RF Test Report

For

Applicant Name:	**Shanghai AllyNav Technology Co.,Ltd.**
Address:	Room 201, Buliding 1,No 215, Gaoguang RD, Qingpu District, Shanghai, China
EUT Name:	GNSS Receiver
Brand Name:	STEC
Model Number:	R90
Series Model Number:	R26pro, R27
FCC ID:	2AT4H-R90

Issued By

Company name:	**BTF Testing Lab (Shenzhen) Co., Ltd.**
Address:	Plant 101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, Guangdong, China
Report number:	BTF260305R00401
Test standards:	FCC CFR Title 47 Part 90
Test conclusion:	Pass
Date of sample receipt:	2026-03-05
Test date:	2026-03-06 to 2026-03-19
Date of issue:	2026-03-20
Test by:	Sean He / Tester
Prepared by:	Chris Liu/ Project engineer
Approved by:	Ryan.CJ /EMC manager

Note: All the test results in this report only related to the testing samples. Which can be duplicated completely for the legal use with approval of applicant; it shall not be reproduced except in full without the written approval of BTF Testing Lab (Shenzhen) Co., Ltd., All the objections should be raised within thirty days from the date of issue. To validate the report, you can contact us.

Revision History		
Version	Issue Date	Revisions Content
R_V0	2026-03-20	Original

BTF Testing Lab (Shenzhen) Co., Ltd.
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BTF Testing Lab (Shenzhen) Co., Ltd.
Plant 101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, Guangdong, China

1 Introduction

1.1 Laboratory Location

Test location:	BTF Testing Lab (Shenzhen) Co., Ltd.
Address:	Plant 101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, Guangdong, China
Phone number:	+86-0755-23146130
Fax number:	+86-0755-23146130

1.2 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Designation No.: CN1409**

  BTF Testing Lab (Shenzhen) Co., Ltd. has been accredited as a testing laboratory by FCC (Federal Communications Commission). The test firm Registration No. is 695374.

- **CNAS - Registration No.: CNAS L17568**

  BTF Testing Lab (Shenzhen) Co., Ltd. is accredited to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L17568.

- **A2LA - Registration No.: 6660.01**

  BTF Testing Lab (Shenzhen) Co., Ltd. is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories.

1.3 Announcement

(1) The test report reference to the report template version v0.
(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
(3) The test report is invalid if there is any evidence and/or falsification.
(4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
(6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 Product Information

2.1 Application Information

Company Name:	Shanghai AllyNav Technology Co.,Ltd.
Address:	Room 201, Buliding 1,No 215, Gaoguang RD, Qingpu District, Shanghai, China

2.2 Manufacturer Information

Company Name:	Shanghai AllyNav Technology Co.,Ltd.
Address:	Room 201, Buliding 1,No 215, Gaoguang RD, Qingpu District, Shanghai, China

2.3 Factory Information

Company Name:	Shanghai AllyNav Technology Co.,Ltd.
Address:	Room 201, Buliding 1,No 215, Gaoguang RD, Qingpu District, Shanghai, China

2.4 General Description of Equipment under Test (EUT)

EUT name	GNSS Receiver
Under test model name	R90
Series model name	R26pro, R27
Description of model name differentiation	Just the model name is different, everything else is the same
Hardware Version	V1.0
Software Version	V1.0
Rating:	Adapter: Model: XYY-PD45CA Input : 100-240V~50/60Hz 1 A Output: TYPE-C:5V⎓3A/9V⎓3A/12.0V⎓3.0A/15.0V⎓3.0A/20.0V⎓2.25A OUTPUT:C+A:30W+5V⎓2.4A Battery:DC 7.4V 7000mAh 51.8Wh

2.5 Technical Information

Operation frequency:	450MHz-470MHz
Channel separation:	12.5kHz
Modulation technology:	4FSK, π/4 BPSK
Max. ERP Power:	29.05 dBm (Declare power：30dBm)
Antenna type:	External antenna
Antenna gain:	4.0 dBi (declare by Applicant)
Antenna transmit mode:	SISO (1TX, 1RX)

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3 Summary of Test Results

3.1 Test Standards

The tests were performed according to following standards:
FCC 47 CFR Part 90 : Private Land Mobile Radio Services.
FCC Part 2 : Frequency allocations and radio treaty matters, general rules and regulations.
ANSI TIA-102.CAAA-E: Project 25 Digital C4FM/CQPSK Transceiver Measurement Methods
ANSI C63.26: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
KDB 971168 D01： KDB 971168 D01 Power Meas License Digital Systems v03r01
KDB 579009 D03： KDB 579009 D03 Applications Part 90 Refarming Bands v01
KDB 634817 D01： KDB 634817 D01 Freq Range Listing for Grants v04r01

3.2 Uncertainty of Test

Measurement	Value
Occupied Channel Bandwidth	±5 %
Supply voltages	±3 %
Time	±5 %
Conducted Emission for LISN (9kHz ~ 150kHz)	±2.97 dB
Conducted Emission for LISN (150kHz ~ 30MHz)	±2.45 dB
Radiated Emission (30MHz ~ 1000MHz)	±4.80 dB
Radiated Emission (1GHz ~ 18GHz)	±4.82 dB
Modulation Limiting	0.42 %
Audio level	±0.98dB
Audio Frequency Response	6.8 %
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

3.3 Summary of Test Result

Item	FCC Rules	Description Of Test	Result
1	47 CFR FCC PART 90	Antenna Equipment	Pass
2	§90.205& 2.1046	Maximum Transmitter Power	Pass
3	§90.207& 2.1047	Modulation Characteristic	N/A
4	§2.1047	Audio Low Pass Filter Response	N/A
5	§90.209& 2.1049	*26dB Emission Bandwidth and* 99% Occupied Bandwidth	Pass
6	§90.210& 2.1049	Emission Mask	Pass
7	§90.213& 2.1055	Frequency Tolerance	Pass
8	§90.214	Transmitter Frequency Behavior	Pass
9	§90.210& 2.1051	Spurious Emission on Antenna Port	Pass

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10	§90.210& 2.1053	Spurious Radiated Emission	Pass

4 Test Configuration

4.1 Test Equipment List

Radiated Emission Test					
Test Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
EMI Receiver	Rohde & Schwarz	ESCI7	101032	2025/10/17	2026/10/16
Signal Analyzer	Rohde & Schwarz	FSQ40	100010	2025/10/17	2026/10/16
Log periodic antenna	Schwarzbeck	VULB 9168	01328	2025/10/18	2026/10/17
Preamplifier (30MHz ~ 1GHz)	Schwarzbeck	BBV9744	00246	2025/5/26	2026/5/25
BELOW-Cable	REBES Talent	9K1G	21101576	2025/8/23	2026/8/22
Horn Antenna	Schwarzbeck	BBHA9120D	2597	2025/10/18	2026/10/17
Preamplifier (1GHz ~ 18GHz)	Schwarzbeck	BBV9718D	00008	2025/5/26	2026/5/25
Preamplifier	TSTPASS	LNA10180G45	TS2215007	2025/5/26	2026/5/25
ABOVE-Cable	REBES Talent	1~18G	21101558	2025/8/23	2026/8/22
Horn Antenna	SCHWARZBECK	BBHA9170	1157	2025/10/18	2026/10/17
Low Noise Pre-amplifier	Sket	LNPA_1840G-50	SK2022032902	2025/10/17	2026/10/16
ABOVE-Cable2	REBES Talent	18~40G	21101686	2025/8/23	2026/8/22
ABOVE-Cable1	REBES Talent	18~40G	21101687	2025/8/23	2026/8/22
Test Software	Frad	EZ_EMC	Version: FA-03A2 RE+		

Conducted test method					
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Cell Site Test Set	HP	8921A	US35010158	2025/10/17	2026/10/16
Spectrum Analyzer	Keysight	N9020A	MY50410020	2025/10/17	2026/10/16
ESG Vector Signal Generator	Agilent	E4438C	MY45094854	2025/10/17	2026/10/16
MXG Vector Signal Generator	Agilent	N5182A	MY46240163	2025/10/17	2026/10/16
Wideband Radio Communication Tester	Rohde&Schwarz	CMW500	161997	2025/10/17	2026/10/16
Programmable Constant Temperature And Humidity Test Chamber	ZZCKONG	ZZ-K02A	20210928007	2025/10/17	2026/10/16

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DC Power Supply	Tongmen	etm-6050c	20211026123	2025/10/17	2026/10/16
RF Control Unit	Techy	TR1029-1	/	2025/10/17	2026/10/16
RF Sensor Unit	Techy	TR1029-2	/	2025/10/17	2026/10/16
RF shielding box	Yinuoxin Electronics	50*50*50 cm	N/A	2025/5/26	2026/5/25
Test Software	TST Pass	/	Version: 2.0		

4.2 Test Auxiliary Equipment

Eut can work independently.

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4.3 Test Modes

No.	Test Modes	Description
1	TX Bottom channel-UHF	12.5 kHz
2	TX Middle channel-UHF	12.5 kHz
3	TX Top channel-UHF	12.5 kHz

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5 TEST CONDITIONS AND RESULTS

5.1 Frequency Stability

Test Requirement:	According to FCC Part 2 Section 2.1055(d)(2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacturer.
Test Limit:	According to FCC Part 90 Section 90.213, the frequency tolerance must be maintained within 0.00025% for 12.5 kHz channel separation and 0.0001% for 6.25 kHz channel separation.
Procedure:	**Frequency stability versus environmental temperature** 1. Setup the configuration per figure 1 for frequencies measurement inside an environment chamber, Install new battery in the EUT. 2. Turn on EUT and set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 1kHz and Video Resolution Bandwidth to 1kHz and Frequency Span to 50kHz.Record this frequency as reference frequency. 3. Set the temperature of chamber to 50℃. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency. 4. Repeat step 2 with a 10℃ decreased per stage until the lowest temperature -30℃ is measured, record all measured frequencies on each temperature step. **Frequency stability versus input voltage** 1. Setup the configuration per figure 1 for frequencies measured at temperature if it is within 15℃ to 25℃. Otherwise, an environment chamber set for a temperature of 20℃ shall be used. The EUT shall be powered by DC 7.4V. 2. Set SA center frequency to the EUT radiated frequency. Set SA Resolution Bandwidth to 1 kHz and Video Resolution Bandwidth to 1kHz. Record this frequency as reference frequency. 3. Supply the EUT primary voltage at the operating end point which is specified by manufacturer and record the frequency.

5.1.1 E.U.T. Operation:

Operating Environment:	
Temperature:	23 °C
Humidity:	45.4 %
Atmospheric Pressure:	1010 mbar
Test Voltage:	

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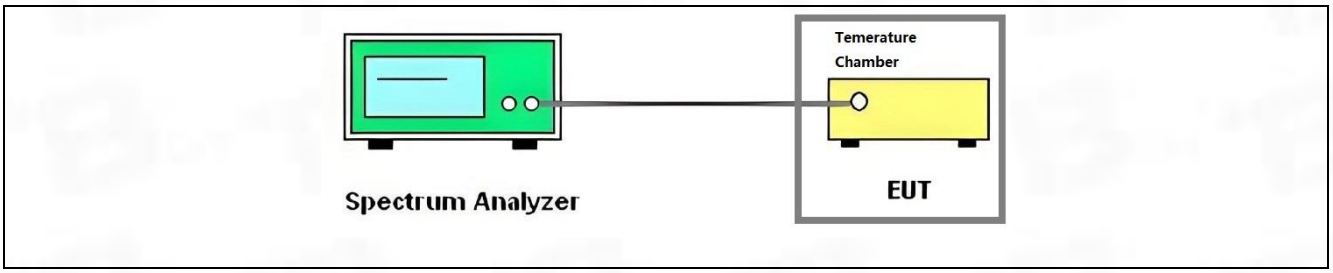
5.1.2 Test Setup Diagram:



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5.1.3 Test Data:

12.5 kHz Channel Separation, Analog modulation, Assigned Frequency For UHF-1W						
Test conditions		Frequency error (ppm)			Limit (ppm)	Result
Voltage (V)	Temp (℃)	Test Frequency (MHz)				
		450.125	460.125	469.125		
7.40	-30	0.601	0.553	0.869	2.5	Pass
	-20	0.939	0.852	0.418		
	-10	0.87	0.986	0.717		
	0	0.52	0.492	0.491		
	10	0.411	0.958	0.767		

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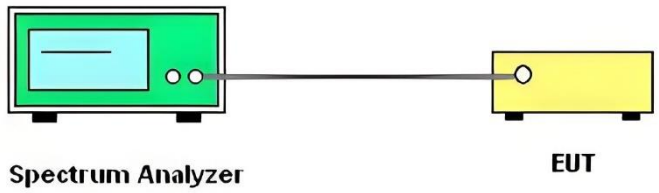
5.2 26dB Emission Bandwidth and 99% Occupied Bandwidth

Test Requirement:	FCC Part 90.209 & FCC Part 2.1049
Test Limit:	The authorized bandwidth shall be 11.25 kHz for 12.5 kHz channel separation and 6 kHz for 6.25 kHz channel separation
Procedure:	1. The EUT was modulated by 2.5kHz sine wave audio signal; the level of the audio signal employed is 16dB greater than that necessary to produce 50% of rated system deviation. 2. Rated system deviation is 2.5 kHz for 12.5kHz channel spacing. 3. Spectrum set as follow: 4. Centre frequency = fundamental frequency. 5. Span=50kHz for 12.5kHz channel spacing. 6. RBW=100Hz, VBW=300Hz, Sweep = auto. 7. Detector function = peak, Trace = max hold. 8. Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth. 9. Measure and record the results in the test report.

5.2.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.2.2 Test Setup Diagram:



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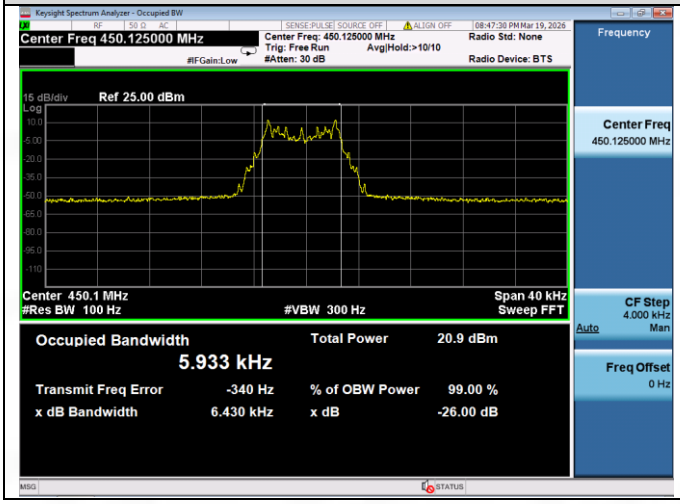
5.2.3 Test Data:

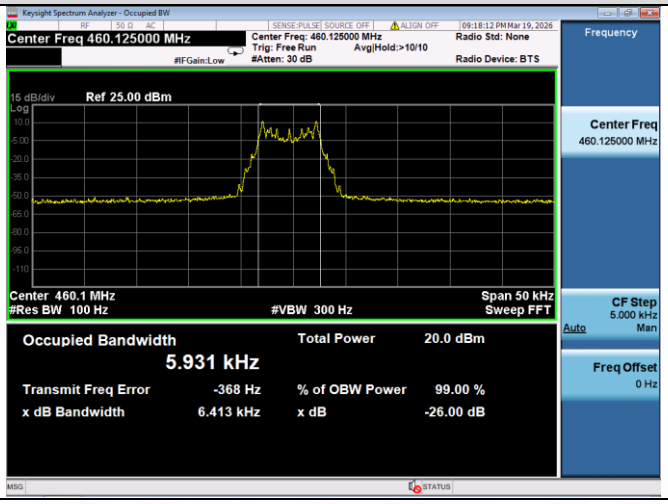
Measurement Result of UHF-Digital Modulation-1W				
Operating Frequency	12.5 kHz Channel Separation			
	Occupied Bandwidth	Emission Bandwidth	Limits	Result
450.125MHz	5.933 kHz	6.430 kHz	11.25 kHz	Pass
460.125MHz	5.931 kHz	6.413 kHz	11.25 kHz	Pass
469.125MHz	5.934 kHz	6.418 kHz	11.25 kHz	Pass

Test plot as follows:

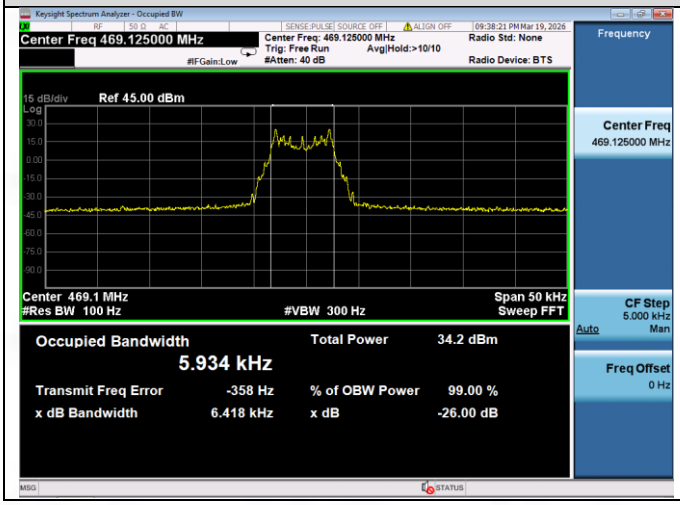
12.5kHz, 4FSK Modulation:450.125MHz-1W



12.5kHz, 4FSK Modulation:460.125MHz-1W



12.5kHz, 4FSK Modulation:469.125MHz-1W



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5.3 Emission Mask

Test Requirement:	According to FCC §2.1053 and §90.210
Test Limit:	the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with each channel separation. Emission Mask D -for 12.5 kHz Channel Separation: (1) On any frequency removed from the center of the authorized bandwidth fo to 5.625 kHz removed from fo: Zero dB. (2) On any frequency removed from the center of the authorized bandwidth by a displacement Frequency (fd in kHz) fo of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27*(fd-2.88 kHz) dB (3) On any frequency removed from the center of the authorized bandwidth by a displacement Frequency (fd in kHz)fo of more than 12.5 kHz: At least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.
Procedure:	1. On a test site, the EUT shall be placed on a turntable, and in the position closest to the normal use as declared by the user. 2. The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the transmitter. 3. The output of the antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit. 4. The transmitter shall be switched on; if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test. 5. The test antenna shall be raised and lowered through the specified range of height until the measuring receiver detects a maximum signal level. 6. The transmitter shall than be rotated through 360°in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 7. The test antenna shall be raised and lowered again through the specified range of height until the measuring receiver detects a maximum signal level. 8. The maximum signal level detected by the measuring receiver shall be noted. 9. The measurement shall be repeated with the test antenna set to horizontal polarization. 10. (Replace the antenna with a proper Antenna (substitution antenna). 11. The substitution antenna shall be oriented for vertical polarization and, if necessary, the length of the substitution antenna shall be adjusted to correspond to the frequency of transmitting. 12. The substitution antenna shall be connected to a calibrated signal generator. 13. If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver. 14. The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received. 15. The input signal to substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuation setting of the measuring receiver. 16. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver. 17. The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

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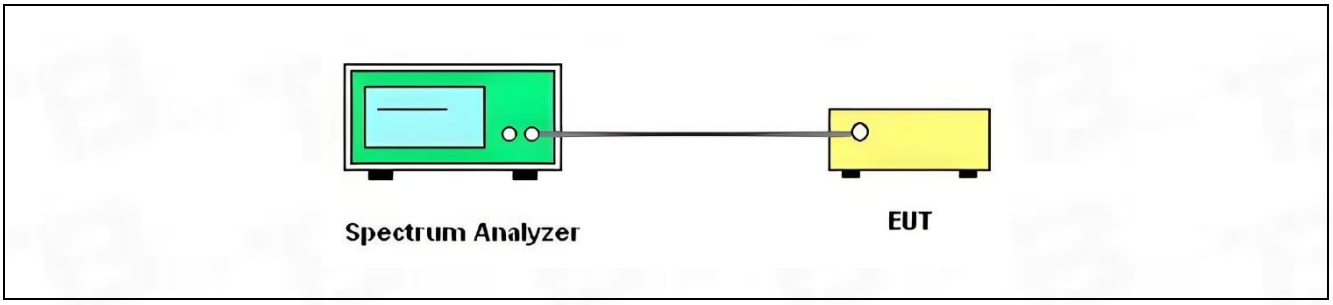
5.3.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

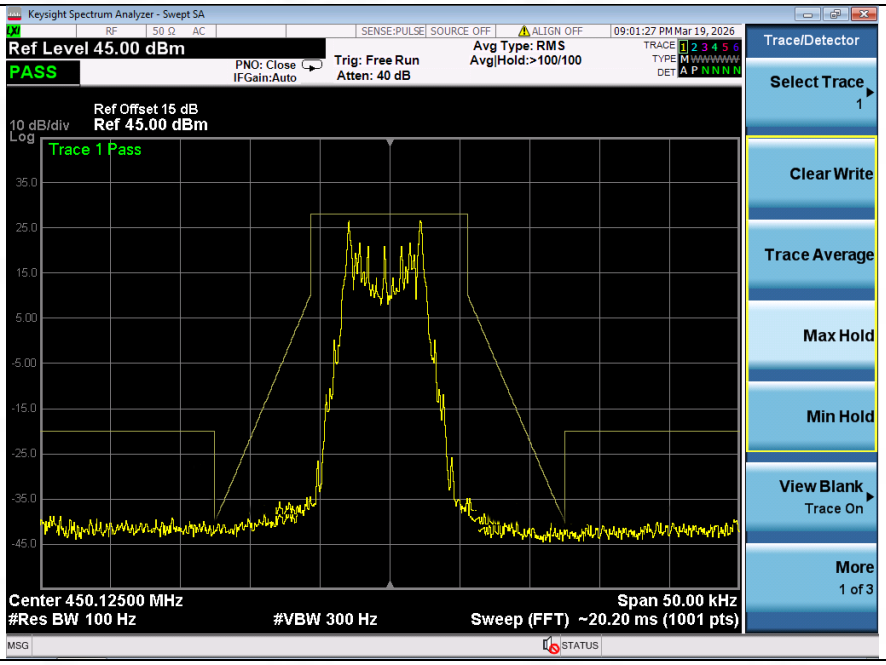
5.3.2 Test Setup Diagram:



5.3.3 Test Data:

Test Graph

450.125MHz



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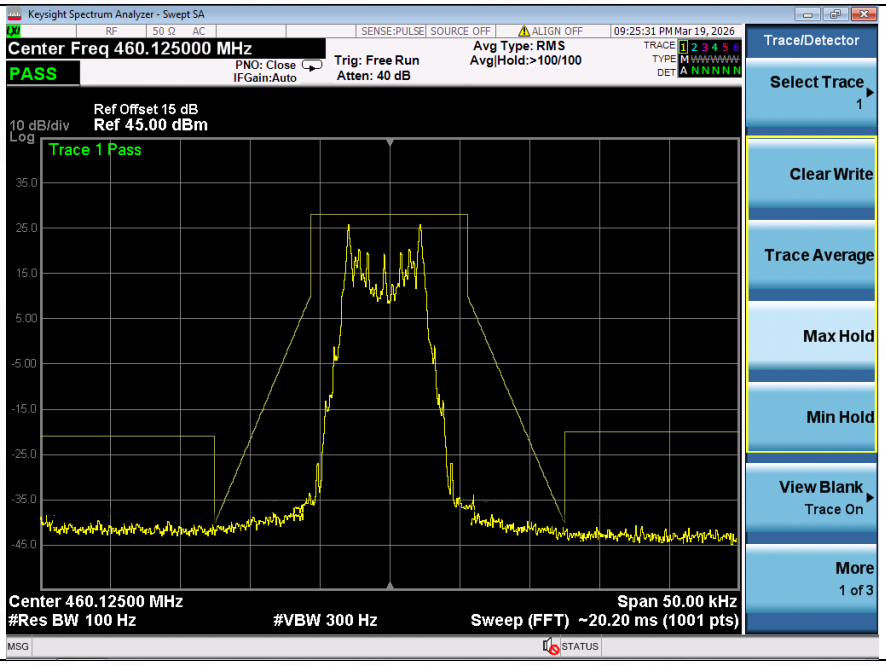
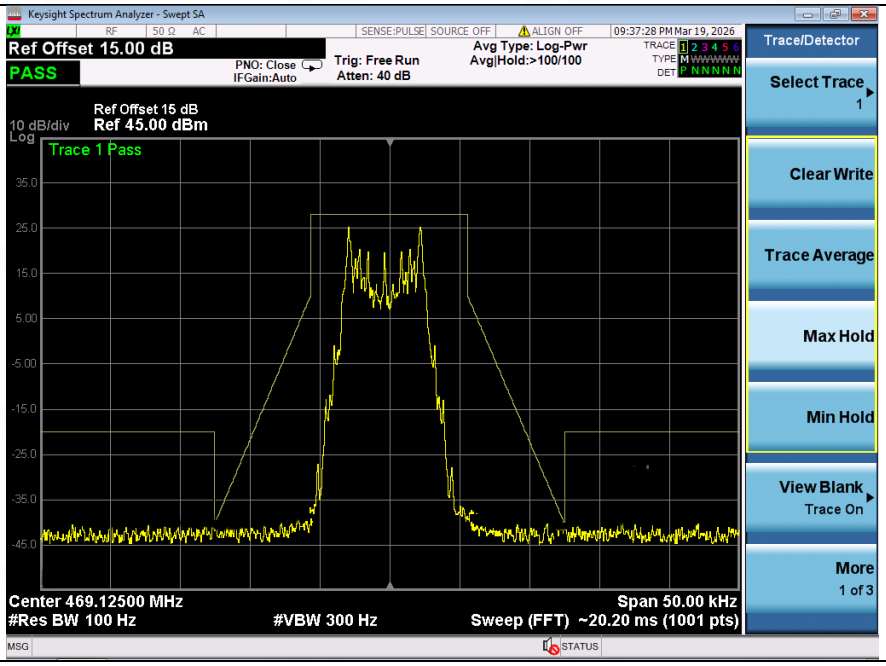
460.125MHz



469.125MHz



Test Result:PASS

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5.4 Transmitter Radiated Spurious Emission

Test Requirement:	FCC §2.1053 and §90.210,
Test Limit:	On any frequency removed from the center of the authorized bandwidth by a displacement Frequency (fd in kHz)fo of more than 12.5 kHz: At least 50+10 log(P) dB or 70 dB, whichever is lesser attenuation.
Procedure:	1. On a test site, the EUT shall be placed on a turntable, and in the position closest to the normal use as declared by the user. 2. The test antenna shall be oriented initially for vertical polarization located 3m from the EUT to correspond to the transmitter. 3. The output of the antenna shall be connected to the measuring receiver and either a peak or quasi-peak detector was used for the measurement as indicated on the report. The detector selection is based on how close the emission level was approaching the limit. 4. The transmitter shall be switched on; if possible, without the modulation and the measurement receiver shall be tuned to the frequency of the transmitter under test. 5. The test antenna shall be raised and lowered through the specified range of height until the measuring receiver detects a maximum signal level. 6. The transmitter shall than be rotated through 360°in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 7. The test antenna shall be raised and lowered again through the specified range of height until the measuring receiver detects a maximum signal level. 8. The maximum signal level detected by the measuring receiver shall be noted. 9. The measurement shall be repeated with the test antenna set to horizontal polarization. 10. (Replace the antenna with a proper Antenna (substitution antenna). 11. The substitution antenna shall be oriented for vertical polarization and, if necessary, the length of the substitution antenna shall be adjusted to correspond to the frequency of transmitting. 12. The substitution antenna shall be connected to a calibrated signal generator. 13. If necessary, the input attenuator setting of the measuring receiver shall be adjusted in order to increase the sensitivity of the measuring receiver. 14. The test antenna shall be raised and lowered through the specified range of the height to ensure that the maximum signal is received. 15. The input signal to substitution antenna shall be adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuation setting of the measuring receiver. 16. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver. 17. The measurement shall be repeated with the test antenna and the substitution antenna oriented for horizontal polarization.

5.4.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

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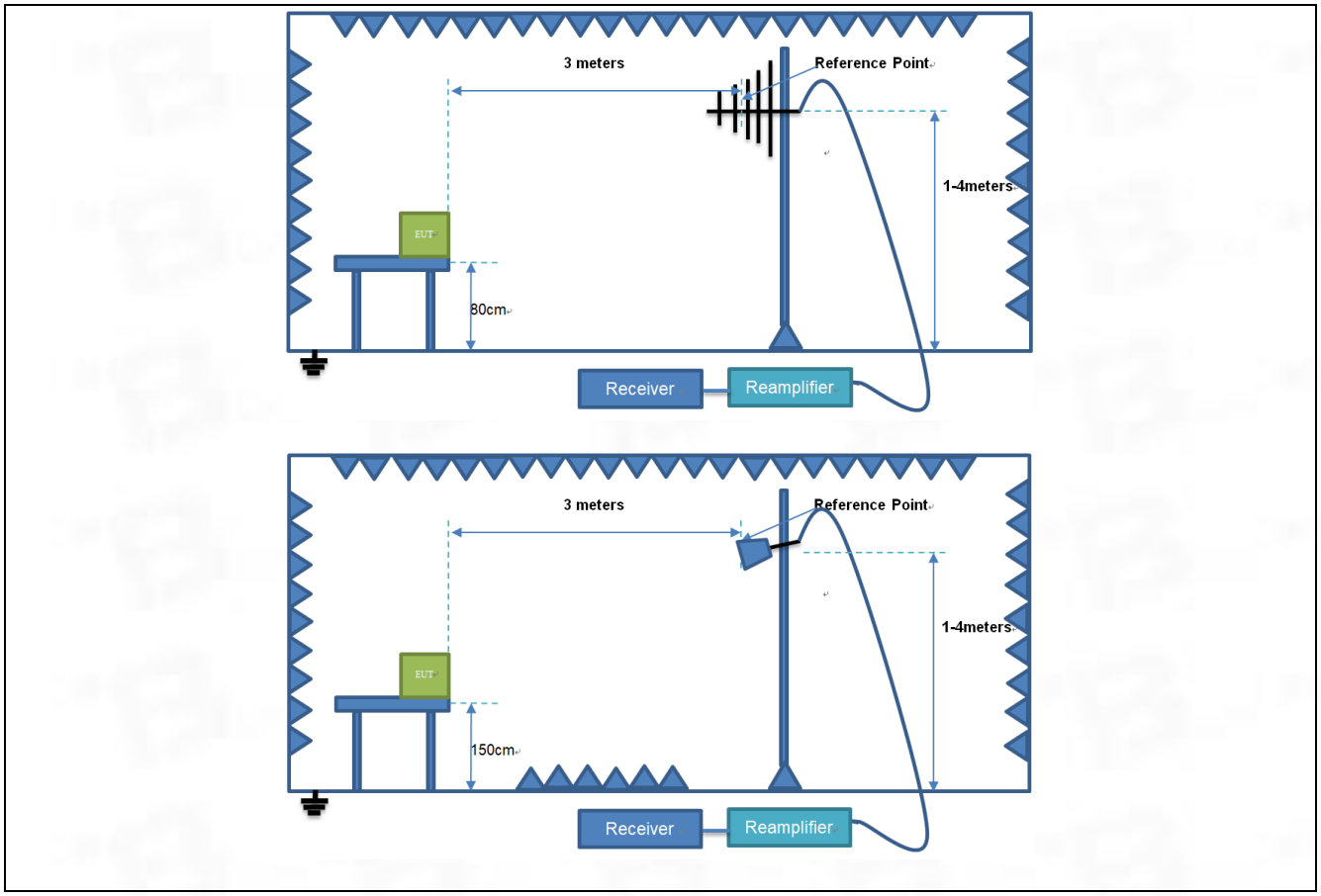
5.4.2 Test Setup Diagram:



5.4.3 Test Data:

450.125MHz						
Frequency (MHz)	Read Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
900.25	-56.92	17.88	-39.04	-20	-19.04	Horizontal
1350.375	-32.52	-8.01	-40.53	-20	-20.53	Horizontal
1800.5	-30.1	-3.09	-33.19	-20	-13.19	Horizontal
2250.625	-18.87	-16.09	-34.96	-20	-14.96	Horizontal
900.25	-63.05	17.88	-45.17	-20	-25.17	Vertical
1350.375	-33.98	-8.01	-41.99	-20	-21.99	Vertical
1800.5	-29.16	-3.09	-32.25	-20	-12.25	Vertical
2250.625	-17.53	-16.09	-33.62	-20	-13.62	Vertical
460.125MHz						
Frequency (MHz)	Read Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
920.25	-65.18	17.93	-47.25	-20	-27.25	Horizontal
1380.375	-40.78	-7.22	-48	-20	-28	Horizontal
1840.5	-38.36	-4.41	-42.77	-20	-22.77	Horizontal
2300.625	-30.13	-2.57	-32.7	-20	-12.7	Horizontal
920.25	-71.31	17.93	-53.38	-20	-33.38	Vertical
1380.375	-42.24	-7.22	-49.46	-20	-29.46	Vertical
1840.5	-37.42	-4.41	-41.83	-20	-21.83	Vertical
2300.625	-28.79	-2.57	-31.36	-20	-11.36	Vertical
469.125MHz						
Frequency (MHz)	Read Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
938.25	-57.18	17.95	-39.23	-20	-19.23	Horizontal
1407.375	-33.78	-6.46	-40.24	-20	-20.24	Horizontal
1876.5	-38.36	-3.86	-42.22	-20	-22.22	Horizontal
2345.625	-28.13	-2.04	-30.17	-20	-10.17	Horizontal
938.25	-59.31	17.95	-41.36	-20	-21.36	Vertical
1407.375	-39.37	-6.46	-45.83	-20	-25.83	Vertical
1876.5	-37.42	-3.86	-41.28	-20	-21.28	Vertical
2345.625	-28.79	-2.04	-30.83	-20	-10.83	Vertical

Note:
Level=Reading+Factor = Reading +Antenna Factor + Cable loss – Pre-amplifier
Marging=Level-Limit

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5.5. Modulation Characteristics

Test Requirement:	FCC§2.1047 and §90.207
Test Limit:	According to FCC§2.1047 and §90.207, for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.
Procedure:	Modulation Limit 1. Test layout and build equipment as shown below. 2. adjust the audio input for 60% of rated system deviation at 1kHz using this level as a reference (0dB). 3. Vary the input level from –20 to +20dB. 4. Record the frequency deviation obtained as a function of the input level. 5. Repeat step 2 with input frequency changing to 300, 1000, 1500 and 3000Hz in sequence. Audio Frequency Response 1. Test layout and build equipment as shown below. 2. Adjust the audio input for 20% of rated system deviation at 1 kHz using this level as a reference (0 dB). 3. Vary the Audio frequency from 100 Hz to 10 kHz and record the frequency deviation. 4. Audio Frequency Response = 20log10 (Deviation of test frequency/Deviation of 1 kHz reference).

5.5.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.5.2Test Setup Diagram:

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5.5.3 Test Data:

Test result: Not Applicable

This EUT only has digital modulation

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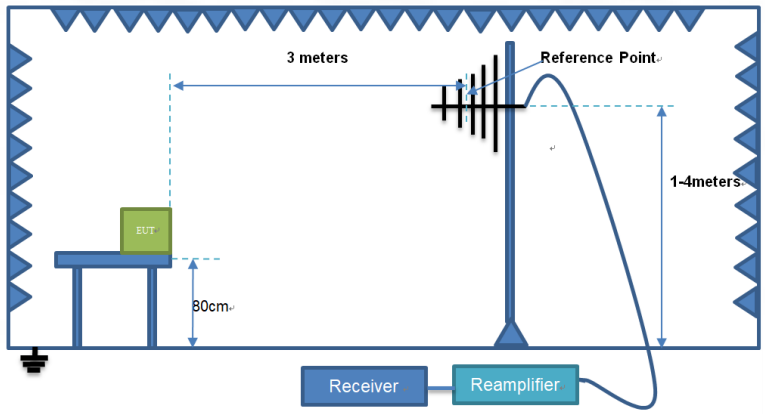
5.6.Maximum Transmitter Power

Test Requirement:	FCC §2.1046 and §90.205
Test Limit:	Maximum ERP is dependent upon the station's antenna HAAT and required service area.
Procedure:	The RF output of Two-way Radio was conducted to a spectrum analyzer through an appropriate attenuator. In the semi-anechoic chamber, setup as illustrated above the DUT placed on the 0.8m height of Turn Table, rotated the table 45 degree each interval to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power for each degree interval. The "Read Value" is the spectrum reading of maximum power value. The substitution antenna is substituted for DUT at the same position and signals generator (S.G) export the CW signal to the substitution antenna via a TX cable. The receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum radiation power. Record the power level of maximum radiation power from spectrum. So, the Measured substitution value = Ref level of S.G + TX cables loss – Substituted Antenna Gain. EIRP = "Read Value" + Measured substitution value + 2.15..

5.6.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.6.2 Test Setup Diagram:



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5.6.3Test Data:

Conducted Power Measurement Results			
Mode	Channel Separation	Test Channel	Measurement Result (dBm)
			For 30.00dBm(1W)
Digital (Voice + Data)	12.5 kHz	Bottom(450.125MHz)	29.05
		Middle(460.125MHz)	28.75
		Top (469.125MHz)	28.84

Note:
Calculation Formula: CP = R + A + L

- CP: The final Conducted Power
- R: The reading value from spectrum analyzer
- A: The attenuation value of the used attenuator
- L: The loss of all connection cables
- Measurement Result=Peak Power (Max)

Radiated Power Measurement Results							
Test Mode	Frequency (MHz)	Reading Level (dBm)	Factor	Level (dBm)	ERP Results (dBm)	Limit (dBm)	Antenna Polarization
Digital (Voice+Data)	450.1250	20.62	10.48	31.1	28.95	30.00	V
	450.1250	20.72	10.48	31.2	29.05	30.00	H
	460.1250	20.32	10.58	30.9	28.75	30.00	V
	460.1250	20.29	10.58	30.87	28.72	30.00	H
	469.1250	20.23	10.76	30.99	28.84	30.00	V
	469.1250	20.22	10.76	30.98	28.83	30.00	H

Note:
Level(dBm)=Reading Level(dBm)+Factor
ERP Results(dBm)=Level(dBm)-2.15

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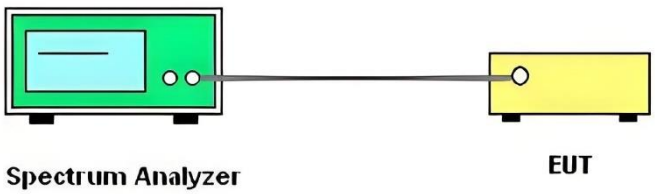
5.7. Spurious Emission on Antenna Port

Test Requirement:	Please refer to FCC 47 CFR 2.1051, 2.1057 & 90.210 for specification details
Test Limit:	At least 50 + 10 log (P) dB
Procedure:	1. The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. 2. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to 3. show any out of band emission up to 10th . Harmonic for the lower and the highest frequency range. 4. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz, while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic. 5. The audio input was set the unmodulated carrier, the resulting picture is print out for each channel separation.

5.7.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.7.2 Test Setup Diagram:



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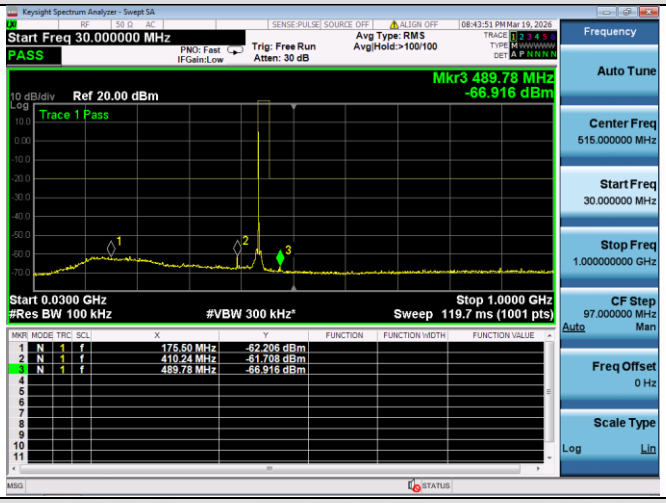
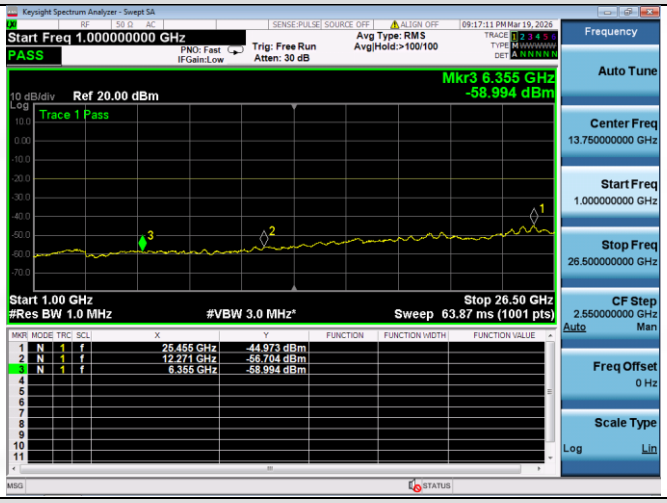
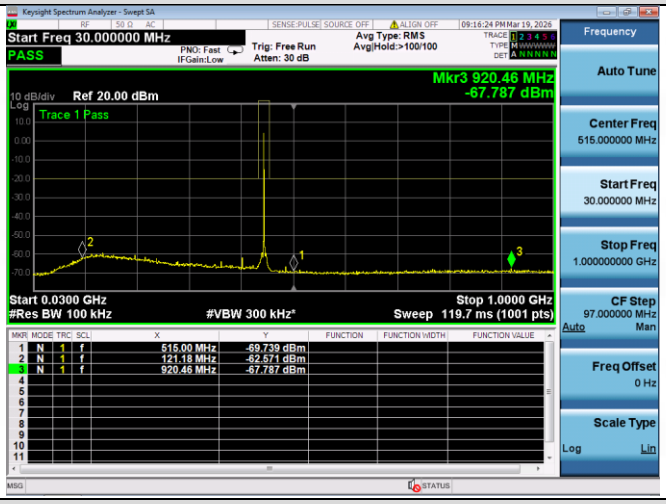
5.7.3 Test Data:

12.5kHz, Analog modulation, Assigned Frequency:450.125MHz, 1W

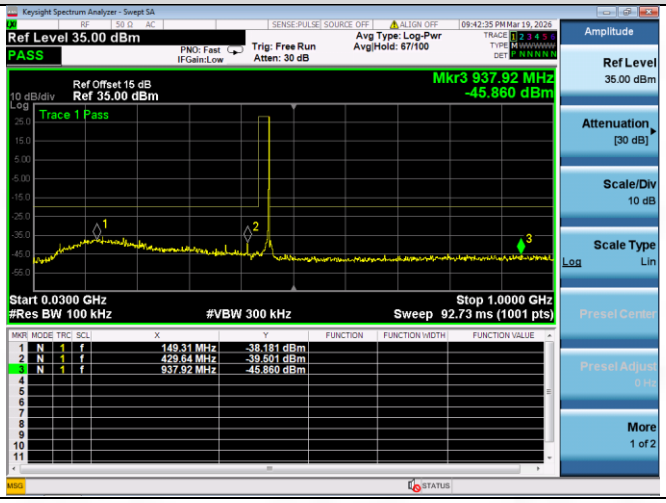


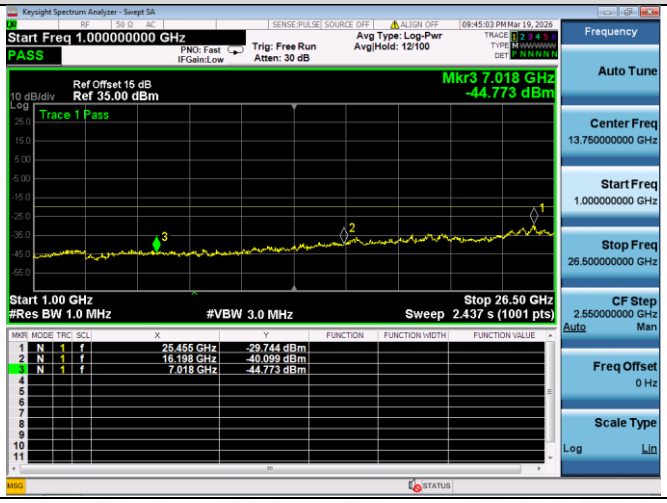


12.5kHz, Analog modulation, Assigned Frequency:460.125MHz, 1W



12.5kHz, Analog modulation, Assigned Frequency:469.125MHz, 1W





Note: All test frequencies was tested, but only the worst data be recorded in this part.

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5.8. Transmitter Frequency Behavior

Test Requirement:	Please refer to 47CFR FCC PART §90.214
Test Limit:	Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1] [2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1 [4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3 [4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1 [4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3 [4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1 [4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3 [4]	±6.25 kHz	5.0 ms	10.0 ms

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t_1 is the time period immediately following t_{on}.

t_2 is the time period immediately following t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

t_{off} is the instant when the 1 kHz test signal starts to rise.

[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.

[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.

[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Procedure:	According to TIA/EIA-603 2.2.19 requirement, as for the product different from PTT, we use test steps as follows: 1. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON; 2. Input 1kHz signal into DUT; 3. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a 4. single-shot turn-on of the transmitter signals;

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	5. Keep DUT in OFF state and Key the PTT; 6. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t1 and t2,and shall also remain within limits following t2; 7. Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal. 8. Keep the digital portable radio in ON state and unkey the PTT; 9. Observe the stored oscilloscope of modulation domain analyzer, The signal trace shall be maintained within the allowable limits during the period t3. 10. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±12.5 kHz deviation and set its output level to -100dBm. 11. Turn on the transmitter. 12. Supply sufficient attenuation via the RF attenuator to provide an input level to the stored oscilloscope that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power 13. level. Note this power level on the stored oscilloscope as P0. 14. Turn off the transmitter. 15. Adjust the RF level of the signal generator to provide RF power equal to P0. This signal generator RF level shall be maintained throughout the rest of the measurement. 16. Remove the attenuation, so the input power to the stored oscilloscope is increased by 30 dB when the transmitter is turned on. 17. Adjust the vertical amplitude control of the stored oscilloscope to display the 1000 Hz at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to “Video”, and tune the “trigger level” on suitable level. Then set the “tiger offset” to -10ms for turn on and -15ms for turn off. 18. Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. 19. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be ton. The trace should be maintained within the allowed divisions during the period t1 and t2. 20. Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t3. ■ **Describe limit line of transmitter frequency behavior:** ● **ton:** The switch-on instant ton of a transmitter is defined by the condition when the output power, measured at the antenna terminal, exceeds 0,1 % of the full output power (-30 dBc). ● **t1:** period of time starting at ton and finishing according to above 11.1 ● **t2:** period of time starting at the end of t1 and finishing according to above 11.1 ● toff: switch-off instant defined by the condition when the output power falls below 0,1 % of the full output power (-30 dBc). ● **t3**: period of time that finishing at toff and starting according to above 11.1

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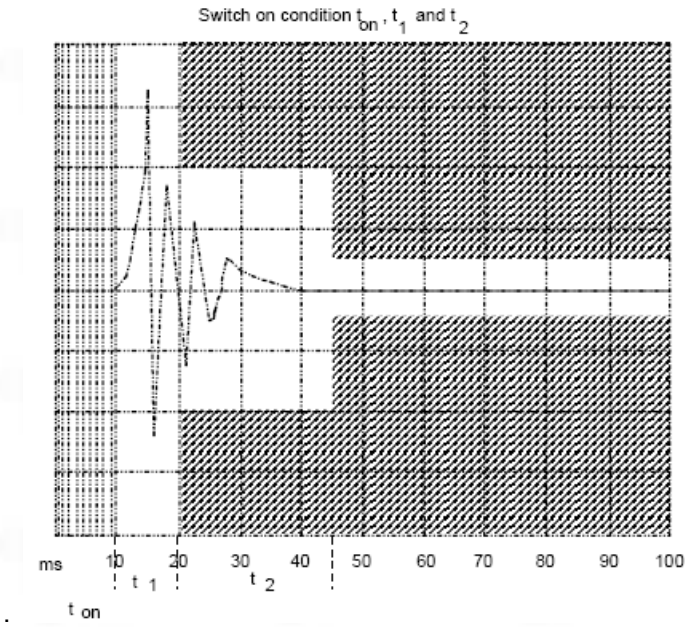

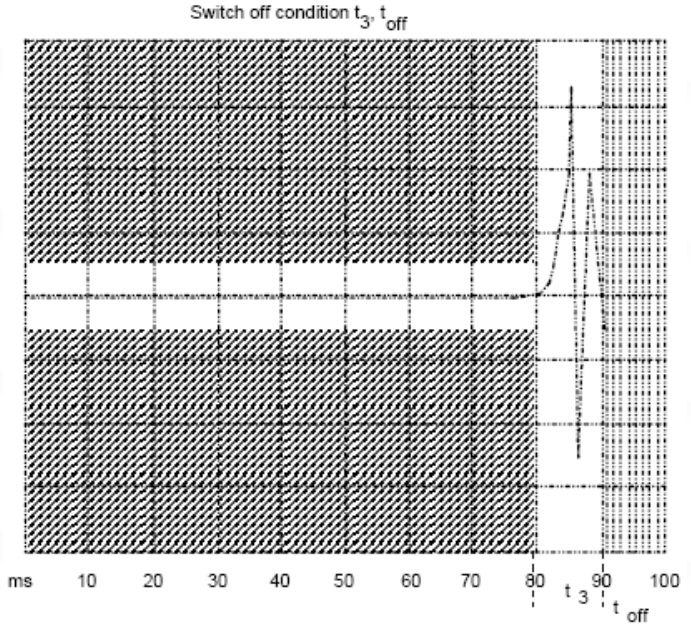

5.8.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.8.2 Test Setup Diagram:

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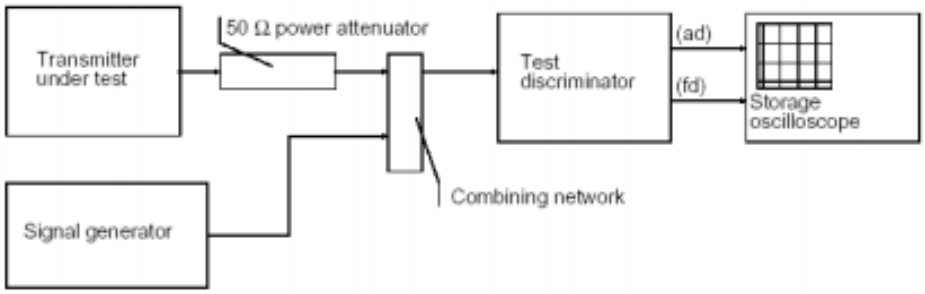

5.8.3 Test Data:

Test result: Not Applicable

Note:The carrier frequency is controlled by a PLL synthesizer and is not affected by modulation transitions. Therefore, FCC §90.214 is not applicable to this device.

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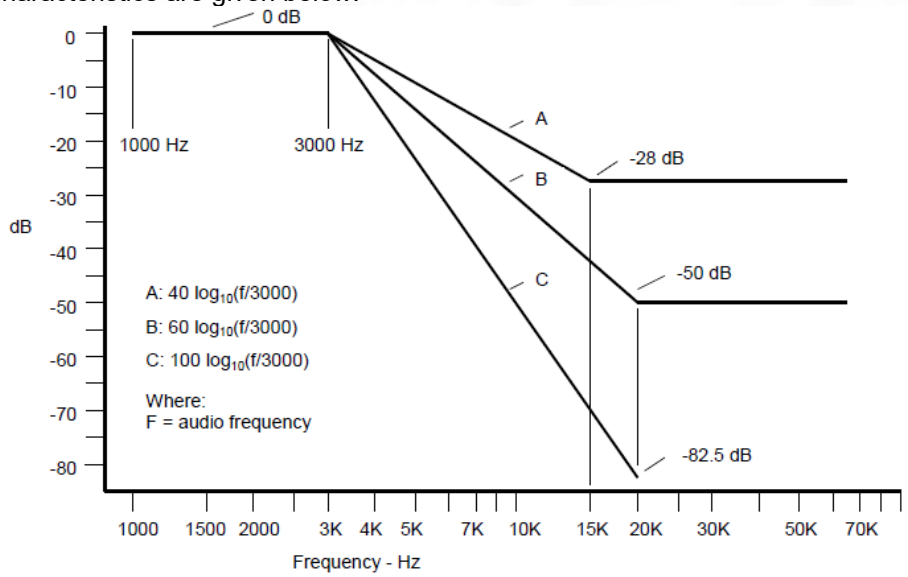
5.9. Audio Low Pass Filter Response

Test Requirement:	2.1047(a): Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.
Test Limit:	ANSI TIA/EIA 603-E:2016 3.2.15: Recommended audio filter attenuation characteristics are given below:  For audio frequencies above 3000 Hz, the audio response of the post limiter low-pass filter shall meet or exceed the following requirements: a) For equipment operating on 20, 25 or 30 kHz channel bandwidth in the 25 MHz to 174 MHz range: At frequencies from 3000 Hz through 15,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: 40 log10 (f / 3000) dB where: f is the audio frequency in Hz. At frequencies above 15,000 Hz, the attenuation shall be greater than the attenuation at 1000 Hz, by at least: 28 dB. b) For equipment operating with 25 kHz bandwidth channels between 406 and 512 MHz through 896 MHz, and between 929 MHz through 930 MHz: At frequencies from 3000 Hz through 20,000 Hz, the attenuation shall be greater than the attenuation at 1000 Hz by at least: 60 log10 (f / 3000) dB where: f is the audio frequency in Hz. At frequencies above 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: 50 dB. c) For equipment operating on channels between 896 MHz through 901 MHz, between 935 MHz through 940 MHz, and 12.5 or 15 kHz spaced channels in the frequency range 138-174 MHz and 406-512 MHz. At frequencies from 3000 Hz through 20,000 Hz the attenuation shall be greater than the attenuation at 1000 Hz by at least: 100 log10 (f / 3000) dB where: f is the audio frequency in Hz.
Procedure:	. The rated audio input signal was applied to the input of the audio low-pass filter (or of all modulation stages) using an audio oscillator, this input signal level and its

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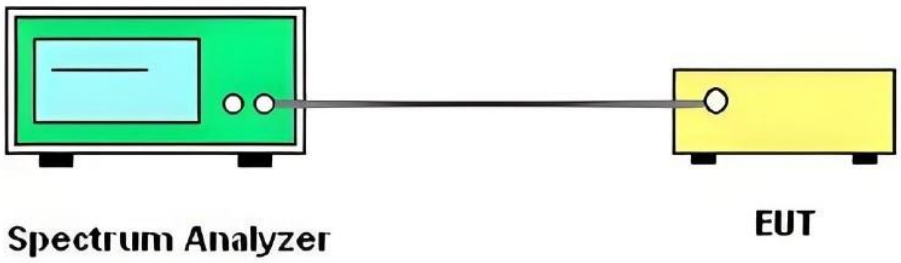
	corresponding output signal were then measured and recorded using the FFT Digital Spectrum Analyzer. Tests were repeated at different audio signal frequencies from 0 to 50 kHz. The DUT transmitter output port was connected to Modulation Analyzer. 2) Path loss for the measurement included. 3) Press 23.1SPCL on modulation analyzer to enable the external LO from Signal. 4) Set the Signal frequency to Fc + 1.5 MHz, RF output level to 0dBm without modulation. 5) Transmit the radio and set the audio analyzer to 1 kHz audio frequency and 60% of the Full rated system deviation. 6) Up the amplitude by 20dB. 7) On DSA, get the reference point to 0dB. 8) Vary the frequency on audio analyzer from 3 kHz to 20 kHz, record the audio tone from DSA

5.9.1 E.U.T. Operation:

Operating Environment:	
Temperature:	22.9 °C
Humidity:	49.6 %
Atmospheric Pressure:	1010 mbar

5.7.2 Test Setup Diagram:



5.7.3Test Data:

Not Applicable
Note: This EUT only has digital modulation

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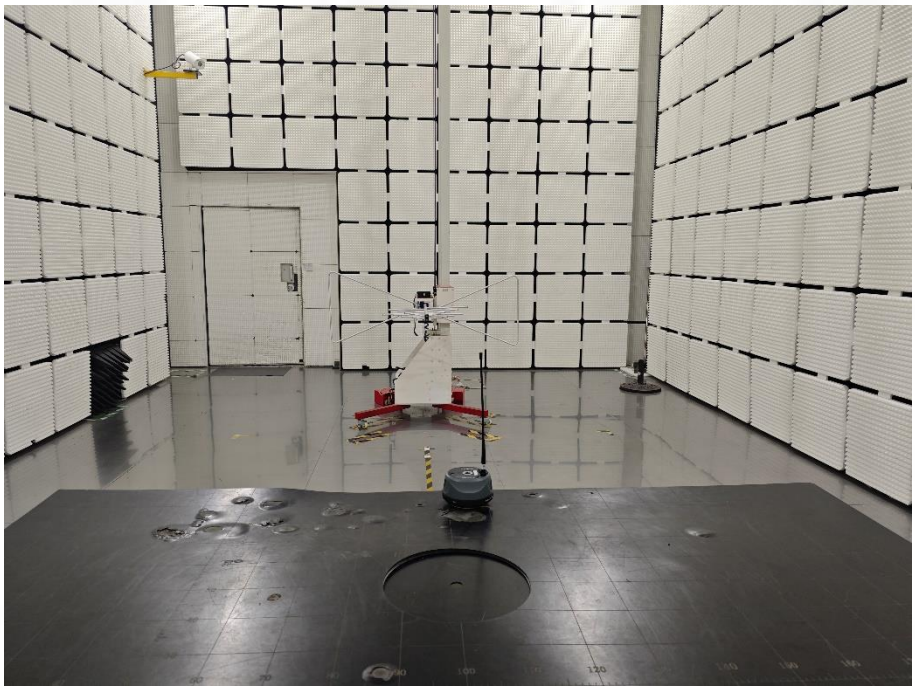
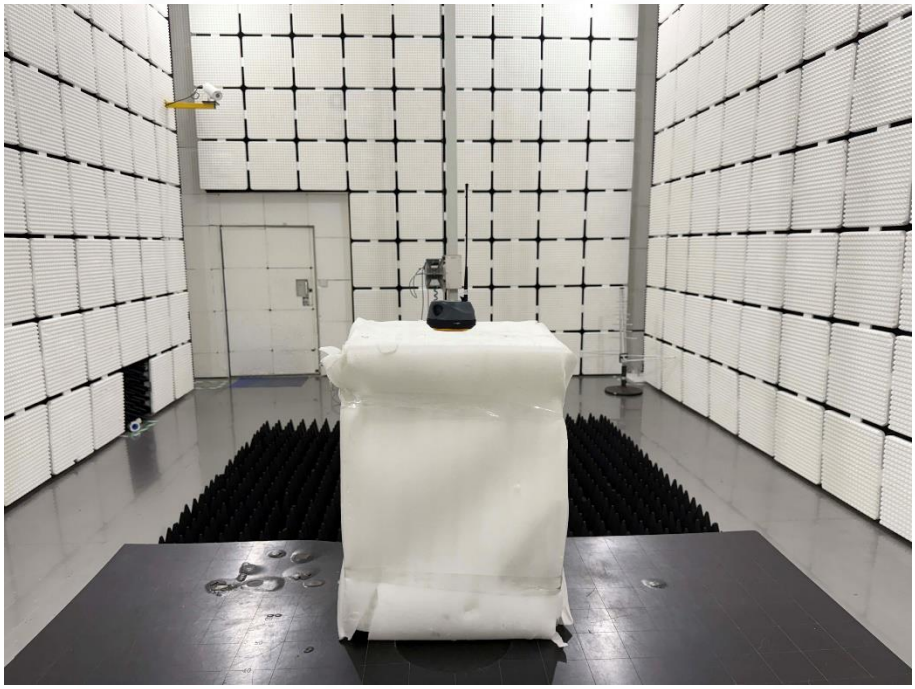
6 Test Setup Photos

Emissions in Non-restricted Frequency Bands(30 MHz–1 GHz)



Emissions in Restricted Frequency Bands
Emissions in Non-restricted Frequency Bands(Above 1 GHz)



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7 EUT Constructional Details (EUT Photos)

Please refer to the Appendix II External Photos &Appendix III External Photos

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