REPORT No.: SZ24010027W01

TEST REPORT

APPLICANT	:	Adec & Partner AG
PRODUCT NAME	:	earis MAX Charging station
MODEL NAME	:	HC-01
BRAND NAME	:	Humantechnik
FCC ID	:	U94MAX0124C
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2024-01-04
TEST DATE	:	2024-02-18 to 2024-02-27
ISSUE DATE	:	2024-05-08

Edited by: Peng Mi (Rapporteur)

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MORLAB

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DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2024-05-08	First edition

1. Summary of Test Result

No.	Section	Description	Test Date	Test Engineer	Result	Method Determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	15.247(a) 15.247(h)	Hopping Mechanism	N/A	N/A	PASS	No deviation
3	15.247(a)	Number of Hopping Frequency	Feb. 18, 2024	He Yuyang	PASS	No deviation
4	ANSI C63.10	Duty Cycle	Feb. 18, 2024	He Yuyang	PASS	No deviation
5	15.247(b)	Maximum Peak Conducted Output Power	Feb. 18, 2024	He Yuyang	PASS	No deviation
6	15.247(b)	Maximum Average Conducted Output Power	Feb. 18, 2024	He Yuyang	PASS	No deviation
7	15.247(a)	20dB Bandwidth	Feb. 18, 2024	He Yuyang	PASS	No deviation
8	15.247(a)	Carrier Frequency Separation	Feb. 18, 2024	He Yuyang	PASS	No deviation
9	15.247(a)	Time of Occupancy (Dwell time)	Feb. 18, 2024	He Yuyang	PASS	No deviation
10	15.247(d)	Conducted Spurious Emission	Feb. 18, 2024	He Yuyang	PASS	No deviation
11	15.207	Conducted Emission	Feb. 18&19, 2024	Wang Deyong	PASS	No deviation
12	15.247(d)	Restricted Frequency Bands	Mar. 26, 2024	Su Zhan	PASS	No deviation
13	15.209,	Radiated	Feb. 26&27,	Su Zhan	PASS	No deviation

	15.247(d)	Emission	2024			

Note 1: The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013, KDB558074 D01 v05r02 and DA 00-075.

Note 2: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

Note 3: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

1.1. Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

• 47 CFR Part 15 Subpart C Radio Frequency Devices

1.2. Test Equipment List

1.2.1 Conducted Test Equipment

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
EXA Signal Analyzer	MY53470836	N9010A	Agilent	2023.02.27	2024.02.26
				2024.02.19	2025.02.18
RF Cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial Cable	CB02	RF02	Morlab	N/A	N/A
SMA Connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

1.2.2 Conducted Emission Test Equipment

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY56400093	N9038A	KEYSIGHT	2024.01.25	2025.01.24
LISN	8127449	NSLK 8127	Schwarzbeck	2024.02.02	2025.02.01
Pulse Limiter (10dB)	VTSD 9561 F-B #206	VTSD 9561-F	Schwarzbeck	2023.06.27	2024.06.26
RF Coaxial Cable (DC-100MHz)	BNC	MRE04	Qualwave	N/A	N/A

1.2.3 List of Software Used

Description	Manufacturer	Software Version
Test System	MaiWei	2.0.0.0
Morlab EMCR	Morlab	V1.2
TS+ -[JS32-CE]	Tonscend	V2.5.0.0

1.2.4 Radiated Test Equipment

Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	MY54130016	N9038A	Agilent	2023.06.21	2024.06.20
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2023.07.01	2024.06.30
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2023.06.26	2024.06.25
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2023.07.01	2024.06.30
Test Antenna – Horn	BBHA9170 #773	BBHA9170	Schwarzbeck	2023.07.01	2024.06.30
Preamplifier (10MHz-6GHz)	46732	S10M100L3802	LUCIX CORP.	2023.06.27	2024.06.26
Preamplifier (2GHz-18GHz)	61171/61172	S020180L3203	LUCIX CORP.	2023.06.27	2024.06.26
Preamplifier (18GHz-40GHz)	DS77209	DCLNA0118-40C-S	Decentest	2023.07.04	2024.07.03
RF Coaxial Cable (DC-18GHz)	MRE001	PE330	Pasternack	2023.06.27	2024.06.26
RF Coaxial Cable (DC-18GHz)	MRE002	CLU18	Pasternack	2023.06.27	2024.06.26
RF Coaxial Cable (DC-18GHz)	MRE003	CLU18	Pasternack	2023.06.27	2024.06.26
RF Coaxial Cable (DC-40GHz)	22290045	QA360-40-KK-0.5	Qualwave	2023.07.04	2024.07.03
RF Coaxial Cable (DC-40GHz)	22290046	QA360-40-KKF-2	Qualwave	2023.07.04	2024.07.03
RF Coaxial Cable (DC-18GHz)	22120181	QA500-18-NN-5	Qualwave	2023.07.04	2024.07.03
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	N/A	N/A
Anechoic Chamber	N/A	9m*6m*6m	CRT	2022.05.10	2025.05.09

1.3. Measurement Uncertainty

Test Items	Uncertainty	Remark
Number of Hopping Frequency	±5%	Confidence levels of 95%
Peak Output Power	±2.22dB	Confidence levels of 95%
Bandwidth	±5%	Confidence levels of 95%
Carrier Frequency Separation	±5%	Confidence levels of 95%
Time of Occupancy (Dwell time)	±5%	Confidence levels of 95%
Conducted Spurious Emission	±2.77dB	Confidence levels of 95%
Restricted Frequency Bands	±5%	Confidence levels of 95%
Radiated Emission	±2.95dB	Confidence levels of 95%
Conducted Emission	±2.44dB	Confidence levels of 95%

1.4. Testing Laboratory

Laboratory Name	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone	+86 755 36698555
Facsimile	+86 755 36698525
FCC Designation Number	CN1192
FCC Test Firm Registration Number	226174

2. General Description

2.1. Information of Applicant and Manufacturer

Applicant	Adec & Partner AG
Applicant Address	Staldenbachstrasse 30 CH-8808 Pfaffikon, Switzerland
Manufacturer	Humantechnik GmbH
Manufacturer Address	Im Wörth 25D-79576 Weil am Rhein

2.2. Information of EUT

Product Name:	earis MAX Charging station
Sample No.:	9#
Hardware Version:	V2
Software Version:	V1.06
Modulation Type:	DSSS
Operating Frequency Range:	2402MHz-2480MHz
Antenna Type:	PIFA Antenna
Antenna Gain:	-1.00dBi

Note 1: We use the dedicated software to control the EUT continuous transmission.

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

2.3. Channel List of EUT

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	**2402**	15	2432	30	2462
1	2404	16	2434	31	2464
2	2406	17	2436	32	2466
3	2408	18	2438	33	2468
4	2410	**19**	**2440**	34	2470
5	2412	20	2442	35	2472
6	2414	21	2444	36	2474
7	2416	22	2446	37	2476
8	2418	23	2448	38	2478
9	2420	24	2450	**39**	**2480**
10	2422	25	2452		
11	2424	26	2454		
12	2426	27	2456		
13	2428	28	2458		
14	2430	29	2460		

Note 1: The black bold channels were selected for test.

2.4. Test Configuration of EUT

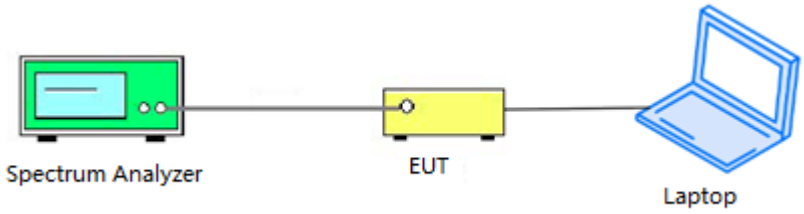
Test mode is used to control the EUT under the maximum power level during test.

2.5. Test Conditions

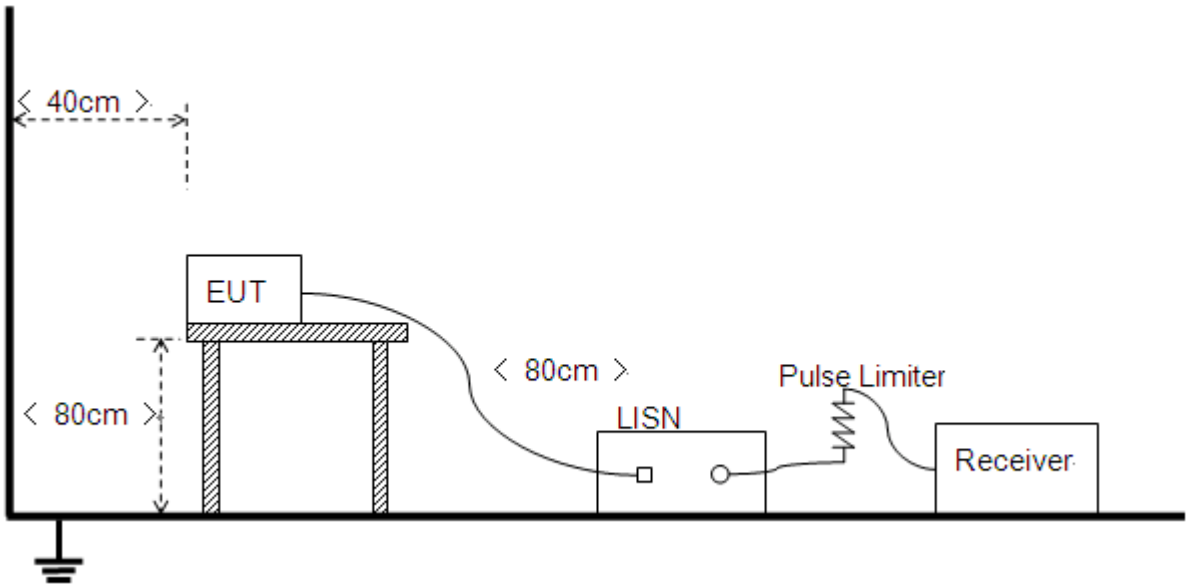
Temperature (°C)	15-35
Relative Humidity (%)	30-60
Atmospheric Pressure (kPa)	86-106

2.6. Test Setup Layout Diagram

2.6.1.Conducted Measurement

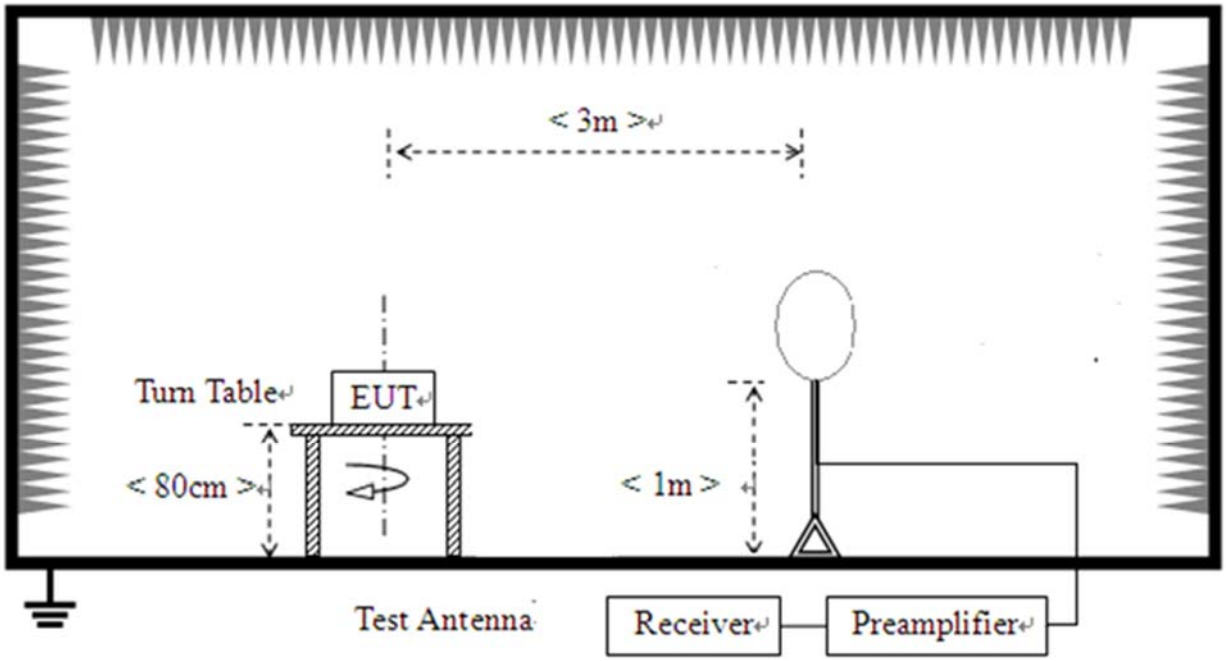


2.6.2.Conducted Emission Measurement

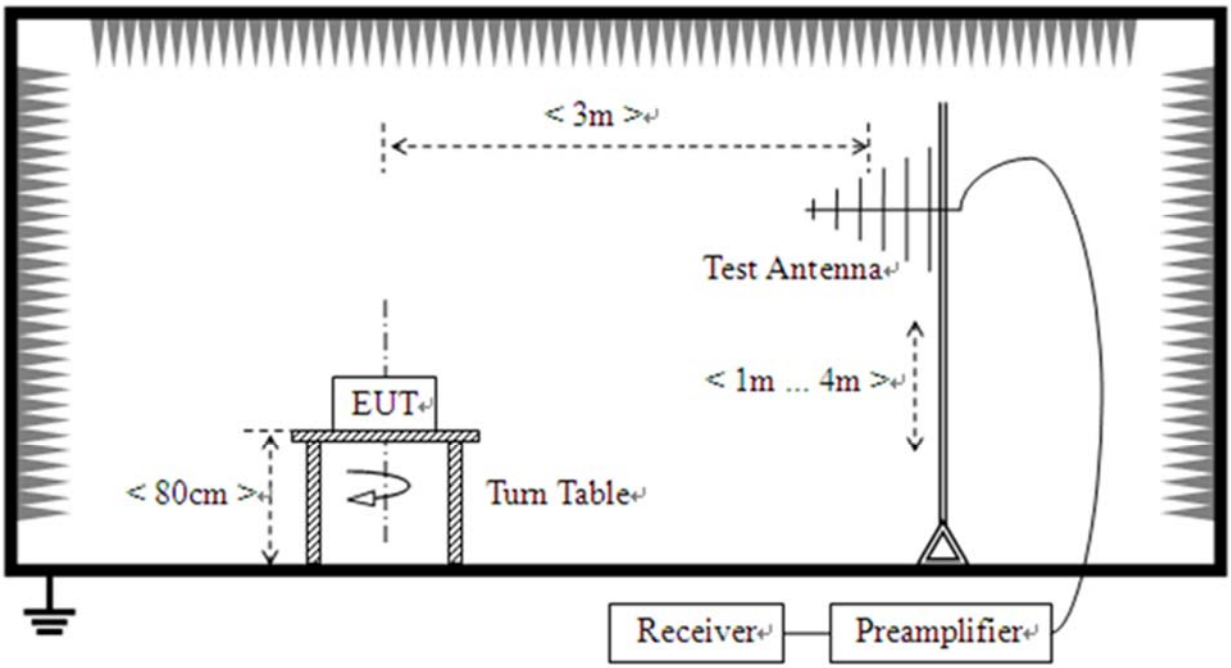


2.6.3.Radiation Measurement

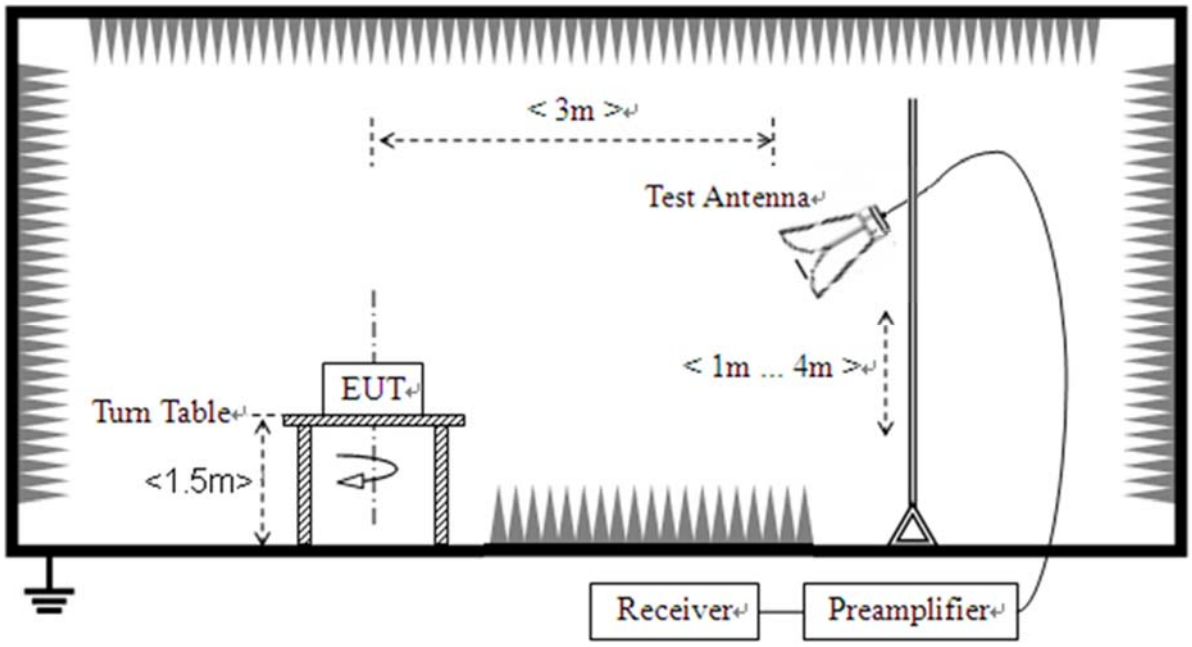
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



3. Test Results

3.1. Antenna Requirement

3.1.1.Requirement

According to FCC 15.203, 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 shall be considered sufficient to comply with the provisions of this section.

3.1.2.Test Result

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

3.2. Hopping Mechanism

3.2.1.Requirement

According to FCC section 15.247(a)(1), a frequency hopping spread spectrum system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.
According to FCC section 15.247(h), the incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3.2.2.Test Result

The hopping mechanism of the EUT is in compliance with the document "***Bluetooth core specification v5.1***".

3.3. Number of Hopping Frequency

3.3.1.Requirement

According to FCC section 15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

3.3.2.Test Procedures

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = the frequency band of operation
RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

3.3.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.3.4.Test Result

Refer to Annex A.1 in this report.

3.4. Duty Cycle of Test Signal

3.4.1.Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%).When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration(T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e.,no transmitter OFF-time is to be considered).
When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than ±2%; otherwise, the duty cycle is considered to be non constant.

3.4.2.Test Result

Refer to Annex A.2 in this report.

3.5. Maximum Peak Conducted Output Power

3.5.1.Requirement

According to FCC section 15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

3.5.2.Test Procedures

KDB 558074 Section 8.3.1 was used in order to prove compliance.

3.5.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.5.4.Test Result

Refer to Annex A.3 in this report.

3.6. Maximum Average Conducted Output Power

3.6.1.Requirement

According to FCC section 15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

3.6.2.Test Procedures

KDB 558074 Section 8.3.2 was used in order to prove compliance.

3.6.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.6.4.Test Result

Refer to Annex A.4 in this report.

3.7. 20 dB Bandwidth

3.7.1.Requirement

According to FCC section 15.247(a)(1), the 20 dB bandwidth is known as the 99% emission bandwidth, or 20 dB bandwidth (10*log1% = 20 dB) taking the total RF output power.

3.7.1.Test Procedures

Use the following spectrum analyzer settings:
Span = between 2 to 5 times the OBW, centered on the test channel
RBW= 1% to 5% of the OBW
VBW ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold

3.7.2.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.7.3.Test Result

Refer to Annex A.5 in this report.

3.8. Carried Frequency Separation

3.8.1.Requirement

According to FCC section 15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

3.8.2.Test Procedures

The EUT must have its hopping function enabled. According to DA 00-705, use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
Video (or Average) Bandwidth (VBW) ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

3.8.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.8.4.Test Result

Refer to Annex A.6 in this report.

3.9. Time of Occupancy (Dwell time)

3.9.1.Requirement

According to FCC section 15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

3.9.2.Test Procedures

Normal Mode:
DH1: Dwell time equal to Pulse time (ms) *(1600 / 2 /79)*31.6 Millisecond DH3: Dwell time equal to Pulse time (ms) * (1600 /4 /79) *31.6 Millisecond DH5: Dwell time equal to Pulse Time (ms)* (1600 / 6 /79) *31.6 Millisecond
AFH Mode:
DH1: Dwell time equal to Pulse time (ms) *(800 / 2 /20)*(0.4*20) Millisecond DH3: Dwell time equal to Pulse time (ms) * (800 / 4 /20)*(0.4*20) Millisecond DH5: Dwell time equal to Pulse Time (ms)* (800 / 6 /20)*(0.4*20) Millisecond.

3.9.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.9.4.Test Result

Refer to Annex A.7 in this report.

3.10. Conducted Spurious Emissions and Band Edge

3.10.1.Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

3.10.2.Test Procedures

Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize.

3.10.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.10.4.Test Result

Refer to Annex A.8 and A.9 in this report.

3.11. Restricted Frequency Bands

3.11.1.Requirement

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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).

3.11.2.Test Procedures

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.
For the Test Antenna:
Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1GHz, 100 kHz for f < 1GHz
VBW = 3 MHz
Sweep = auto
Detector function = peak/average
Trace = max hold
Allow the trace to stabilize

3.11.3.Test Setup Layout

Refer to chapter 2.6.3 in this report.

3.11.4.Test Result

Refer to Annex A.9 in this report.

3.12. Conducted Emission

3.12.1.Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

Note:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

3.12.2.Test Procedures

The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

3.12.3.Test Setup Layout

Refer to chapter 2.6.2 in this report.

3.12.4.Test Result

Refer to Annex A.10 in this report.

3.13. Radiated Emission

3.13.1.Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
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

Note1: For above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
Note2: For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

3.13.2.Test Procedures

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz.The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions. For measurements above 1 GHz, keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.

3.13.3.Test Setup Layout

Refer to chapter 2.6.3 in this report.

3.13.4.Test Result

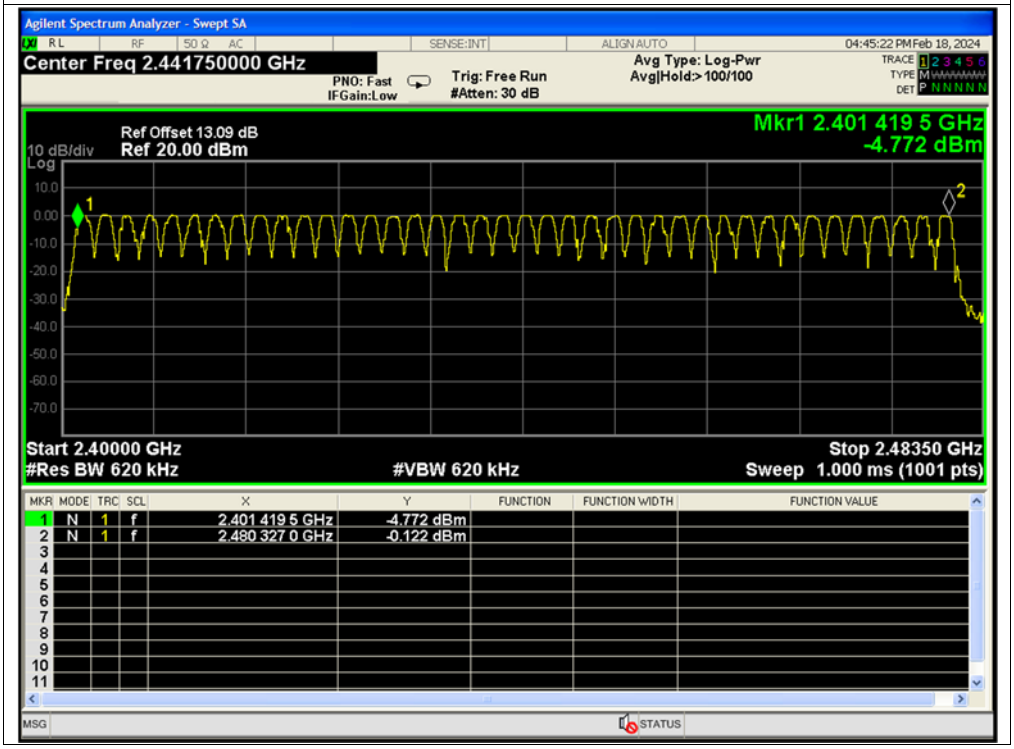
Refer to Annex A.12 in this report.

Annex A Test Data and Result

A.1. Number of Hopping Frequency

Condition	Mode	Antenna	Hopping Number	Limit	Verdict
NVNT	2.4G Hopping	Ant1	40	15	Pass

Test Graphs
Hopping No. NVNT 2.4G Hopping 2402MHz Ant1

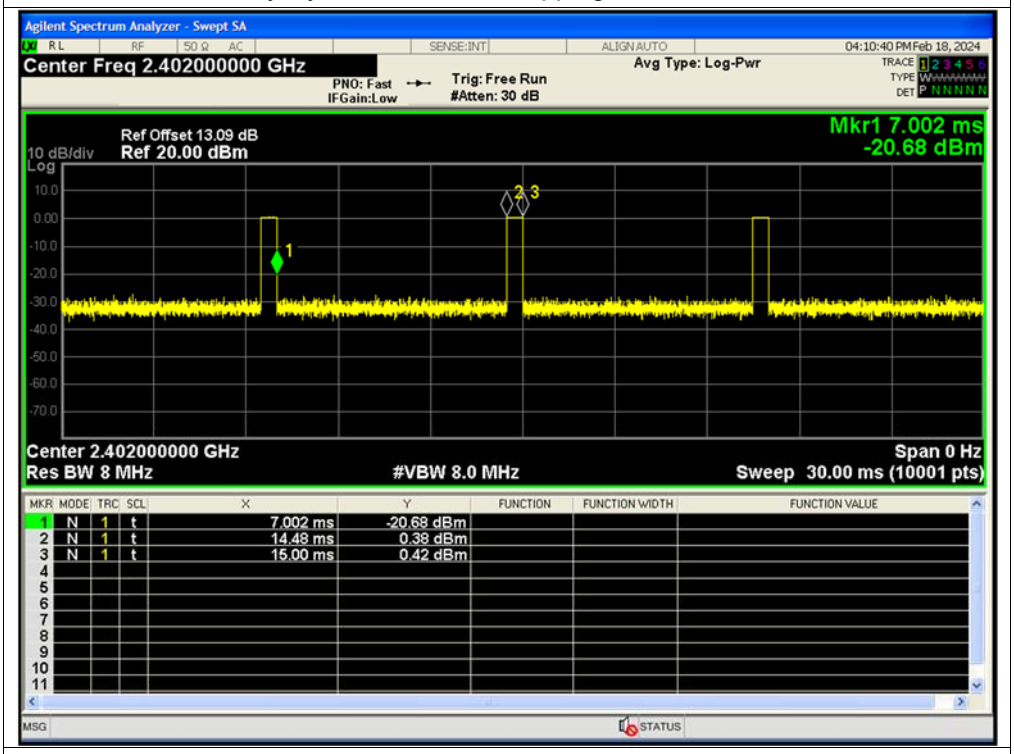


A.2. Duty Cycle of Test Signal

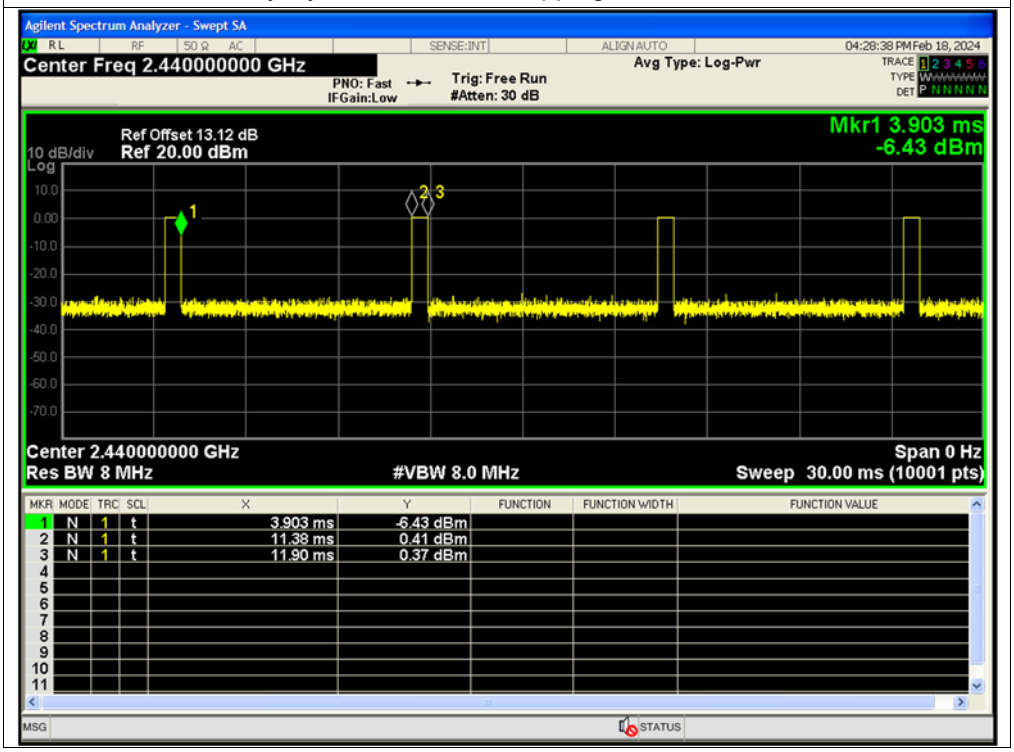
Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	2.4G Hopping	2402	Ant1	6.53	11.85	1.92
NVNT	2.4G Hopping	2440	Ant1	6.53	11.85	1.92
NVNT	2.4G Hopping	2480	Ant1	6.53	11.85	1.92

Test Graphs

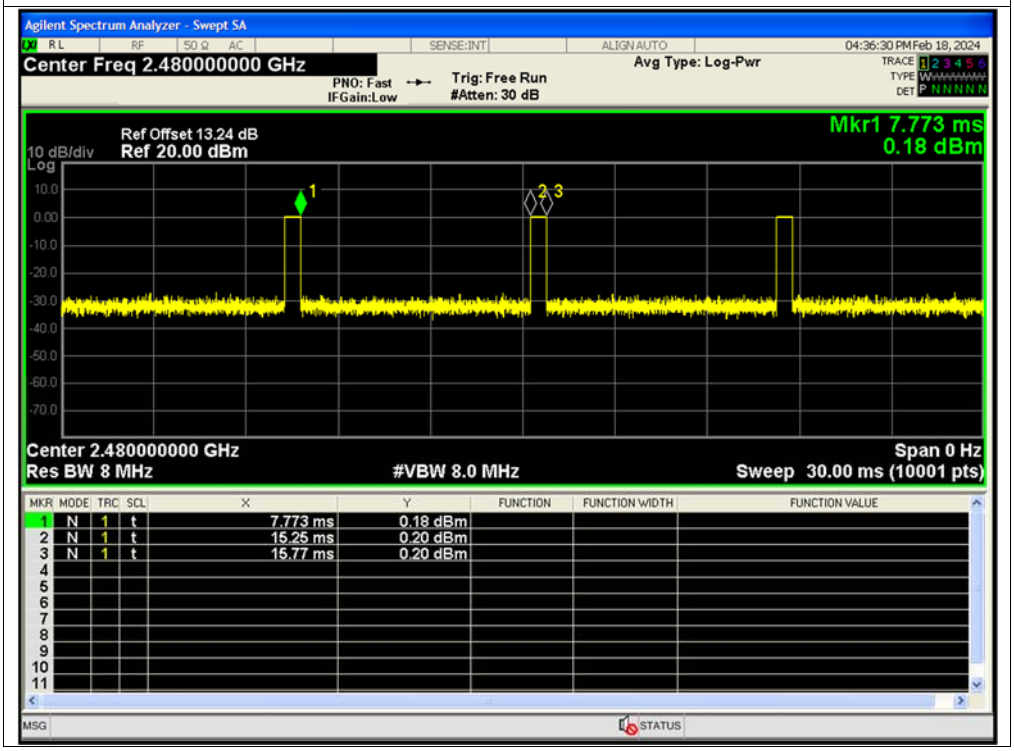
Duty Cycle NVNT 2.4G Hopping 2402MHz Ant1



Duty Cycle NVNT 2.4G Hopping 2440MHz Ant1



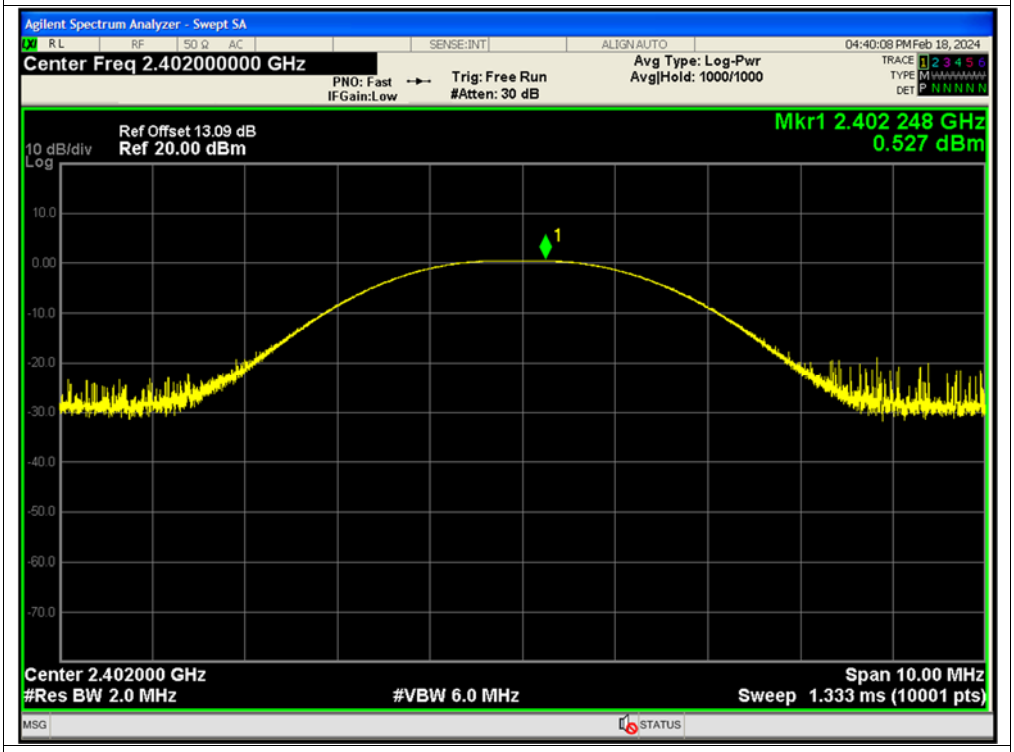
Duty Cycle NVNT 2.4G Hopping 2480MHz Ant1



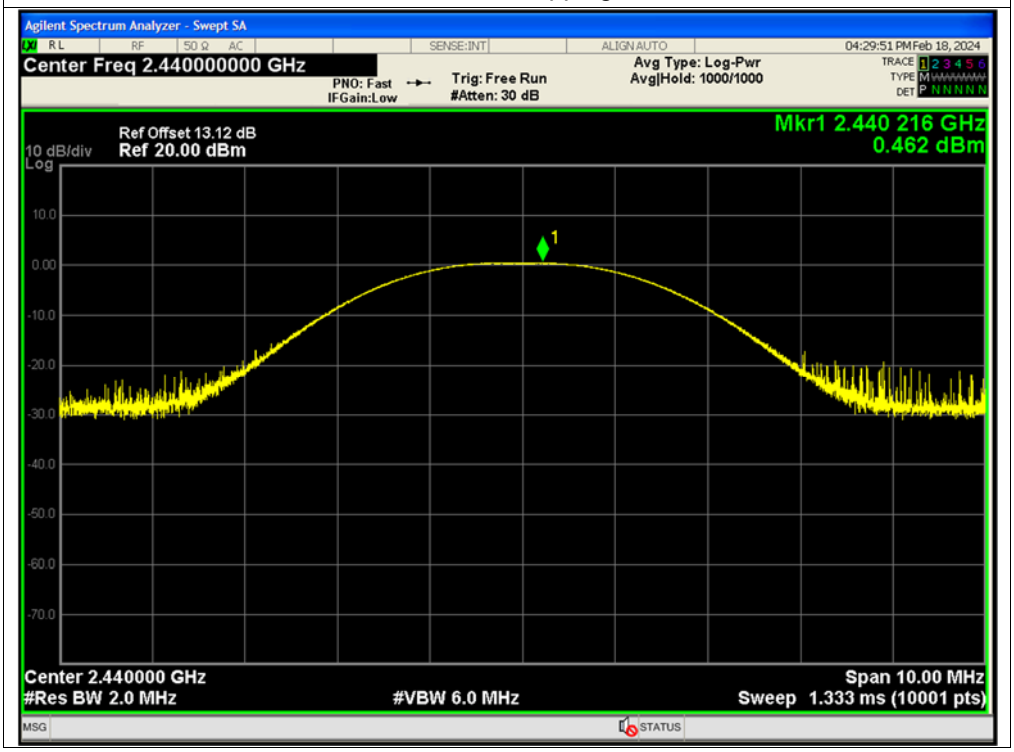
A.3. Maximum Peak Conducted Output Power

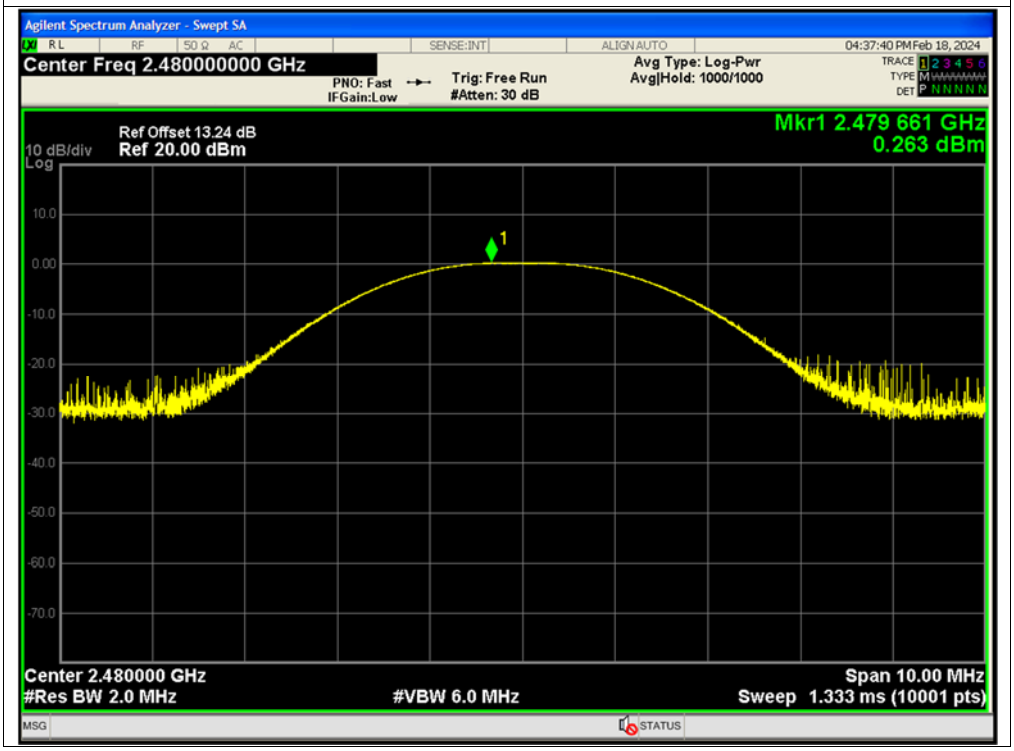
Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (W)	Limit Conducted (dBm)	Verdict
NVNT	2.4G Hopping	2402	Ant1	0.53	0	0.53	0.00113	30	Pass
NVNT	2.4G Hopping	2440	Ant1	0.46	0	0.46	0.00111	30	Pass
NVNT	2.4G Hopping	2480	Ant1	0.26	0	0.26	0.00106	30	Pass

Test Graphs
Peak Power NVNT 2.4G Hopping 2402MHz Ant1



Peak Power NVNT 2.4G Hopping 2440MHz Ant1

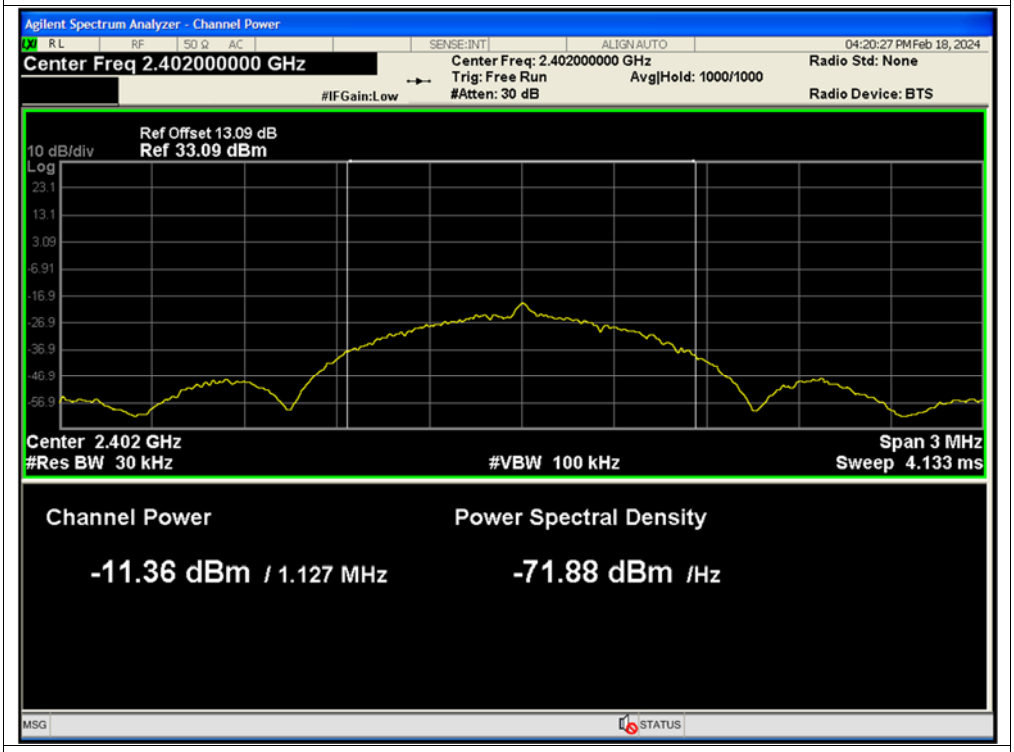


Peak Power NVNT 2.4G Hopping 2480MHz Ant1


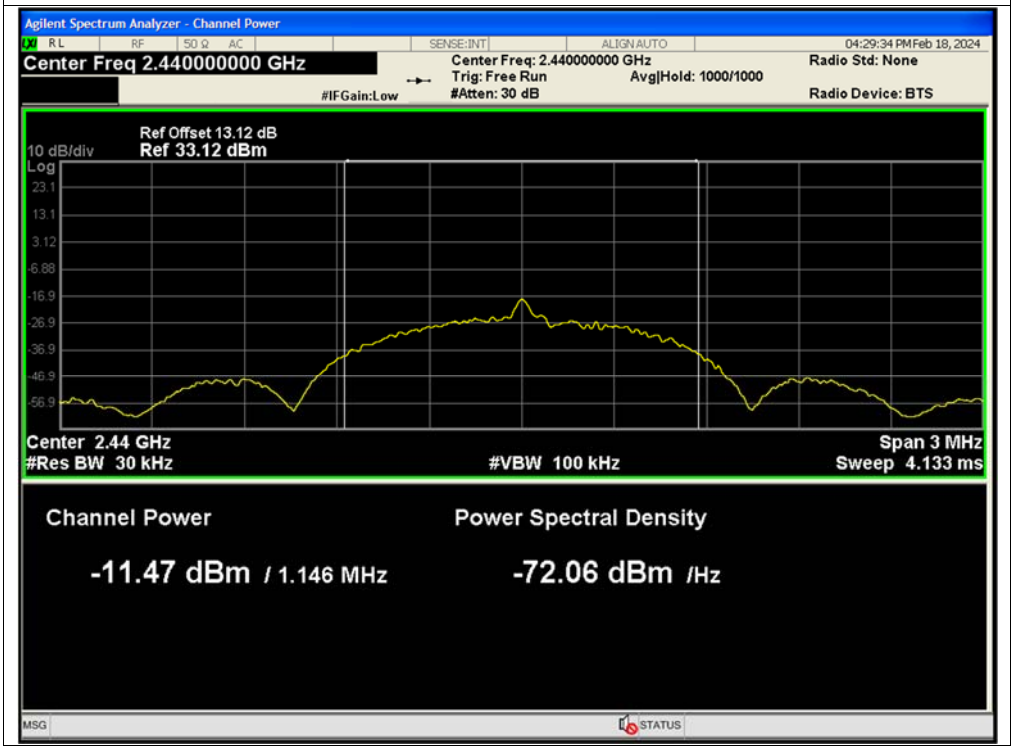
A.4. Maximum Average Conducted Output Power

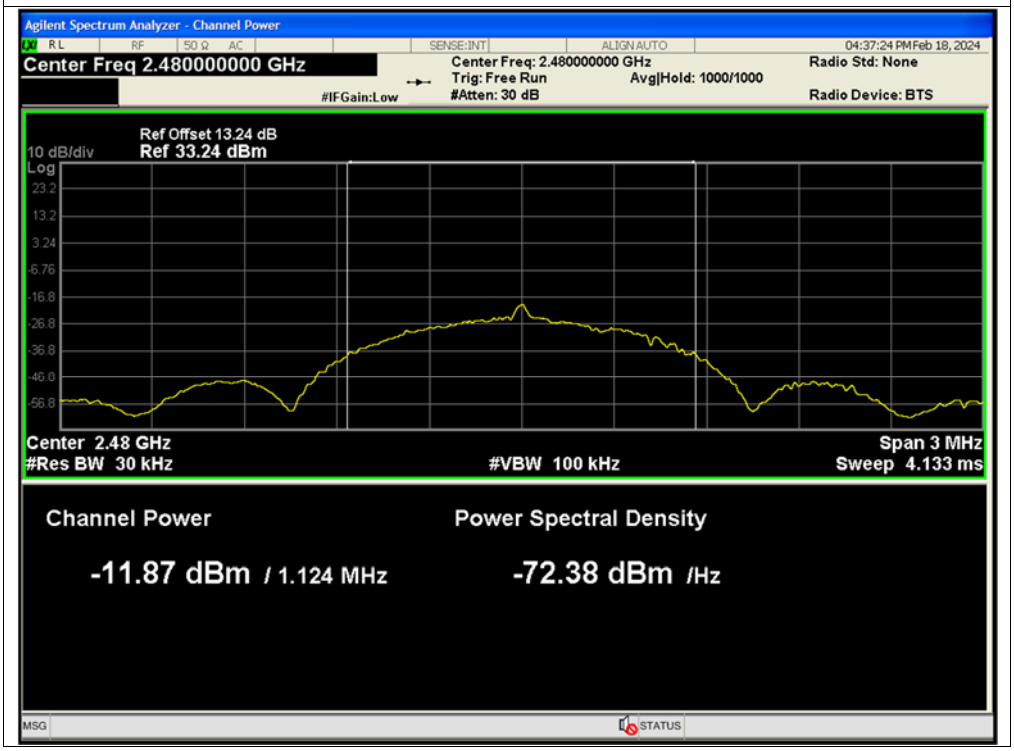
Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (W)	Limit Conducted (dBm)	Verdict
NVNT	2.4G Hopping	2402	Ant1	-11.36	11.85	0.49	0.00112	30	Pass
NVNT	2.4G Hopping	2440	Ant1	-11.47	11.85	0.38	0.00109	30	Pass
NVNT	2.4G Hopping	2480	Ant1	-11.87	11.85	-0.02	0.001	30	Pass

Test Graphs
Average Power NVNT 2.4G Hopping 2402MHz Ant1



Average Power NVNT 2.4G Hopping 2440MHz Ant1

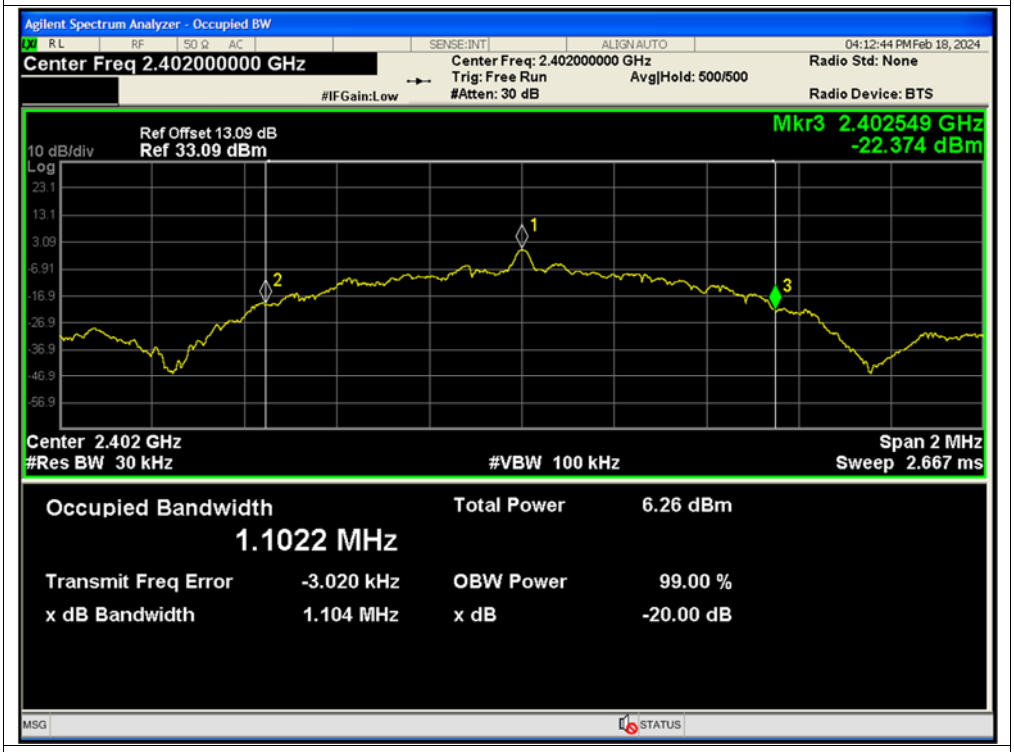


Average Power NVNT 2.4G Hopping 2480MHz Ant1


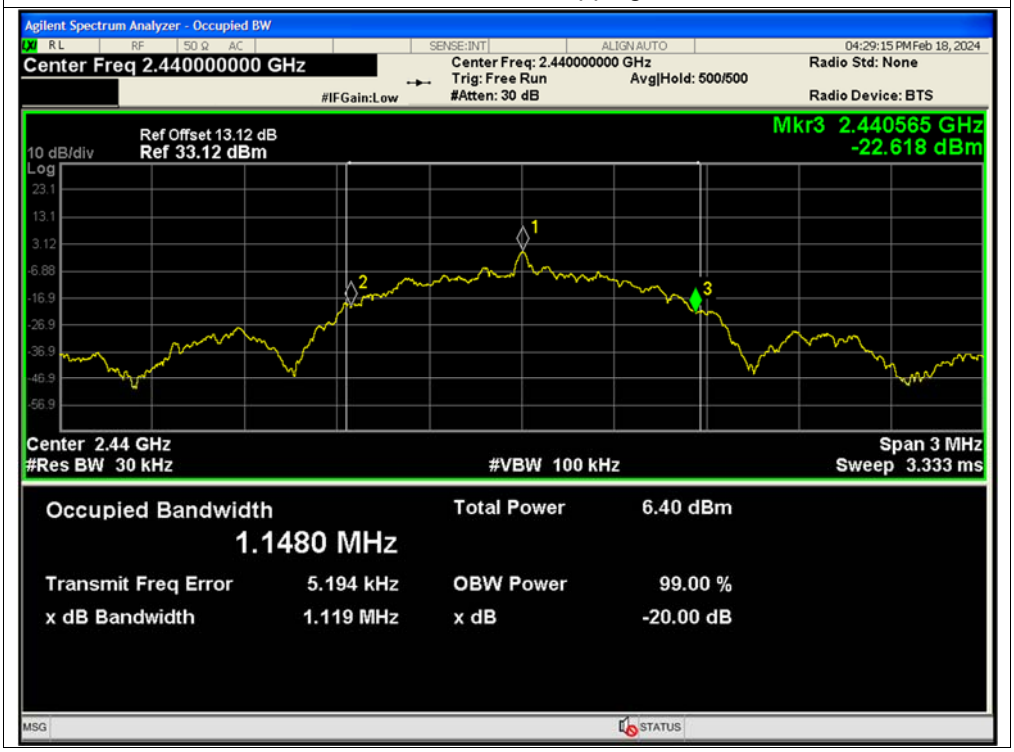
A.5. 20 dB Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	-20 dB Bandwidth (MHz)
NVNT	2.4G Hopping	2402	Ant1	1.104
NVNT	2.4G Hopping	2440	Ant1	1.119
NVNT	2.4G Hopping	2480	Ant1	1.117

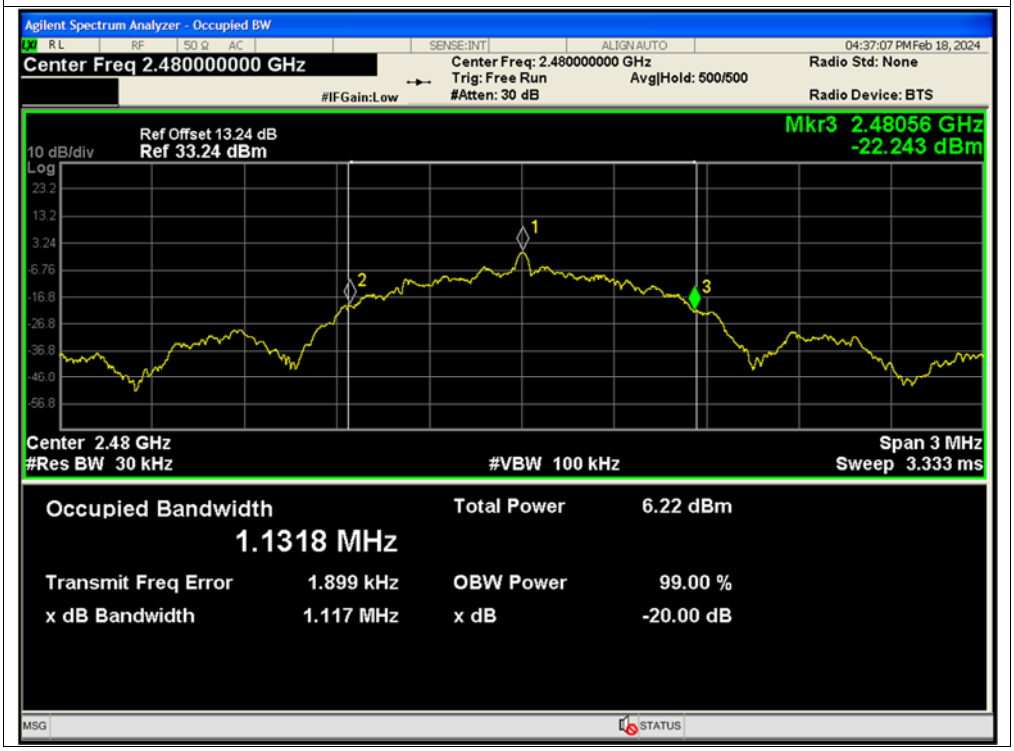
Test Graphs
-20dB Bandwidth NVNT 2.4G Hopping 2402MHz Ant1



-20dB Bandwidth NVNT 2.4G Hopping 2440MHz Ant1



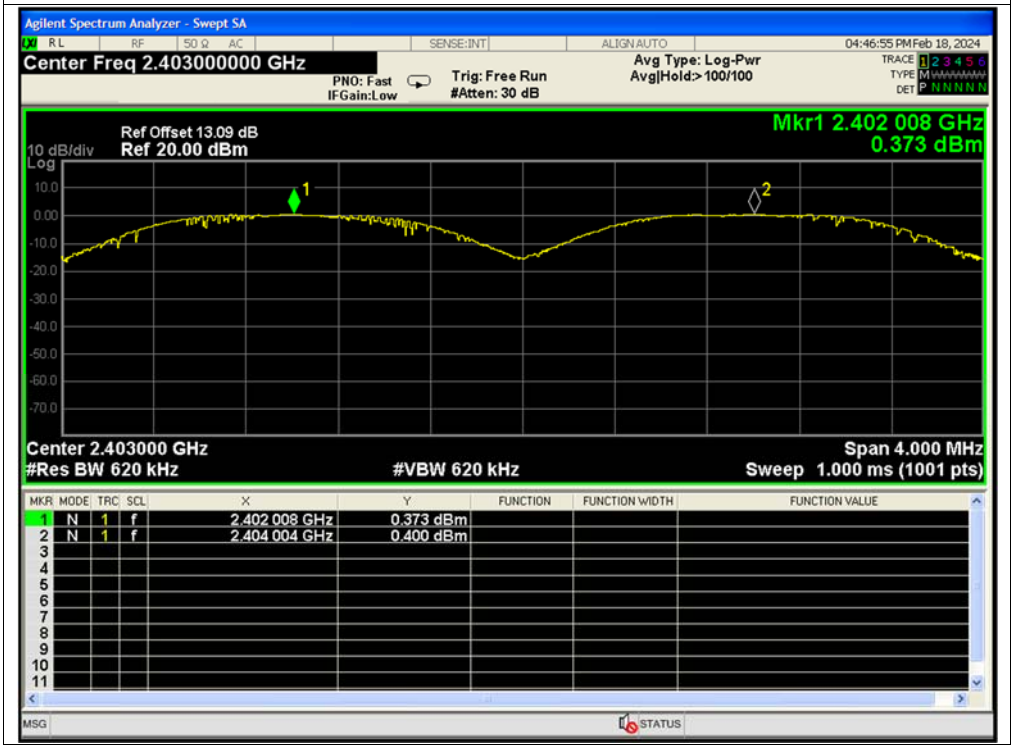
-20dB Bandwidth NVNT 2.4G Hopping 2480MHz Ant1



A.6. Carried Frequency Separation

Condition	Mode	Antenna	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	2.4G Hopping	Ant1	2402.008	2404.004	1.996	0.736	Pass

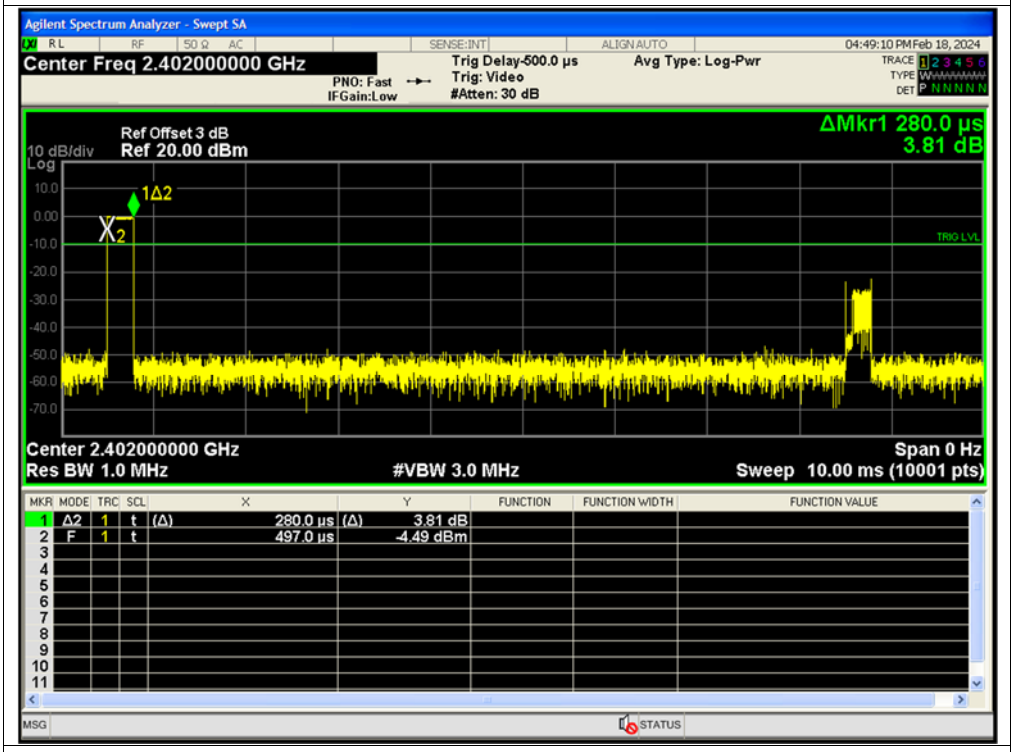
Test Graphs
CFS NVNT 2.4G Hopping 2402MHz Ant1



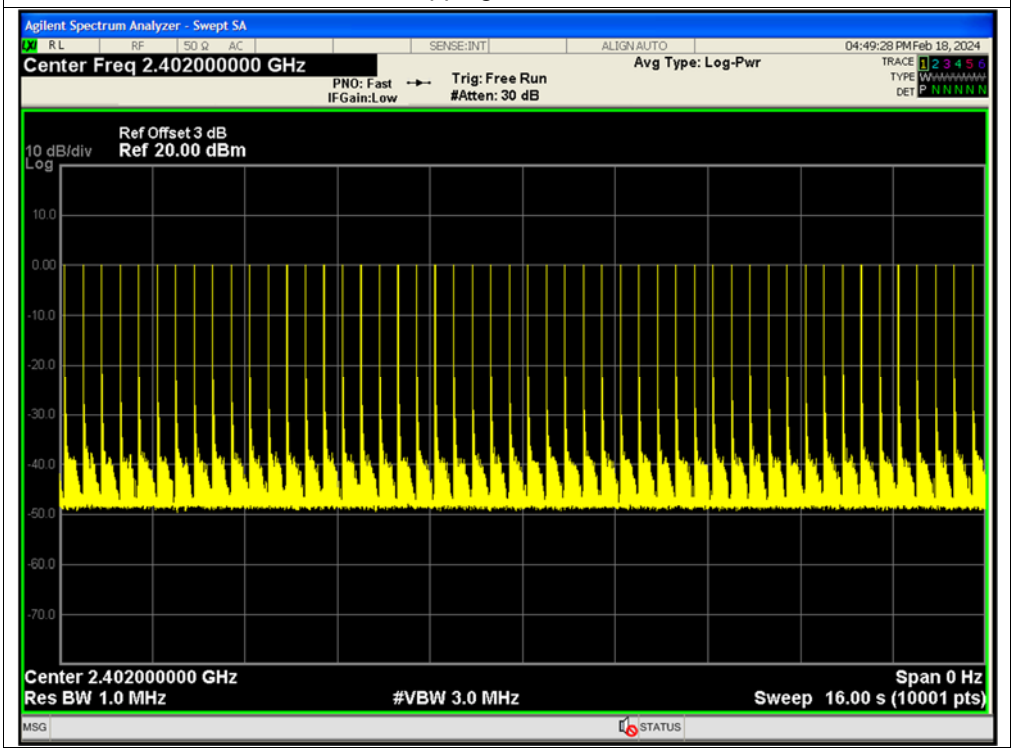
A.7. Time of Occupancy (Dwell time)

Condition	Mode	Frequency (MHz)	Antenna	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	2.4G Hopping	2402	Ant1	0.28	13.72	49	16000	400	Pass

Test Graphs
Dwell NVNT 2.4G Hopping 2402MHz Ant1 One Burst



Dwell NVNT 2.4G Hopping 2402MHz Ant1 Accumulated

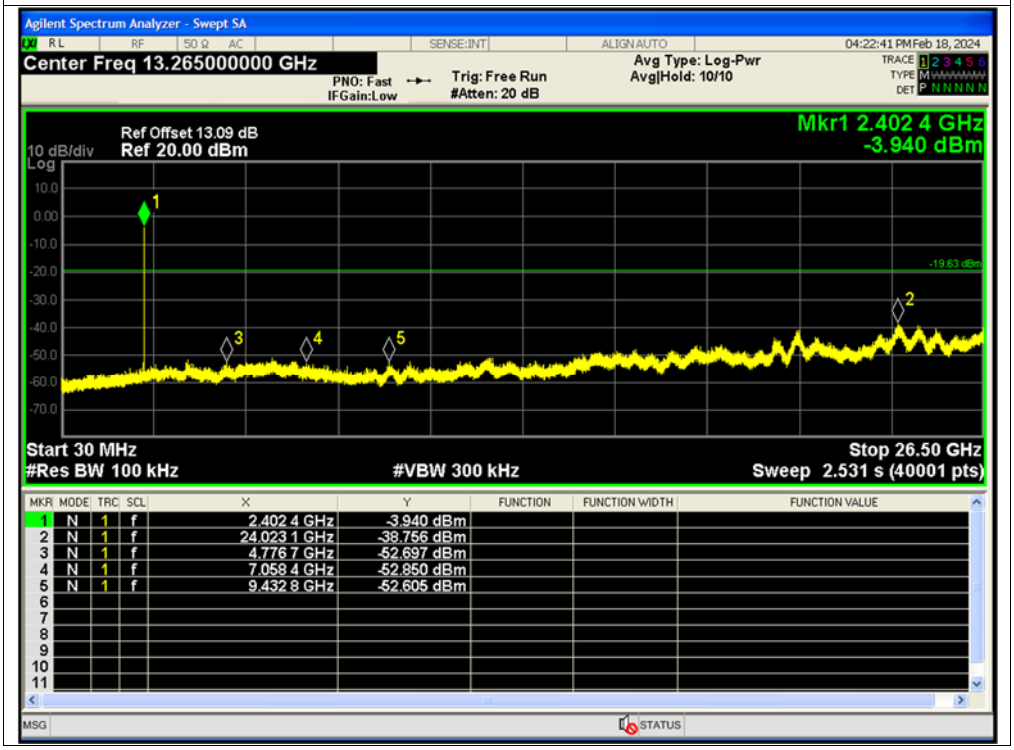


A.8. Conducted Spurious Emissions

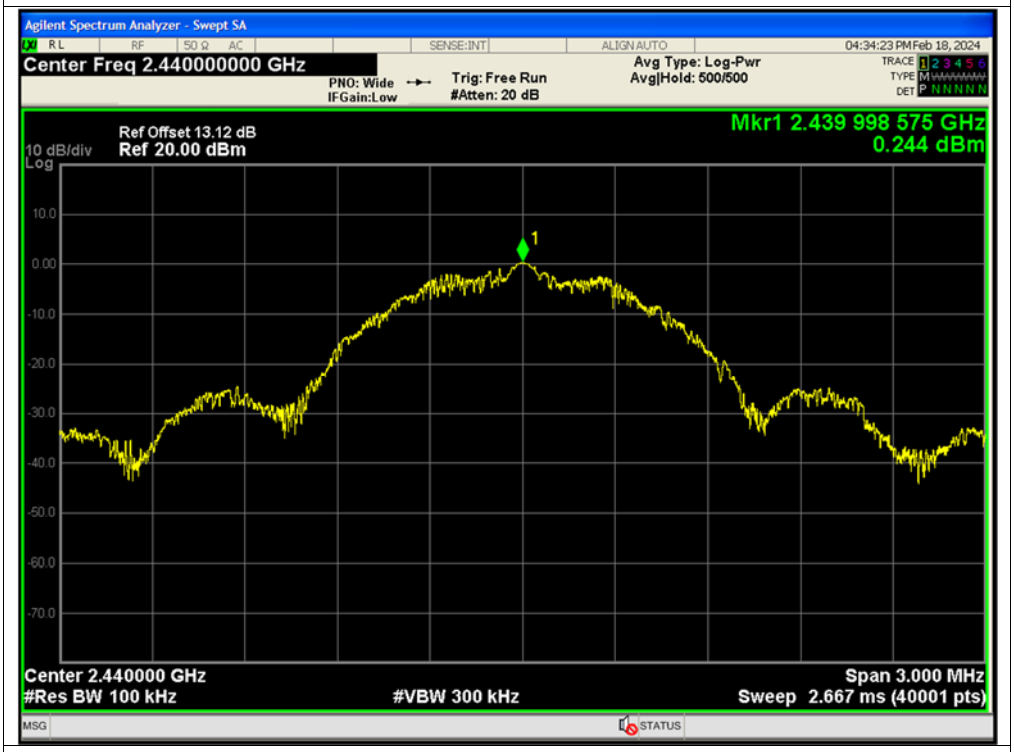
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2.4G Hopping	2402	Ant1	-39.12	-20	Pass
NVNT	2.4G Hopping	2440	Ant1	-38.97	-20	Pass
NVNT	2.4G Hopping	2480	Ant1	-37.92	-20	Pass

Test Graphs
Tx. Spurious NVNT 2.4G Hopping 2402MHz Ant1 Ref

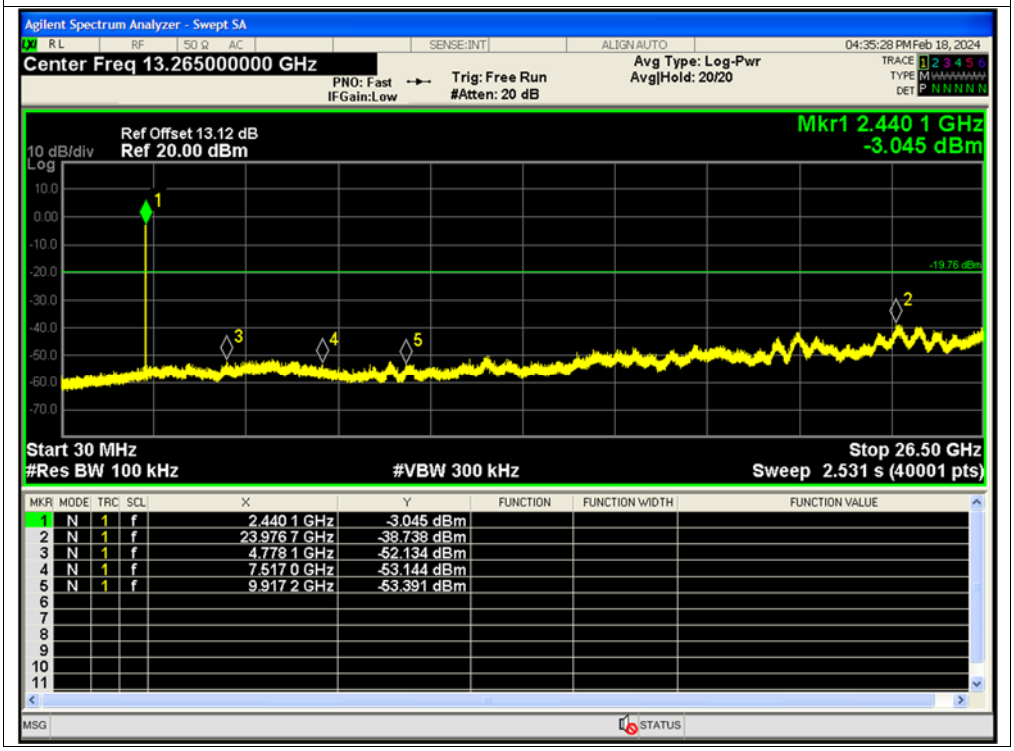
Tx. Spurious NVNT 2.4G Hopping 2402MHz Ant1 Emission



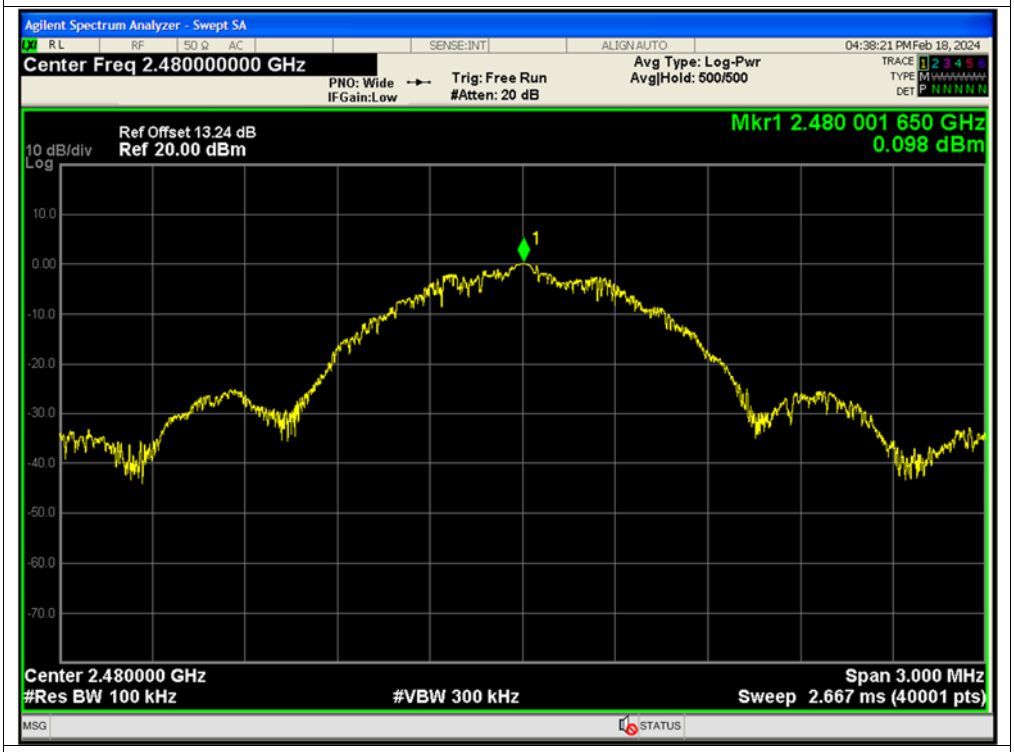
Tx. Spurious NVNT 2.4G Hopping 2440MHz Ant1 Ref



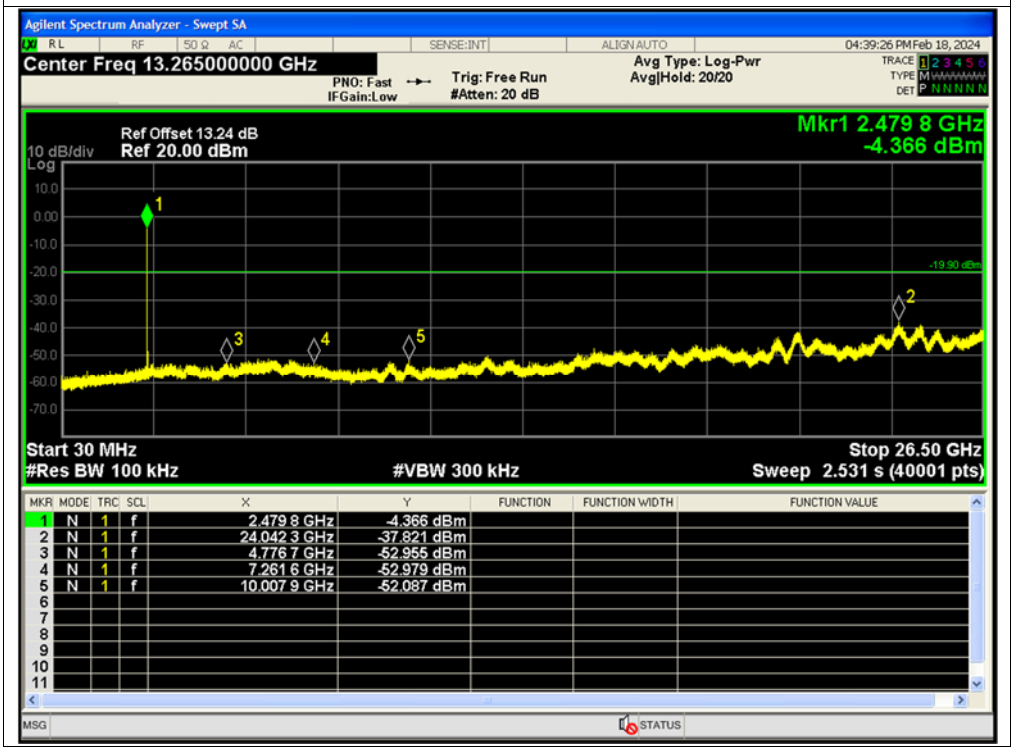
Tx. Spurious NVNT 2.4G Hopping 2440MHz Ant1 Emission



Tx. Spurious NVNT 2.4G Hopping 2480MHz Ant1 Ref



Tx. Spurious NVNT 2.4G Hopping 2480MHz Ant1 Emission



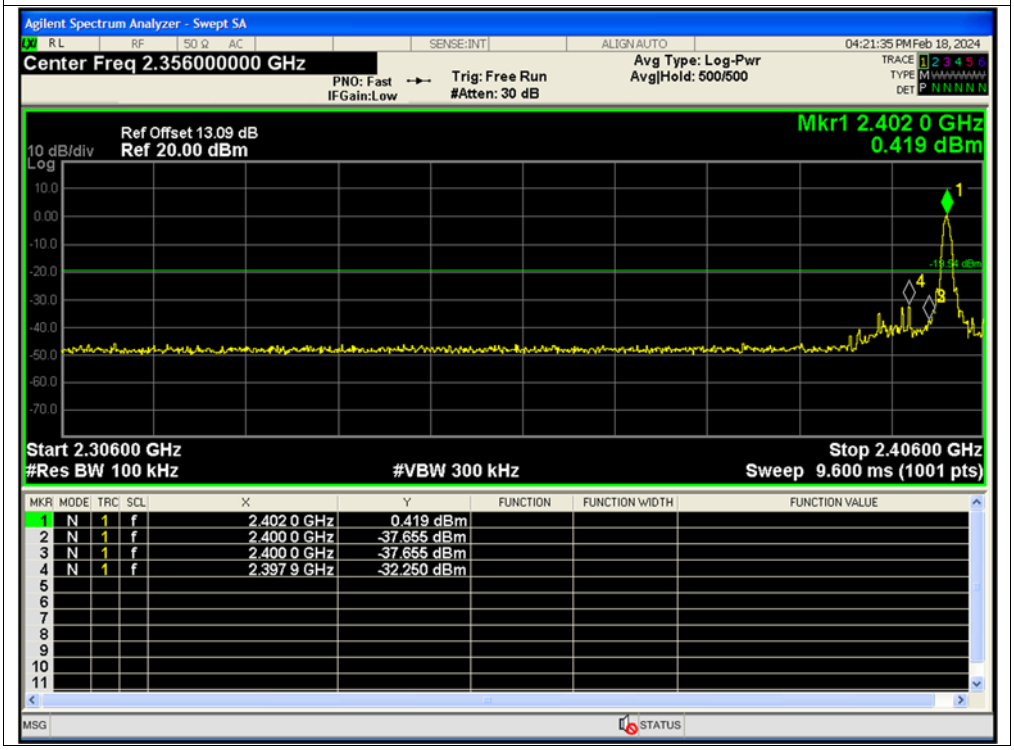
A.9. Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	2.4G Hopping	2402	Ant1	No-Hopping	-32.71	-20	Pass
NVNT	2.4G Hopping	2480	Ant1	No-Hopping	-32.52	-20	Pass
NVNT	2.4G Hopping	2402	Ant1	Hopping	-45.37	-20	Pass
NVNT	2.4G Hopping	2480	Ant1	Hopping	-39.91	-20	Pass

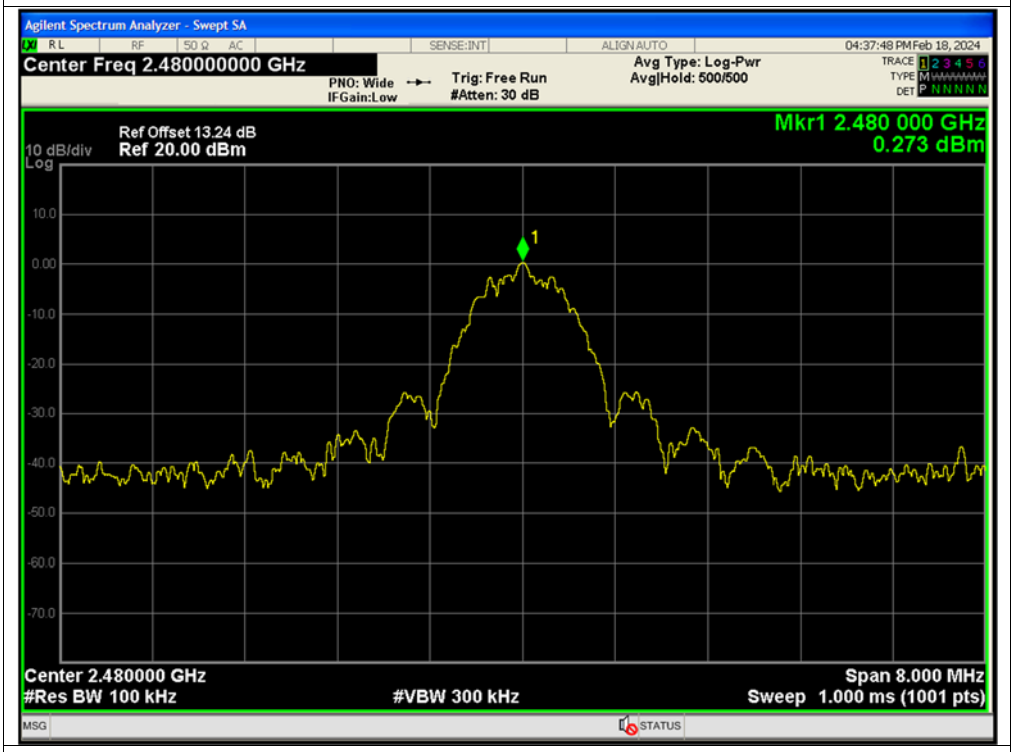
Test Graphs

Band Edge NVNT 2.4G Hopping 2402MHz Ant1 No-Hopping Ref

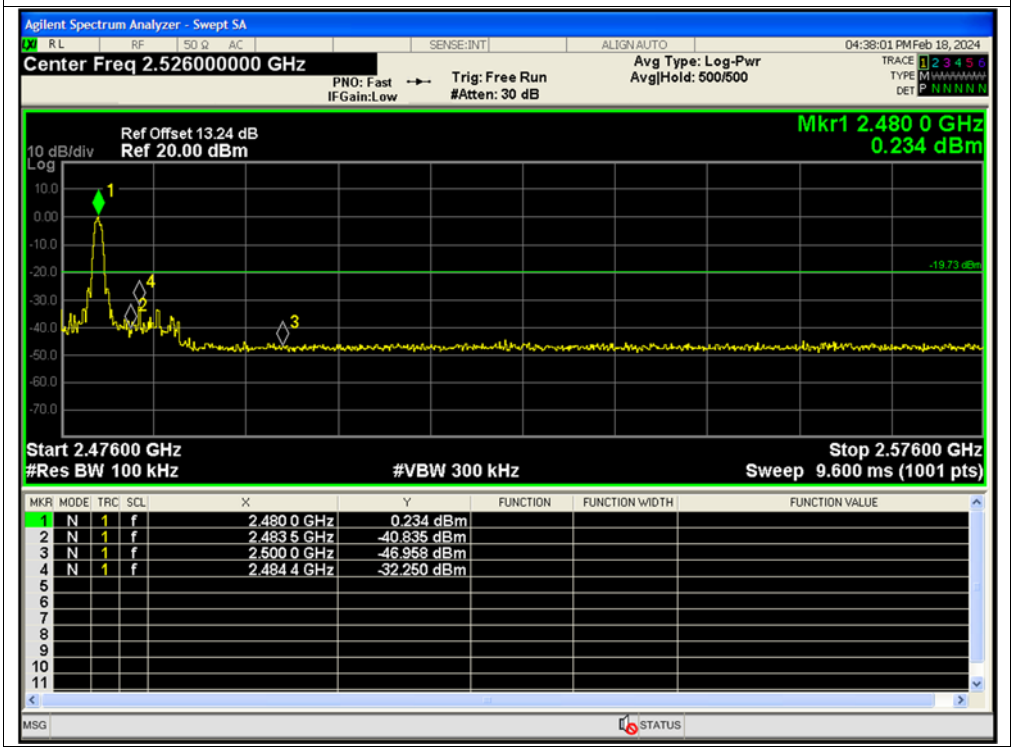
Band Edge NVNT 2.4G Hopping 2402MHz Ant1 No-Hopping Emission



Band Edge NVNT 2.4G Hopping 2480MHz Ant1 No-Hopping Ref

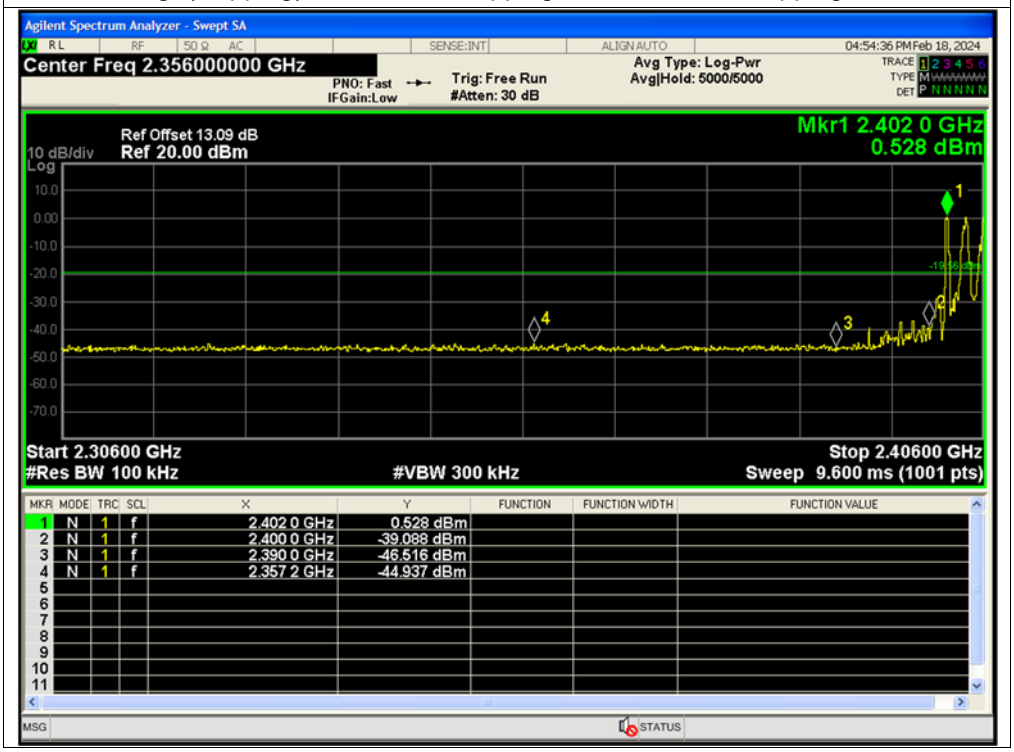


Band Edge NVNT 2.4G Hopping 2480MHz Ant1 No-Hopping Emission



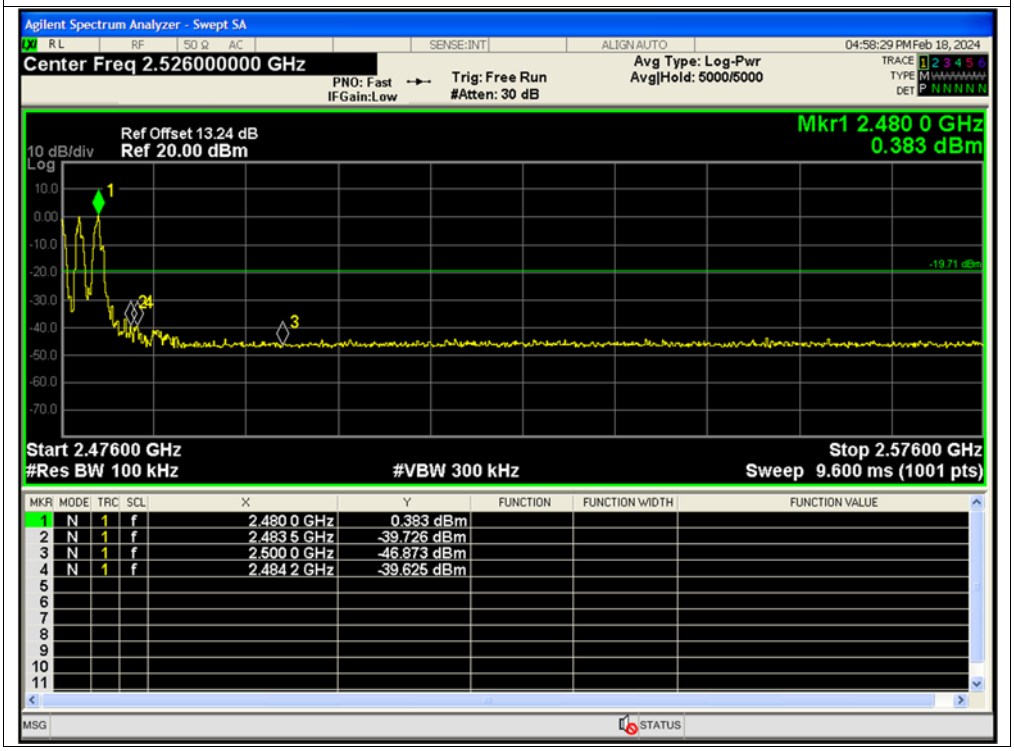
Test Graphs
Band Edge(Hopping) NVNT 2.4G Hopping 2402MHz Ant1 Hopping Ref

Band Edge(Hopping) NVNT 2.4G Hopping 2402MHz Ant1 Hopping Emission



Band Edge(Hopping) NVNT 2.4G Hopping 2480MHz Ant1 Hopping Ref

Band Edge(Hopping) NVNT 2.4G Hopping 2480MHz Ant1 Hopping Emission



A.10. Conducted Emission

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Set RBW=9kHz, VBW=30kHz. Refer to recorded points and plots below.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hz were considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A. Test Setup:

Test Mode: EUT+Adapter+USB Cable + 2.4G TX

Test voltage: AC 120V/60Hz

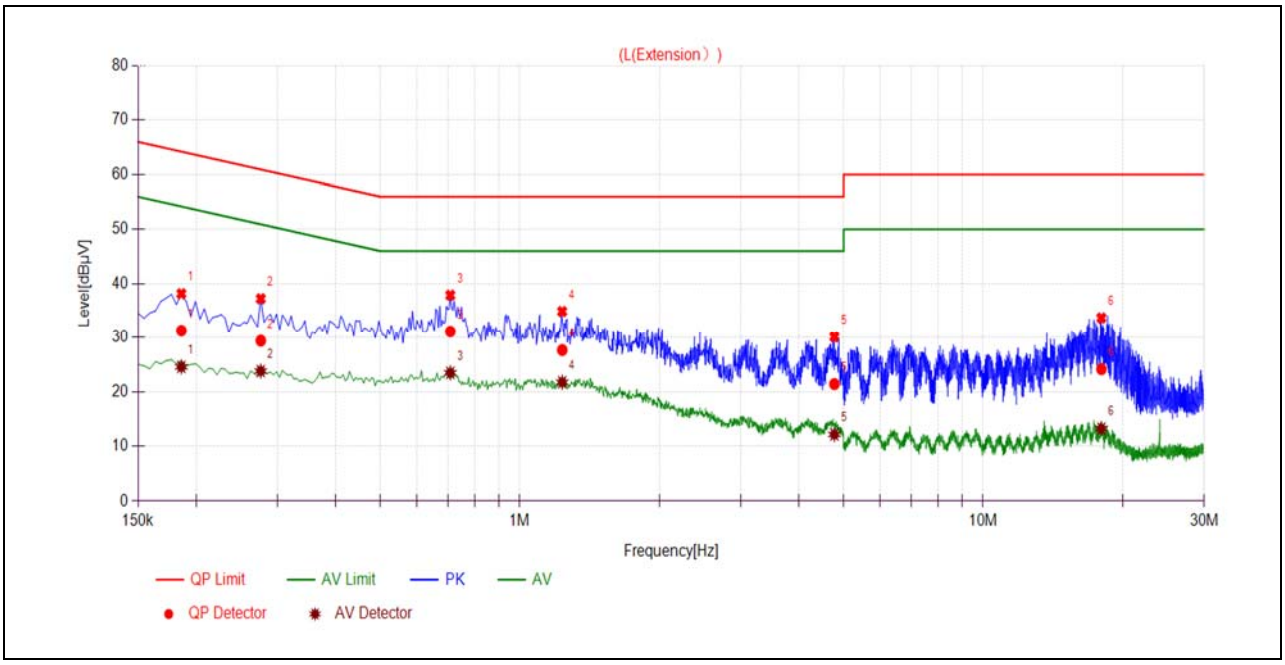
The measurement results are obtained as below:

$E\ [dB\mu V] = U_R + L_{Cable\ loss}\ [dB] + A_{Factor}$

U_R: Receiver Reading

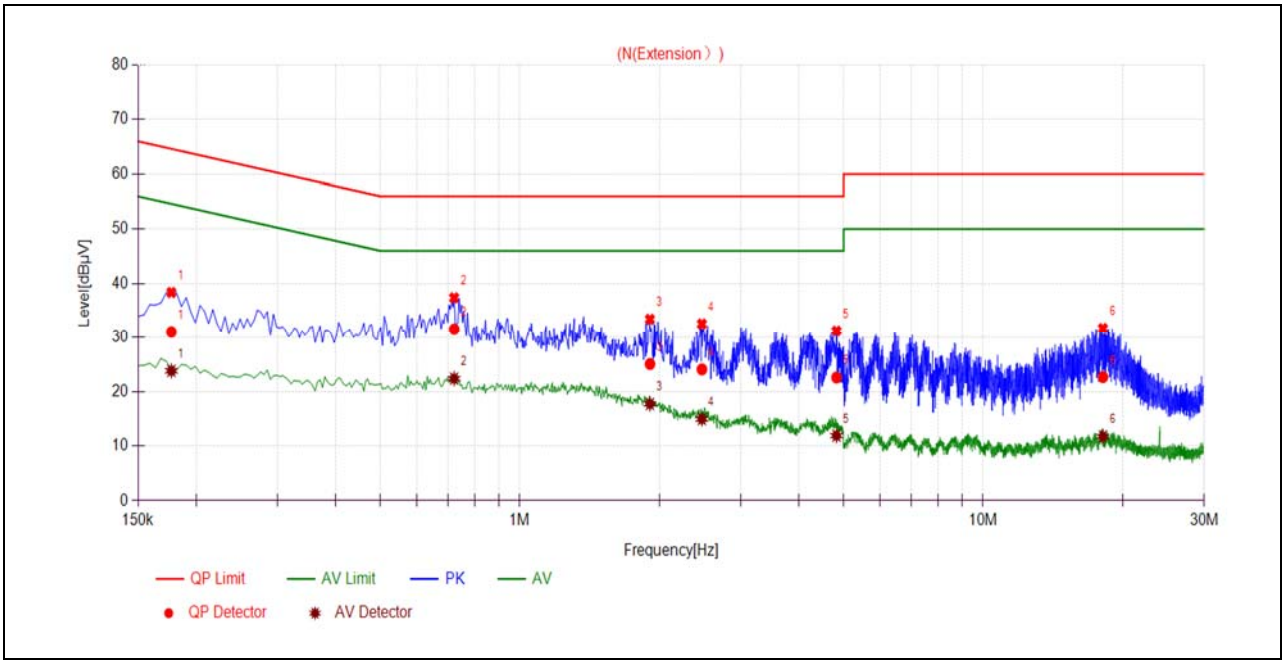
A_{Factor}: Voltage division factor of LISN

B. Test Plot:



(L Phase)

No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1860	31.28	24.54	64.21	54.21	Line	PASS
2	0.2760	29.38	23.77	60.93	50.93		PASS
3	0.7080	31.12	23.44	56.00	46.00		PASS
4	1.2346	27.64	21.71	56.00	46.00		PASS
5	4.7758	21.38	12.14	56.00	46.00		PASS
6	18.0019	24.13	13.21	60.00	50.00		PASS



(N Phase)

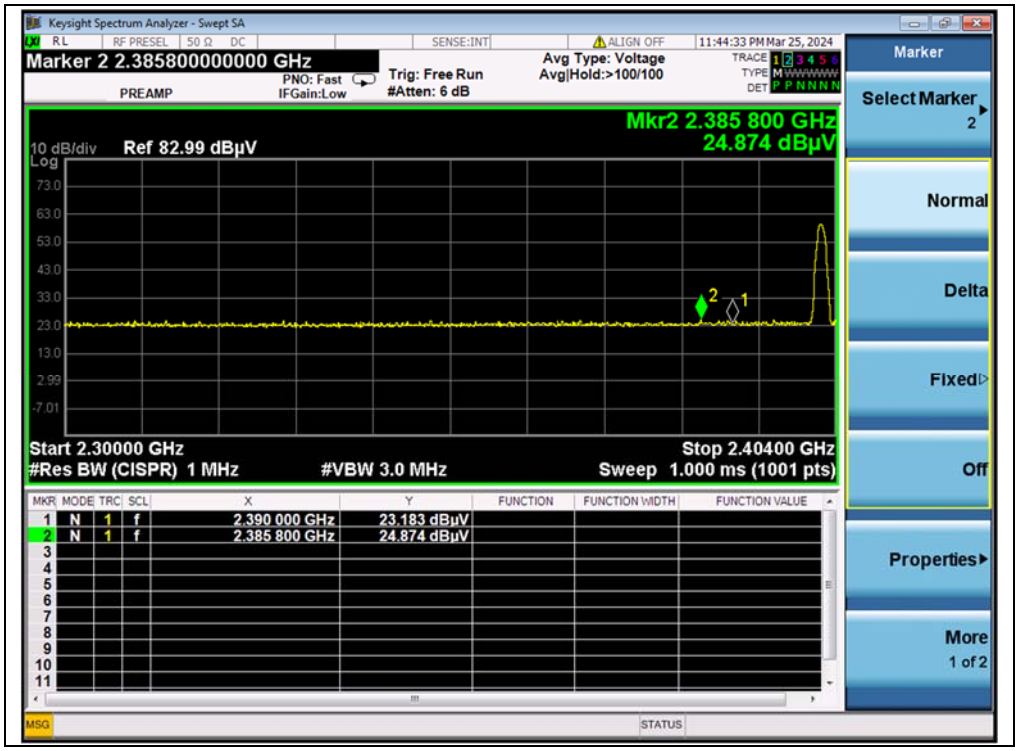
No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1770	31.05	23.80	64.63	54.63	Neutral	PASS
2	0.7216	31.56	22.37	56.00	46.00		PASS
3	1.9096	25.06	17.70	56.00	46.00		PASS
4	2.4722	24.07	14.92	56.00	46.00		PASS
5	4.8253	22.58	11.86	56.00	46.00		PASS
6	18.1379	22.66	11.71	60.00	50.00		PASS

A.11. Restricted Frequency Bands

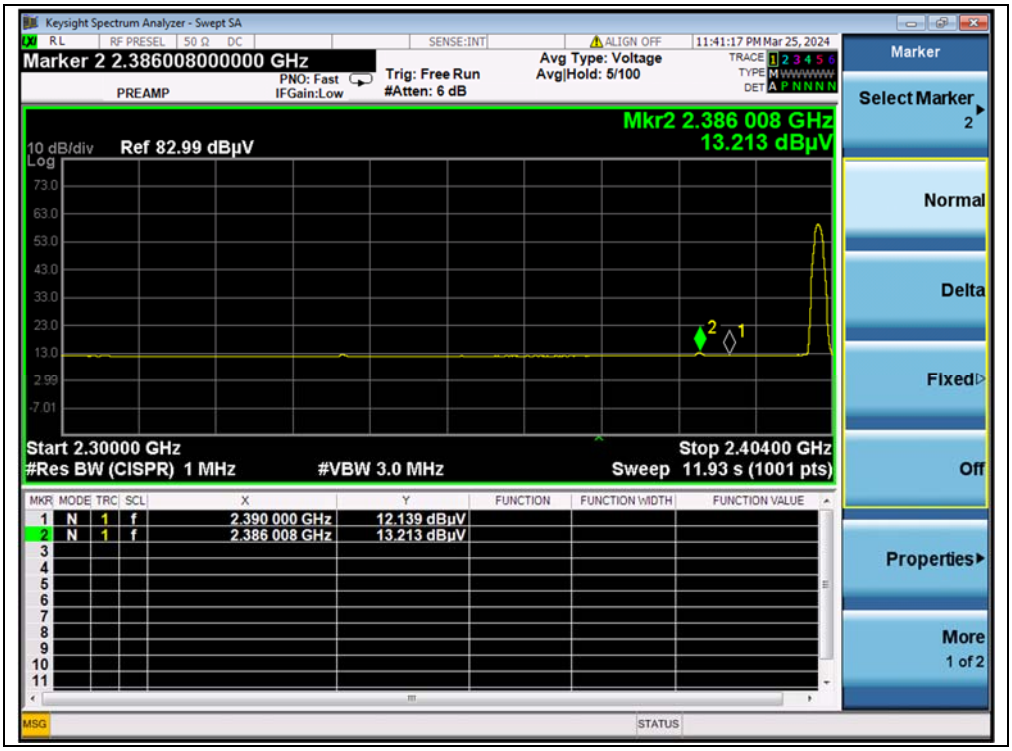
The lowest and highest channels are tested to verify the Restricted Frequency Bands.
The measurement results are obtained as below:
E [dBμV/m] =U_R + A_T + A_{Factor} [dB]; A_T =$L_{Cable\ loss}$ [dB]-G_{preamp} [dB]
A_T: Total correction Factor except Antenna
U_R: Receiver Reading
G_{preamp}: Preamplifier Gain
A_{Factor}: Antenna Factor at 3m

Note: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBμV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dBμV/m)	Limit (dBμV/m)	Verdict
		PK/ AV						
0	2385.80	PK	24.87	6.74	27.20	58.81	74	PASS
0	2386.01	AV	13.21	6.74	27.20	47.15	54	PASS
39	2486.89	PK	25.03	6.74	27.20	58.97	74	PASS
39	2495.93	AV	12.47	6.74	27.20	46.41	54	PASS

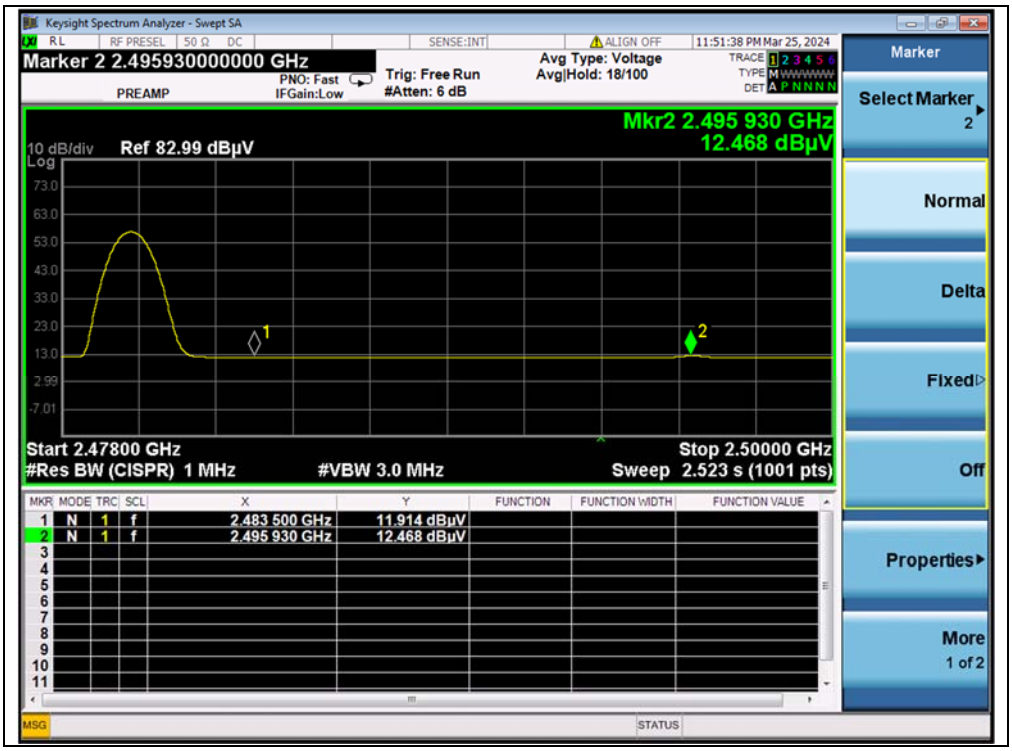


(PEAK, Channel 0)



(AVERAGE, Channel 0)

(PEAK, Channel 39)



(AVERAGE, Channel 39)

A.12. Radiated Emission

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

The measurement results are obtained as below:

$E\ [dB\mu V/m] = U_R + A_T + A_{Factor}\ [dB]$; $A_T = L_{Cable\ loss}\ [dB] - G_{preamp}\ [dB]$

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

A_{Factor}: Antenna Factor at 3m

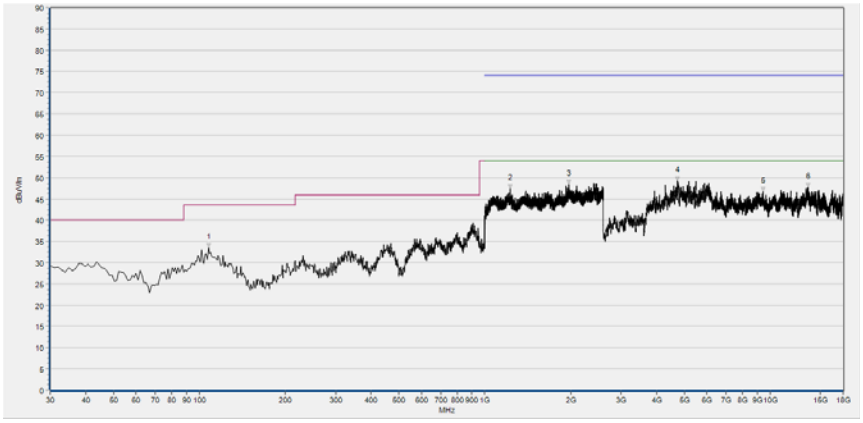
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

Note1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note2: For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

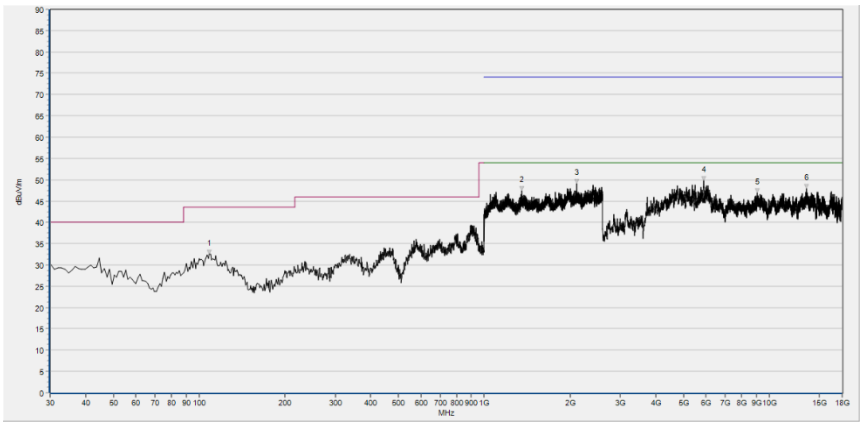
Note3: For the frequency, which started from 18GHz to 10th harmonic of the highest frequency, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Plots for Channel 0



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
107.600	33.51	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1227.733	47.44	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
1973.867	48.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4734.440	49.28	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
9412.960	46.84	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
13583.280	47.72	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

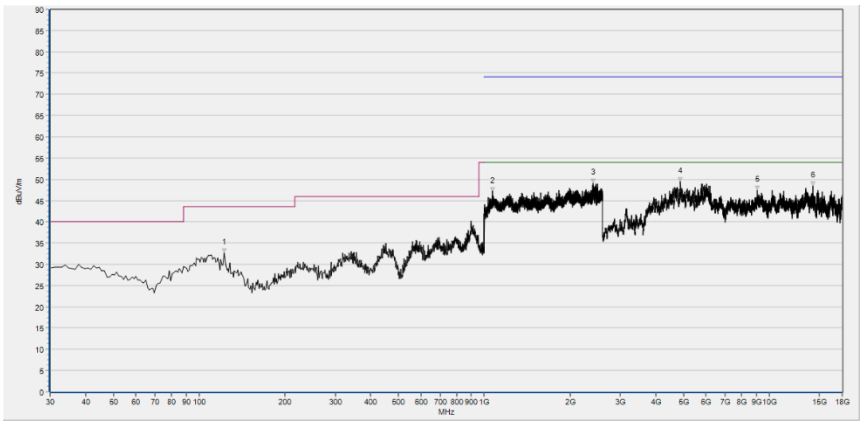
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
108.570	32.44	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1353.067	47.39	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2113.067	49.07	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5889.440	49.73	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
9071.080	46.98	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
13484.720	47.89	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

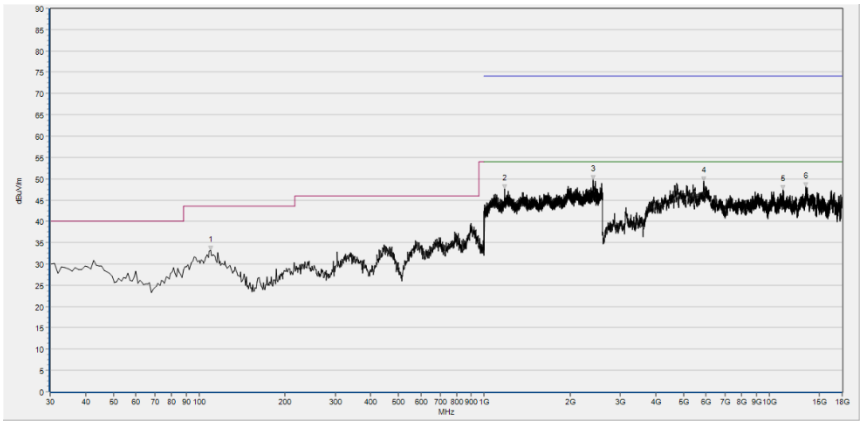
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 19



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
122.150	32.68	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1069.867	47.05	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2408.533	49.13	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
4879.200	49.40	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
9074.160	47.35	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
14239.320	48.43	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

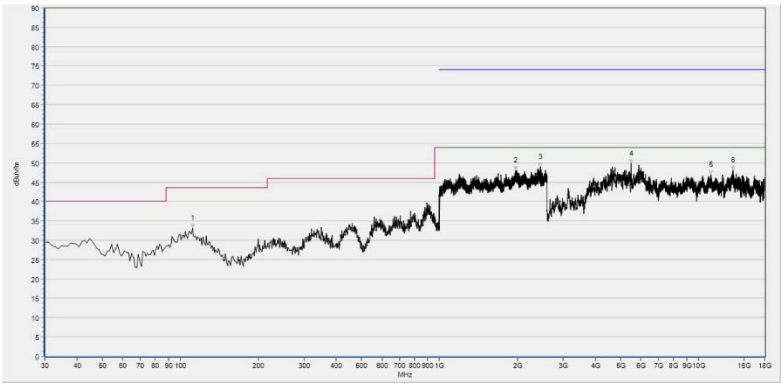
(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
109.540	33.27	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1180.267	47.55	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2414.933	49.69	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5898.680	49.39	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
11137.760	47.38	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
13438.520	48.14	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

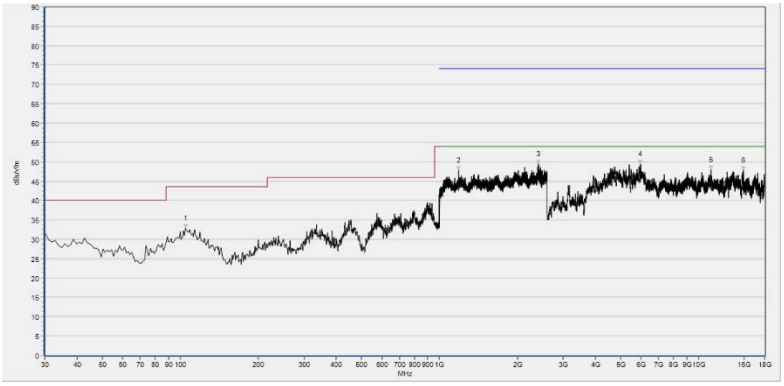
(Antenna Vertical, 30MHz to 18GHz)

Plot for Channel 39



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
111.480	33.19	N/A	N/A	N/A	43.50	N/A	Horizontal	PASS
1965.333	48.09	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
2451.733	49.02	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
5479.800	49.85	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
11162.400	46.89	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS
13564.800	48.14	N/A	N/A	74.00	N/A	54.00	Horizontal	PASS

(Antenna Horizontal, 30MHz to 18GHz)



Fre. (MHz)	PK (dBμV/m)	QP (dBμV/m)	AV (dBμV/m)	Limit-PK (dBμV/m)	Limit-QP (dBμV/m)	Limit-AV (dBμV/m)	Antenna	Verdict
104.690	32.86	N/A	N/A	N/A	43.50	N/A	Vertical	PASS
1186.667	47.73	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
2404.267	49.43	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
5969.520	49.48	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
11174.720	47.95	N/A	N/A	74.00	N/A	54.00	Vertical	PASS
14855.320	47.68	N/A	N/A	74.00	N/A	54.00	Vertical	PASS

(Antenna Vertical, 30MHz to 18GHz)

END OF REPORT