FCC TEST REPORT

For

South Surveying & Mapping Technology Co., Ltd.

GNSS RECEIVER

Test Model: INNO8

Additional Model No.: Please Refer to Page 7

Prepared for	:	South Surveying & Mapping Technology Co., Ltd.
Address	:	No.39, Sicheng Road, Tianhe District, Guangzhou
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	May 24, 2024
Number of tested samples	:	2
Sample No.	:	A240511060-1, A240511060-2
Serial number	:	Prototype
Date of Test	:	May 24, 2024 ~ July 23, 2024
Date of Report	:	July 24, 2024

FCC TEST REPORT
FCC Part 90

Report Reference No.	:	**LCSA05164163EK**
Date of Issue.....	:	July 24, 2024
Testing Laboratory Name.....	:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address.....	:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China
Testing Location/ Procedure.....	:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name.....	:	**South Surveying & Mapping Technology Co., Ltd.**
Address.....	:	No.39, Sicheng Road, Tianhe District, Guangzhou
Test Specification		
Standard.....	:	FCC CFR Title 47 Part 2, Part 90
Test Report Form No.	:	LCSEMC-1.0
TRF Originator.....	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF.....	:	Dated 2011-03

Shenzhen LCS Compliance Testing Laboratory Ltd. All rights reserved.
This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen LCS Compliance Testing Laboratory Ltd. is acknowledged as copyright owner and source of the material. Shenzhen LCS Compliance Testing Laboratory Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Test Item Description.....	:	**GNSS RECEIVER**
Trade Mark.....	:	SOUTH, KOLIDA, SANDING, RUIDE, TIANYU
Test Model.....	:	INNO8
Ratings	:	Please Refer to Page 7
Result	:	**Positive**

Compiled by:	Supervised by:	Approved by:
Diamond Lu/ Administrator	Cary Luo/ Technique principal	Gavin Liang/ Manager

RADIO -- TEST REPORT

Test Report No. : LCSA05164163EK	July 24, 2024 Date of issue

Test Model.....	: INNO8
EUT.....	: GNSS RECEIVER
Applicant.....	**: South Surveying & Mapping Technology Co., Ltd.**
Address.....	: No.39, Sicheng Road, Tianhe District, Guangzhou
Telephone.....	: /
Fax.....	: /
Manufacturer.....	**: South Surveying & Mapping Technology Co., Ltd.**
Address.....	: No.39, Sicheng Road, Tianhe District, Guangzhou
Telephone.....	: /
Fax.....	: /
Factory.....	**: /**
Address.....	: /
Telephone.....	: /
Fax.....	: /

Test Result	**Positive**

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Report Version	Issue Date	Revision Content	Revised By
000	July 24, 2024	Initial Issue	--

TABLE OF CONTENTS

Test Report Description Page

1.GENERAL INFORMATION 7
1.1. DESCRIPTION OF DEVICE (EUT) 7
1.2. SUPPORT EQUIPMENT LIST 10
1.3. EXTERNAL I/O CABLE 10
1.4. DESCRIPTION OF TEST FACILITY 10
1.5. STATEMENT OF THE MEASUREMENT UNCERTAINTY 10
1.6. MEASUREMENT UNCERTAINTY 11
1.7. DESCRIPTION OF TEST MODES 11
2.SYSTEM TEST CONFIGURATION 14
2.1. TEST STANDARDS 14
2.2. EUT CONFIGURATION 14
2.3. EUT EXERCISE 14
2.4. TEST SAMPLE 14
3.SYSTEM TEST CONFIGURATION 15
3.1. JUSTIFICATION 15
3.2. EUT EXERCISE SOFTWARE 15
3.3. SPECIAL ACCESSORIES 15
3.4. BLOCK DIAGRAM/SCHEMATICS 15
3.5. EQUIPMENT MODIFICATIONS 15
3.6. TEST SETUP 15
4.SUMMARY OF TEST RESULT 16
5.TEST CONDITIONS AND RESULTS 17
5.1. MAXIMUM TRANSMITTER POWER 17
5.1.1 Test Applicable 17
5.1.2 Test Procedure 17
5.1.3 Test Configuration 17
5.1.4 Test Results 17
5.2. OCCUPIED BANDWIDTH AND EMISSION MASK TEST 18
5.2.1 Test Applicable 18
5.2.2 Test Configuration 18
5.2.3 Test Procedure 18
5.2.4 Test Results 19
5.3. TRANSMITTER RADIATED SPURIOUS EMISSION 22
5.3.1 Test Applicable 22
5.3.2 Test Configuration 22
5.3.3 Test Arrangement 23
5.3.4 Test Procedure 23
5.3.5 Limit 24
5.3.5 Test Results 24
5.4. SPURIOUS EMISSION ON ANTENNA PORT 26
5.4.1 Test Applicable 26
5.4.2 Test Procedure 26
5.4.3 Test Configuration 26
5.4.4 Limit 26
5.4.5 Test Results 27
5.5. FREQUENCY STABILITY TEST 31
5.5.1 Test Applicable 31
5.5.2 Test Procedure 31
5.5.3 Test Configuration 31
5.5.4 Test Limits 31
5.5.5 Test Results 32
5.6. TRANSMITTER FREQUENCY BEHAVIOR 33
5.6.1 Test Applicable 33
5.6.2 Test Configuration 33

5.6.3 Test Procedure *33*
5.6.4 Test Results *34*
6.LIST OF MEASURING EQUIPMENT **35**
7.TEST SETUP PHOTOGRAPHS OF EUT **36**
8.EXTERIOR PHOTOGRAPHS OF THE EUT **36**
9.INTERIOR PHOTOGRAPHS OF THE EUT **36**

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: GNSS RECEIVER
Test Model	: INNO8
Additional Model No.	: ALPS1, ALPS2, ALPS3, ALPS4, ALPS5, ALPS6, INNO9, INNO6, INNO5, INNO3, INNO8 Pro, K60 Pro, K60, K2, KR1, KR2, KR3, T7, T7 Pro, T6, T6 Pro, T5, T5 Pro, RENO2S, RENO1 Pro, ROVA3, RAMA1, RAMA2, RAMA3, RAMA4, K50, K9S, T14, T15, RENO2, RENO3, ROVA2, Insight V3, V1
Model Declaration	: PCB board, structure and internal of these model(s) are the same, So no additional models were tested
Ratings	: For AC Adapter Input: 100-240V~, 50/60Hz, 1.4A MAX Adapter Output: PD3.0: 5V⎓3A/9V⎓3A/15V⎓3A/20V⎓2.25A PPS: 3.3-11.0V⎓3A QC: 5V⎓3A/9V⎓3A/12V⎓3A DC 7.4V by Rechargeable Li-ion Battery, 10000mAh
Hardware Version	: H0X0DY0N0210008063135G048C12
Software Version	: PurpleCowY_RTK-V20231019
Bluetooth	:
Frequency Range	: 2402MHz~2480MHz
Channel Number	: 79 channels for Bluetooth V4.2 (DSS) 40 channels for Bluetooth V4.2 (DTS)
Channel Spacing	: 1MHz for Bluetooth V4.2 (DSS) 2MHz for Bluetooth V4.2 (DTS)
Modulation Type	: GFSK, π/4-DQPSK, 8-DPSK for Bluetooth V4.2 (DSS) GFSK for Bluetooth V4.2 (DTS)
Bluetooth Version	: V4.2
Antenna Description	: Internal Antenna, 2.70dBi(Max.)
WIFI(2.4G Band)	:
Frequency Range	: 2412MHz~2462MHz
Channel Spacing	: 5MHz
Channel Number	: 11 Channels for 20MHz bandwidth (2412~2462MHz) 7 Channels for 40MHz bandwidth (2422~2452MHz)
Modulation Type	: IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: Internal Antenna, 2.70dBi(Max.)
WIFI(5.2G Band)	:
Frequency Range	: 5180MHz~5240MHz
Channel Number	: 4 Channels for 20MHz bandwidth(5180MHz~5240MHz) 2 channels for 40MHz bandwidth(5190MHz~5230MHz)

Modulation Type	: IEEE 802.11a/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: Internal Antenna, 8.07dBi(Max.)
WIFI(5.3G Band)	:
Frequency Range	: 5260MHz~5320MHz
Channel Number	: 4 Channels for 20MHz bandwidth(5260MHz~5320MHz) 2 channels for 40MHz bandwidth(5270MHz~5310MHz)
Modulation Type	: IEEE 802.11a/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: Internal Antenna, 6.95dBi(Max.)
WIFI(5.5G Band)	:
Frequency Range	: 5500MHz~5700MHz
Channel Number	: 11 Channels for 20MHz bandwidth(5500MHz~5700MHz) 5 Channels for 40MHz bandwidth(5510MHz~5670MHz)
Modulation Type	: IEEE 802.11a/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Description	: Internal Antenna, 6.95dBi(Max.)
2G	:
Support Band	: ☒GSM 850 (U.S.-Band) ☒PCS 1900 (U.S.-Band)
Release Version	: R99
GPRS Class	: Class 12
EGPRS Class	: Class 12
Type Of Modulation	: GMSK for GSM/GPRS; GMSK/8PSK for EGPRS
Antenna Description	: Internal Antenna 0.63dBi (max.) For GSM 850 1.54dBi (max.) For PCS 1900
3G	:
Support Band	: ☒WCDMA Band V (U.S.-Band)
Release Version	: R9
Type Of Modulation	: QPSK,16QAM
Antenna Description	: Internal Antenna 0.63dBi (max.) For WCDMA Band V
LTE	:
Support Band	: ☒E-UTRA Band 5(U.S.-Band) ☒E-UTRA Band 7(U.S.-Band) ☒E-UTRA Band 41(U.S.-Band)
LTE Release Version	: R9
Type Of Modulation	: QPSK/16QAM
Antenna Description	: Internal Antenna 0.63dBi (max.) For E-UTRA Band 5 1.78dBi (max.) For E-UTRA Band 7 2.55dBi (max.) For E-UTRA Band 41

Power Class	: Class 3
NFC	:
Frequency Range	: 13.56MHz
Modulation Type	: ASK
Antenna Description	: Internal Antenna, 0dBi(Max.)
PMR	:
Operating Frequency	: 410MHz~470MHz
Channel Separation	: 12.5KHz
Modulation Type	: GMSK
rated power	: 3W
Antenna Description	: External Antenna, 2.14dBi(Max.)
Extreme temp. Tolerance	: -30°C to +50°C
Extreme vol. Limits	: 6.7VDC to 8.4VDC (nominal: 7.4VDC)

1.2. Support Equipment List

Manufacturer	Description	Model	Serial Number	Certificate
Diwen Enterprise Co., Ltd	SWITCHING POWER SUPPLY	S045SU2000225	---	FCC

1.3. External I/O Cable

I/O Port Description	Quantity	Cable
UHF Antenna Port	1	N/A
Type-C USB Port	1	USB Cable: 0.8m, unshielded
SIM Card Slot	1	N/A

1.4. Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

Test Firm Registration Number: 254912.

The sites are constructed in conformance with the requirements of ANSI C63.4 (2014) and CISPR Publication 22.

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to ETSI TR 100 028 " Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics" and is documented in the
Shenzhen LCS Compliance Testing Laboratory Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item	Uncertainty	Note
Frequency error	30 Hz	(1)
Transmitter power conducted	0.62 dB	(1)
Transmitter power Radiated	2.67 dB	(1)
Conducted spurious emission 9KHz-12.75 GHz	1.22 dB	(1)
Conducted Emission 9KHz-30MHz	1.63 dB	(1)
Radiated spurious emission 30~1000MHz	3.10 dB	(1)
Radiated spurious emission 1~18GHz	3.80 dB	(1)
Radiated spurious emission 18-40GHz	3.90 dB	(1)
Occupied Bandwidth	35Hz	(1)
Emission Mask	1.25dB	(1)
Transmitter Frequency Behavior	6.8%	(1)

(1) . This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

1.7. Description of Test Modes

The EUT has been tested under typical operating condition. As, test modes selected as below by the technical parameters of the EUT:

Operation Mode	Description of operation mode	Additional information
TM1	GMSK+BW12.5KHz+TX	The EUT is set with GMSK modulation and 12.5KHz bandwidth at maximum rated power for transmitter, powered by DC 7.4V power Rechargeable Li-ion Battery

Frequency list:

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	101	**410.125**	111	415.125
		102	410.625	112	415.625
		103	411.125	113	416.125
		104	411.625	114	416.625
		105	412.125	115	417.125
		106	412.625	116	417.625
		107	413.125	117	418.125
		108	413.625	118	418.625
		109	414.125	119	419.125
		110	414.625	120	419.625

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	81	420.125	91	425.125
		82	420.625	92	425.625
		83	421.125	93	426.125
		84	421.625	94	426.625
		85	422.125	95	427.125
		86	422.625	96	427.625
		87	423.125	97	428.125
		88	423.625	98	428.625
		89	424.125	99	429.125
		90	424.625	100	429.625

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	61	430.125	71	435.125
		62	430.625	72	435.625
		63	431.125	73	436.125
		64	431.625	74	436.625
		65	432.125	75	437.125
		66	432.625	76	437.625
		67	433.125	77	438.125
		68	433.625	78	428.625
		69	434.125	79	439.125
		70	434.625	80	**439.625**

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	41	440.125	51	445.125
		42	440.625	52	445.625
		43	441.125	53	446.125
		44	441.625	54	446.625
		45	442.125	55	447.125
		46	442.625	56	447.625
		47	443.125	57	448.125
		48	443.625	58	448.625
		49	444.125	59	449.125
		50	444.625	60	449.625

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	21	450.125	31	455.125
		22	450.625	32	455.625
		23	451.125	33	456.125
		24	451.625	34	456.625
		25	452.125	35	457.125
		26	452.625	36	457.625
		27	453.125	37	458.125
		28	453.625	38	458.625
		29	454.125	39	459.125
		30	454.625	40	459.625

Modulation Type	Channel Separation	Channel	Frequency (MHz)	Channel	Frequency (MHz)
GMSK	12.5KHz	1	460.125	11	465.125
		2	460.625	12	465.625
		3	461.125	13	466.125
		4	461.625	14	466.625
		5	462.125	15	467.125
		6	462.625	16	467.625
		7	463.125	17	468.125
		8	463.625	18	468.625
		9	464.125	19	469.125
		10	464.625	20	**469.625**

Note: The line display in grey was the channel selected for test.

2. SYSTEM TEST CONFIGURATION

2.1. TEST STANDARDS

The tests were performed according to following standards:
FCC Rules Part 90: PRIVATE LAND MOBILE RADIO SERVICES.
ANSI/TIA-603-E-2016: Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.
47 CFR FCC Part 15 Subpart B: Unintentional Radiators
FCC Part 2: FREQUENCY ALLOCA-TIONS AND RADIO TREATY MAT-TERS; GENERAL RULES AND REG-ULATIONS
ANSI C63.26:2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.
ANSI C63.4:2014: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

2.2. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.3. EUT Exercise

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.4. Test Sample

The application provides 1 samples to meet requirement;

Sample Number	Description
Sample 1	continuous transmit

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

N/ A

3.3. Special Accessories

N/ A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULT

Transmitter Requirements				
FCC General Rules Part (47CFR)	Description of Test	Test Sample	Result	Remark
2.1046 90.205	Maximum Transmitter Power	Sample 1	Compliant	Note 1
2.1047 (a) 90.207	Modulation Characteristics - Audio Frequency Response	Sample 1	N/A*	Note 2
2.1047 (b) 90.207	Modulation Characteristics - Modulation Limiting	Sample 1	N/A*	Note 2
2.1049 90.210	Occupied Bandwidth Tests; Emission Mask	Sample 1	Compliant	Note 1
2.1055 90.213	Frequency Stability	Sample 1	Compliant	Note 1
90.214	Transmitter Frequency Behavior	Sample 1	Compliant	Note 1
2.1053 90.210	Transmitter Radiated Spurious Emission	Sample 1	Compliant	Note 1
2.1051 90.210	Spurious Emission On Antenna Port	Sample 1	Compliant	Note 1

Remark:
1. Note 1 – Test results inside test report;
2. Note 2 – N/A - Not Applicable for this device.*

5. TEST CONDITIONS AND RESULTS

5.1. Maximum Transmitter Power

5.1.1 Test Applicable

Per FCC Part 2.1046 and Part 90.205(s): The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with § 90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization.

5.1.2 Test Procedure

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels.
The EUT connect to the Receiver through 20 dB attenuator.
Measurement with Spectrum Analyzer conducted external power supply with 7.4V stabilized supply voltage.

5.1.3 Test Configuration

5.1.4 Test Results

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Test Results (dBm)	Test Results (W)	Limit (W)
Digital GMSK	12.5KHz	TM1	Ch101	410.125	33.888	2.4479	2.4-3.6
			Ch80	439.625	33.836	2.4188	2.4-3.6
			Ch20	469.625	33.883	2.4451	2.4-3.6
Results	PASS						

5.2. Occupied Bandwidth and Emission Mask Test

5.2.1 Test Applicable

(a). Occupied Bandwidth: The EUT was connected to the audio signal generator and the spectrum analyser via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyser.

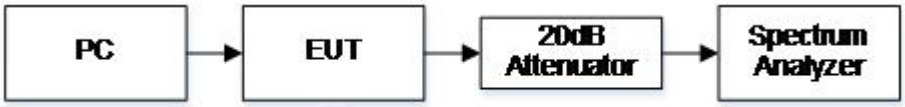
(b). Emission Mask D, 12.5 kHz channel bandwidth equipment: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the centre of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d - 2.88 kHz) dB.

(3) On any frequency removed from the centre 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.

5.2.2 Test Configuration



5.2.3 Test Procedure

1 Set EUT as normal operation.

2 Set SPA Centre Frequency = fundamental frequency, RBW=100Hz, VBW= 300Hz, span =50 KHz .

3 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth.

5.2.4 Test Results

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

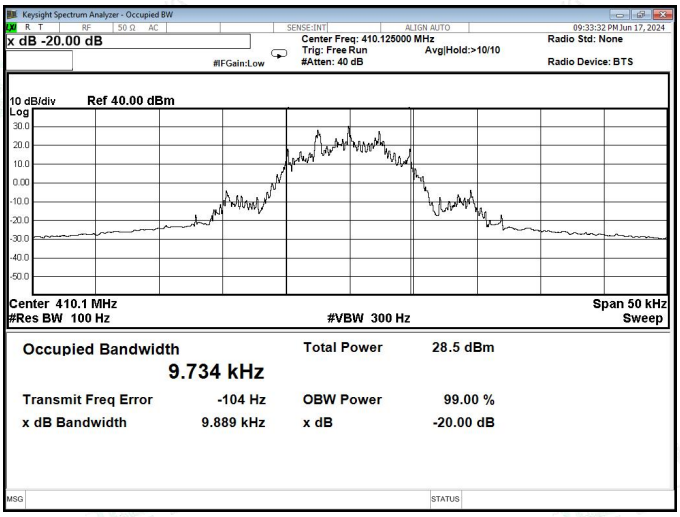
Occupied Bandwidth

Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)	
				99%	26dB
GMSK	12.5 KHz	Ch101	410.125	9.734	9.889
		Ch80	439.625	9.691	9.758
		Ch20	469.625	9.737	9.942
Limit		11.25KHz for 12.5KHz Channel Separation			

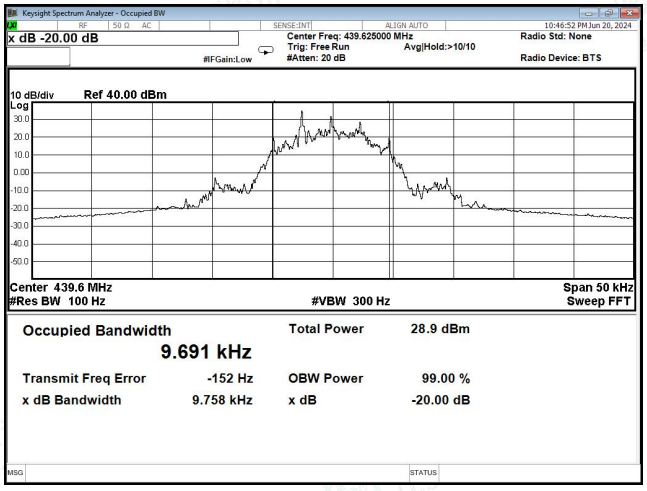
Remark:

Please refer to following plots.

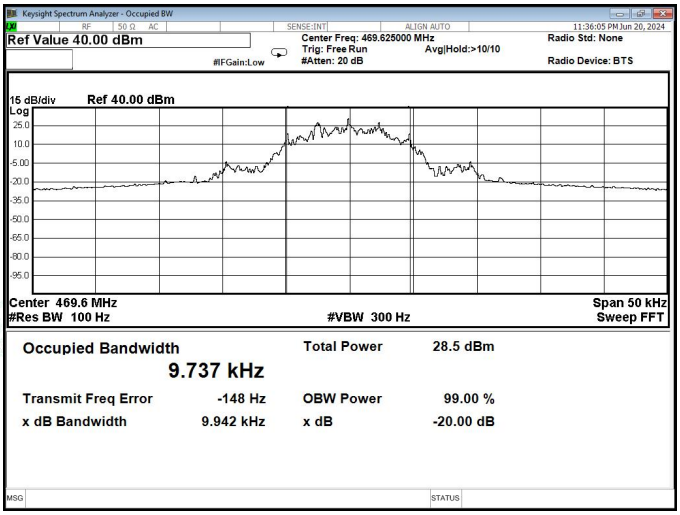
99% and 26dB Bandwidth



Channel 101 / 410.125 MHz



Channel 80 / 439.625 MHz



Channel 20 / 469.625 MHz

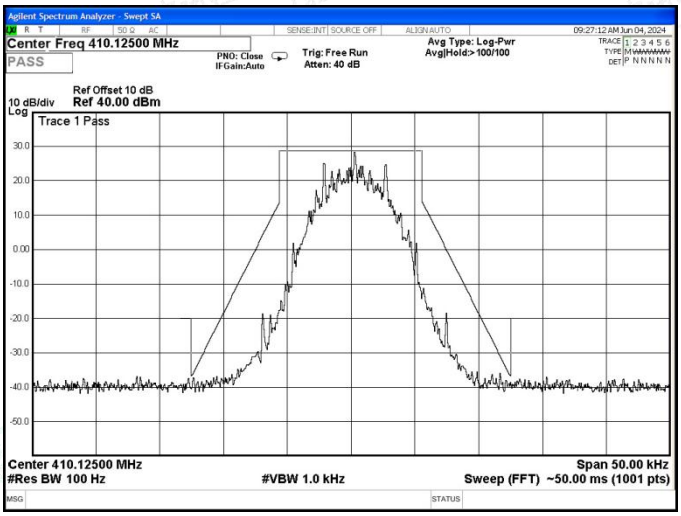
Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Emission Mask

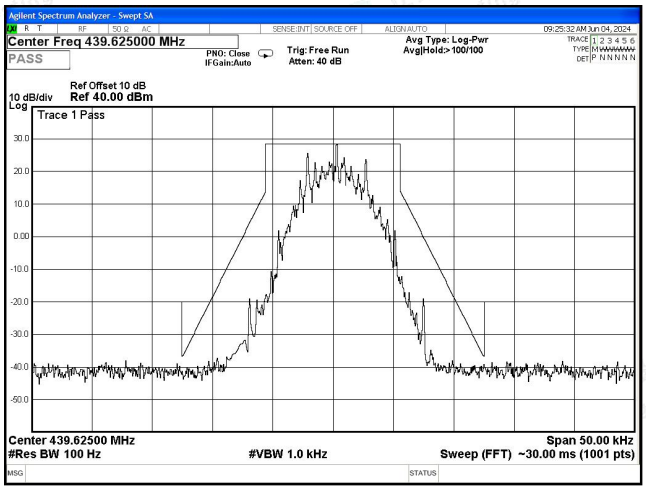
Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)
GMSK	12.5 KHz	Ch101	410.125	D	100
		Ch80	439.625	D	100
		Ch20	469.625	D	100
Test Results		PASS			

Please refer to following plots.

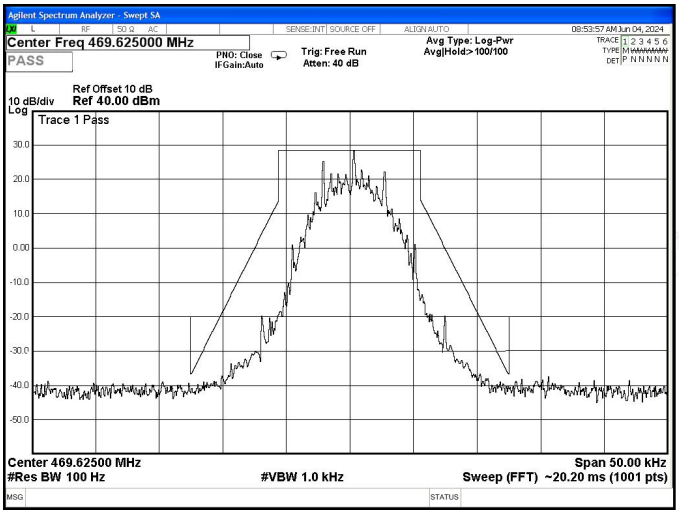
Emission Mask



Channel 101 / 410.125 MHz



Channel 80 / 439.625 MHz



Channel 20 / 469.625 MHz

5.3. Transmitter Radiated Spurious Emission

5.3.1 Test Applicable

According to the ANSI C63.26:2015 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

1 On any frequency removed from the centre of the authorized bandwidth f_o to 5.625 KHz removed from f_o: Zero dB

2 On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in KHz) f_o of more than 5.625 KHz but no more than 12.5 KHz: At least 7.27dB

3 On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in KHz) f_o of more than 12.5 KHz: At least 50+10 log (P) dB or 70 dB, whichever is lesser attenuation.

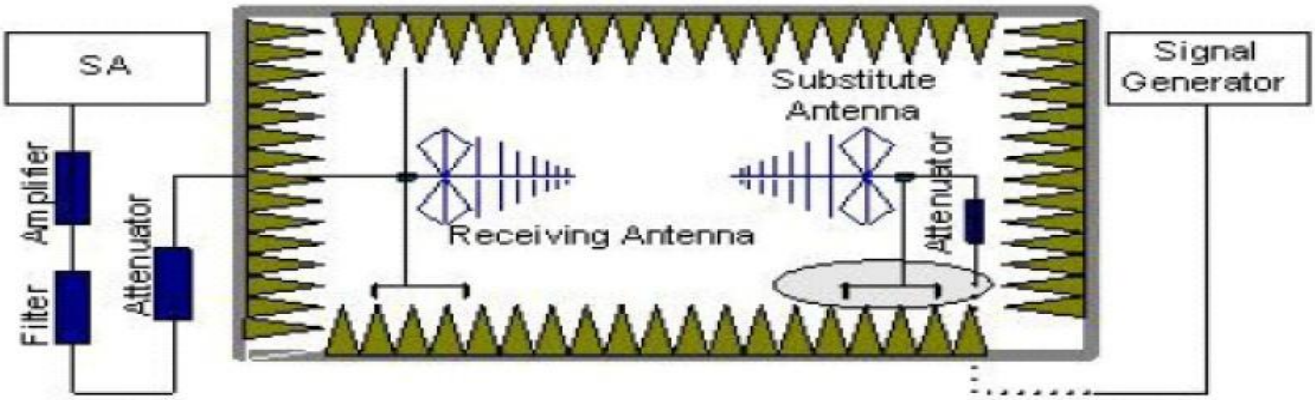
For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

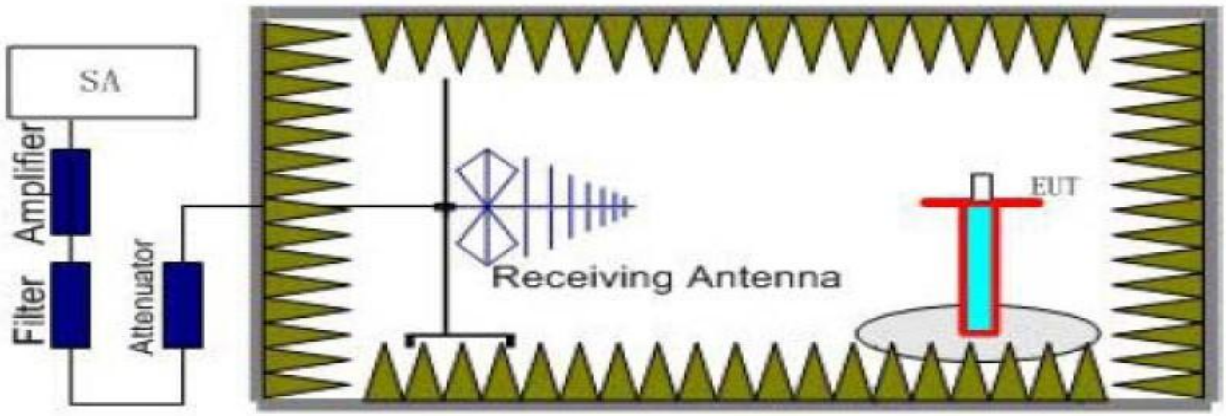
1 On any frequency removed from the assigned frequency by more than 50 percent, but no more than 100 percent of the authorized bandwidth: At least 25 dB.

2 On any frequency removed from the assigned frequency by more than 100 percent, but no more than 250 percent of the authorized bandwidth: At least 35 dB.

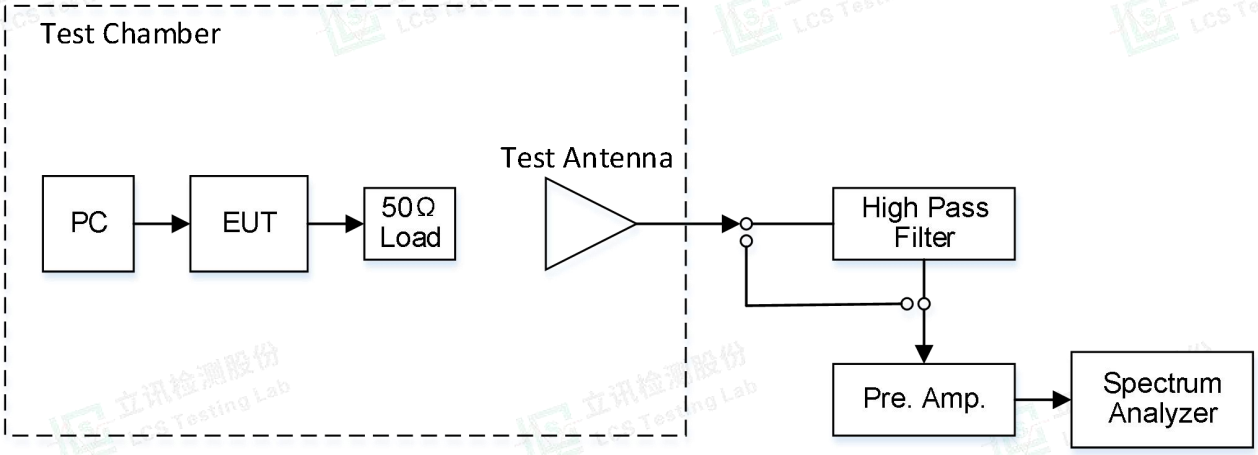
3 On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43+10log (P) dB.

5.3.2 Test Configuration





5.3.3 Test Arrangement



5.3.4 Test Procedure

1. EUT was placed on a 1.50 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.50 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
2. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz for above 1GHz and RBW=100 KHz, VBW=300 KHz for 30MHz to 1GHz, and the maximum value of the receiver should be recorded as (P_r).
4. The EUT shall be replaced by a substitution antenna. In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjusts the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
5. An amplifier should be connected to the Signal Source output port. And the cable should be connecting between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power (EIRP) = P_{Mea}- P_{Ag} - P_{cl} - G_a

The measurement results are amending as described below:

Power (EIRP) = P_{Mea}- P_{cl} - G_a

6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

5.3.5 Limit

Modulation Type: GMSK

FCC Part 90.210:

For 12.5 kHz 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:
Calculation: Limit (dBm) =EL-50-10log (TP) = -20 dBm
Notes: EL is the emission level of the Output Power expressed in 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:
Calculation: Limit (dBm) =EL-43-10log10 (TP) = -13 dBm
Notes: EL is the emission level of the Output Power expressed in dBm.

Note: 1. In general, the worst case attenuation requirement shown above was applied.
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.

5.3.5 Test Results

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Remark:
1. Measured at recorded worst case at TM1 and TM3;
2. Please refer to following page.

Modulation Type: GMSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
Test Channel: Channel 101				Test Frequency:410.125MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
820.34	-42.49	5.26	9.88	2.15	-35.721	-20.00	H
1230.45	-53.07	6.11	11.36	2.15	-45.672	-20.00	H
1640.60	-48.49	7.01	11.42	2.15	-41.927	-20.00	H
820.31	-48.85	5.26	9.88	2.15	-42.083	-20.00	V
1230.46	-51.63	6.11	11.36	2.15	-44.226	-20.00	V
1640.51	-57.81	7.01	11.42	2.15	-51.248	-20.00	V

Modulation Type: GMSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
Test Channel: Channel 80				Test Frequency: 439.625MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
906.28	-42.39	5.39	9.38	2.15	-36.25	-20.00	H
1359.41	-54.21	5.67	11.02	2.15	-46.71	-20.00	H
1812.58	-48.43	6.59	10.98	2.15	-41.89	-20.00	H
906.30	-50.57	5.39	9.38	2.15	-44.43	-20.00	V
1359.46	-52.50	5.67	11.02	2.15	-45.00	-20.00	V
1812.52	-58.31	6.59	10.98	2.15	-51.77	-20.00	V

Modulation Type: GMSK							
Operation Mode: TM1				Channel Separation:12.5KHz			
Test Channel: Channel 20				Test Frequency: 469.625MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak EIRP (dBm)	Limit (dBm)	Polarization
939.29	-42.53	5.28	9.37	2.15	-36.29	-20.00	H
1408.92	-53.68	5.62	10.9	2.15	-46.25	-20.00	H
1878.50	-46.57	6.73	10.83	2.15	-40.32	-20.00	H
939.28	-49.67	5.28	9.31	2.15	-43.49	-20.00	V
1408.91	-51.88	5.84	11.01	2.15	-44.56	-20.00	V
1878.51	-56.55	6.75	11.06	2.15	-50.09	-20.00	V

Notes:

1). Measuring frequencies from 9 KHz~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30MHz;

2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode;

3). Peak EIRP = P_{Mea} + Path Loss + Antenna Gain + Correction Value (2.15).

5.4. Spurious Emission on Antenna Port

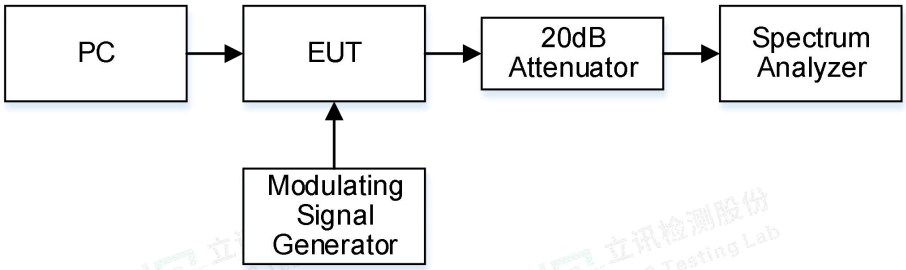
5.4.1 Test Applicable

The same as Section 5.3

5.4.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range. Set RBW 1KHz, VBW 3KHz in the frequency band 9KHz to 150KHz, set RBW 10KHz, VBW 30 KHz in the frequency band 150KHz to 30 MHz, 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.
The audio input was set to 0 to get the unmodulated carrier, the resulting picture is print out for each channel separation.

5.4.3 Test Configuration



5.4.4 Limit

Modulation Type: GMSK

FCC Part and 90.210:

For 12.5 kHz 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:
Calculation: Limit (dBm) =EL-50-10log (TP) = -20 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:
Calculation: Limit (dBm) =EL-43-10log (TP) = -13 dBm
Notes: EL is the emission level of the Output Power expressed in dBm.

Note: 1. In general, the worst case attenuation requirement shown above was applied.
2. The measurement frequency range from 9 KHz to 6GHz.

5.4.5 Test Results

Temperature	22.6℃	Humidity	53.7%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Operation Mode	Test Channel	Test Frequency (MHz)	Measured Frequency Range	Spurious RF Conducted Emission (dBm)	Limits (dBm)	Verdict
TM1	Ch101	410.125	9 KHz – 6 GHz	<-20	-20	PASS
	Ch80	439.625	9 KHz – 6 GHz	<-20		
	Ch20	469.625	9 KHz – 6 GHz	<-20		

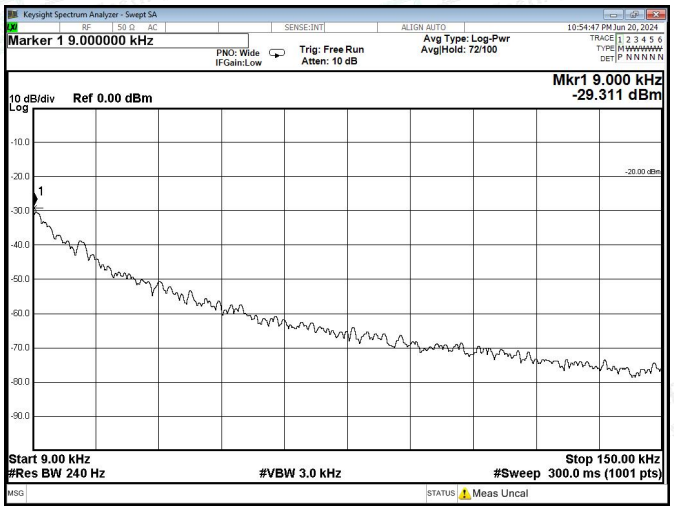
Remark:

1. Measured at recorded worst case at TM1;

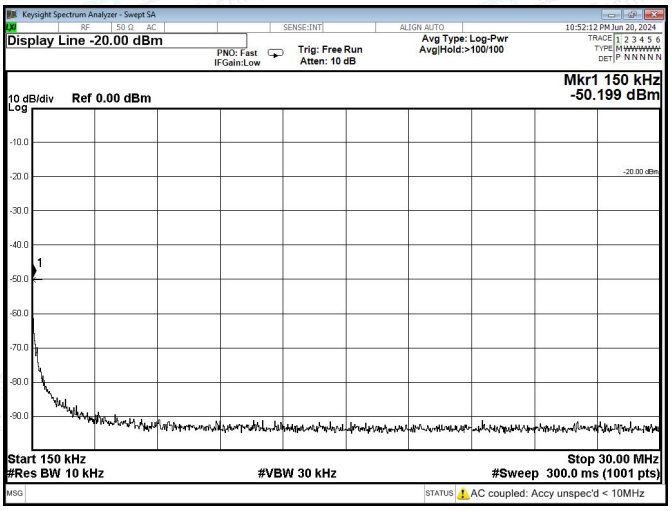
2. Please refer to following plot.

Spurious Emission on Antenna Port

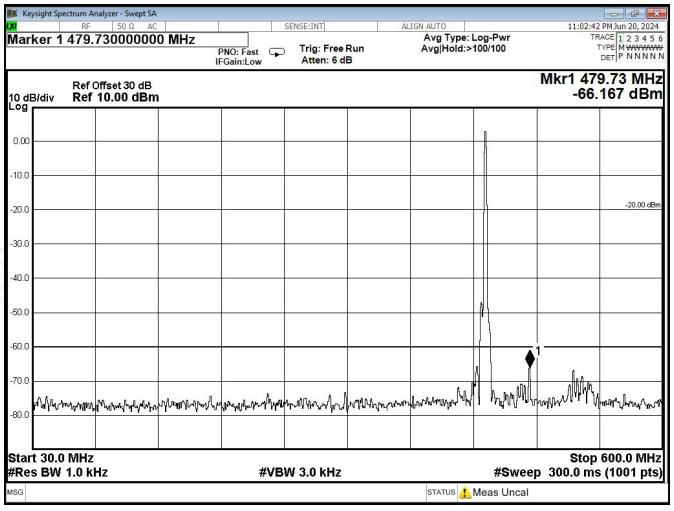
TM3 / Channel 101 / 410.125 MHz



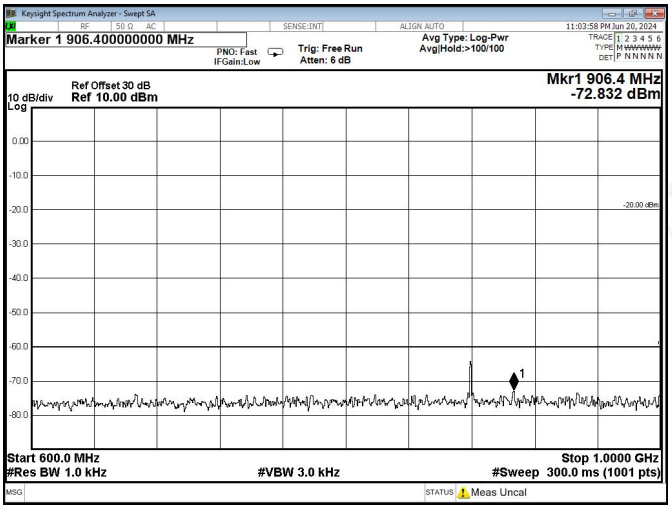
9KHz – 150KHz



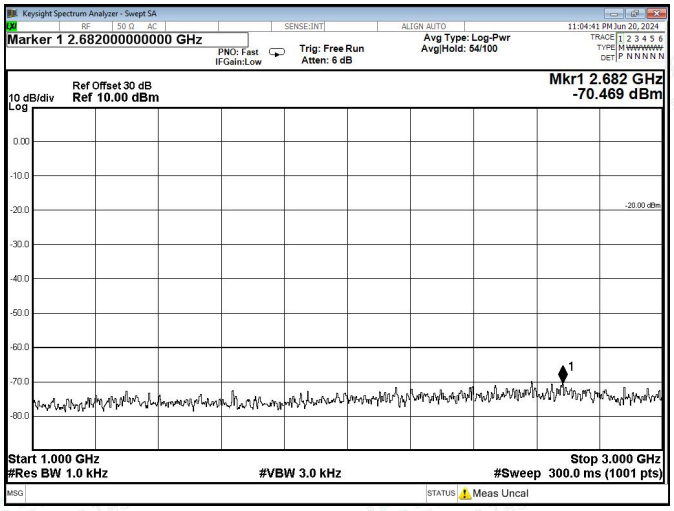
150KHz – 30MHz



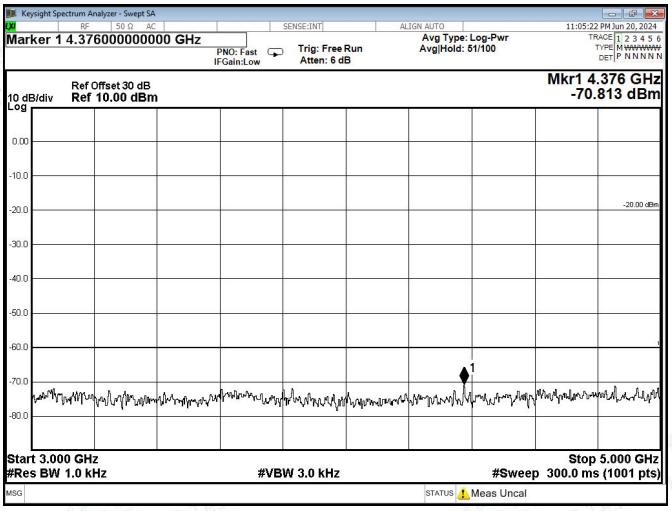
30MHz – 600MHz



600MHz – 1GHz



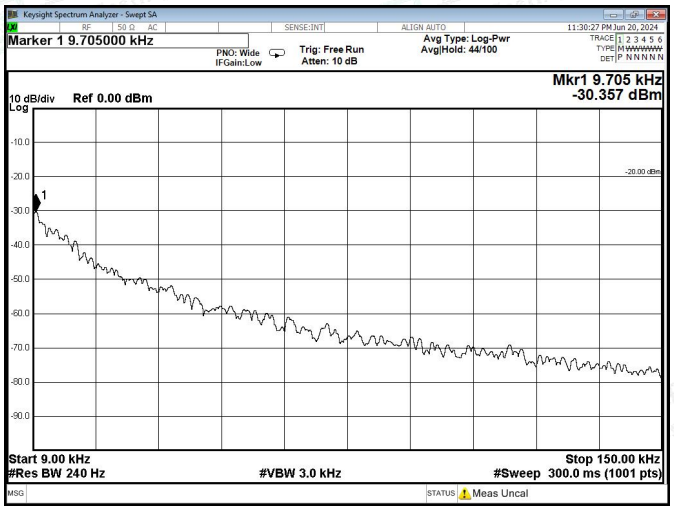
1GHz – 3GHz



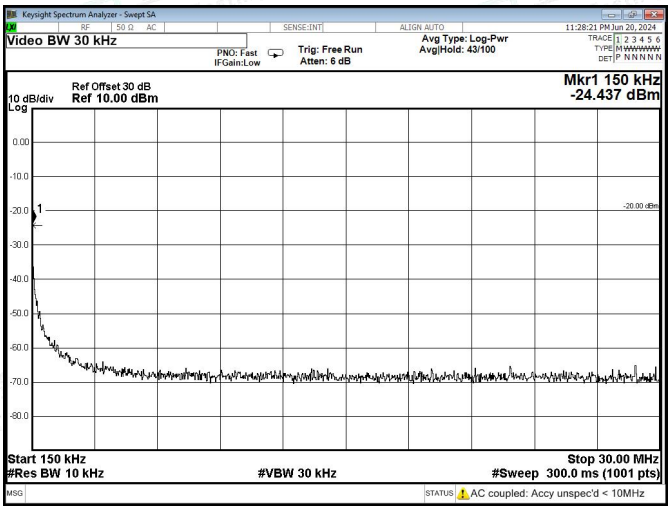
3GHz – 5GHz

Spurious Emission on Antenna Port

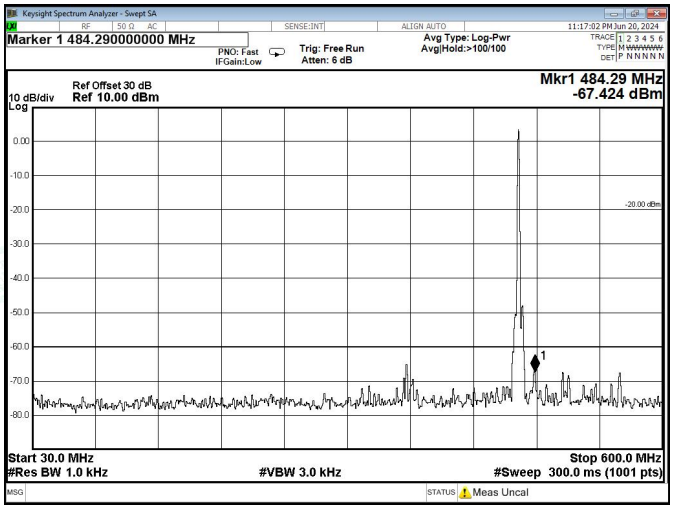
TM1 / Channel 80 / 439.625 MHz



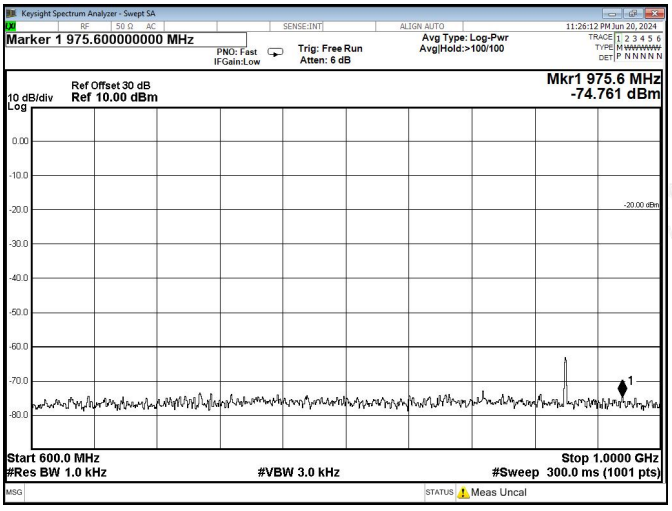
9KHz – 150KHz



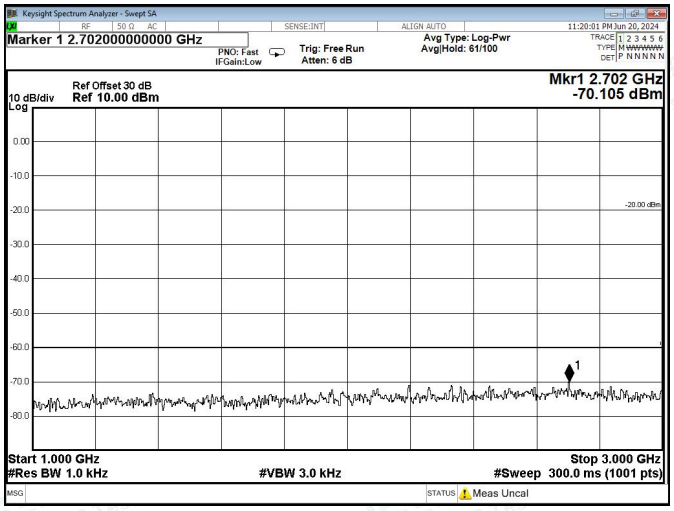
150KHz – 30MHz



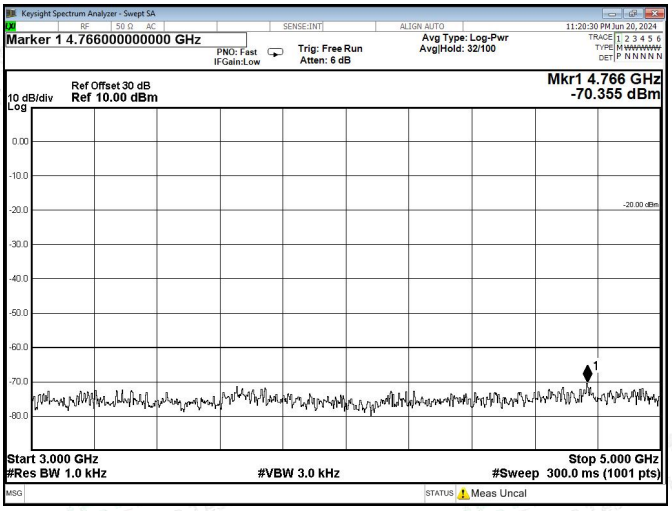
30MHz – 600MHz



600MHz – 1GHz



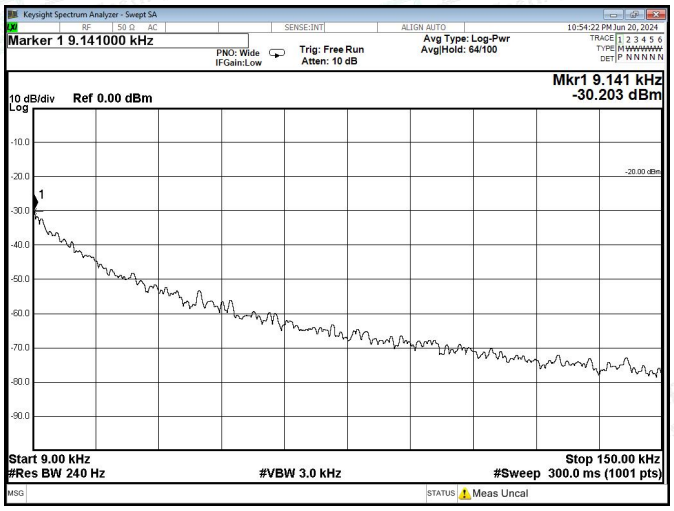
1GHz – 3GHz



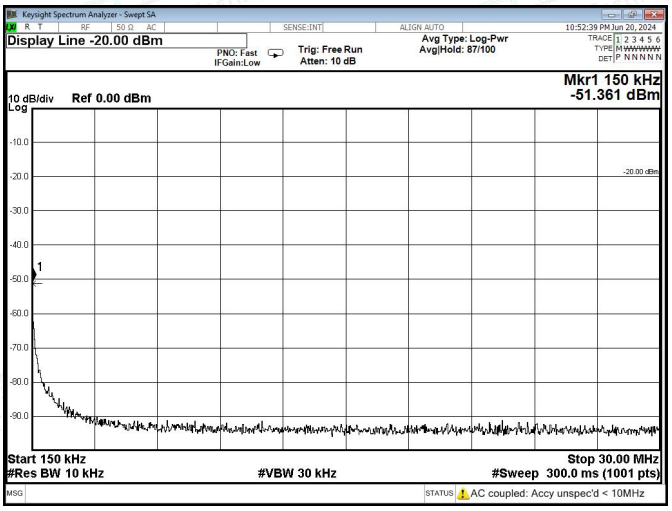
3GHz – 5GHz

Spurious Emission on Antenna Port

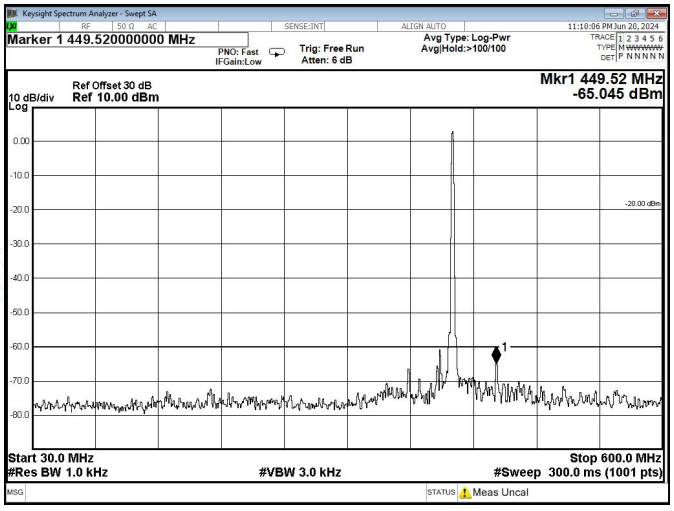
TM1 / Channel 20 / 469.625 MHz



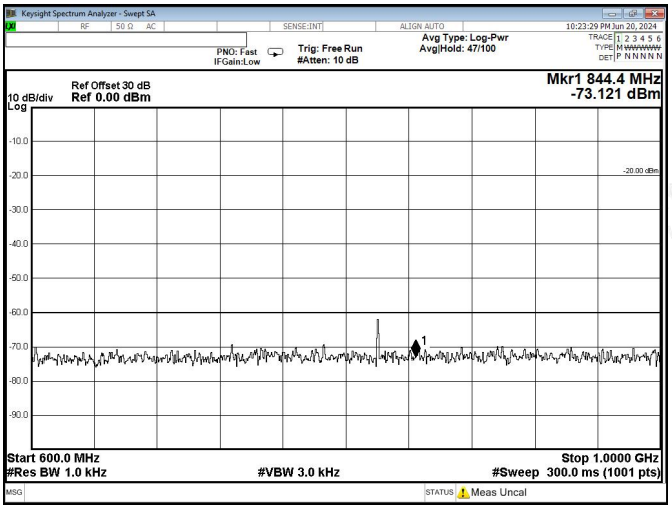
9KHz – 150KHz



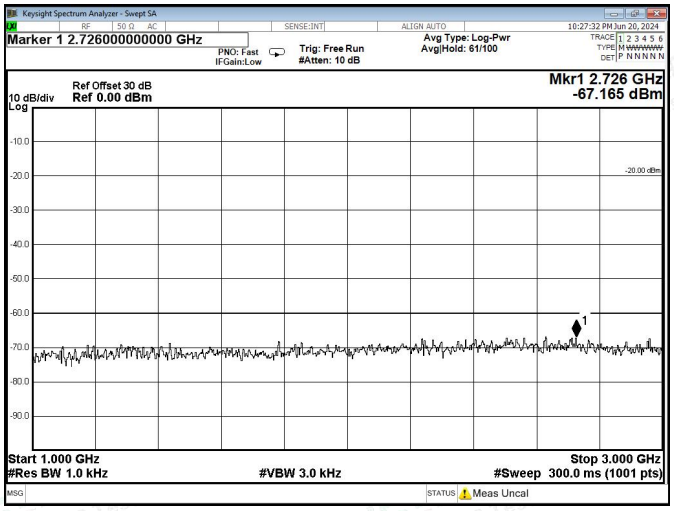
150KHz – 30MHz



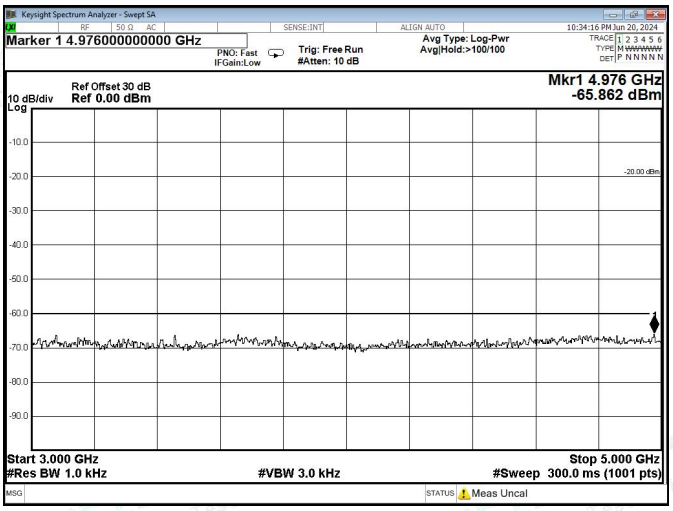
30MHz – 600MHz



600MHz – 1GHz



1GHz – 3GHz



3GHz – 5GHz

5.5. Frequency Stability Test

5.5.1 Test Applicable

1 According to FCC Part 2 Section 2.1055 (a) (1), the frequency stability shall be measured with variation of ambient temperature from -30℃ to +60℃ centigrade.

2 According to FCC Part 2 Section 2.1055 (e) (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 manufacture.

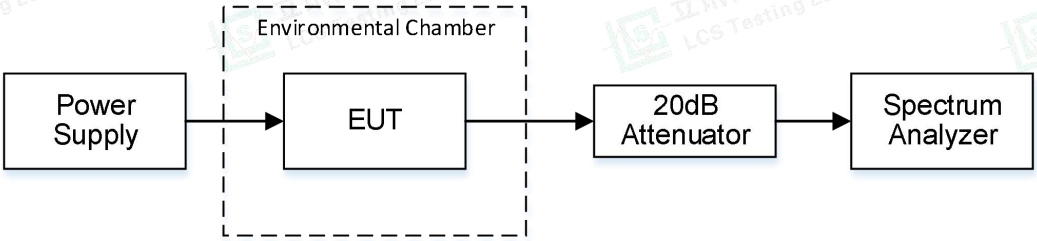
3 Vary primary supply voltage from 85 to 115 percent of the nominal value.

4 According to §90.213, the frequency stability limit is 1.5 ppm for 12.5KHz and 5.0ppm for 25KHz channel separation

5.5.2 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 Spectrum Analyzer ESCI3. The coupling loss of the additional cables was recorded and taken in account for all the measurements. 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. The result was recorded.

5.5.3 Test Configuration



5.5.4 Test Limits

According to 90.213, Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range	Channel Bandwidth	Frequency Tolerance (ppm)		
		Fixed and Base Station	Mobile Stations	
			> 2W	≤ 2W
150-174MHz	6.25	1.0	2.0	2.0
	12.5	2.5	5.0	5.0
	25	5.0	5.0	50.0*
421-512MHz	6.25	0.5	1.0	1.0
	12.5	1.5	2.5	2.5
	25	2.5	5.0	5.0

* Stations operating in the 154.45 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
* Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 1.5 ppm in the 421-512 MHz band.

5.5.5 Test Results

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(℃)	460.125	439.625	469.625
TM1	12.5KHz	7.4V	-30	-0.007	-0.011	-0.001
			-20	-0.009	-0.019	-0.002
			-10	-0.001	-0.008	-0.005
			0	0.010	0.007	-0.009
			10	0.015	-0.002	0.010
			20	-0.010	-0.006	-0.004
			30	0.018	0.014	0.014
			40	0.008	0.005	0.012
			50	-0.007	-0.002	0.001
		7.14 (85% Rated)	20	0.015	0.011	-0.006
		9.66(115% Rated)	20	0.003	-0.008	0.019
Limit			1.5ppm			
Test Results			PASS			

Remark:

1. Measured at recorded worst case at TM1.

5.6. Transmitter Frequency Behavior

5.6.1 Test Applicable

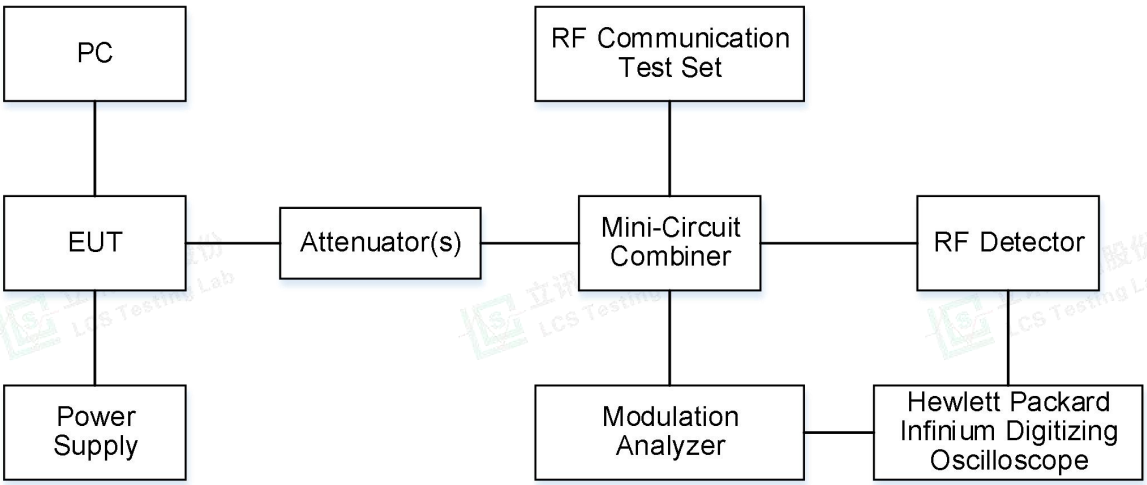
Section 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		1500 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25KHz Channels			
t_1 [4].....	± 25.0KHz	5.0ms	10.0ms
t_1	± 12.5KHz	20.0ms	25.0ms
t_3 [4].....	± 25.0KHz	5.0ms	10.0ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5KHz Channels			
t_1 [4].....	±12.5KHz	5.0ms	10.0ms
t_1	± 6.25KHz	20.0ms	25.0ms
t_3 [4].....	± 12.5KHz	5.0ms	10.0ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25KHz Channels			
t_1 [4].....	±6.25KHz	5.0ms	10.0ms
t_1	± 3.125KHz	20.0ms	25.0ms
t_3 [4].....	± 6.25KHz	5.0ms	10.0ms

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 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 for this time period.

5.6.2 Test Configuration



5.6.3 Test Procedure

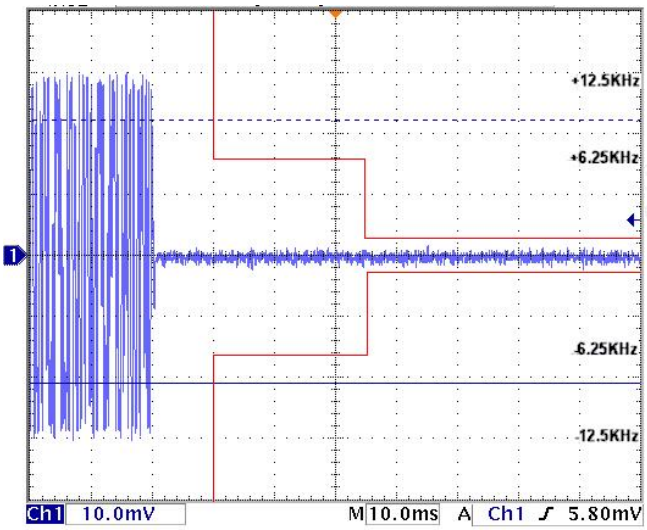
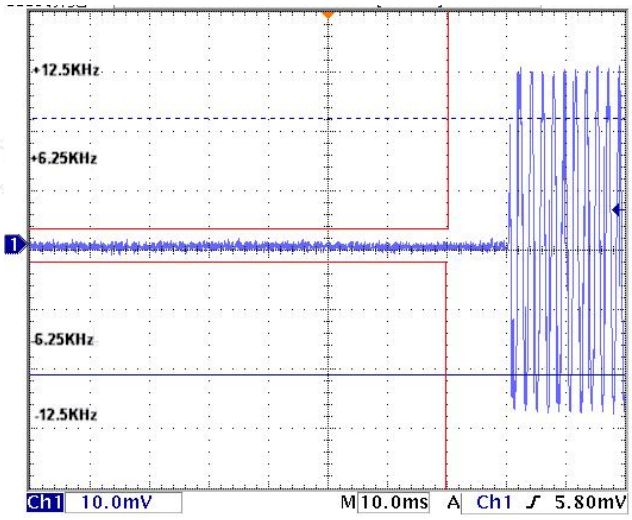
According to TIA/EIA-603 2.2.19 requirement.

5.6.4 Test Results

Temperature	23.8℃	Humidity	52.1%
Test Engineer	Paddi Chen	Test Voltage	Normal Voltage

Measured at recorded worst case at TM1.

Modulation Type: GMSK

Transmitter Frequency Behavior	
	
12.5 KHz Channel Separation------Off – On	*12.5 KHz Channel Separation------On – Off*

6. LIST OF MEASURING EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	Power Meter	R&S	NRVS	100444	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
2	Power Sensor	R&S	NRV-Z81	100458	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
3	Power Sensor	R&S	NRV-Z32	10057	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
4	ESG Vector Signal Generator	Agilent	E4438C	MY49072627(3G)	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
5	MXA Signal Analyzer	Agilent	N9020A	MY49061051	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
6	DC Power Supply	Agilent	E3642A	N/A	2022-10-29	2023-10-28
7	EMI Test Software	AUDIX	E3	/	N/A	N/A
8	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
9	Positioning Controller	MF	MF7082	MF78020803	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
10	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2021-08-29	2024-08-28
11	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2021-09-12	2024-09-11
12	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2021-09-05	2024-09-04
13	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2021-08-29	2024-08-28
14	Broadband Preamplifier	SCHWARZBECK	BBV9745	9719-025	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
15	EMI Test Receiver	R&S	ESR 7	101181	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
16	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2022-10-29	2023-10-28
17	6dB Attenuator	/	100W/6dB	1172040	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
18	3dB Attenuator	/	2N-3dB	/	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
19	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
20	Combiner	N/A	N/A	SHWLCB2-52500S	2022-10-29	2023-10-28
21	Audio Analyzer	R&S	UPV	1146.2003K02-101721-UW	2022-10-29	2023-10-28
22	MXG Vector Signal Generator	Agilent	N5182A	MY47071151	2023-06-09	2024-06-08
					2024-06-06	2025-06-05
23	RF Filter	Micro-Tronics	BRC50721	013	2022-10-29	2023-10-28
24	RF Filter	Micro-Tronics	BRM50702	195	2023-08-15	2024-08-14
25	EMI Test Software	Farad	EZ	/	N/A	N/A
26	By-log Antenna	SCHWARZBECK	VULB9163	S/N01143	2023-06-15	2024-06-14
					2024-06-06	2025-06-05

7. TEST SETUP PHOTOGRAPHS OF EUT

Pleaserefer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

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