	PASS

GMSK mode (27W) 25KHz Channel Spacing:					
Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	11.61	9.820	20	PASS
Mid	440.000	11.64	9.776	20	PASS
High	469.950	11.92	9.809	20	PASS

GMSK mode (11W) 6.25KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	2.881	2.111	6	PASS
Mid	440.000	2.882	2.098	6	PASS
High	469.950	2.905	2.078	6	PASS

GMSK mode (11W) 12.5KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	6.110	4.924	11.25	PASS
Mid	440.000	6.162	4.927	11.25	PASS
High	469.950	6.151	4.929	11.25	PASS

GMSK mode (11W) 25KHz Channel Spacing:

Channel	Frequency (MHz)	26dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)	99% Occupied Bandwidth Limit (KHz)	Result
Low	410.050	11.73	9.783	20	PASS
Mid	440.000	11.61	9.788	20	PASS
High	469.950	11.79	9.756	20	PASS

Emission Mask:

GMSK mode (27W) 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 mode (27W) 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

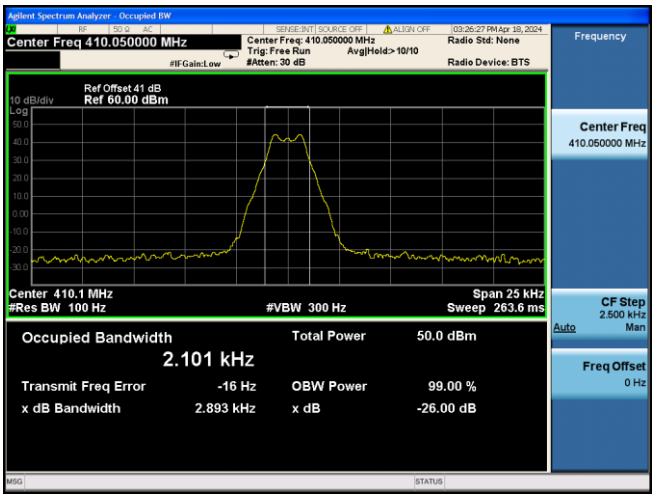
GMSK mode (27W) 25KHz Channel Spacing:

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

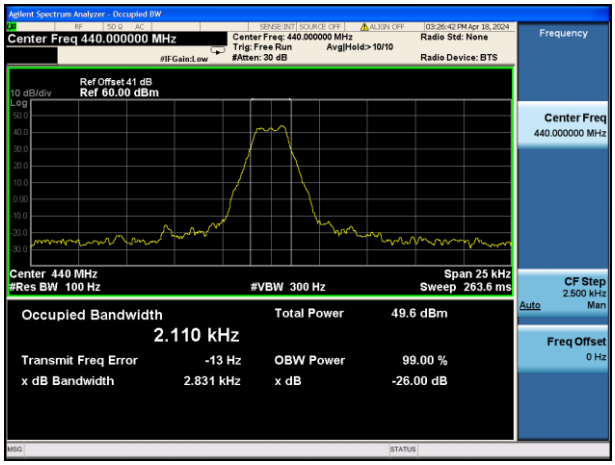
Test plots as follows:

GMSK mode (27W) 6.25KHz Channel Spacing: Occupied Bandwidth

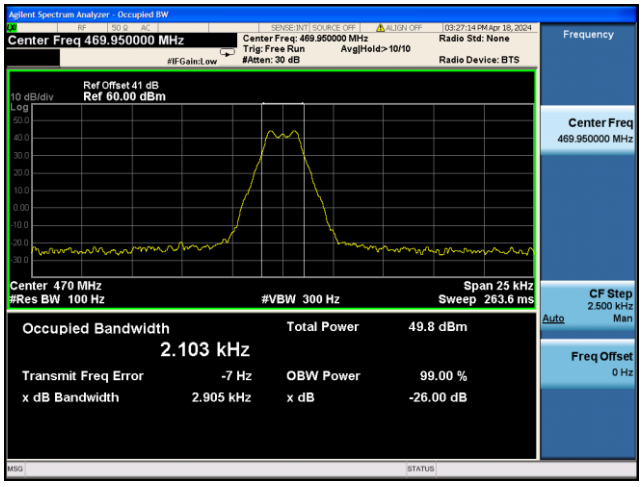
Low: 410.050MHz



Mid: 440.000MHz



High: 470.00MHz



GMSK mode (27W) 12.5KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz

Mid: 440.000MHz

High: 470.00MHz

GMSK mode (27W) 25KHz Channel Spacing: Occupied Bandwidth

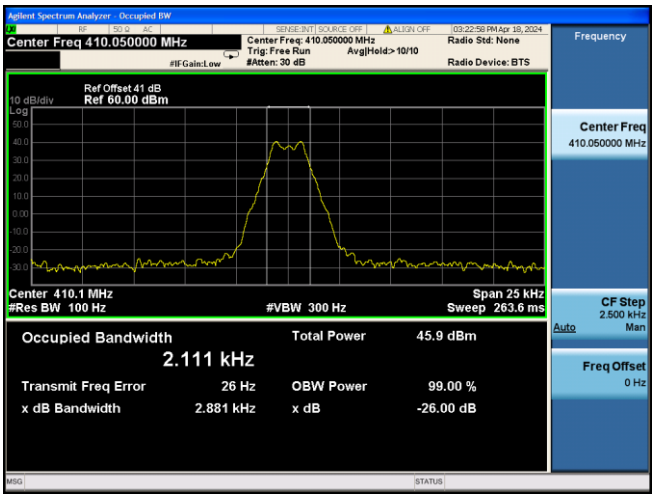
Low: 410.050MHz

Mid: 440.000MHz

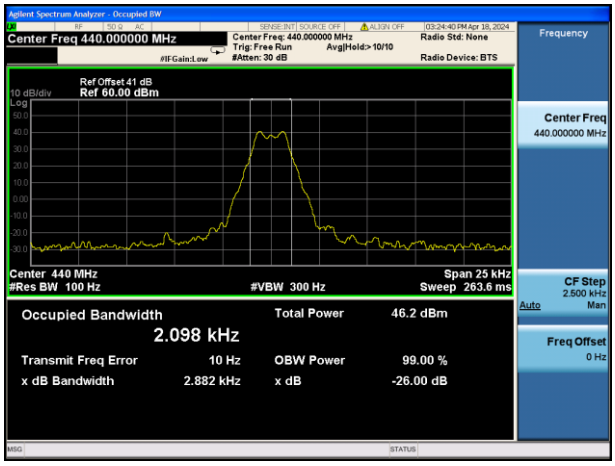
High: 469.850MHz

GMSK mode (11W) 6.25KHz Channel Spacing: Occupied Bandwidth

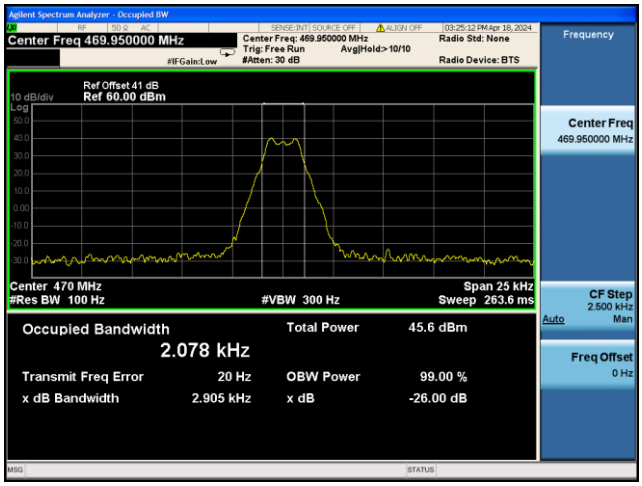
Low: 410.050MHz



Mid: 440.000MHz



High: 470.00MHz



GMSK mode (11W) 12.5KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz

Mid: 440.000MHz

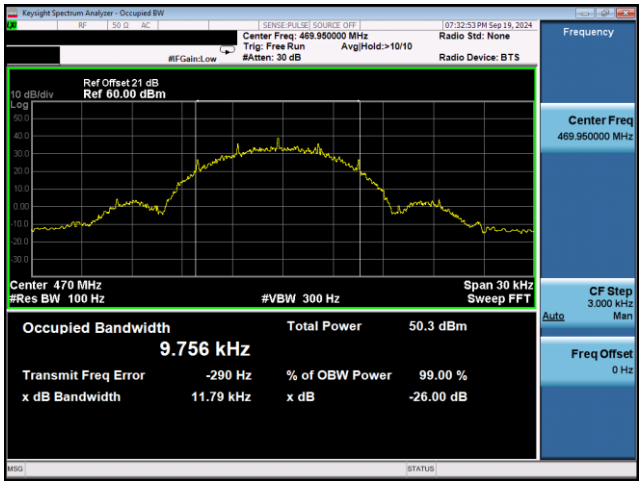
High: 470.00MHz

GMSK mode (11W) 25KHz Channel Spacing: Occupied Bandwidth

Low: 410.050MHz

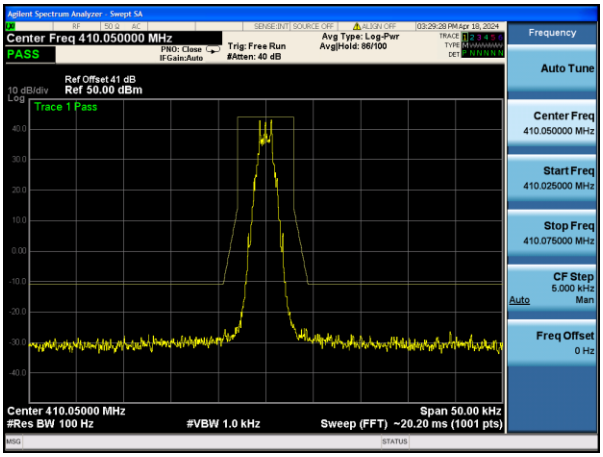
Mid: 440.000MHz

High: 469.850MHz

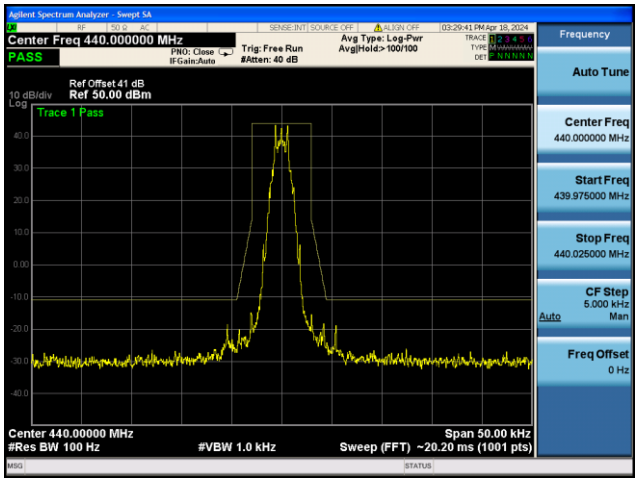


GMSK mode (27W) 6.25KHz Channel Spacing: **Emission Mask**

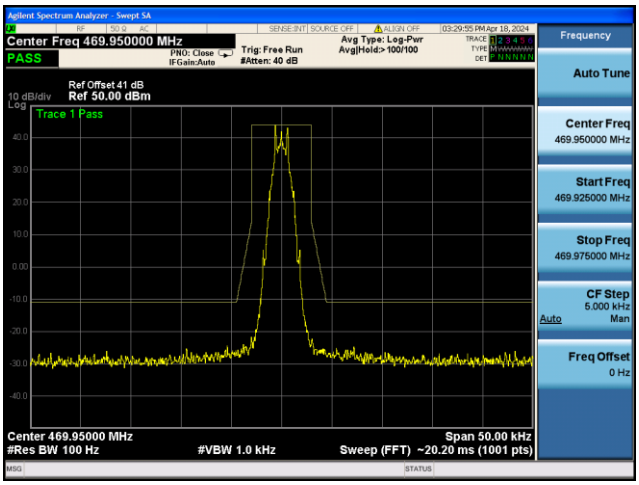
Low: 410.050MHz



Mid: 440.000MHz

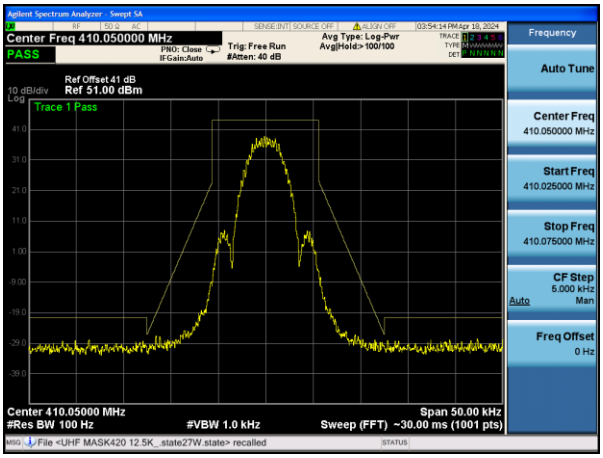


High: 469.950MHz

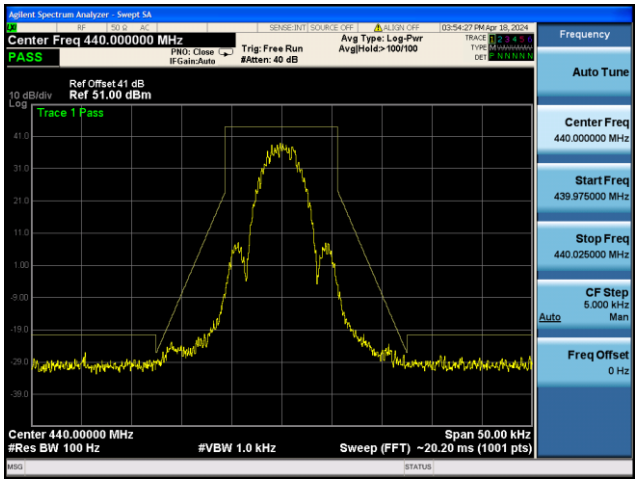


GMSK mode (27W) 12.5KHz Channel Spacing: **Emission Mask**

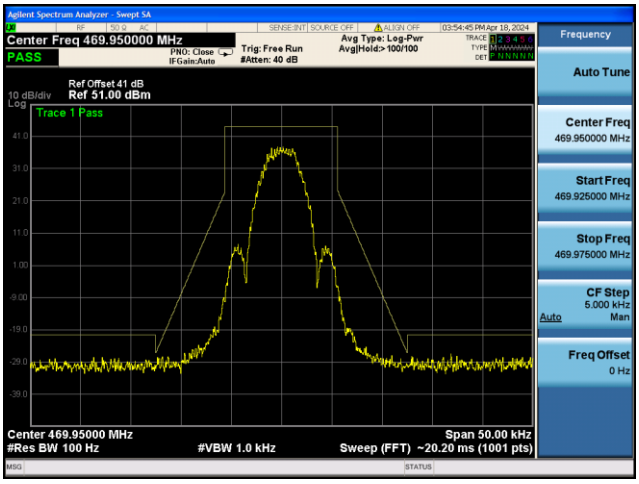
Low: 410.050MHz



Mid: 440.000MHz

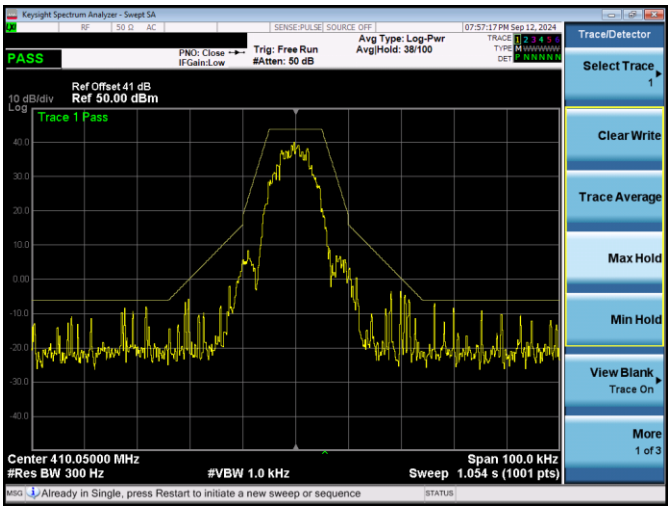


High: 469.950MHz

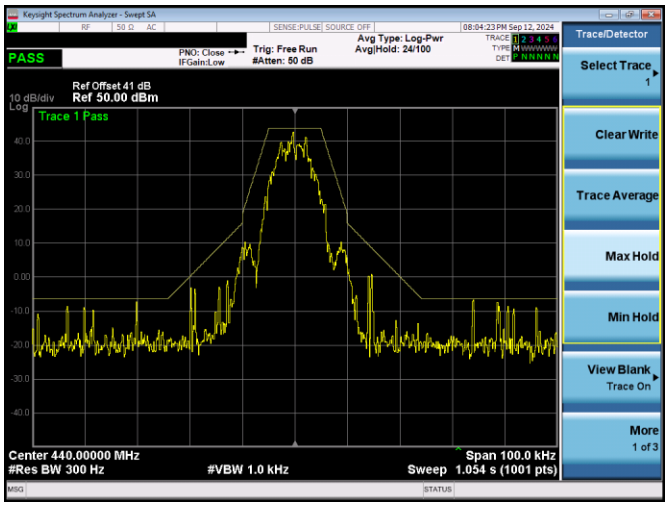


GMSK mode (27W) 25KHz Channel Spacing: **Emission Mask**

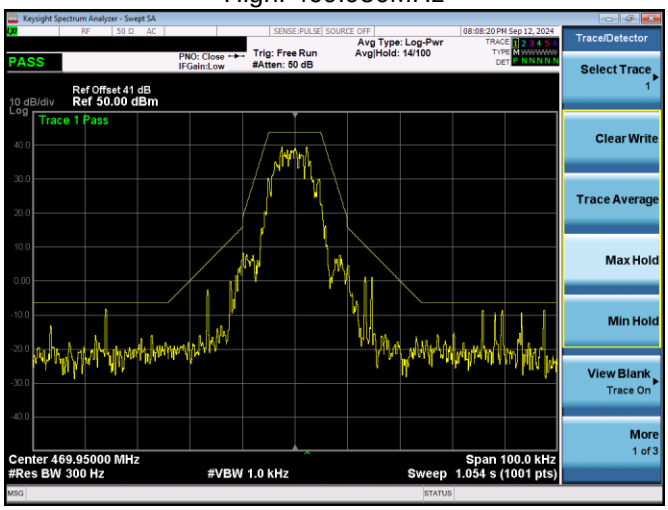
Low: 410.050MHz



Mid: 440.000MHz



High: 469.950MHz



3.3. Spurious Emissions(conducted)

3.3.1.Test Specification

Test Requirement:	FCC Part 90.210
Test Setup:	
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 (fd in kHz) of more than 4.6 kHz at least: 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation. 55 + 10 log (Pwatts) = 55 + 10 log (27) =69.313 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 44.31 dBm for High rated power. High: Limit (dBm) = 44.31 – 65 = -20.69 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) dB or 70 dB, whichever is the lesser attenuation. 50 + 10 log (Pwatts) = 50 + 10 log (27) =64.313 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 44.31 dBm for High rated power. Limit (dBm) = 44.31 – 50 – 10log (27) = -20 dBm For 25 kHz bandwidth: On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 62.5 kHz at least: 43 + 10 log (Pwatts) = 43 + 10 log (27) = 14.313 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 44.31 dBm for High rated power. Limit (dBm) = 44.31 – 43 – 10log (27) = -13 dBm Note: 1. In general, the worst case attenuation requirement shown above was applied. For emission inside from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of channel spacing, emission mask limit should be compliant. 2. The measurement frequency range from 9 KHz to 5 GHz. 3. *** means that the emission level is too low to be measured or at least 20 dB down than the limit.

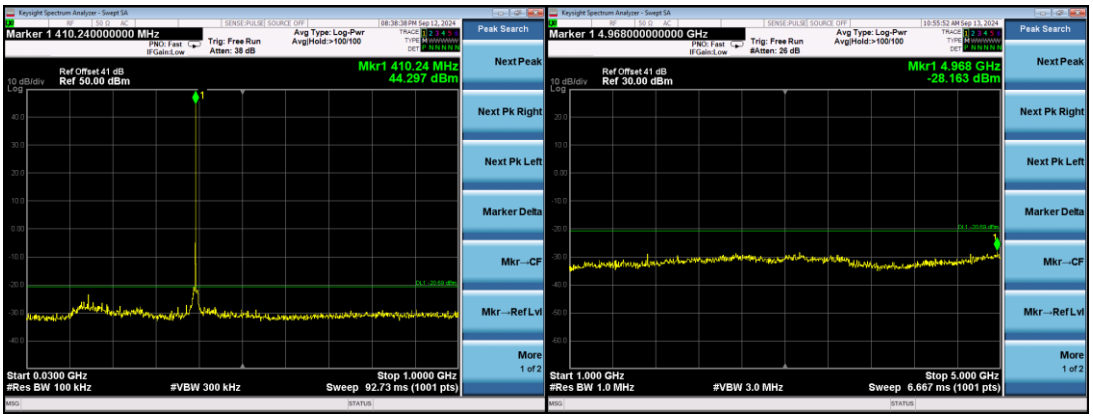
	4. ERP for below 1GHz and EIRP above 1GHz.
Test Result:	PASS

3.3.2.Test data

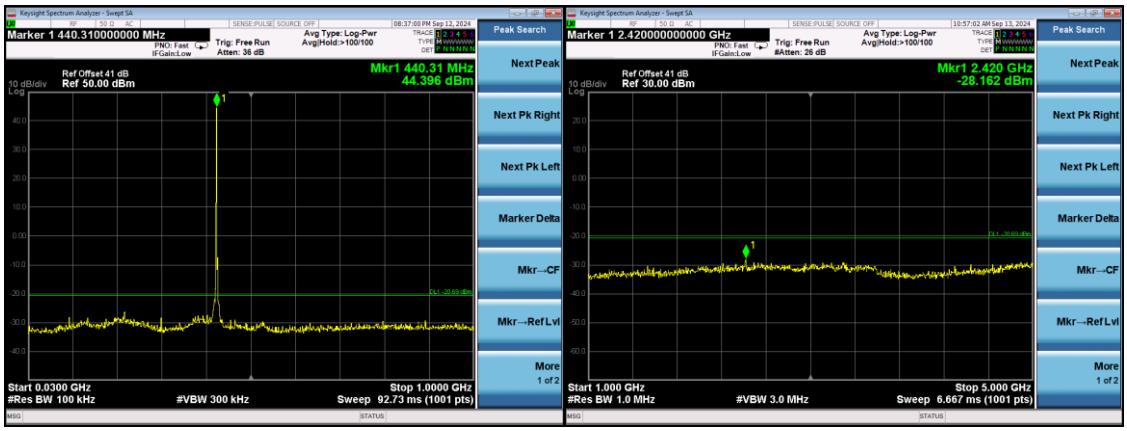
Test plots as follows:

GMSK 6.25KHz Channel Spacing:

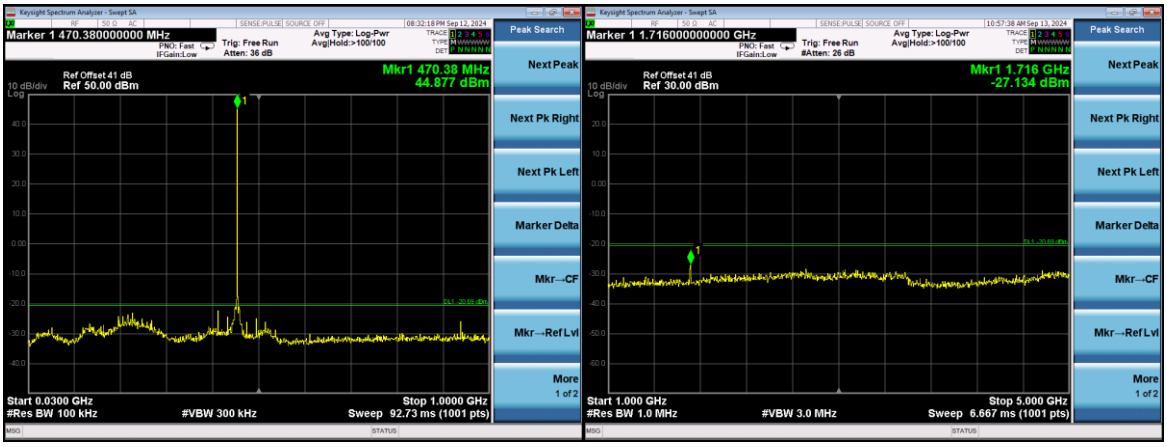
Low: 410.050MHz



Mid: 440.000MHz



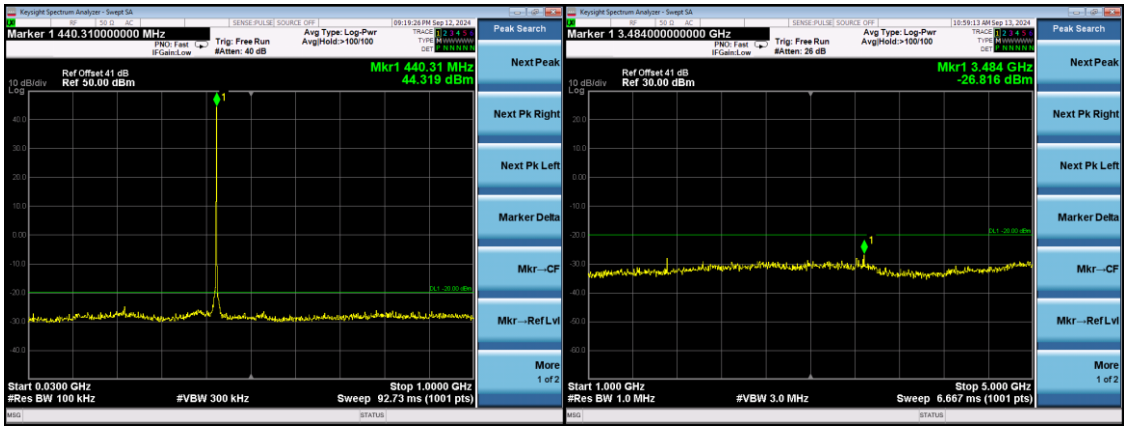
High: 469.950MHz



GMSK 12.5KHz Channel Spacing:

Low: 410.050MHz

Mid: 440.000MHz



High: 469.950MHz