



SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 1 of 52

TEST REPORT

Application No.: SHCR2407001463HS
FCC ID: 2AT72-LUNA4HAIR
IC: 25565-LUNA4HAIR
Applicant: VIS (Shanghai) Technology Limited
Address of Applicant: No.58, Linsheng Road, Tinglin Town, Jinshan District, Shanghai, China
Manufacturer: FOREO AB
Address of Manufacturer: KARLAVAGEN 41, 114 31 STOCKHOLM, SWEDEN
Factory: VIS (Shanghai) Technology Limited
Address of Factory: No.58, Linsheng Road, Tinglin Town, Jinshan District, Shanghai, China
Equipment Under Test (EUT):
EUT Name: LUNA™ 4 hair
Model No.: LUNA™ 4 hair
Trade Mark: FOREO
Standard(s) : 47 CFR Part 15, Subpart C 15.247
RSS-247 Issue 3, August 2023
RSS-Gen Issue 5 Amendment 2 (February 2021)
Date of Receipt: 2024-07-24
Date of Test: 2024-07-26 to 2024-08-09
Date of Issue: 2024-08-13

Test Result:	Pass*
---------------------	--------------

* In the configuration tested, the EUT complied with the standards specified above.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.



SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 2 of 52

Revision Record			
Version	Description	Date	Remark
00	Original	2024-08-13	/

Authorized for issue by:			
Tested By		Bill Wu	
		Bill Wu/Project Engineer	
Approved By		Parlam Zhan	
		Parlam Zhan / Reviewer	

2 Test Summary

Radio Spectrum Technical Requirement				
Item	FCC Requirement	IC Requirement	Method	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration

N/A: Not applicable

Radio Spectrum Matter Part				
Item	FCC Requirement	IC Requirement	Method	Result
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247a(2)	RSS-247 Clause 5.2(a)	ANSI C63.10 (2013) Section 11.8.1	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(3)	RSS-247 Clause 5.4(d)	ANSI C63.10 (2013) Section 11.9.1	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247(e)	RSS-247 Clause 5.2(b)	ANSI C63.10 (2013) Section 11.10.2	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Clause 5.5	ANSI C63.10 (2013) Section 11.13.3.2	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Clause 5.5	ANSI C63.10 (2013) Section 11.11	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	RSS-247 Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass
99% Bandwidth	-	RSS-Gen Section 6.7	ANSI C63.10 Section 6.9.3	Pass

3 Contents

	Page
1 COVER PAGE	1
2 Test Summary.....	3
3 Contents	4
4 General Information.....	6
4.1 Details of E.U.T.	6
4.2 Description of Support Units.....	6
4.3 Power level setting using in test.....	6
4.4 Measurement Uncertainty	6
4.5 Test Location	7
4.6 Test Facility.....	7
4.7 Deviation from Standards.....	7
4.8 Abnormalities from Standard Conditions	7
5 Equipment List	8
6 Radio Spectrum Technical Requirement.....	9
6.1 Antenna Requirement	9
6.1.1 Test Requirement:	9
6.1.2 Conclusion.....	9
7 Radio Spectrum Matter Test Results.....	10
7.1 Radiated Emissions which fall in the restricted bands	10
7.1.1 E.U.T. Operation.....	10
7.1.2 Test Mode Description	10
7.1.3 Test Setup Diagram	10
7.1.4 Measurement Procedure and Data.....	11
7.2 Radiated Spurious Emissions Below 1GHz.....	16
7.2.1 E.U.T. Operation.....	16
7.2.2 Test Mode Description	16
7.2.3 Test Setup Diagram	16
7.2.4 Measurement Procedure and Data.....	17
7.3 Radiated Spurious Emissions Above 1GHz	20
7.3.1 E.U.T. Operation.....	20
7.3.2 Test Mode Description	20
7.3.3 Test Setup Diagram	20
7.3.4 Measurement Procedure and Data.....	21
7.4 Conducted Peak Output Power	28
7.4.1 E.U.T. Operation.....	28
7.4.2 Test Setup Diagram	28
7.4.3 Measurement Procedure and Data.....	28
7.5 Minimum 6dB Bandwidth.....	29
7.5.1 E.U.T. Operation.....	29
7.5.2 Test Mode Description	29
7.5.3 Test Setup Diagram	29
7.5.4 Measurement Procedure and Data.....	29
7.6 Power Spectrum Density	30
7.6.1 E.U.T. Operation.....	30
7.6.2 Test Mode Description	30
7.6.3 Test Setup Diagram	30
7.6.4 Measurement Procedure and Data.....	30
7.7 Conducted Band Edges Measurement	31



SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 5 of 52

7.7.1	<i>E.U.T. Operation</i>	31
7.7.2	<i>Test Mode Description</i>	31
7.7.3	<i>Test Setup Diagram</i>	31
7.7.4	<i>Measurement Procedure and Data</i>	31
7.8	Conducted Spurious Emissions	32
7.8.1	<i>E.U.T. Operation</i>	32
7.8.2	<i>Test Mode Description</i>	32
7.8.3	<i>Test Setup Diagram</i>	32
7.8.4	<i>Measurement Procedure and Data</i>	32
7.9	99% Bandwidth	33
7.9.1	<i>E.U.T. Operation</i>	33
7.9.2	<i>Test Mode Description</i>	33
7.9.3	<i>Test Setup Diagram</i>	33
7.9.4	<i>Measurement Procedure and Data</i>	33
8	Test Setup Photo	34
9	EUT Constructional Details (EUT Photos)	34
10	Appendix	34

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 3.7V 420mAh Rechargeable battery
Test Voltage:	DC 3.7V
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	PCB Antenna
Antenna Gain:	0 dBi (Provided by manufacturer)
Data rate:	1Mbps
S/N:	Hz9FXH74fRwC2t
Firmware Version:	LUNA4hair F.REV.A

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
--	--	--	--

The EUT has been tested as an independent unit.

4.3 Power level setting using in test

Channel	Power setting
0	Default
19	Default
39	Default

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	8.4×10^{-8}
2	Timeout	2s
3	Duty cycle	0.4%
4	Occupied Bandwidth	3%
5	RF conducted power	0.6dB
6	RF power density	2.9dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	5.2dB (Below 1GHz)
		5.9dB (Above 1GHz)
9	Radiated Spurious emission test	4.2dB (Below 30MHz)
		4.5dB (30MHz-1GHz)
		5.1dB (1GHz-6GHz)
		5.4dB (6GHz-18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab
588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China
Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

No tests were sub-contracted.

Note:

1. SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working frequency, antenna gain, cable loss, etc) is provided by the applicant. (If applicable).
2. SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (If applicable).
3. Sample source: sent by customer.

4.6 Test Facility

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

- **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

- **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.
Company Number: 8617A

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None

5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2023-12-19	2024-12-18
Spectrum Analyzer	Keysight	N9020B	SHEM241-1	2023-12-19	2024-12-18
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2024-07-31	2025-07-30
Signal Generator	R&S	SMR20	SHEM006-1	2024-07-31	2025-07-30
Signal Generator	Agilent	N5182A	SHEM182-1	2024-07-31	2025-07-30
Communication Tester	R&S	CMW270	SHEM183-1	2024-05-23	2025-05-22
Communication Tester	R&S	CMW500	SHEM268-1	2024-05-23	2025-05-22
Power Sensor	Keysight	U2021XA * 4	SHEM293-1	2024-07-31	2025-07-30
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2022-11-08	2024-11-07
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2023-12-19	2024-12-18
DC Power Supply	HP	6010A	SHEM222-1	2023-12-19	2024-12-18
Conducted test Cable	/	RF01~RF04	/	2023-12-19	2024-12-18
Switcher	Tonscend	JS0806	SHEM293-1	2024-07-31	2025-07-30
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
Switcher+Power Sensor	TST	TSPS2023R	SHEM263-1	2024-07-31	2025-07-30
Test software	TST	TST PASS	Version: 2.0	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2023-12-19	2024-12-18
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2023-12-19	2024-12-18
Communication Tester	R&S	CMW500	SHEM268-1	2024-05-23	2025-05-22
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2023-12-19	2024-12-18
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2023-09-03	2025-09-02
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2023-04-17	2025-04-16
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2024-08-05	2026-08-04
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2023-09-03	2025-09-02
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2023-09-03	2025-09-02
Pre-Amplifier	HP	8447D	SHEM236-1	2023-12-19	2024-12-18
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2023-12-19	2024-12-18
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2023-05-06	2026-05-05
RE test Cable	/	PT18-NMMN-10M	SHEM217-2	2023-12-19	2024-12-18
Test software	ESE	E3	Version: 6.111221a	/	/

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 0 dBi.

Antenna location: Refer to internal photo.

7 Radio Spectrum Matter Test Results

7.1 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 23.9 °C

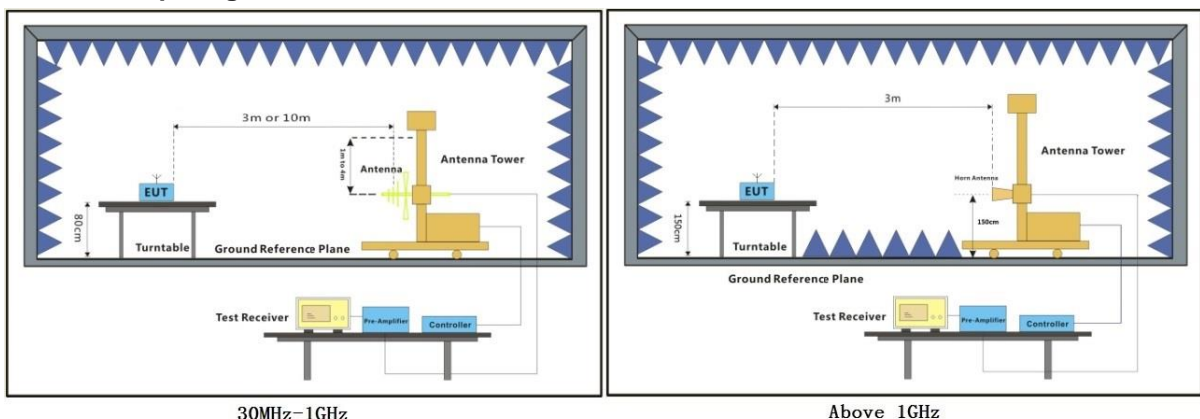
Humidity: 61.4 % RH

Atmospheric Pressure: 1010 mbar

7.1.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.1.3 Test Setup Diagram



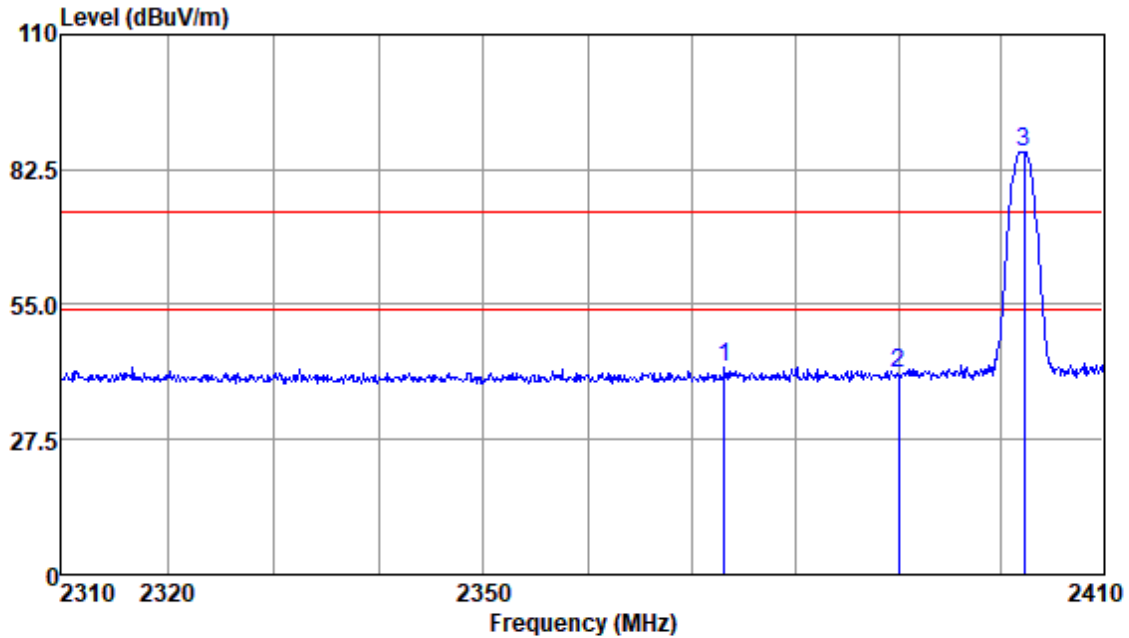
7.1.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



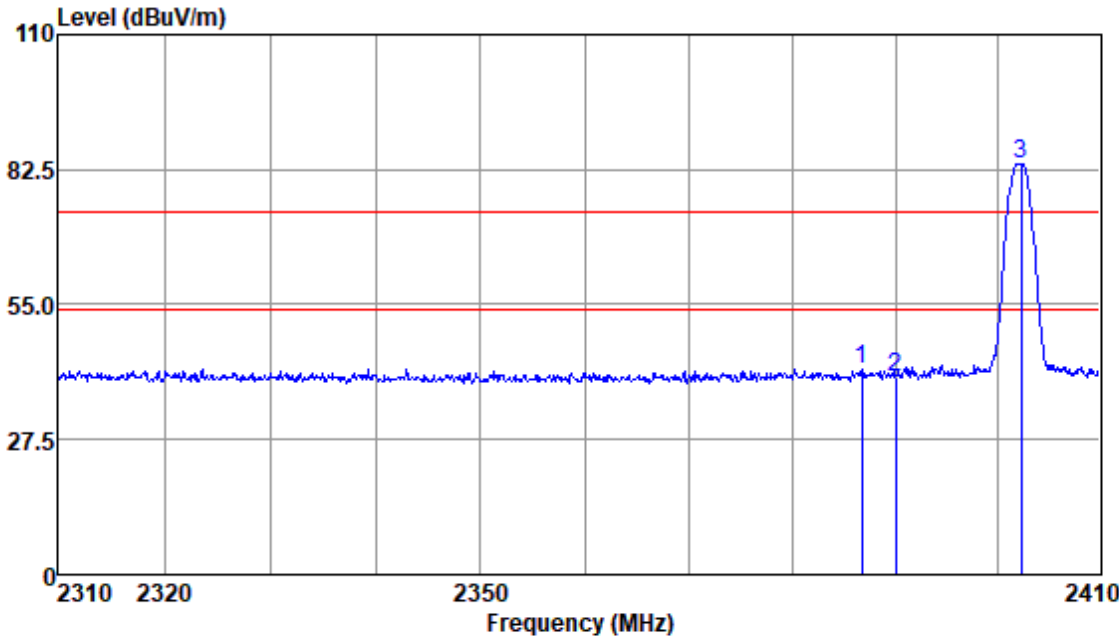
Antenna Polarity :HORIZONTAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2373.11	45.44	28.71	3.32	35.17	42.30	74.00	-31.70	Peak
2390.00	43.92	28.80	3.34	35.18	40.88	74.00	-33.12	Peak
2402.25	89.12	28.85	3.34	35.19	86.12	74.00	12.12	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low

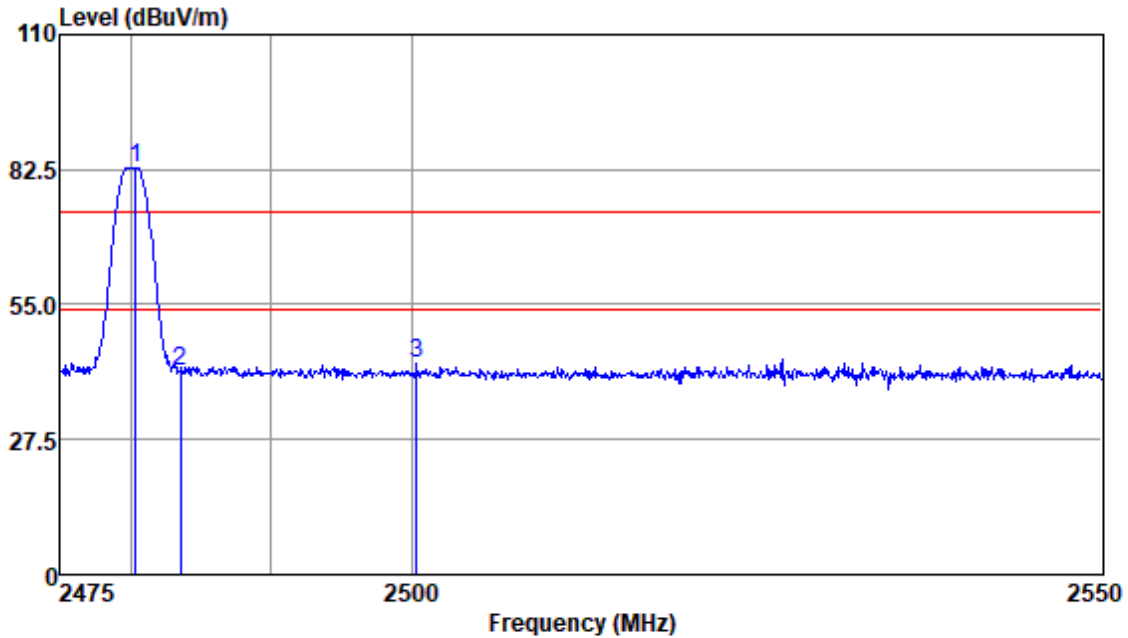


Antenna Polarity :VERTICAL
EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
2386.72	44.94	28.80	3.34	35.18	41.90	74.00	-32.10	Peak
2390.00	43.27	28.80	3.34	35.18	40.23	74.00	-33.77	Peak
2402.25	86.82	28.85	3.34	35.19	83.82	74.00	9.82	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



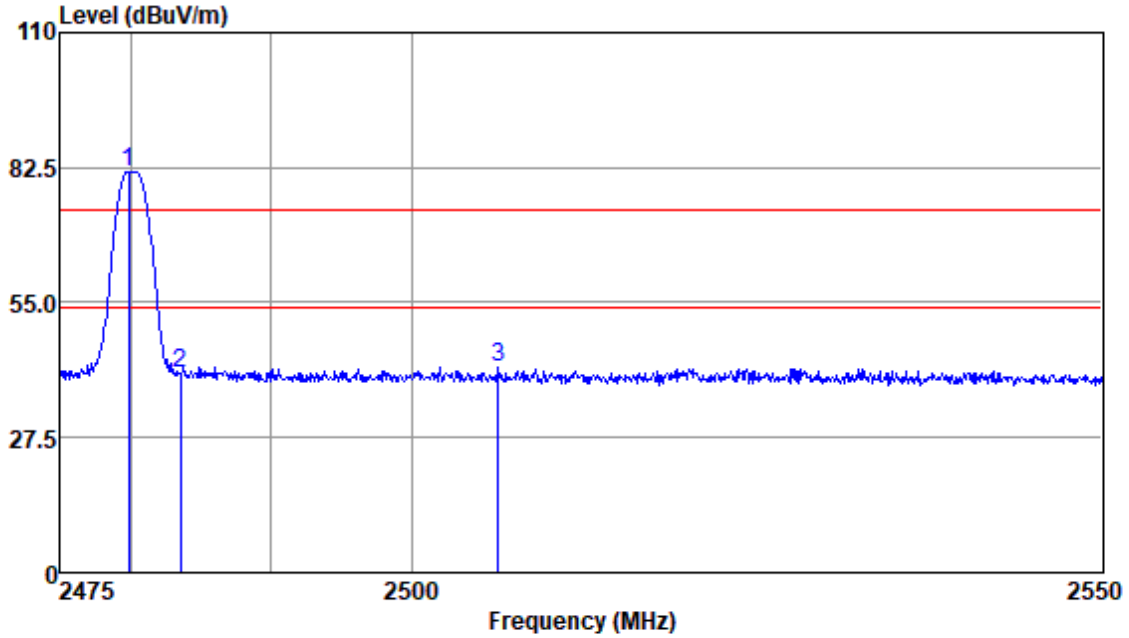
Antenna Polarity :HORIZONTAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2480.33	85.71	29.08	3.40	35.25	82.94	74.00	8.94	Peak
2483.50	44.35	29.09	3.36	35.26	41.54	74.00	-32.46	Peak
2500.40	45.61	29.12	3.36	35.27	42.82	74.00	-31.18	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2479.81	84.39	29.08	3.40	35.25	81.62	74.00	7.62	Peak
2483.50	43.24	29.09	3.36	35.26	40.43	74.00	-33.57	Peak
2506.23	44.70	29.13	3.39	35.28	41.94	74.00	-32.06	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.2 Radiated Spurious Emissions Below 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
960-1000	500	3

7.2.1 E.U.T. Operation

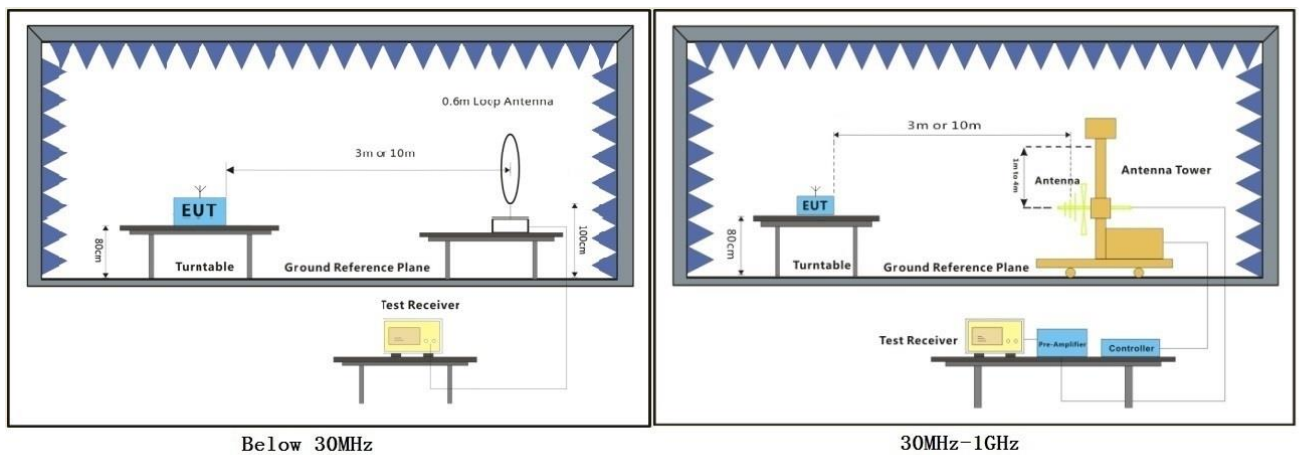
Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

7.2.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.2.3 Test Setup Diagram



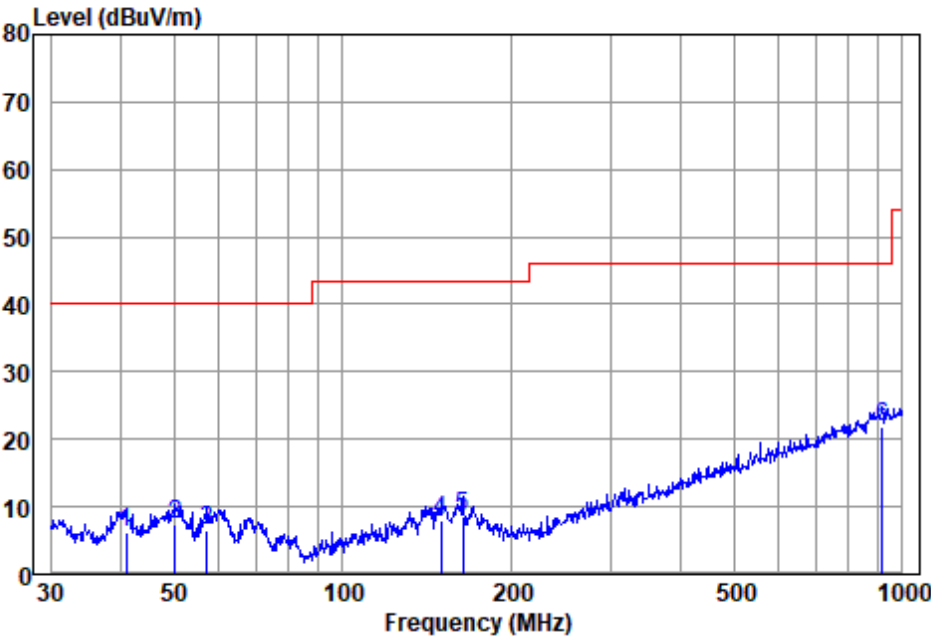
7.2.4 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using quasi-peak method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$
2. Scan from 9kHz to 30MHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

Test Mode: 00; Polarity: Horizontal

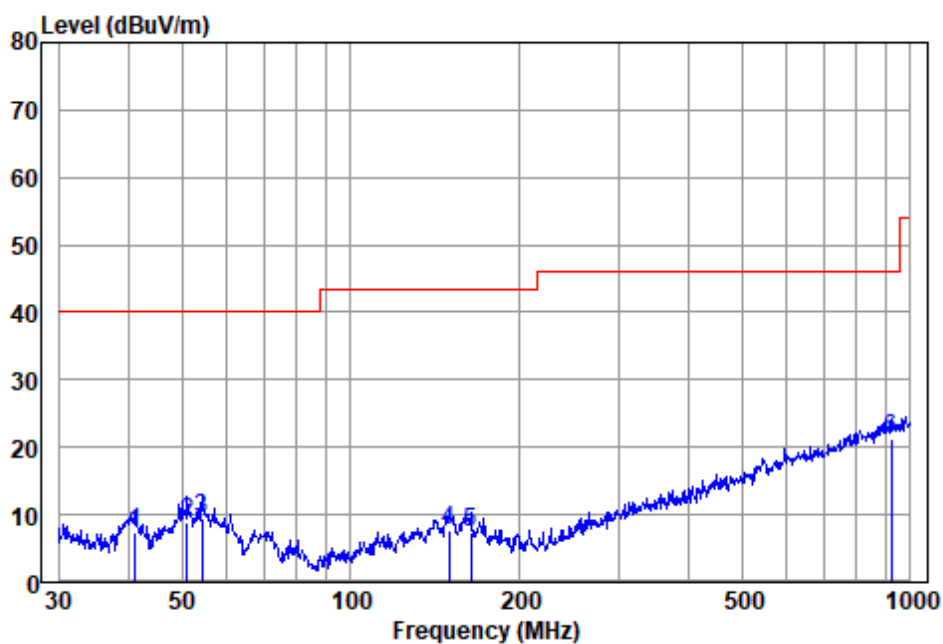


Antenna Polarity :HORIZONTAL
 EUT/Project :1463HS
 Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	40.988	24.58	13.60	1.36	33.20	6.34	40.00	-33.66	QP
2	50.057	25.19	13.90	1.38	33.20	7.27	40.00	-32.73	QP
3	57.191	24.91	13.46	1.46	33.20	6.63	40.00	-33.37	QP
4	150.011	24.51	13.70	2.63	33.00	7.84	43.50	-35.66	QP
5	163.755	25.56	13.30	2.74	33.00	8.60	43.50	-34.90	QP
6	919.287	22.55	23.90	6.99	31.62	21.82	46.00	-24.18	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical



Antenna Polarity :VERTICAL

EUT/Project :1463HS

Test mode :00

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	41.132	25.51	13.60	1.35	33.20	7.26	40.00	-32.74	QP
2	50.942	26.59	13.90	1.45	33.20	8.74	40.00	-31.26	QP
3	54.261	27.46	13.86	1.46	33.20	9.58	40.00	-30.42	QP
4	150.011	24.25	13.70	2.63	33.00	7.58	43.50	-35.92	QP
5	163.755	24.39	13.30	2.74	33.00	7.43	43.50	-36.07	QP
6	922.516	21.96	23.83	7.02	31.60	21.21	46.00	-24.79	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.3 Radiated Spurious Emissions Above 1GHz

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
Above 1000	500	3

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 23.9 °C

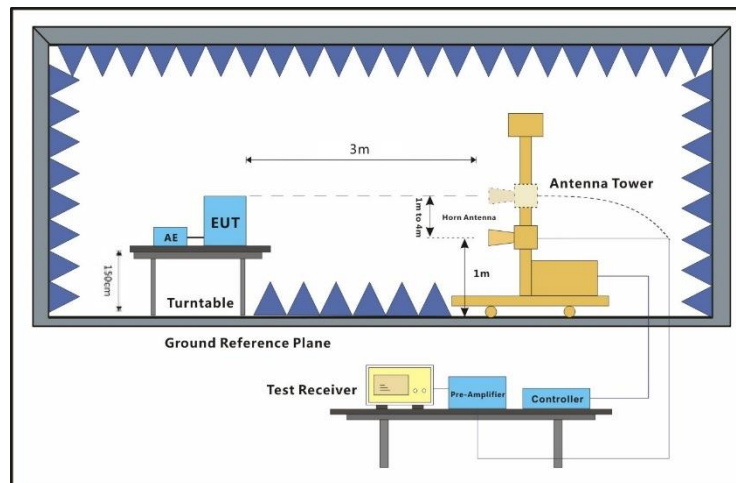
Humidity: 61.3 % RH

Atmospheric Pressure: 1010 mbar

7.3.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.3.3 Test Setup Diagram



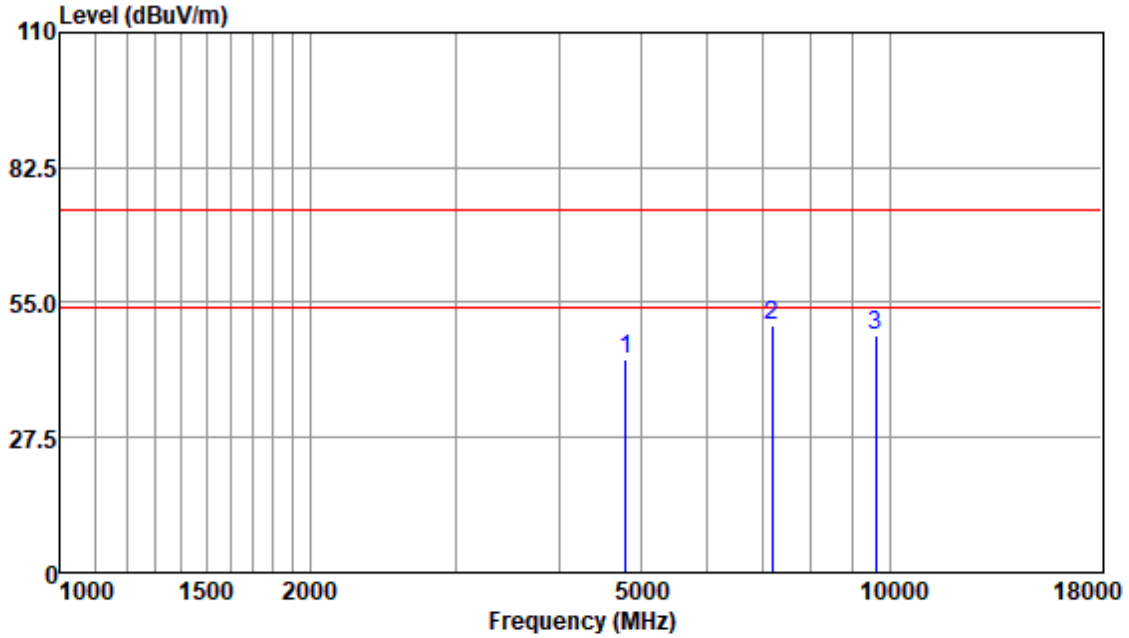
7.3.4 Measurement Procedure and Data

- a. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak or average method as specified and then reported in a data sheet.
- g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- i. Repeat above procedures until all frequencies measured was complete.

Remark:

1. Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor
2. Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
3. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:Low



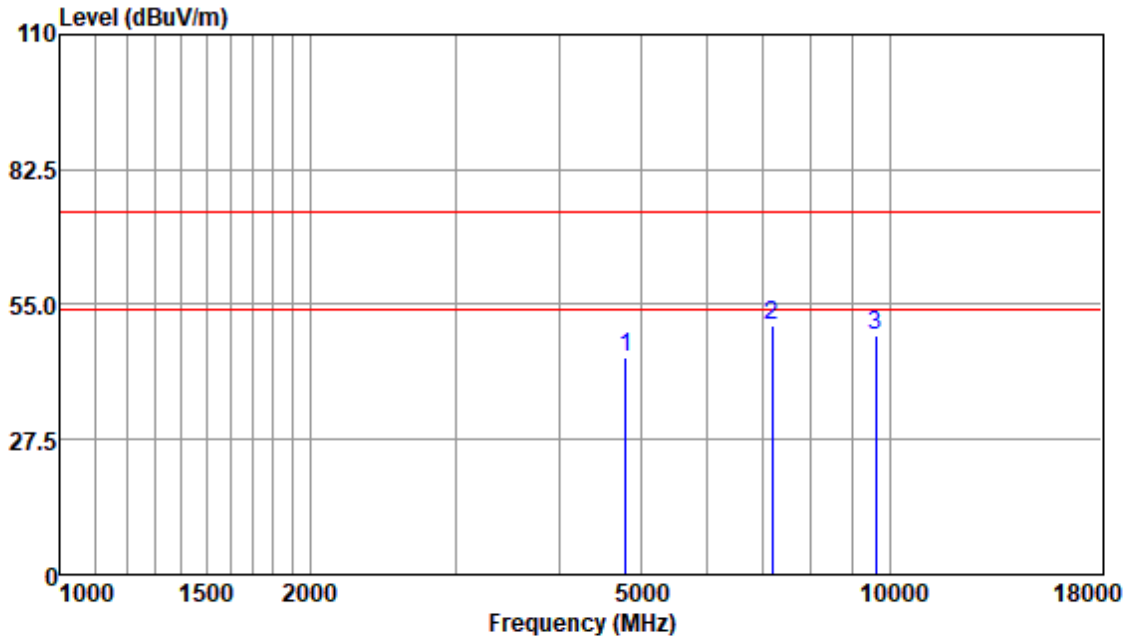
Antenna Polarity :HORIZONTAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.11	41.46	33.57	5.22	36.79	43.46	74.00	-30.54	Peak
7206.31	42.45	36.24	7.13	35.53	50.29	74.00	-23.71	Peak
9608.43	35.56	37.75	8.66	33.58	48.39	74.00	-25.61	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:Low



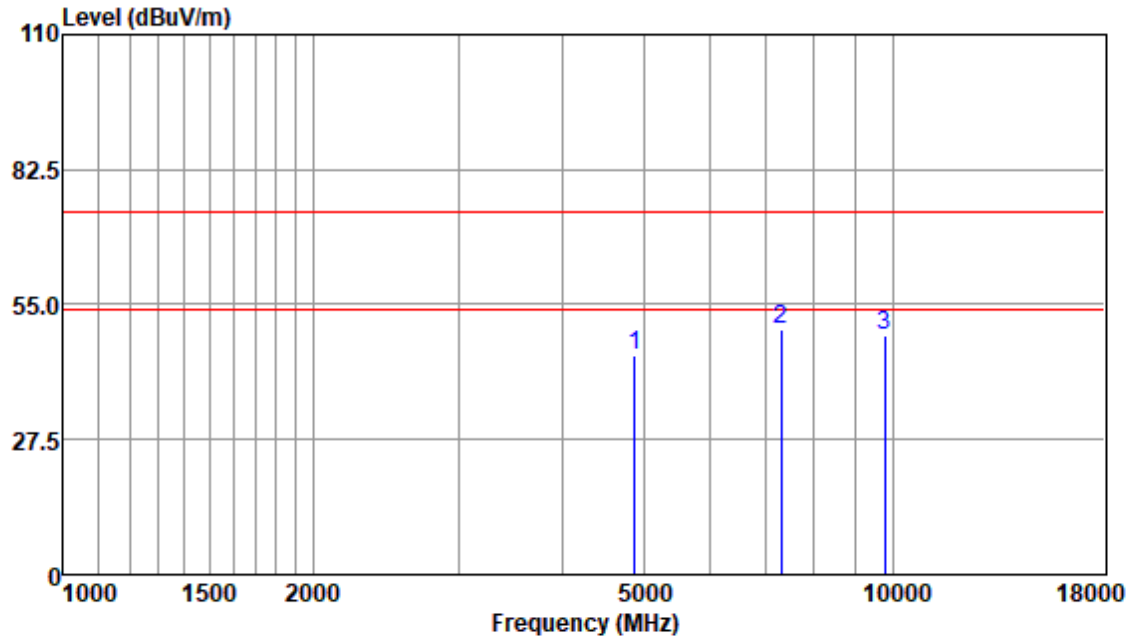
Antenna Polarity :VERTICAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4804.11	42.08	33.57	5.22	36.79	44.08	74.00	-29.92	Peak
7206.31	42.95	36.24	7.13	35.53	50.79	74.00	-23.21	Peak
9608.43	35.82	37.75	8.66	33.58	48.65	74.00	-25.35	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:middle



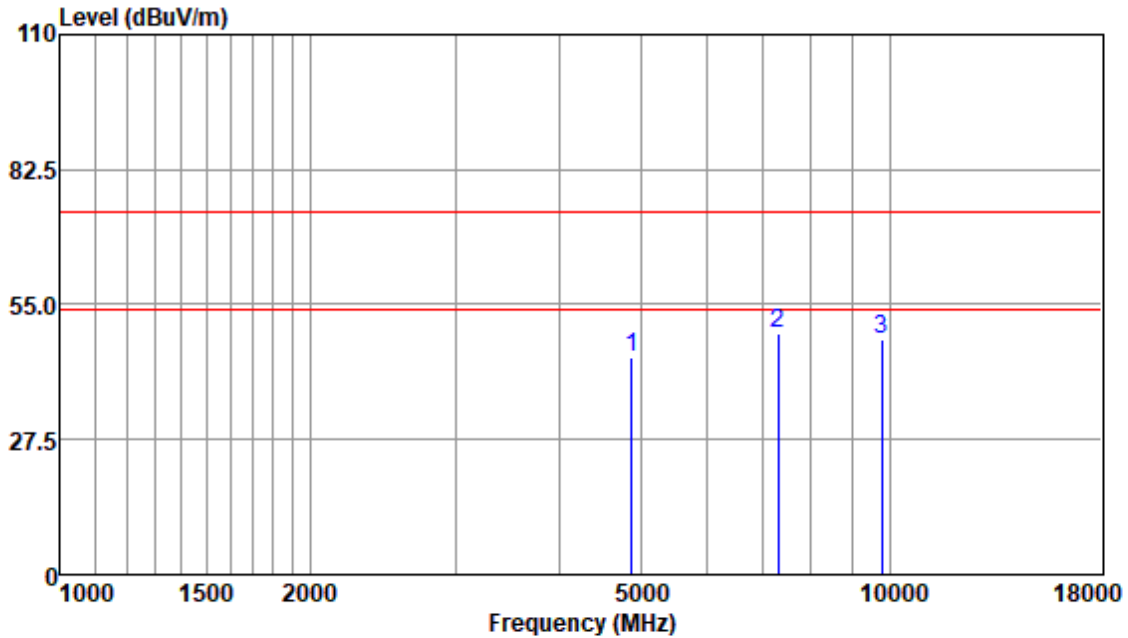
Antenna Polarity :HORIZONTAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
4880.04	42.43	33.66	5.28	36.81	44.56	74.00	-29.44	Peak
7320.27	41.81	36.33	7.33	35.42	50.05	74.00	-23.95	Peak
9760.37	35.88	37.54	8.84	33.50	48.76	74.00	-25.24	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:middle



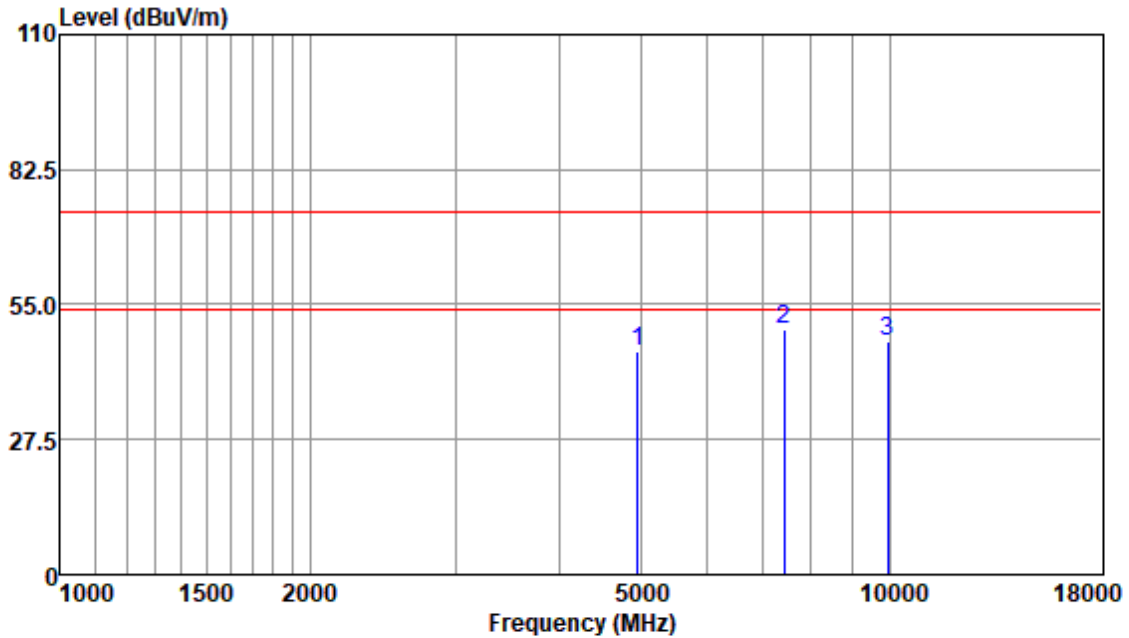
Antenna Polarity :VERTICAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4880.04	41.98	33.66	5.28	36.81	44.11	74.00	-29.89	Peak
7320.27	40.91	36.33	7.33	35.42	49.15	74.00	-24.85	Peak
9760.37	35.17	37.54	8.84	33.50	48.05	74.00	-25.95	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Horizontal; Modulation:GFSK; Channel:High



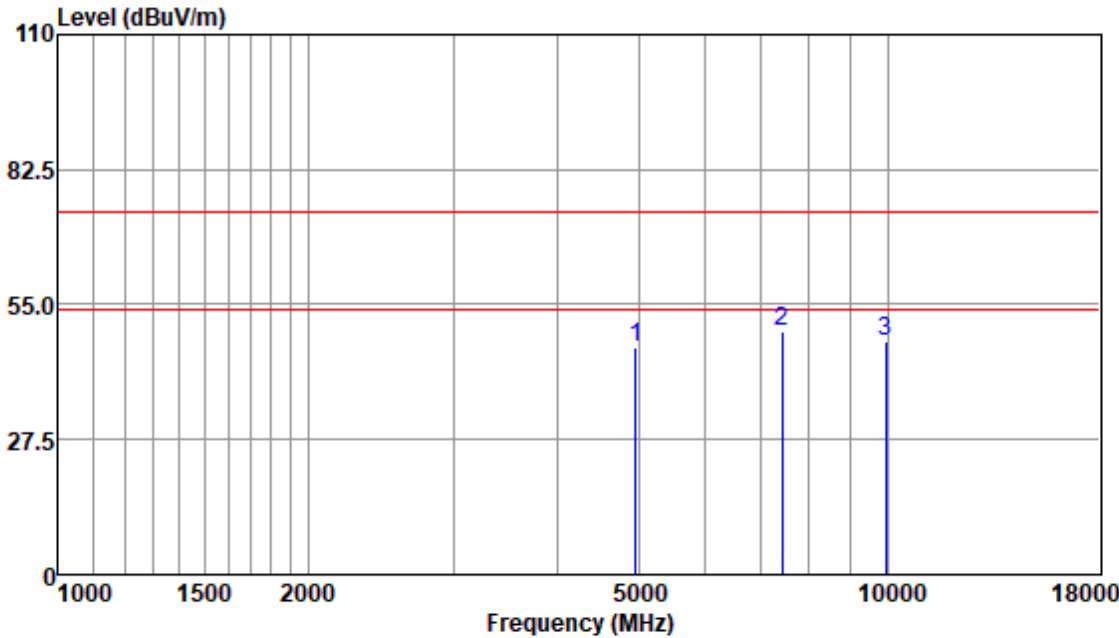
Antenna Polarity :HORIZONTAL

EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.31	43.32	33.65	5.46	36.83	45.60	74.00	-28.40	Peak
7440.91	41.71	36.31	7.43	35.34	50.11	74.00	-23.89	Peak
9920.99	34.42	37.62	8.69	33.41	47.32	74.00	-26.68	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Test Mode: 00; Polarity: Vertical; Modulation:GFSK; Channel:High



Antenna Polarity :VERTICAL
EUT/Project :1463HS

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
4960.31	44.09	33.65	5.46	36.83	46.37	74.00	-27.63	Peak
7440.91	40.99	36.31	7.43	35.34	49.39	74.00	-24.61	Peak
9920.99	34.73	37.62	8.69	33.41	47.63	74.00	-26.37	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.4 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

7.4.1 E.U.T. Operation

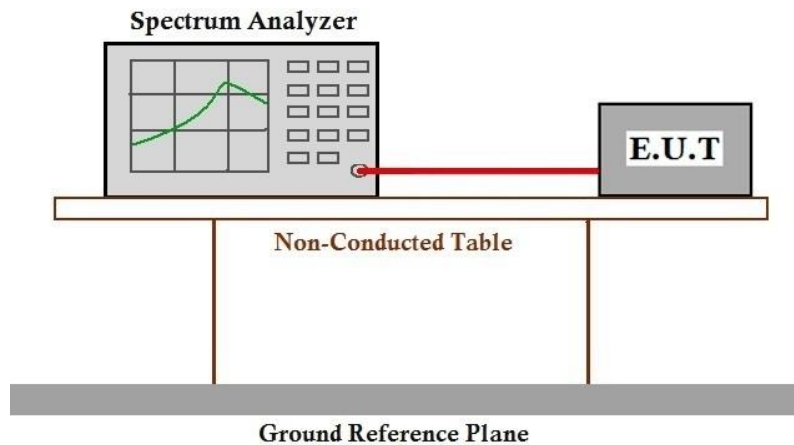
Operating Environment:

Temperature: 23.9 °C

Humidity: 61.3 % RH

Atmospheric Pressure: 1010 mbar

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

Note: Since the verify power the same operating range bandwidth and smaller power can be covered by the higher power.

Please Refer to Appendix for Details

7.5 Minimum 6dB Bandwidth

Test Requirement	47 CFR Part 15, Subpart C 15.247a(2)
Test Method:	ANSI C63.10 (2013) Section 11.8.1
Limit:	≥500 kHz

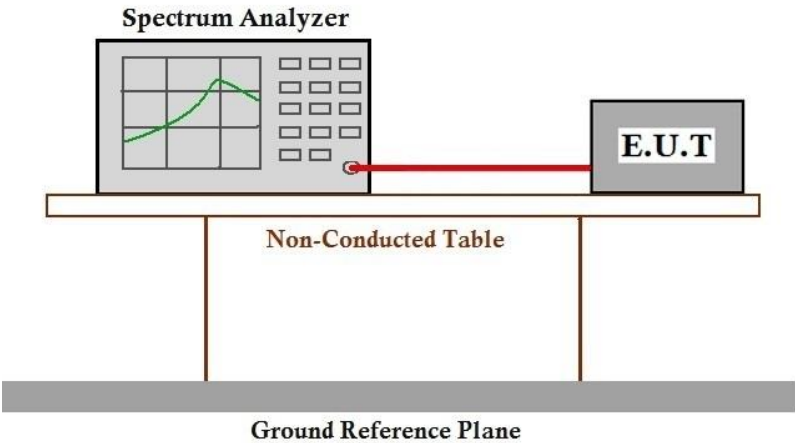
7.5.1 E.U.T. Operation

Operating Environment:			
Temperature:	23.9 °C	Humidity:	61.2 % RH
		Atmospheric Pressure:	1010 mbar

7.5.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.5.3 Test Setup Diagram



7.5.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.6 Power Spectrum Density

Test Requirement 47 CFR Part 15, Subpart C 15.247(e)

Test Method: ANSI C63.10 (2013) Section 11.10.2

Limit:

≤8dBm in any 3 kHz band during any time interval of continuous transmission

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.9 °C

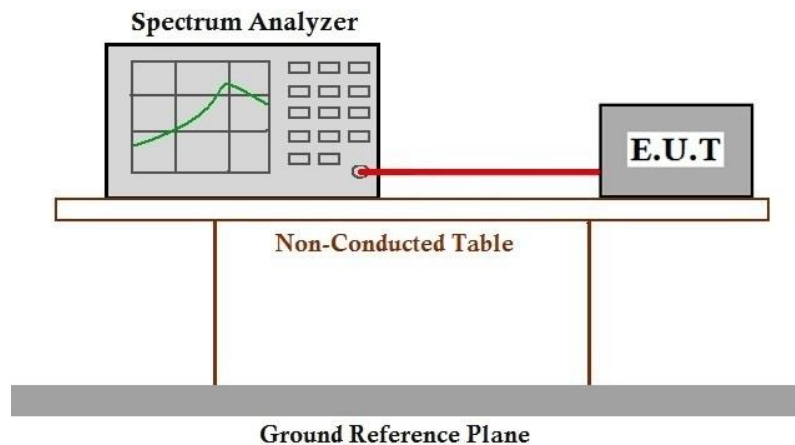
Humidity: 61.3 % RH

Atmospheric Pressure: 1010 mbar

7.6.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.6.3 Test Setup Diagram



7.6.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.7 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)
Test Method: ANSI C63.10 (2013) Section 11.13.3.2

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

7.7.1 E.U.T. Operation

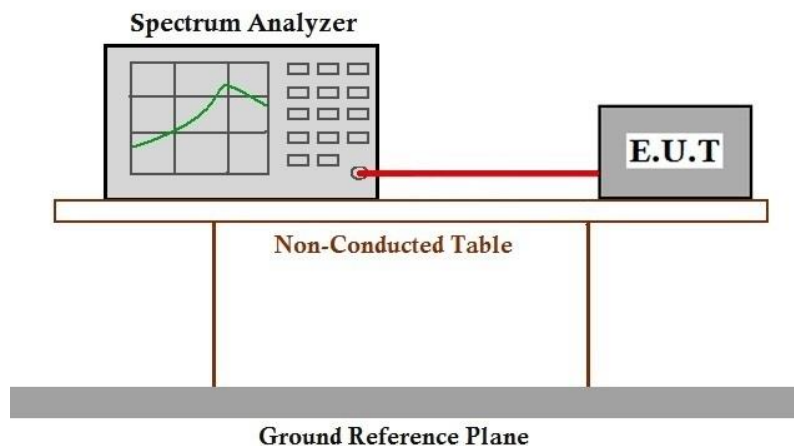
Operating Environment:

Temperature: 23.9 °C Humidity: 61.3 % RH Atmospheric Pressure: 1010 mbar

7.7.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.7.3 Test Setup Diagram



7.7.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.8 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 11.11

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 23.9 °C

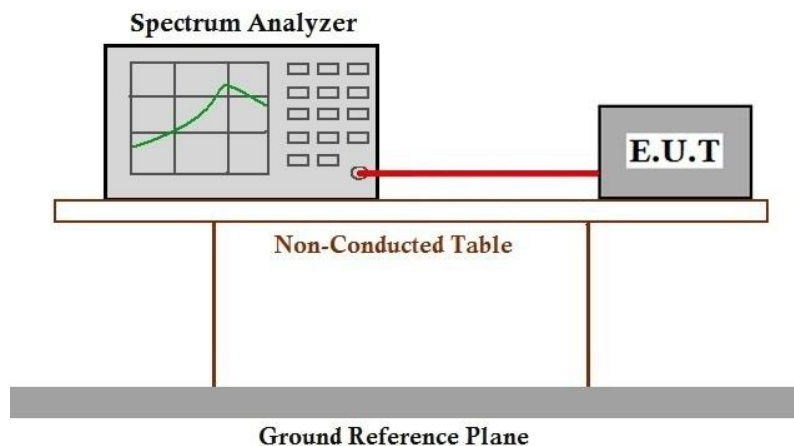
Humidity: 61.2 % RH

Atmospheric Pressure: 1010 mbar

7.8.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.8.3 Test Setup Diagram



7.8.4 Measurement Procedure and Data

Please Refer to Appendix for Details

7.9 99% Bandwidth

Test Requirement RSS-Gen Section 6.7
 Test Method: ANSI C63.10 (2013) Section 6.9.3

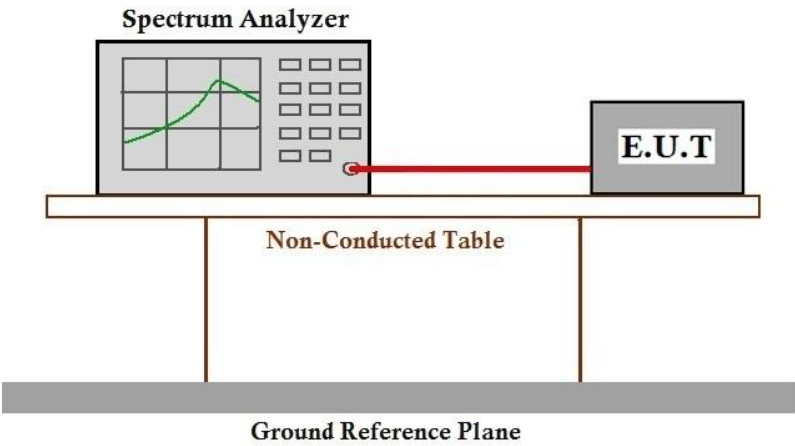
7.9.1 E.U.T. Operation

Operating Environment:
 Temperature: 23.9 °C Humidity: 61.2 % RH Atmospheric Pressure: 1010 mbar

7.9.2 Test Mode Description

Pre-scan / Final test	Mode Code	Description
Final test	00	TX mode(1Mbps)_Keep the EUT in continuously transmitting mode with GFSK modulation.

7.9.3 Test Setup Diagram



7.9.4 Measurement Procedure and Data

Please Refer to Appendix for Details

8 Test Setup Photo

Refer to Appendix - Test Setup Photo for SHCR2407001463HS

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for SHCR2407001463HS

10 Appendix

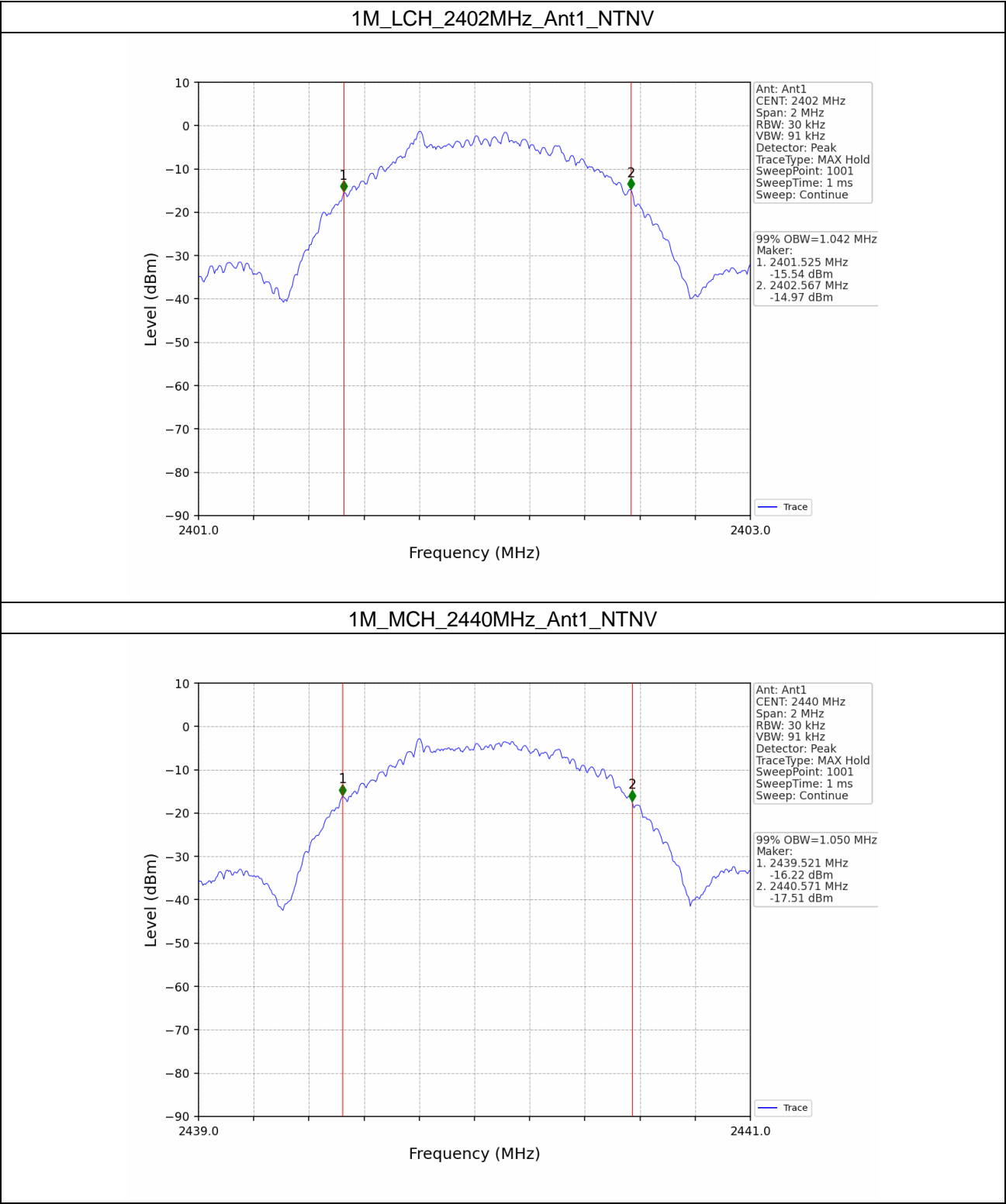
1. Bandwidth

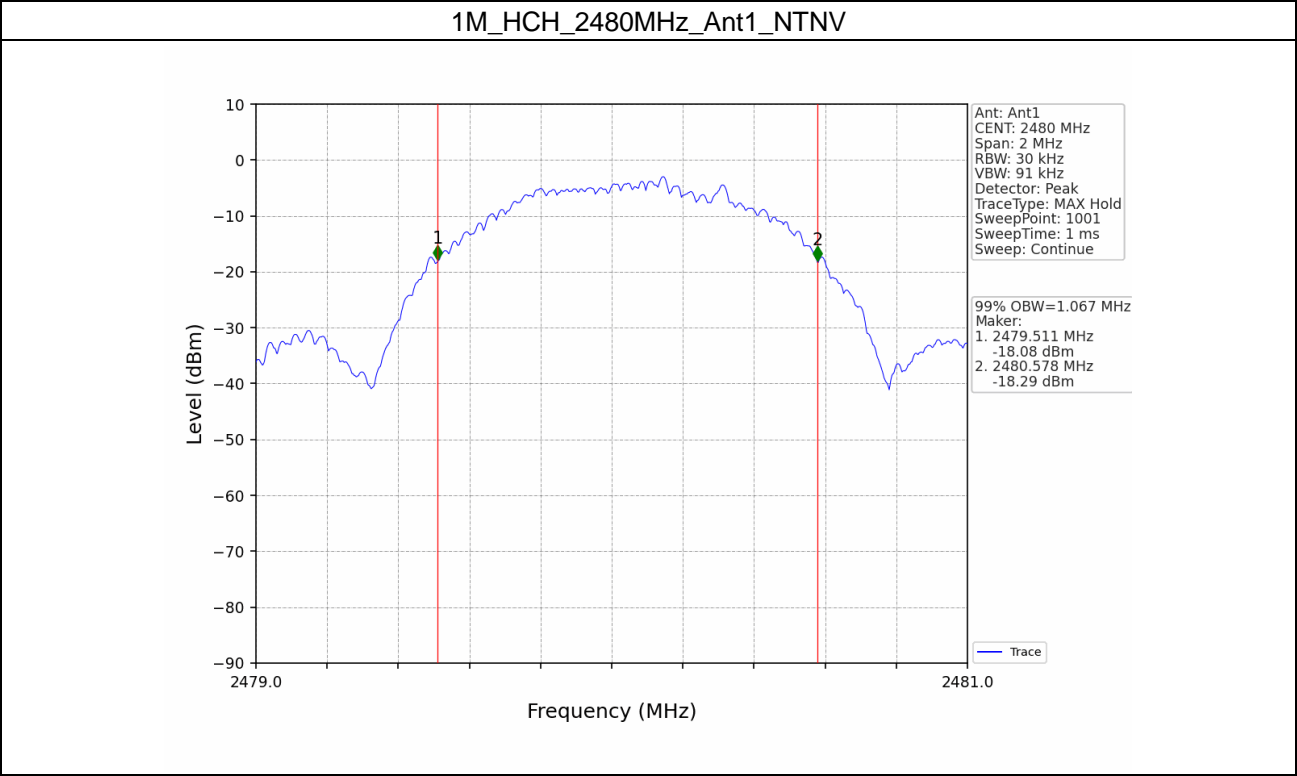
1.1 OBW

1.1.1 Test Result

Mode	TX Type	Frequency (MHz)	ANT	99% Occupied Bandwidth (MHz)		Verdict
				Result	Limit	
1M	SISO	2402	1	1.042	/	Pass
		2440	1	1.050	/	Pass
		2480	1	1.067	/	Pass

1.1.2 Test Graph







SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 37 of 52

1.2 6dB BW

1.2.1 Test Result

Mode	TX Type	Frequency (MHz)	ANT	6dB Bandwidth (MHz)		Verdict
				Result	Limit	
1M	SISO	2402	1	0.710	≥ 0.5	Pass
		2440	1	0.702	≥ 0.5	Pass
		2480	1	0.719	≥ 0.5	Pass



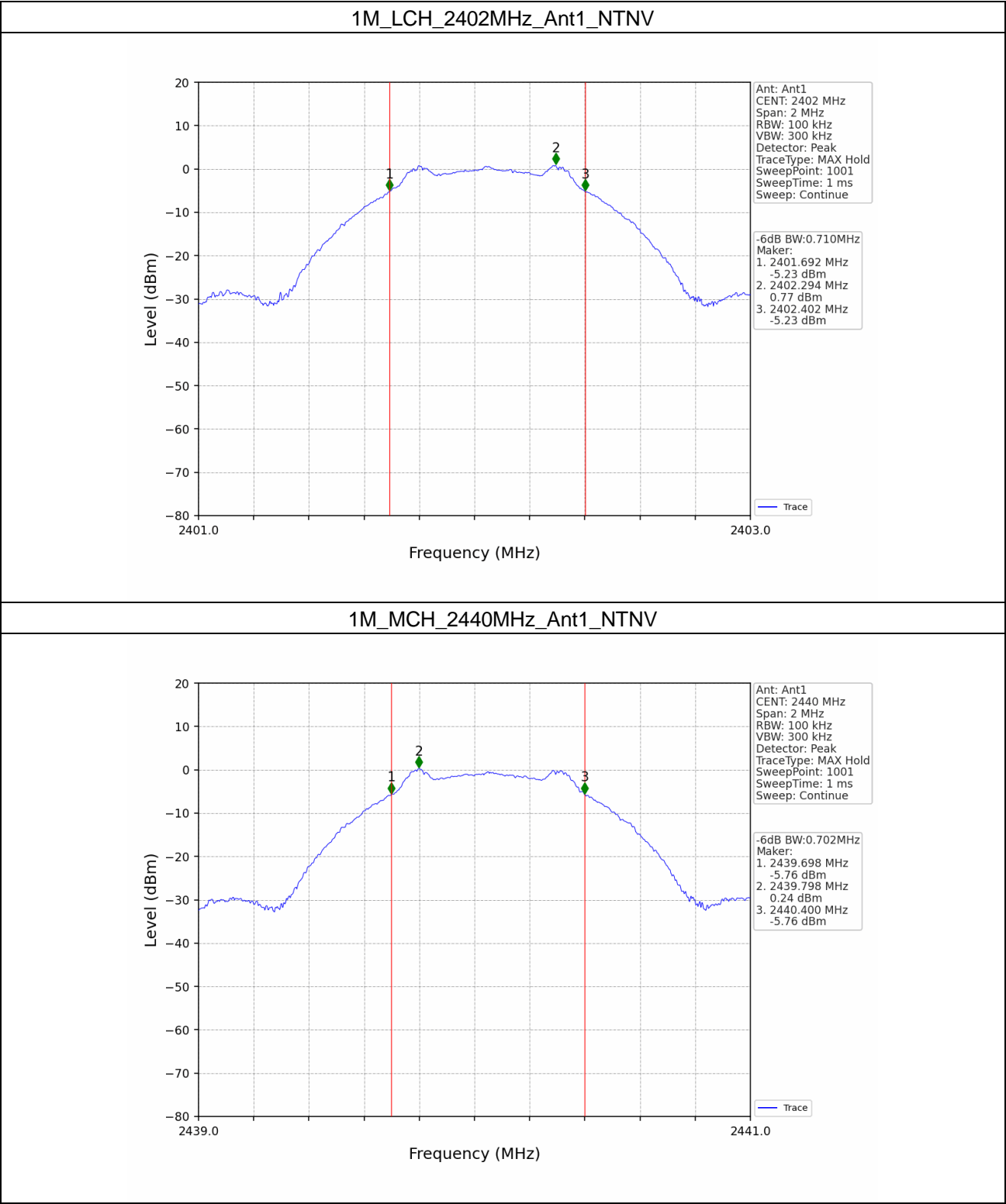
SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

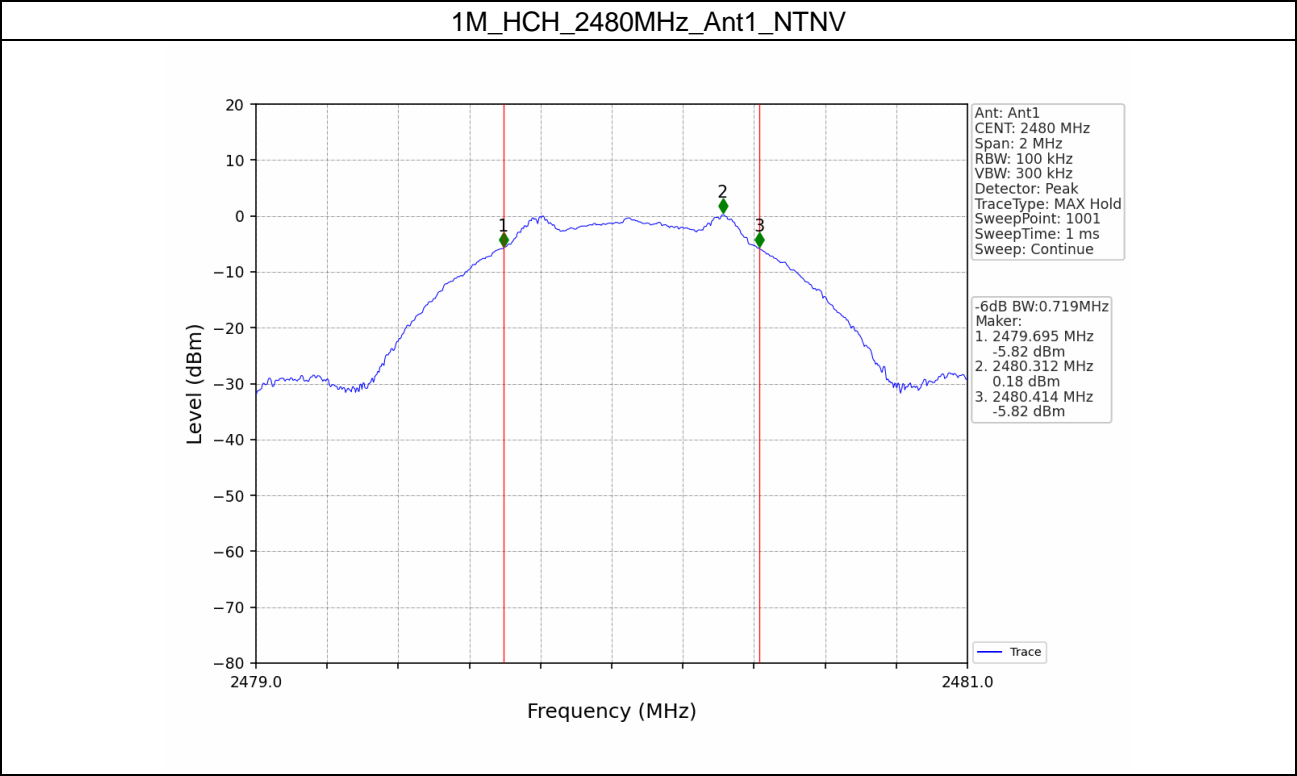
SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 38 of 52

1.2.2 Test Graph







SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 40 of 52

2. Maximum Conducted Output Power

2.1 Power

2.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)		Verdict
			ANT1	Limit	
1M	SISO	2402	-0.61	<=30	Pass
		2440	-0.69	<=30	Pass
		2480	-0.41	<=30	Pass

Note1: Antenna Gain: Ant1: 0.00dBi;



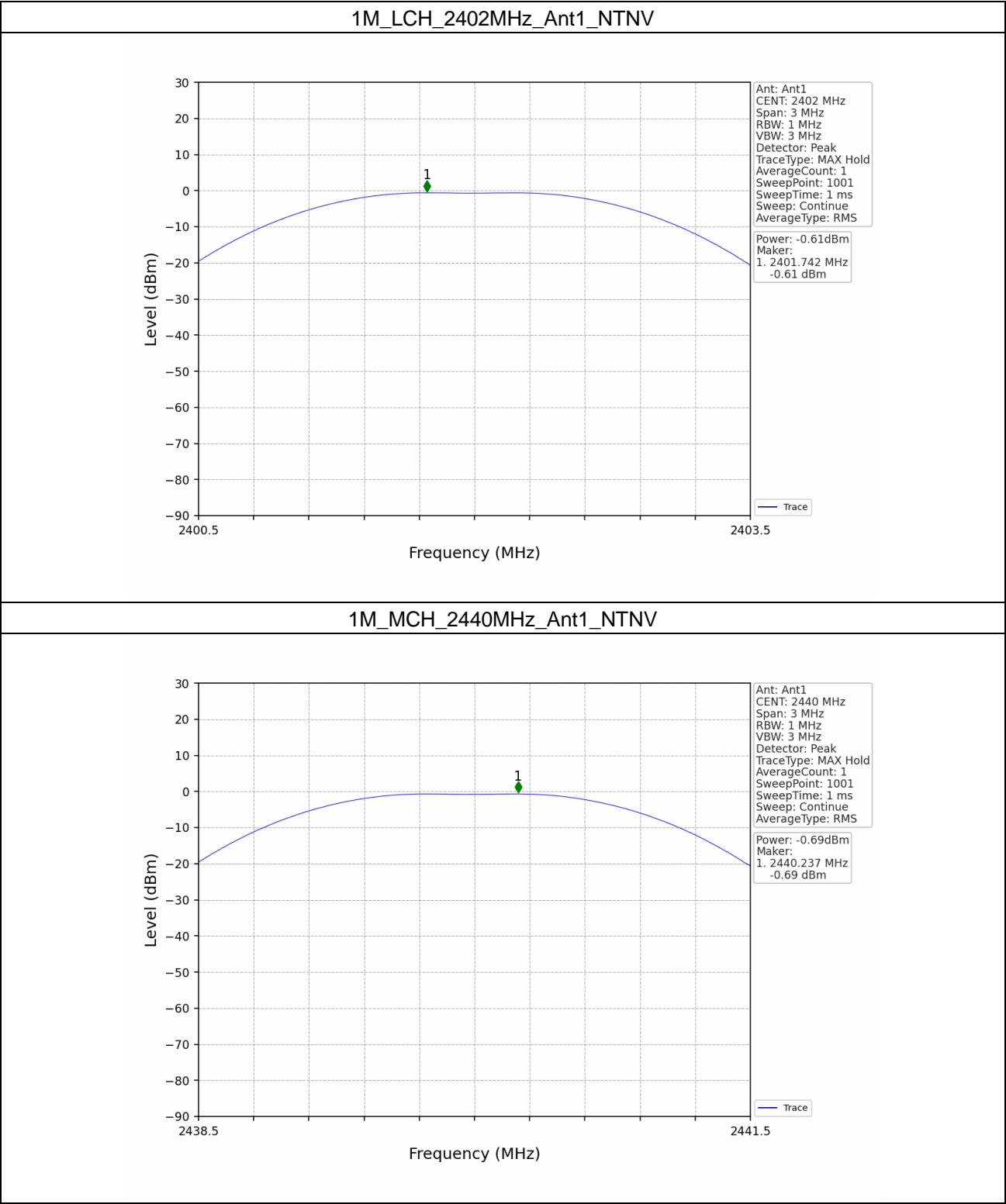
SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 41 of 52

2.1.2 Test Graph



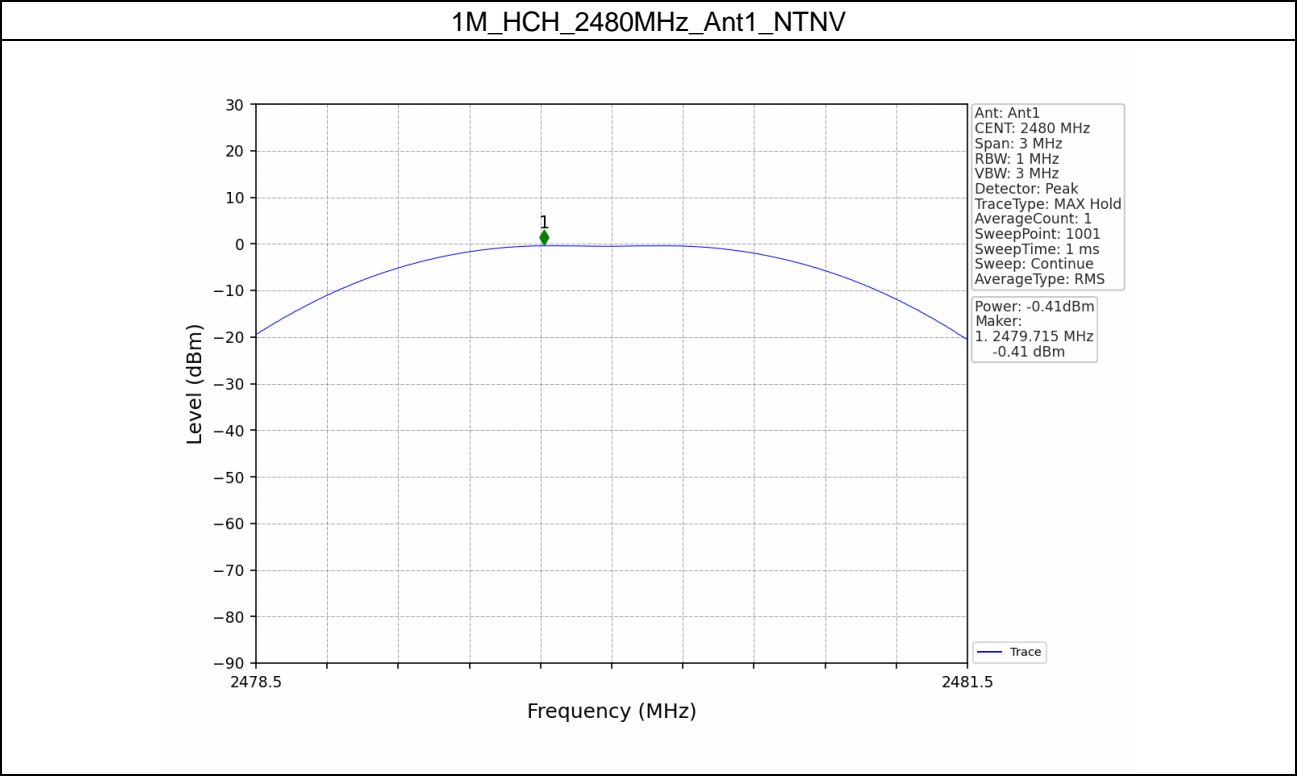


SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 42 of 52





SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 43 of 52

3. Maximum Power Spectral Density

3.1 PSD

3.1.1 Test Result

Mode	TX Type	Frequency (MHz)	Maximum PSD (dBm/3kHz)		Verdict
			ANT1	Limit	
1M	SISO	2402	-10.12	<=8	Pass
		2440	-9.59	<=8	Pass
		2480	-10.36	<=8	Pass

Note1: Antenna Gain: Ant1: 0.00dBi;



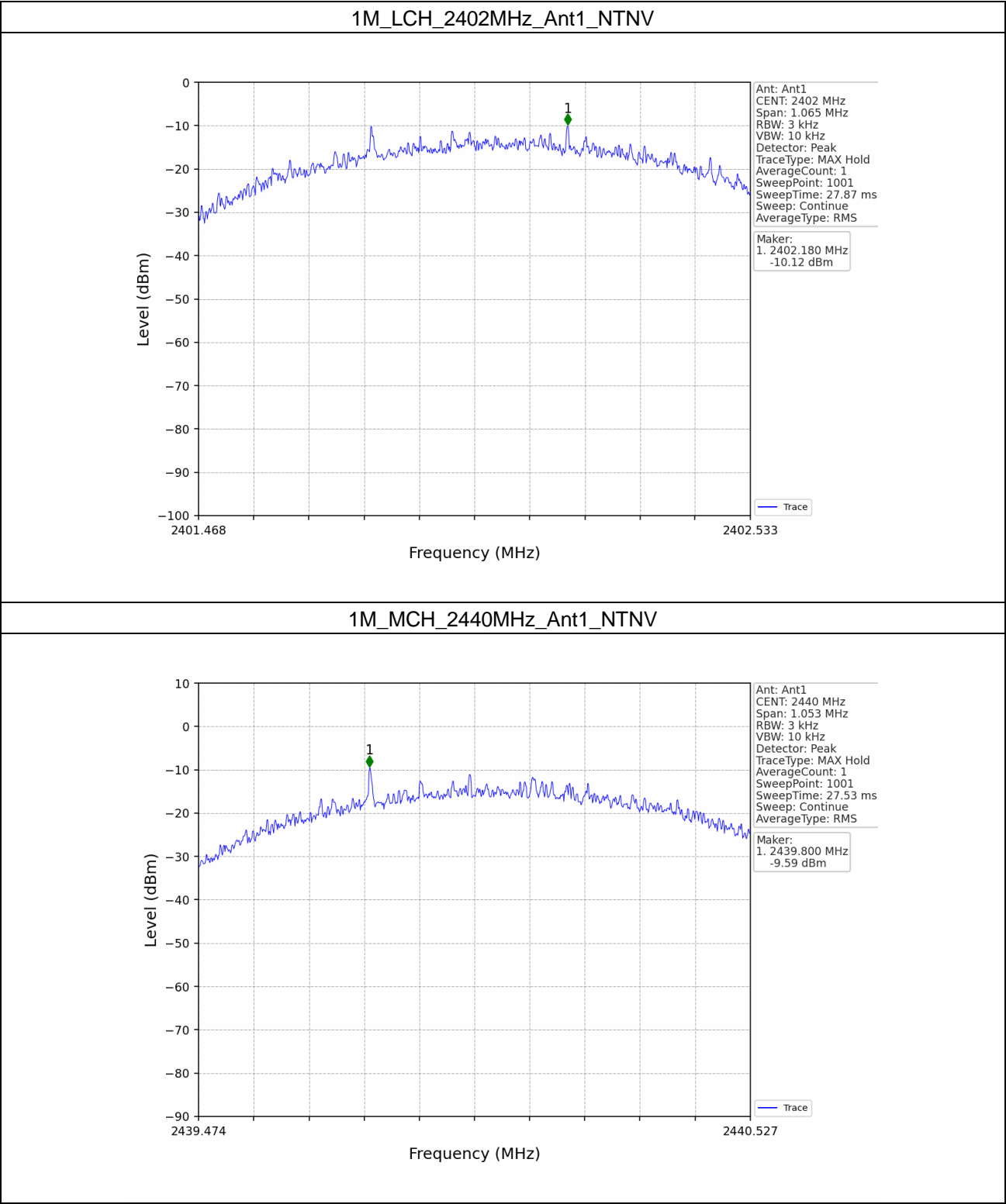
SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

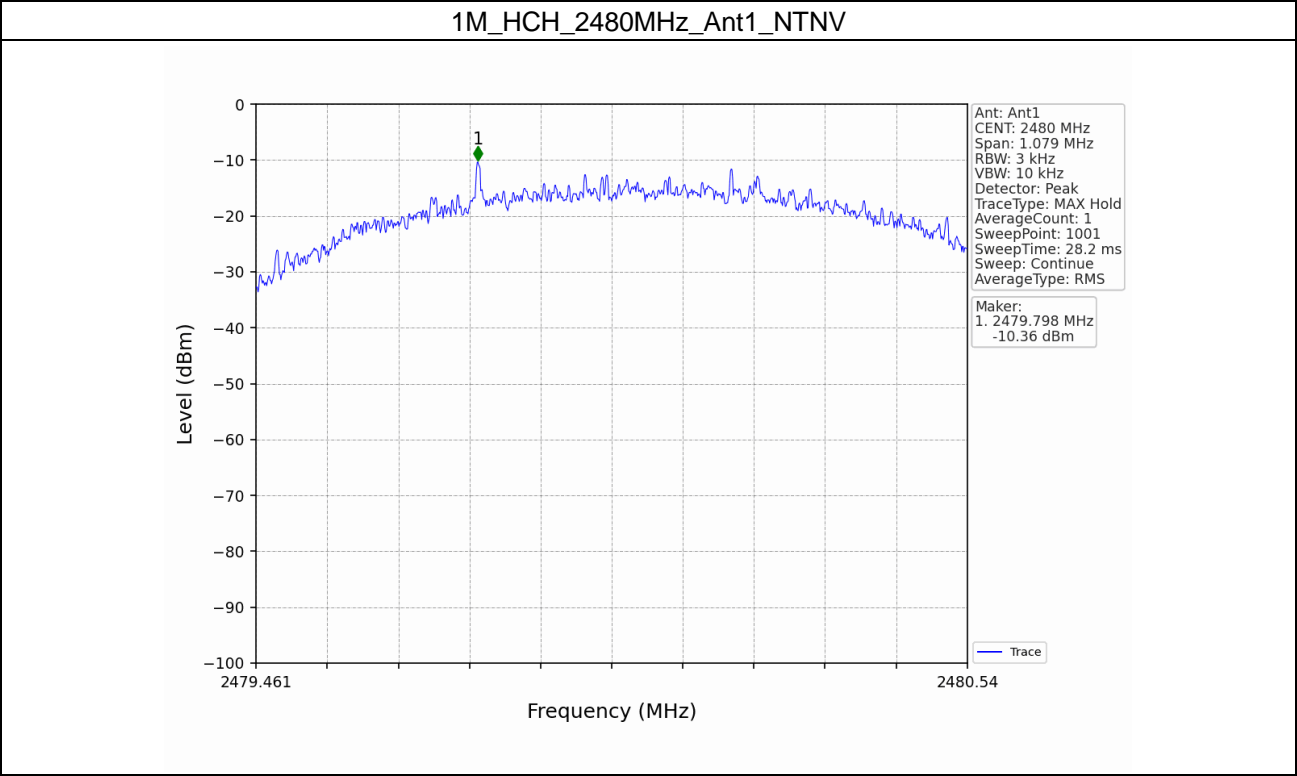
SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 44 of 52

3.1.2 Test Graph





4. Unwanted Emissions In Non-restricted Frequency Bands

4.1 Ref

4.1.1 Test Result

Mode	TX Type	Frequency (MHz)	ANT	Level of Reference (dBm)
1M	SISO	2402	1	0.98
		2440	1	0.22
		2480	1	0.21

Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.



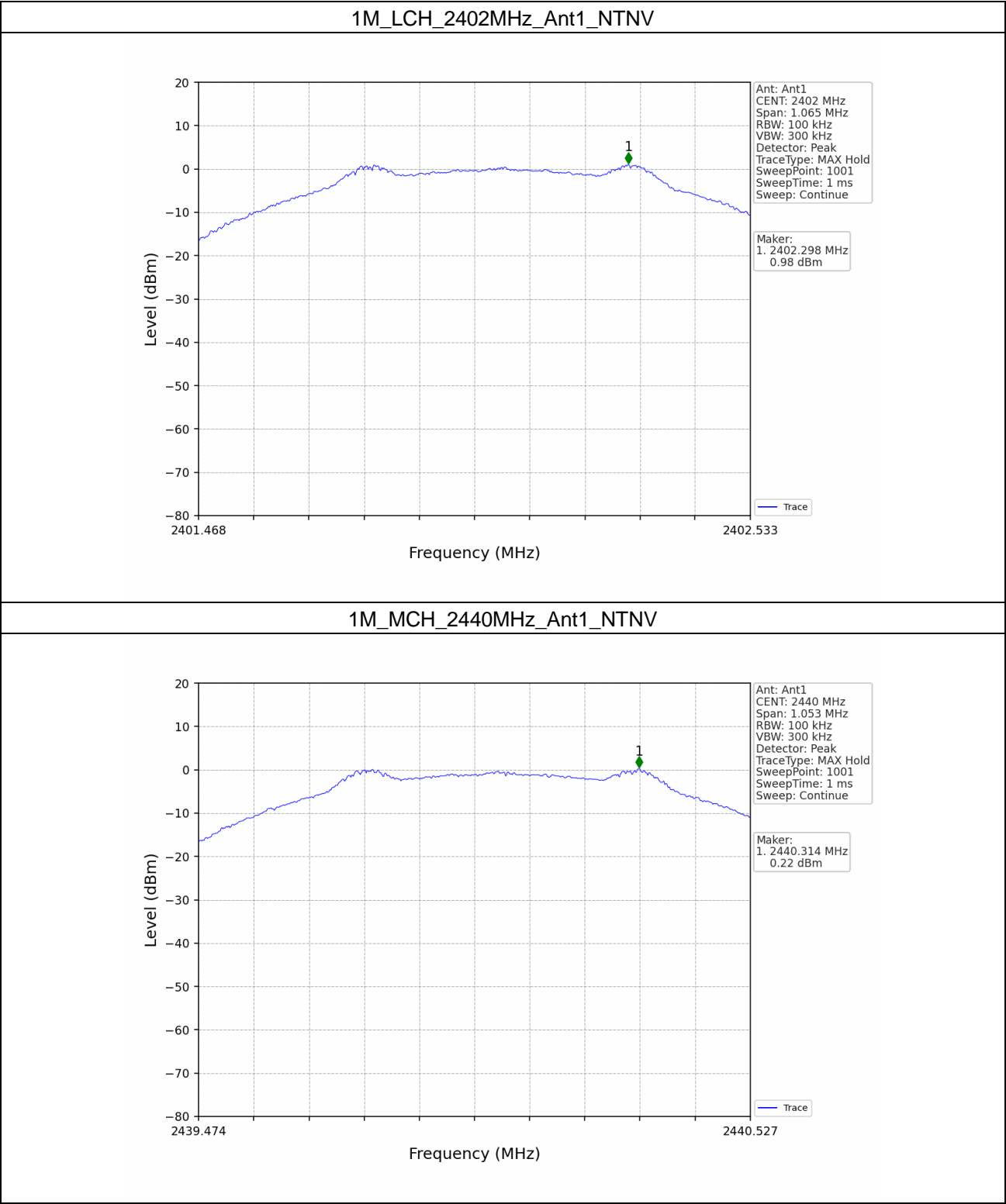
SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

Report No.: SHCR240700146301

Page: 47 of 52

4.1.2 Test Graph



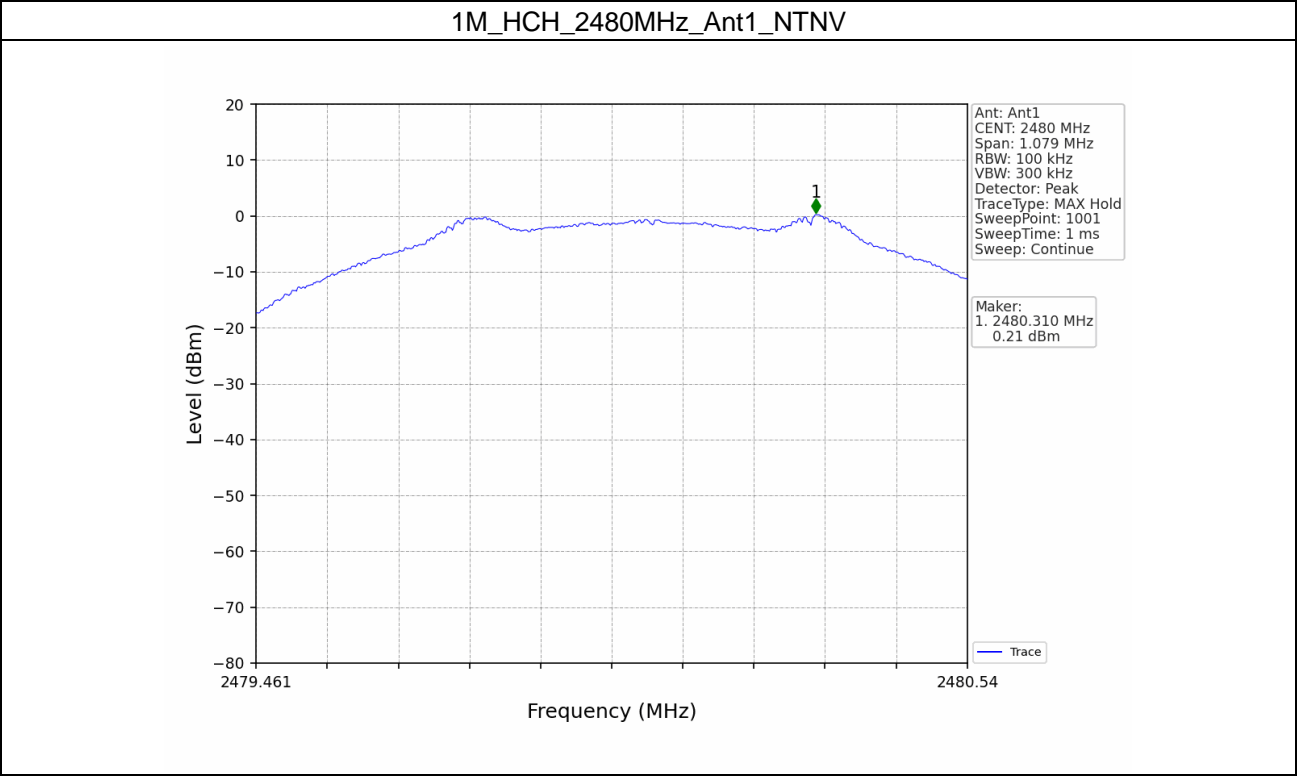


SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

SHEM-TRF-001 Rev. 02 Sep01, 2023

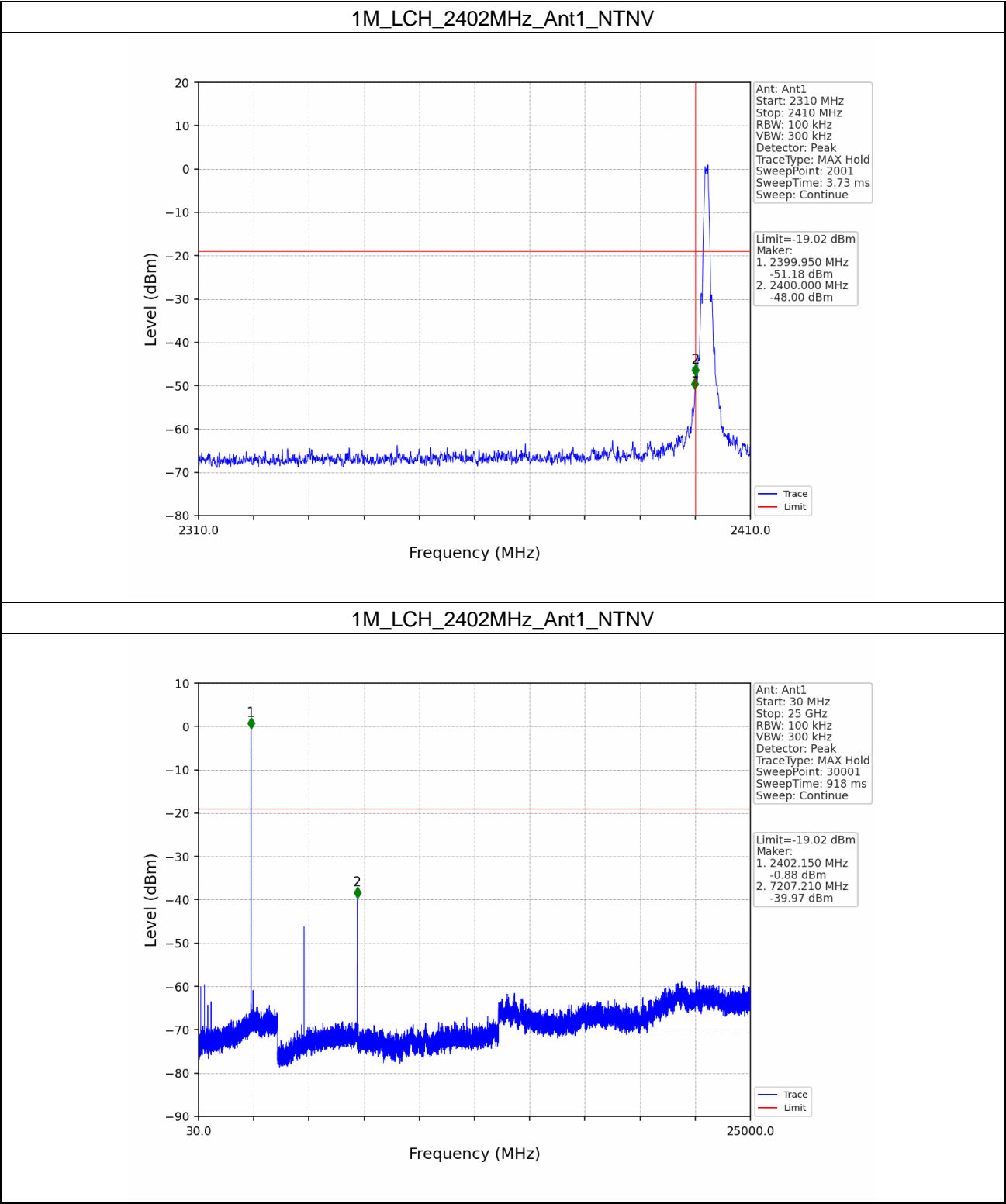
Report No.: SHCR240700146301

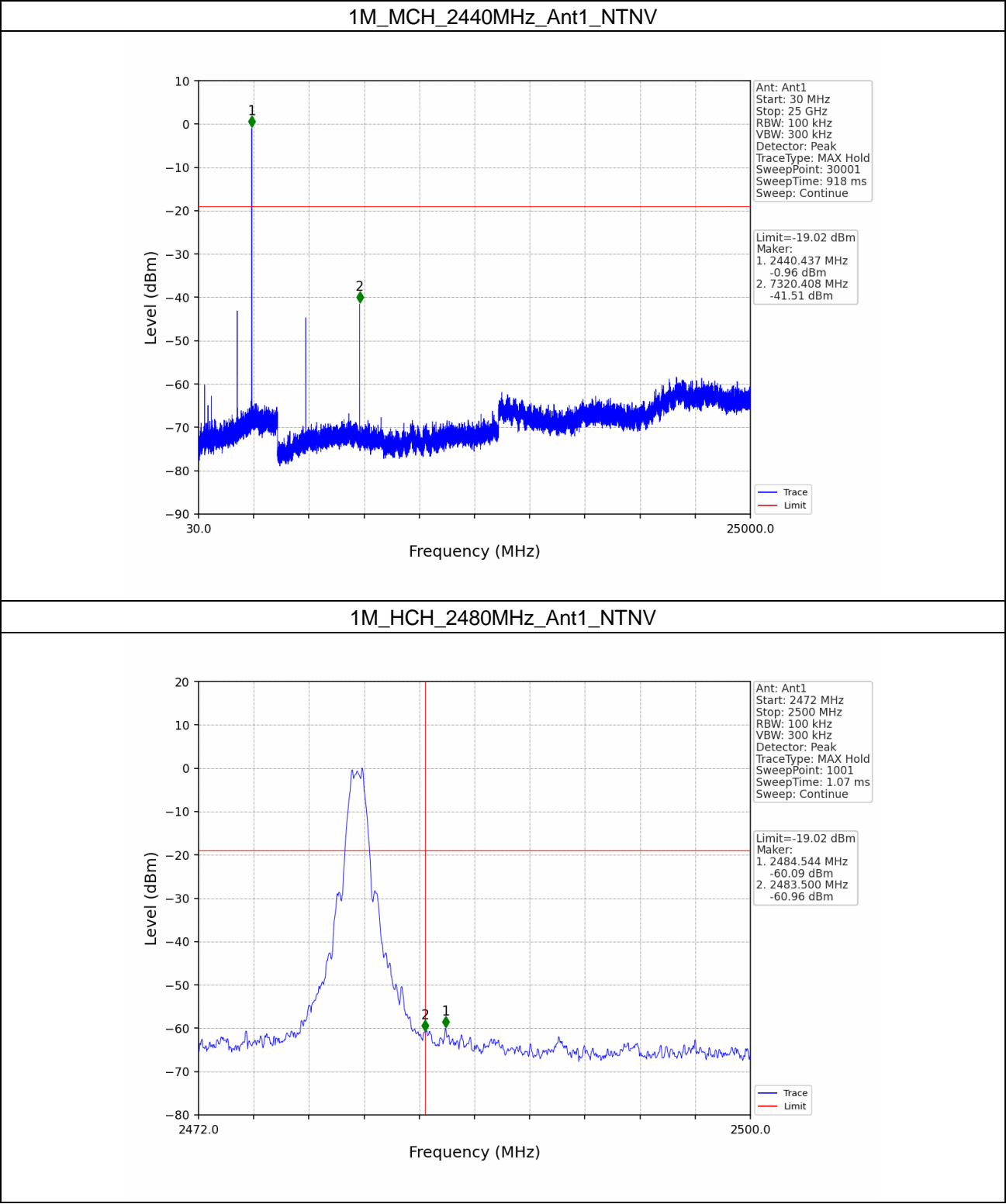
Page: 48 of 52

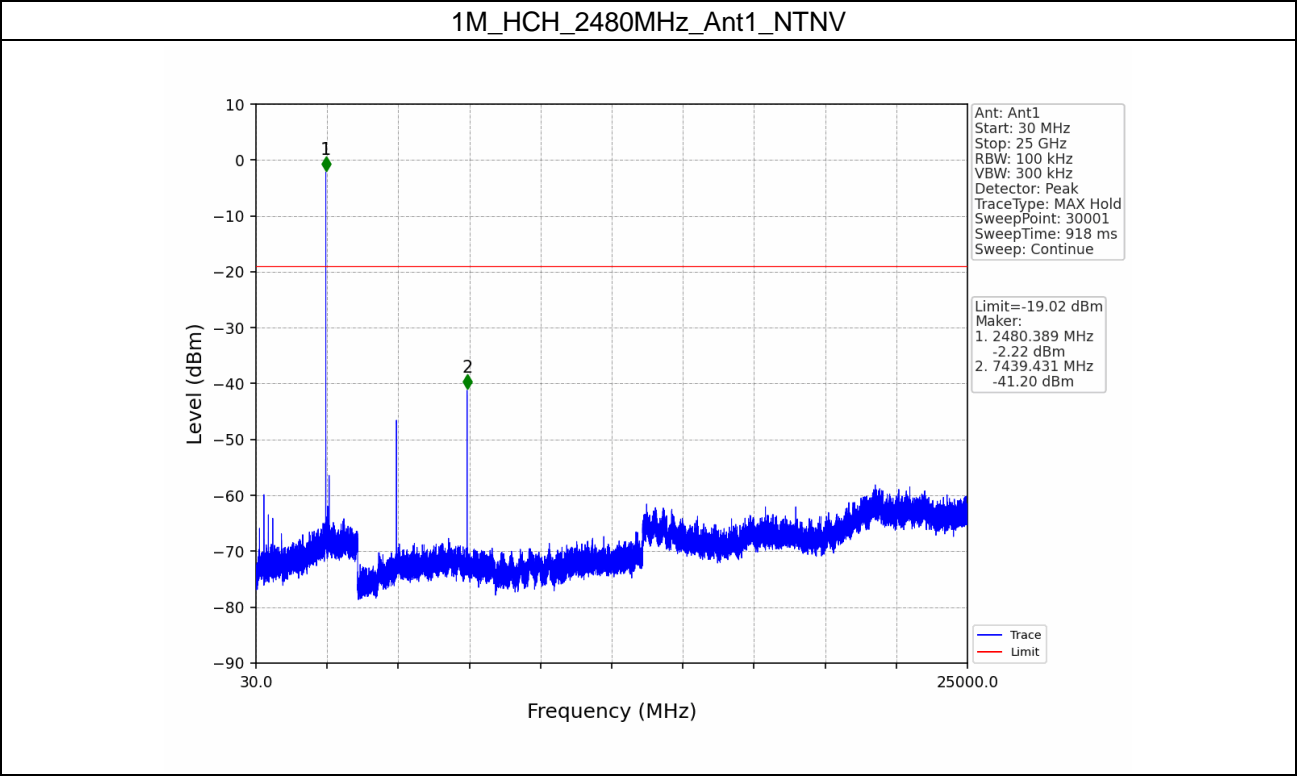


Note1: Refer to FCC Part 15.247 (d) and ANSI C63.10-2013, the channel contains the maximum PSD level was used to establish the reference level.

4.2.2 Test Graph







-- End of the Report -