REPORT No.: SZ25070347W02

TEST REPORT

APPLICANT	:	Shenzhen Thingx Technology Co., Ltd.
PRODUCT NAME	:	Smart Emotion Tracking Pendant
MODEL NAME	:	nuna01
BRAND NAME	:	nuna
FCC ID	:	2BRBQNUNA01
STANDARD(S)	:	47 CFR Part 15 Subpart C
RECEIPT DATE	:	2025-07-24
TEST DATE	:	2025-07-30 to 2025-08-14
ISSUE DATE	:	2025-09-15

Edited by: Su Xiaoxian

Su Xiaoxian (Rapporteur)

Approved by: Shen Junsheng

Shen Junsheng (Supervisor)

MORLAB

Shenzhen Morlab Communications Technology Co., Ltd.
FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

Tel: 86-755-36698555 Fax: 86-755-36698525
Http://www.morlab.cn E-mail: service@morlab.cn

DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2025-09-15	First edition

1. Summary of Test Result

No.	Section	Description	Test Date	Test Engineer	Result	Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	/
2	N/A	Duty Cycle of Test Signal	Aug. 7, 2025	Zhu Peihong	PASS	/
3	15.247(b)	Maximum Peak Conducted Output Power	Aug. 7, 2025	Zhu Peihong	PASS	/
4	15.247(b)	Maximum Average Conducted Output Power	Aug. 7, 2025	Zhu Peihong	PASS	/
5	15.247(a)	Bandwidth	Aug. 7, 2025	Zhu Peihong	PASS	/
6	15.247(d)	Conducted Spurious Emission and Band Edge	Aug. 7, 2025	Zhu Peihong	PASS	/
7	15.247(e)	Power Spectral Density	Aug. 7, 2025	Zhu Peihong	PASS	/
8	15.207	Conducted Emission	Aug. 19, 2025	Wang Yapeng	PASS	/
9	15.247(d)	Restricted Frequency Bands	Jul. 30, 2025	Zhang Liyun	PASS	/
10	15.209, 15.247(d)	Radiated Emission	Jul. 30, 2025	Zhang Liyun	PASS	/

Note 1: The tests were performed according to the method of measurements prescribed in ANSI C63.10-2020 and KDB 558074 D01 v05r02.

Note 2: Any additions, deviation, or exclusions from the method shall be noted in the “Remark”.

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	Serial No.	Type	Manufacturer	Cal. Date	Due Date
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2025.01.15	2026.01.14
RF Cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
SMA Connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

1.2.2 Conducted Emission Test Equipment

Equipment	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Receiver	101052	ESPI	R&S	2025.05.15	2026.05.14
LISN	103131	ENV 216	R&S	2025.03.20	2026.03.19
Pulse Limiter (10dB)	VTSD 9561 F-B #206	VTSD 9561-F	R&S	2025.05.13	2026.05.12
RF Coaxial Cable (DC-100MHz)	EMC-CE-00514	N/A	N/A	2025.05.06	2026.05.05

1.2.3 List of Software Used

Description	Manufacturer	Software Version
Test System	MaiWei	2.0.0.0
JS32-RE	Tonscend	5.0.0
TS+ -[JS32-CE]	Tonscend	2.5.0.0

1.2.4 Radiated Test Equipment

Equipment	Serial No.	Type	Manufacturer	Cal. Date	Due Date
Signal Analyzer	MY56060145	N9020A	Agilent	2025.05.13	2026.05.12
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2025.06.22	2026.06.21
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2025.05.16	2026.05.15
Test Antenna – Horn	01774	BBHA 9120D	Schwarzbeck	2025.06.20	2026.06.19
Test Antenna – Horn	BBHA9170 #773	BBHA9170	Schwarzbeck	2025.06.20	2026.06.19
Preamplifier (10MHz-6GHz)	46732	S10M100L3802	LUCIX CORP.	2025.05.13	2026.05.12
Preamplifier (2GHz-18GHz)	61171/61172	S020180L3203	LUCIX CORP.	2025.05.13	2026.05.12
Preamplifier (18GHz-40GHz)	DS77209	DCLNA0118-40C-S	Decentest	2025.05.13	2026.05.12
RF Coaxial Cable (DC-18GHz)	MRE001	PE330	Pasternack	2025.05.13	2026.05.12
RF Coaxial Cable (DC-18GHz)	MRE002	CLU18	Pasternack	2025.05.13	2026.05.12
RF Coaxial Cable (DC-18GHz)	MRE003	CLU18	Pasternack	2025.05.13	2026.05.12
RF Coaxial Cable (DC-40GHz)	22290045	QA360-40-KK-0.5	Qualwave	2024.09.11	2025.09.10
RF Coaxial Cable (DC-40GHz)	22290046	QA360-40-KKF-2	Qualwave	2024.09.11	2025.09.10
RF Coaxial Cable (DC-18GHz)	22120181	QA500-18-NN-5	Qualwave	2024.09.11	2025.09.10
Notch Filter	N/A	WRCG-2400-2483.5-60SS	Wainwright	N/A	N/A
Anechoic Chamber	N/A	9m*6m*6m	CRT	2025.06.21	2028.06.20
Anechoic Chamber	N/A	9m*6m*6m	CRT	2022.11.30	2025.11.29

1.3. Measurement Uncertainty

Test Items	Uncertainty	Remark
Peak Output Power	±2.22dB	Confidence levels of 95%
Power Spectral Density	±2.22dB	Confidence levels of 95%
Bandwidth	±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	Shenzhen Thingx Technology Co., Ltd.
Applicant Address	Room 510, Shenzhen Research Institute, CUHK, No.10, Yuexing 2nd Road, Nanshan, Shenzhen
Manufacturer	Shenzhen Thingx Technology Co., Ltd.
Manufacturer Address	Room 510, Shenzhen Research Institute, CUHK, No.10, Yuexing 2nd Road, Nanshan, Shenzhen

2.2. Information of EUT

Product Name:	Smart Emotion Tracking Pendant	
Sample No.:	4#, 8#	
Hardware Version:	P01_1V2	
Software Version:	V3.14.4.1212	
Equipment Type:	Bluetooth LE	
Bluetooth Version:	5.2	
Modulation Type:	GFSK	
Data Rate:	1Mbps, 2Mbps	
Operating Frequency Range:	2402MHz-2480MHz	
Antenna Type:	Chip Antenna	
Antenna Gain:	2.0dBi	
Accessory Information:	Battery	
	Brand Name:	ZWDB
	Model No.:	ZWD402030V
	Serial No.:	N/A
	Capacity:	300mAh
	Rated Voltage:	3.8V
	Charge Limit:	4.35V
	Manufacturer Address:	ZHONGSHAN ZHONGWANGDE NEWENERGY TECHNOLOGY.LTD

Note 1: The EUT description presented in the report are provided by applicant and/or manufacturer, and the test laboratory is not responsible for the accuracy of the information. 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)	Channel	Frequency (MHz)
0	**2402**	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	**19**	**2440**	29	2460	**39**	**2480**

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

2.4. Test Configuration of EUT

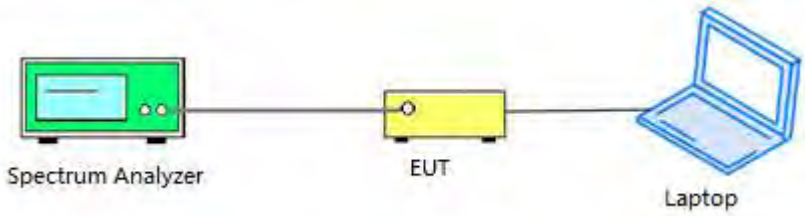
The EUT is controlled by dedicated software to transmit at the default maximum power level.

2.5. Test Conditions

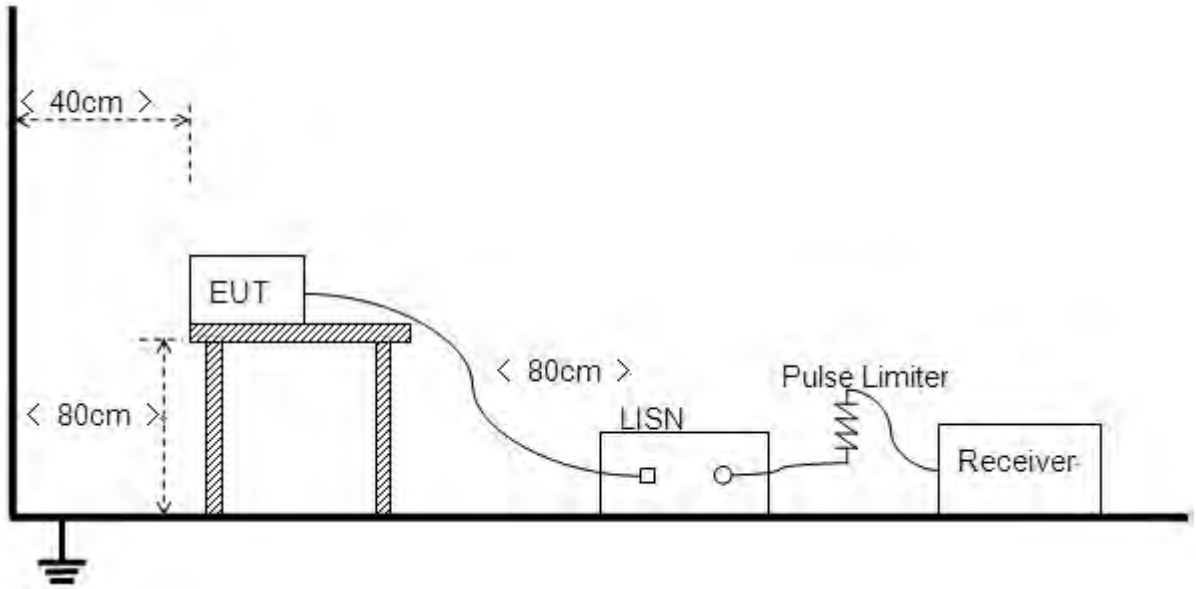
Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106

2.6. Test Setup Layout Diagram

2.6.1.Conducted Measurement

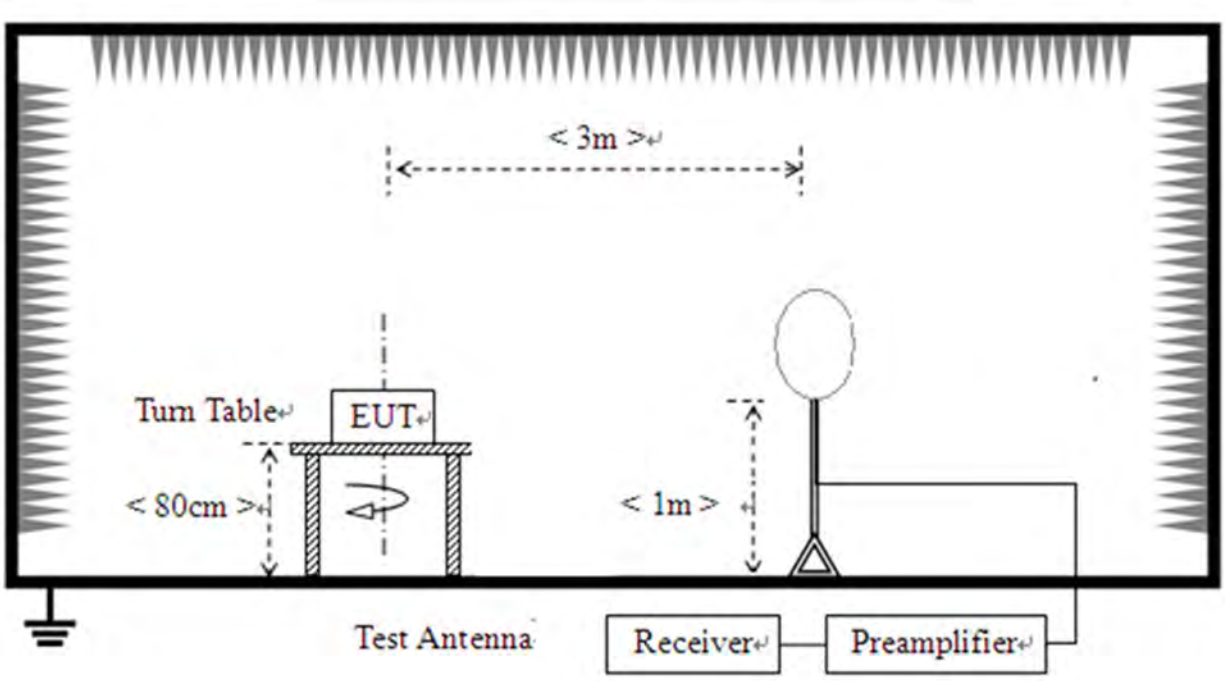


2.6.2.Conducted Emission Measurement

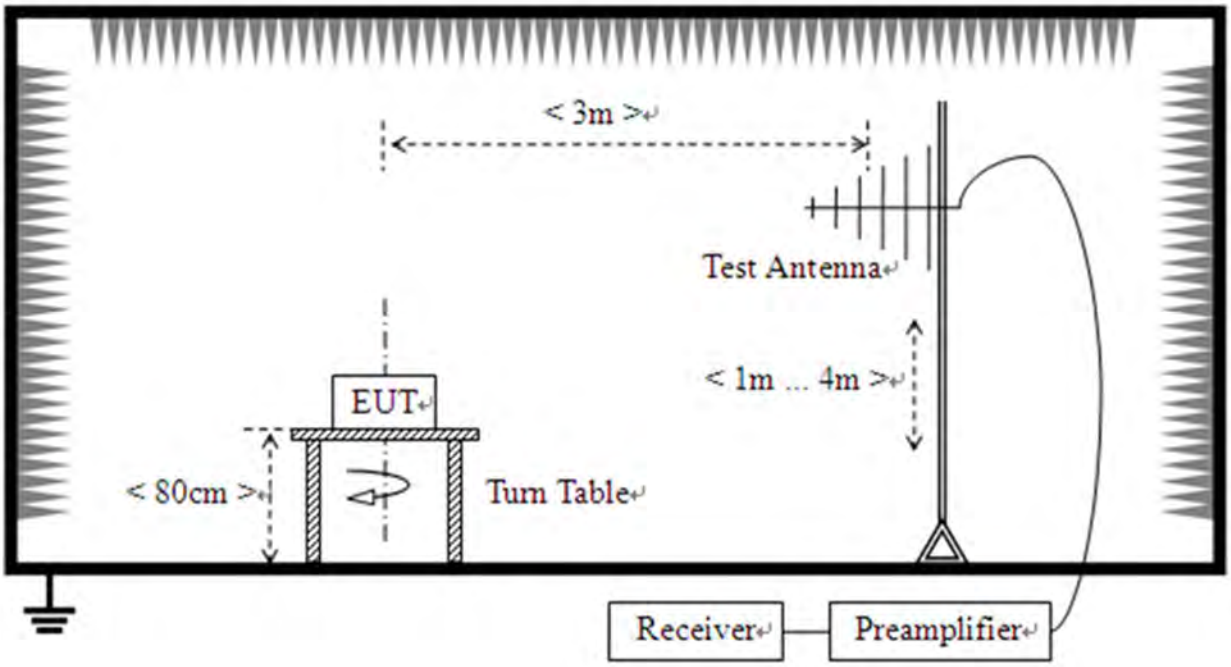


2.6.3.Radiation Measurement

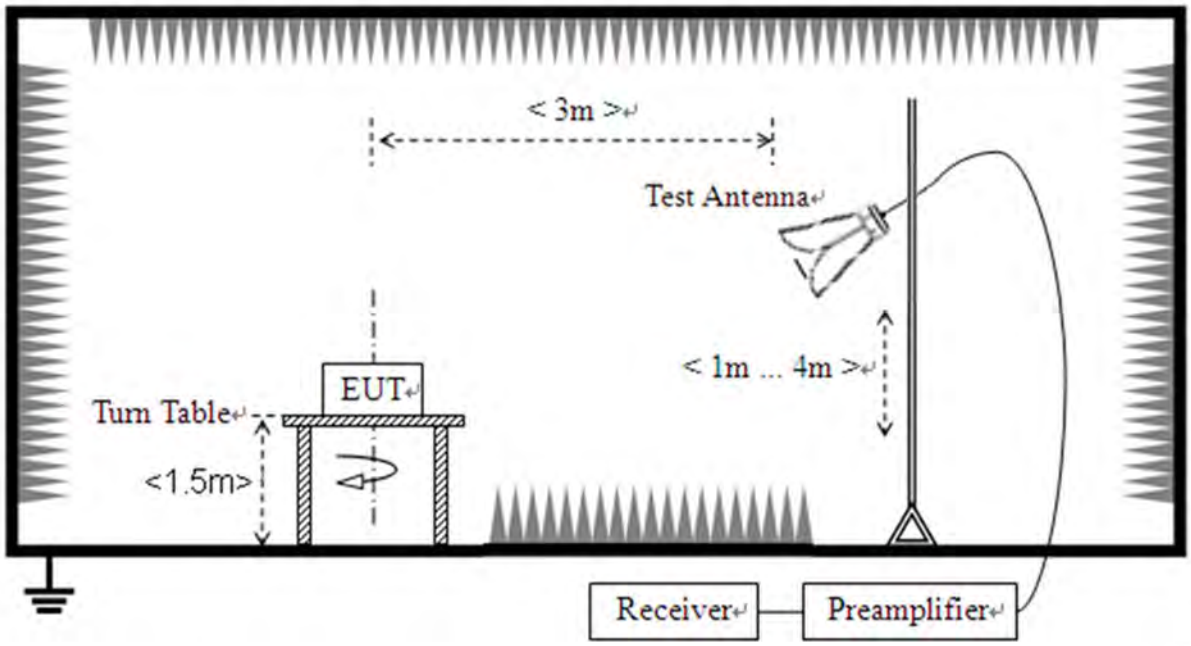
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



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

Antenna location	Antenna Type	Coupling Method
☒Internal ☐External	☐FPC Antenna ☐Spring Antenna ☐Ceramic Antenna ☐Integrated Antenna ☐Dipole Antenna ☐PCB Antenna ☐PIFA Antenna ☒Chip Antenna	☐I-PEX Connector ☐SMA Connector ☐RP-SMA Connector ☐Metal Shrapnel ☒Layout

3.2. Duty Cycle of Test Signal

3.2.1.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.

3.2.2.Test Result

Refer to Annex A.1 in this report.

3.3. Maximum Peak Conducted Output Power

3.3.1.Requirement

According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

3.3.2.Test Procedures

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

3.3.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.3.4.Test Result

Refer to Annex A.2 in this report.

3.4. Maximum Average Conducted Output Power

3.4.1.Requirement

According to FCC section 15.247(b)(3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum average conducted output power of the intentional radiator shall not exceed 1 Watt.

3.4.2.Test Procedures

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

3.4.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.4.4.Test Result

Refer to Annex A.3 in this report.

3.5.6 dB Bandwidth

3.5.1.Requirement

According to FCC section 15.247(a) (2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

3.5.1.Test Procedures

The steps for the first option are as follows:
a) Set analyzer center frequency to channel center frequency
b) Set RBW to100kHz
c) Set VBW to 300kHz
d) Detector = peak.
e) Trace mode = max hold
f) Sweep time = auto couple
g) Allow the trace to fully stabilize
h) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by6 dB relative to the maximum level measured in the fundamental emission
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1 (i.e., RBW = 100 kHz, VBW ≥ 3 ×RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 dB.

3.5.2.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.5.3.Test Result

Refer to Annex A.4 in this report.

3.6. Conducted Spurious Emissions and Band Edge

3.6.1.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.

3.6.2.Test Procedures

KDB 558074 Section 8.5 and 8.7 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.5 and A.6 in this report.

3.7. Power Spectral Density

3.7.1.Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

3.7.2.Test Procedures

The measured power spectral density was calculated by the reading of the spectrum analyzer and calibration. Following is the test procedure for PSD test:
a) Set analyzer center frequency to channel center frequency
b) Set span to1.5 times DTS
c) Set RBW to 3kHz
d) Set VBW to 10kHz
e) Detector = peak
f) Sweep time = auto couple
g) Trace mode = max hold
h) Allow trace to fully stabilize
i) Use the peak marker function to determine the maximum amplitude level within the RBW

3.7.3.Test Setup Layout

Refer to chapter 2.6.1 in this report.

3.7.4.Test Result

Refer to Annex A.7 in this report.

3.8. Conducted Emission

3.8.1.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.

3.8.2.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.

3.8.3.Test Setup Layout

Refer to chapter 2.6.2 in this report.

3.8.4.Test Result

Refer to Annex A.8 in this report.

3.9. Restricted Frequency Bands

3.9.1.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).

3.9.2.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

3.9.3.Test Setup Layout

Refer to chapter 2.6.3 in this report.

3.9.4.Test Result

Refer to Annex A.9 in this report.

3.10. Radiated Emission

3.10.1.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).

3.10.2.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.

3.10.3.Test Setup Layout

Refer to chapter 2.6.3 in this report.

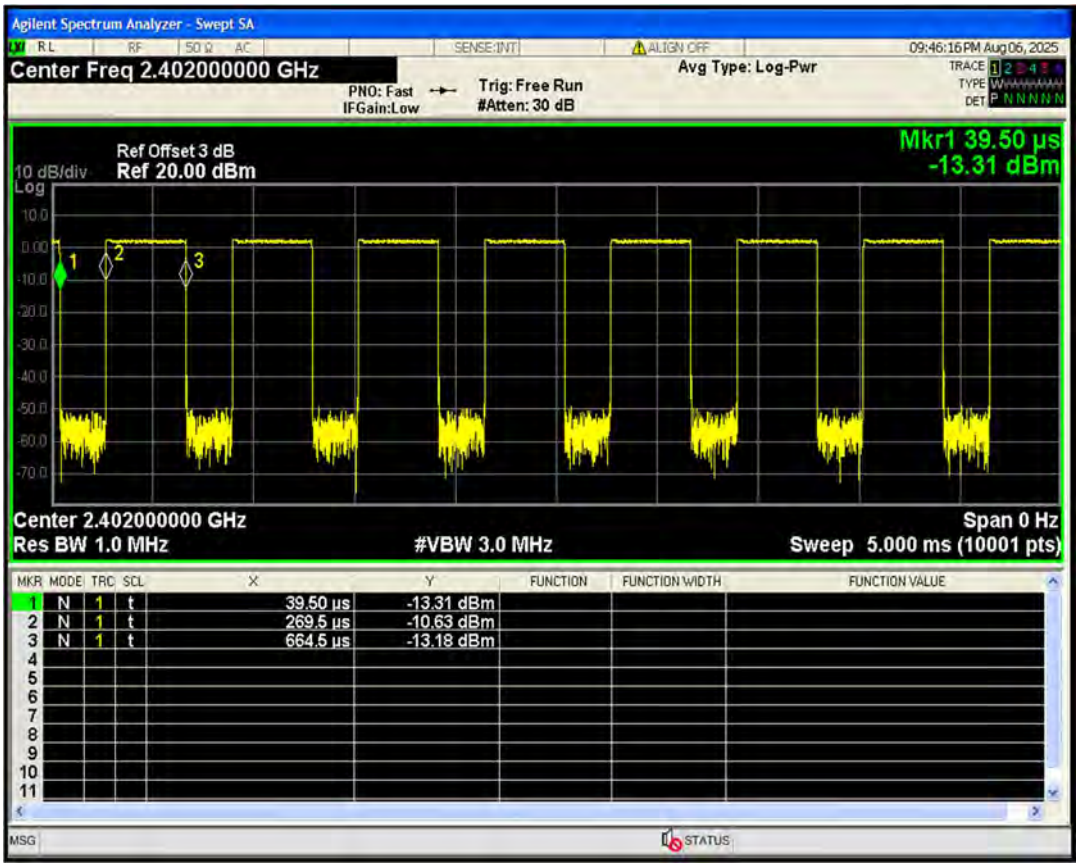
3.10.4.Test Result

Refer to Annex A.10 in this report.

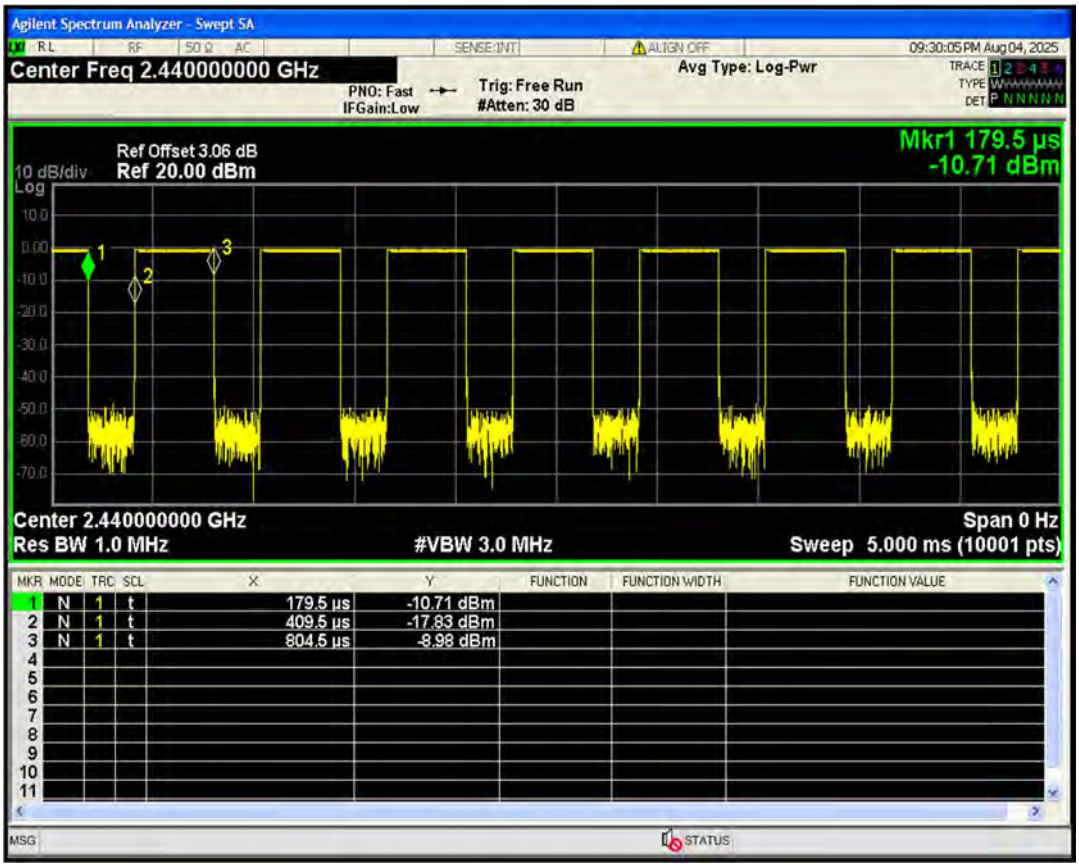
Annex A Test Data and Result

A.1. Duty Cycle of Test Signal

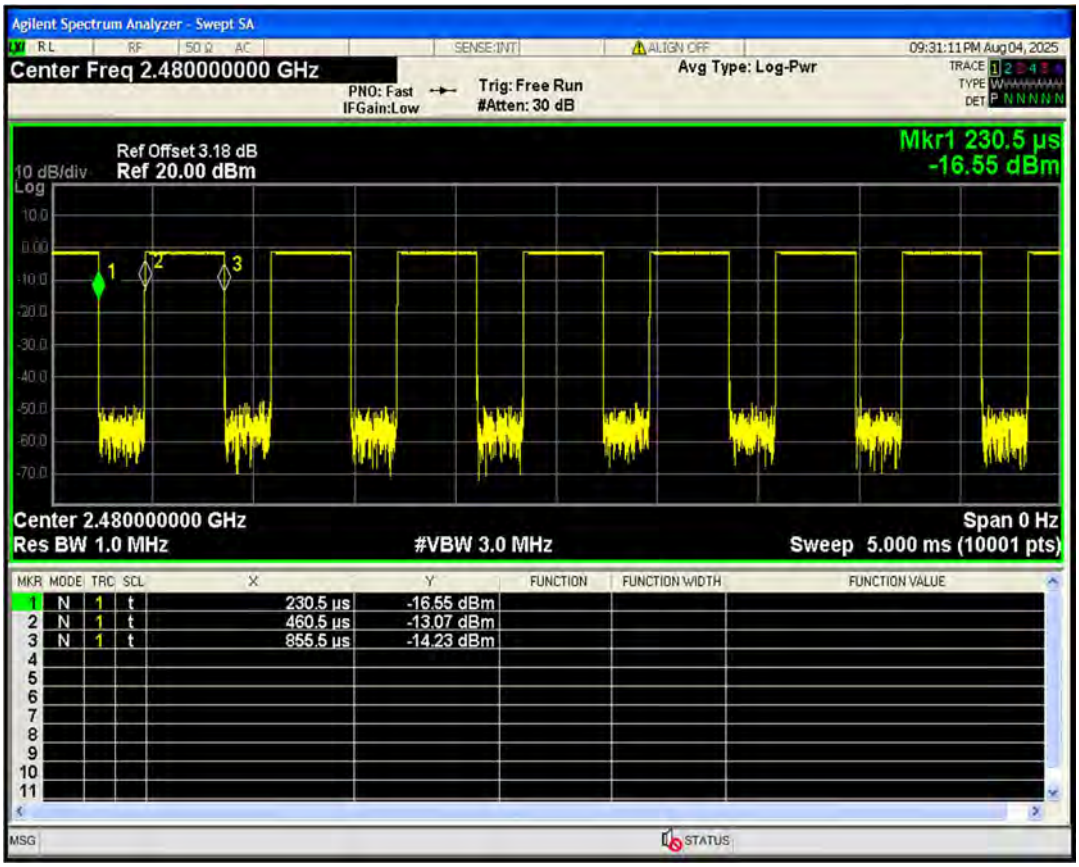
Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	Ant1	63.2	1.99	2.53
NVNT	BLE 1M	2440	Ant1	63.2	1.99	2.53
NVNT	BLE 1M	2480	Ant1	63.2	1.99	2.53
NVNT	BLE 2M	2402	Ant1	33.52	4.75	4.77
NVNT	BLE 2M	2440	Ant1	33.52	4.75	4.77
NVNT	BLE 2M	2480	Ant1	33.52	4.75	4.77



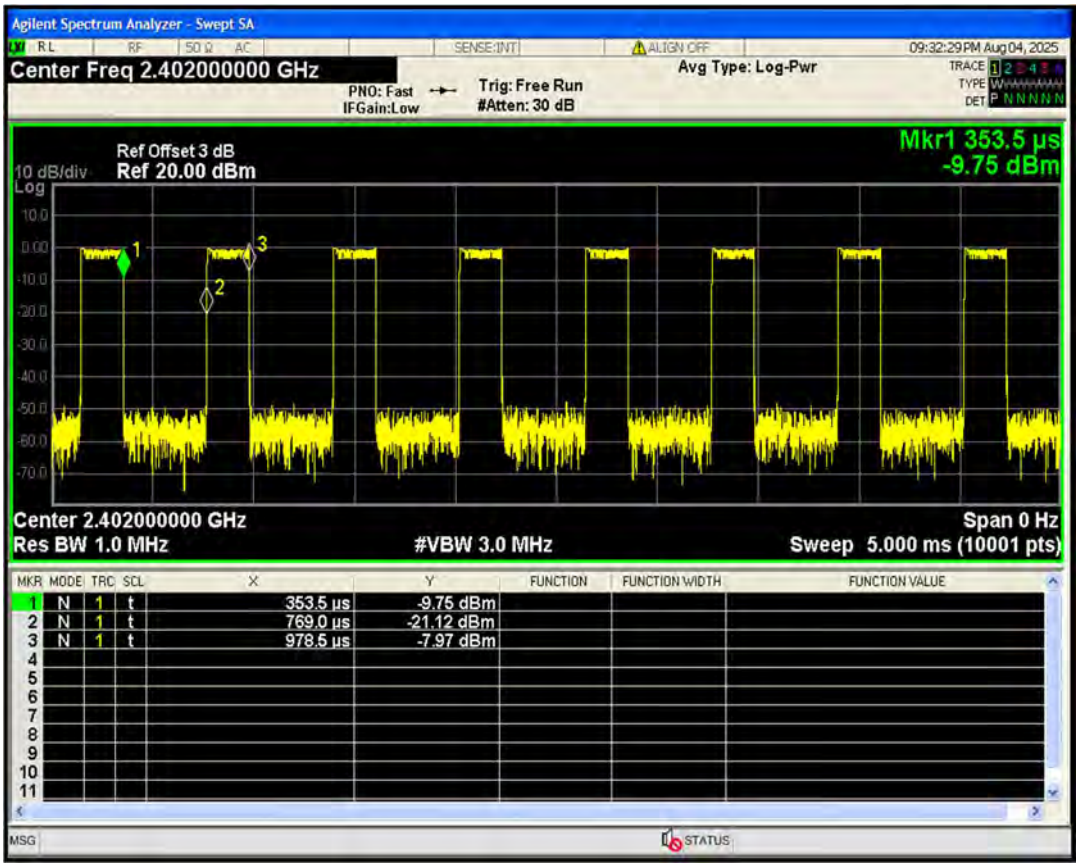
Duty Cycle NVNT BLE 1M 2402MHz Ant1



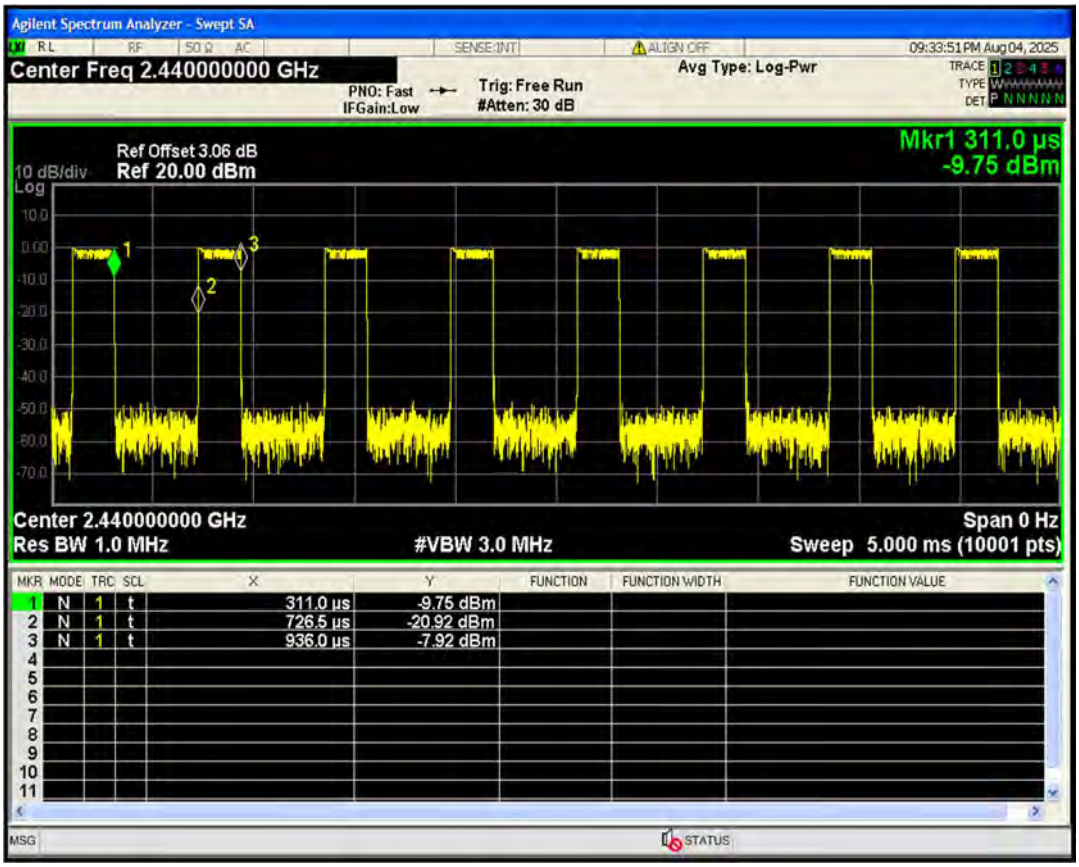
Duty Cycle NVNT BLE 1M 2440MHz Ant1



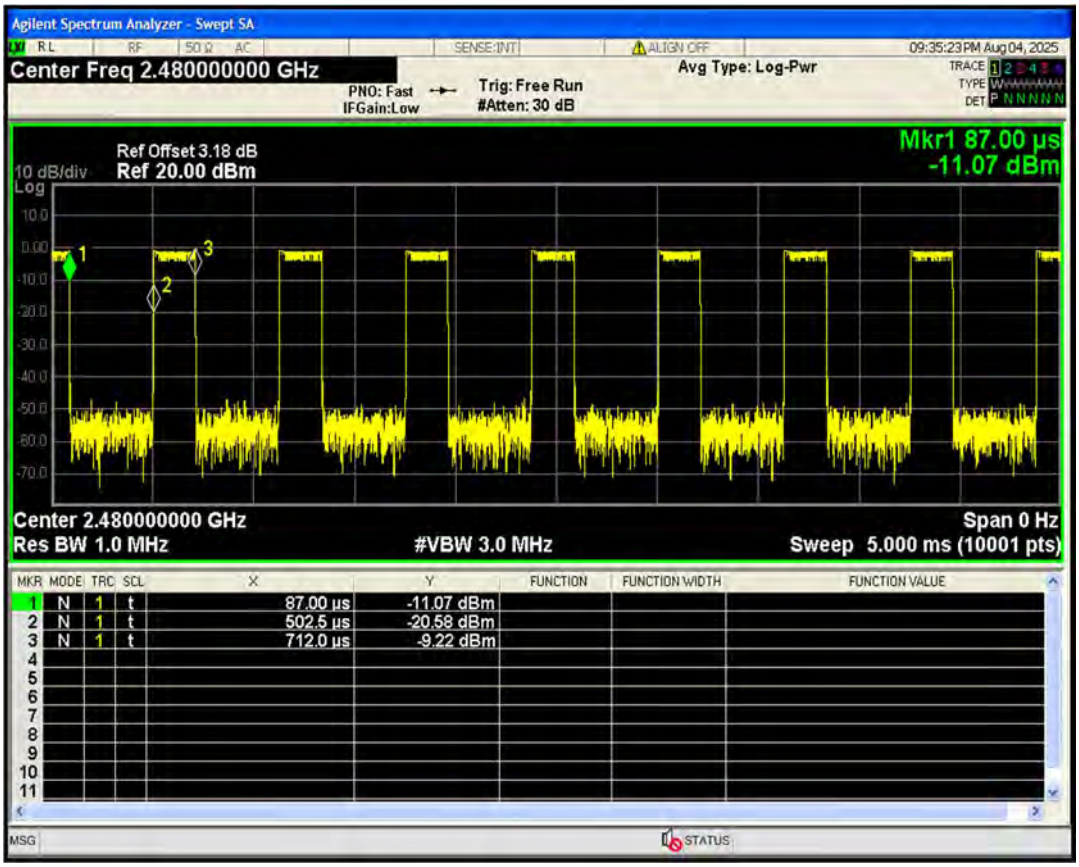
Duty Cycle NVNT BLE 1M 2480MHz Ant1



Duty Cycle NVNT BLE 2M 2402MHz Ant1



Duty Cycle NVNT BLE 2M 2440MHz Ant1



Duty Cycle NVNT BLE 2M 2480MHz Ant1

A.2. 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	BLE 1M	2402	Ant1	6.72	0	6.72	0.0047	30	Pass
NVNT	BLE 1M	2440	Ant1	7.04	0	7.04	0.00506	30	Pass
NVNT	BLE 1M	2480	Ant1	6.85	0	6.85	0.00484	30	Pass
NVNT	BLE 2M	2402	Ant1	7.03	0	7.03	0.00505	30	Pass
NVNT	BLE 2M	2440	Ant1	7.34	0	7.34	0.00542	30	Pass
NVNT	BLE 2M	2480	Ant1	7.13	0	7.13	0.00516	30	Pass

Peak Power NVNT BLE 1M 2402MHz Ant1

Peak Power NVNT BLE 1M 2440MHz Ant1

Peak Power NVNT BLE 1M 2480MHz Ant1

Peak Power NVNT BLE 2M 2402MHz Ant1

Peak Power NVNT BLE 2M 2440MHz Ant1

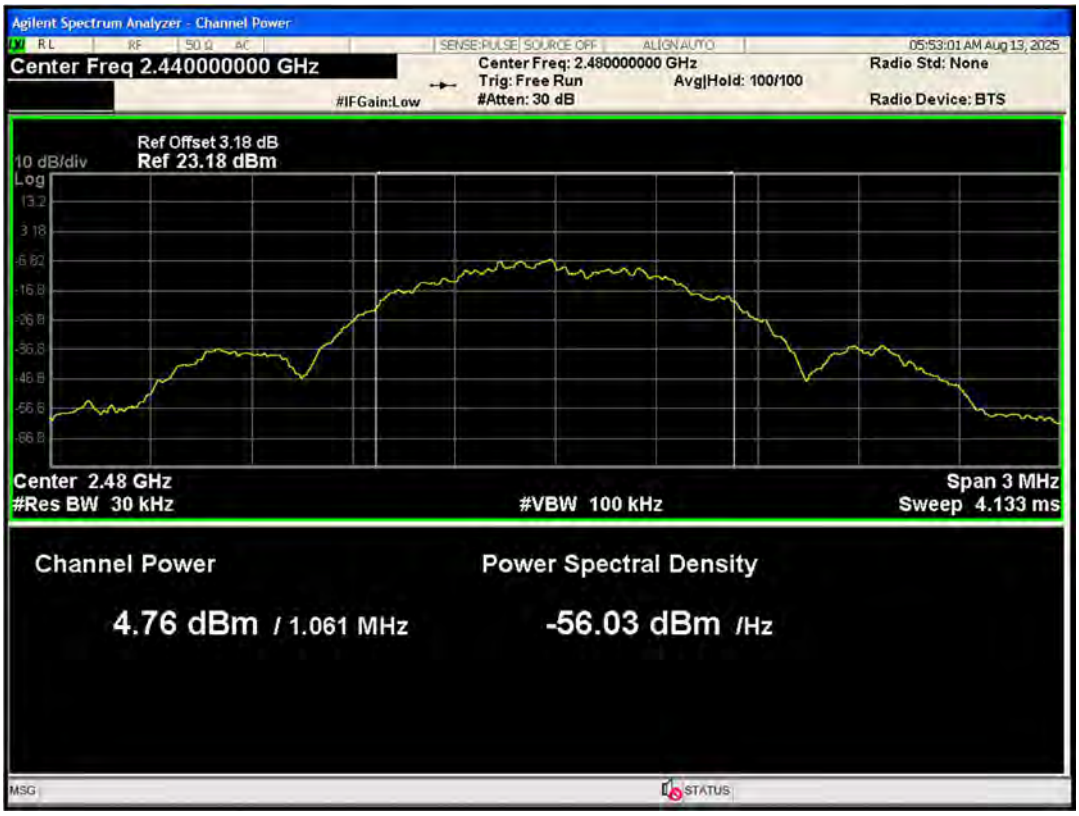
Peak Power NVNT BLE 2M 2480MHz Ant1

A.3. 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	BLE 1M	2402	Ant1	4.53	1.99	6.52	0.00449	30	Pass
NVNT	BLE 1M	2440	Ant1	4.67	1.99	6.66	0.00463	30	Pass
NVNT	BLE 1M	2480	Ant1	4.76	1.99	6.75	0.00473	30	Pass
NVNT	BLE 2M	2402	Ant1	1.94	4.75	6.69	0.00467	30	Pass
NVNT	BLE 2M	2440	Ant1	2.13	4.75	6.88	0.00488	30	Pass
NVNT	BLE 2M	2480	Ant1	2.04	4.75	6.79	0.00478	30	Pass

Average Power NVNT BLE 1M 2402MHz Ant1

Average Power NVNT BLE 1M 2440MHz Ant1



Average Power NVNT BLE 1M 2480MHz Ant1

Average Power NVNT BLE 2M 2402MHz Ant1

Average Power NVNT BLE 2M 2440MHz Ant1

Average Power NVNT BLE 2M 2480MHz Ant1

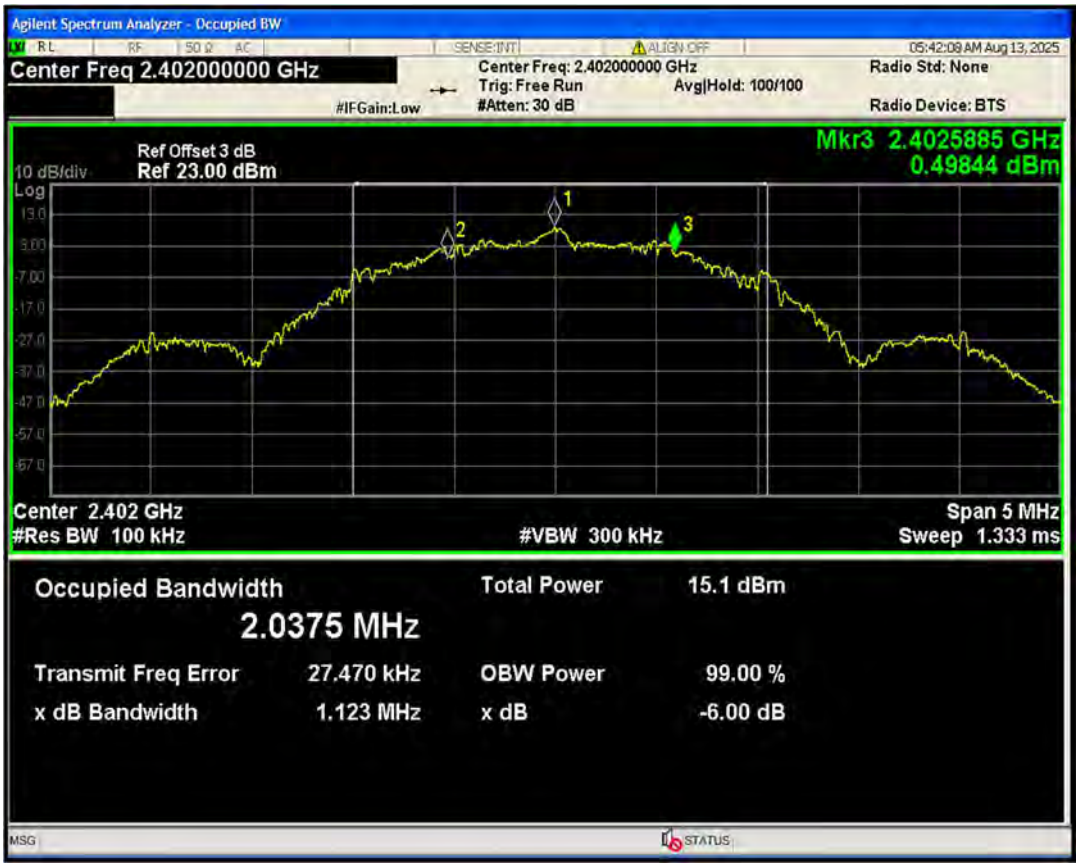
A.4. 6 dB Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE 1M	2402	Ant1	0.6412	0.5	Pass
NVNT	BLE 1M	2440	Ant1	0.6433	0.5	Pass
NVNT	BLE 1M	2480	Ant1	0.6913	0.5	Pass
NVNT	BLE 2M	2402	Ant1	1.123	0.5	Pass
NVNT	BLE 2M	2440	Ant1	0.956	0.5	Pass
NVNT	BLE 2M	2480	Ant1	1.119	0.5	Pass

-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1

-6dB Bandwidth NVNT BLE 1M 2440MHz Ant1

-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1



-6dB Bandwidth NVNT BLE 2M 2402MHz Ant1

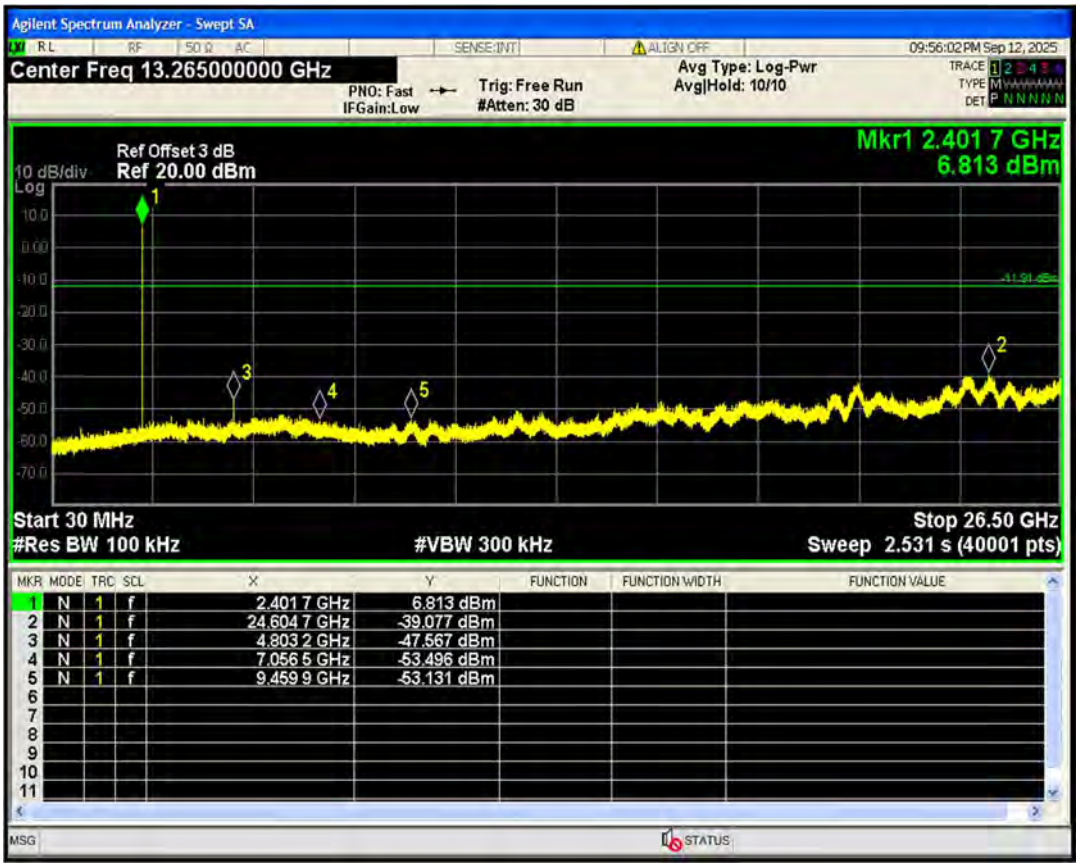
-6dB Bandwidth NVNT BLE 2M 2440MHz Ant1

-6dB Bandwidth NVNT BLE 2M 2480MHz Ant1

A.5. Conducted Spurious Emissions

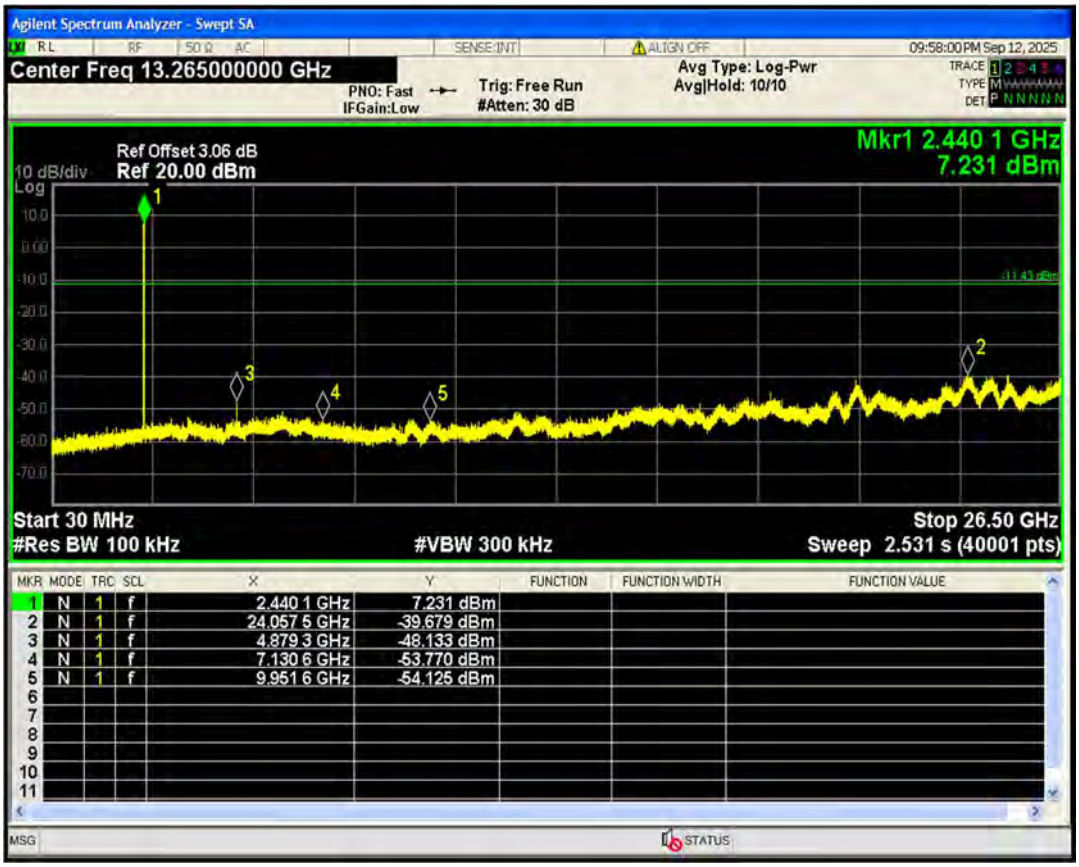
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-47.16	-20	Pass
NVNT	BLE 1M	2440	Ant1	-48.24	-20	Pass
NVNT	BLE 1M	2480	Ant1	-46.58	-20	Pass
NVNT	BLE 2M	2402	Ant1	-47.53	-20	Pass
NVNT	BLE 2M	2440	Ant1	-47.76	-20	Pass
NVNT	BLE 2M	2480	Ant1	-46.95	-20	Pass

Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref



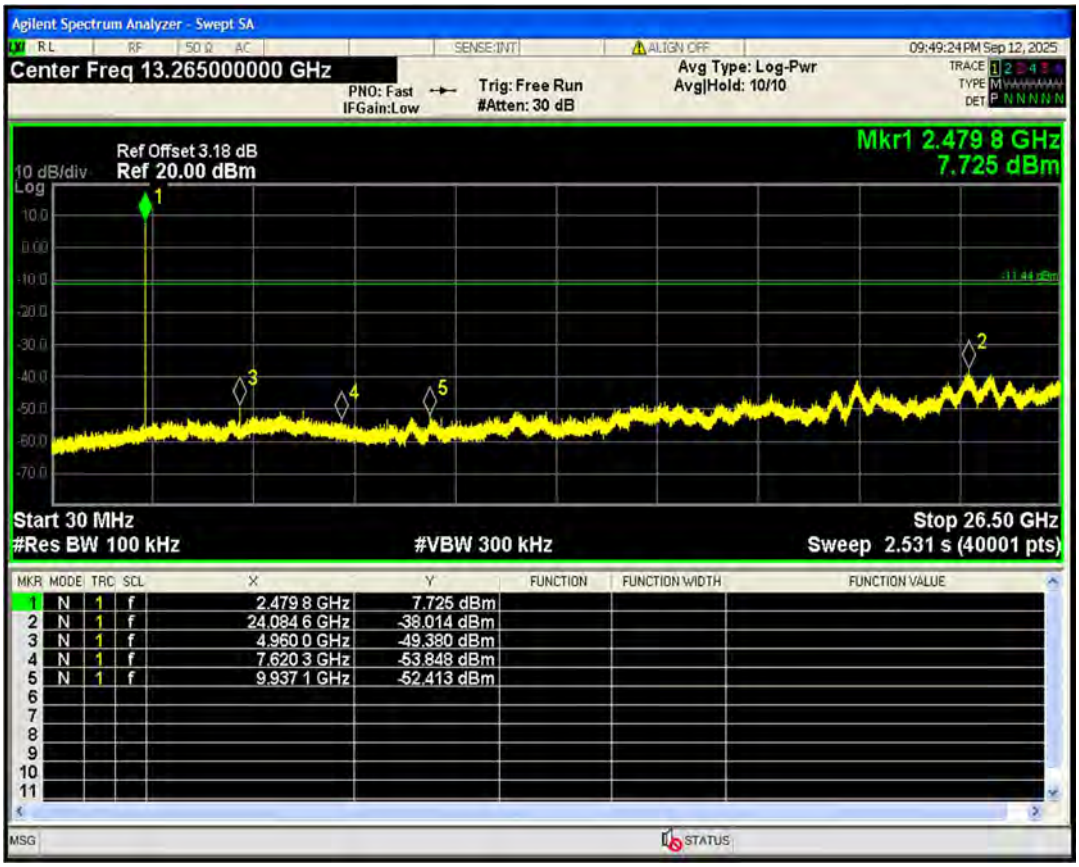
Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission

Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Ref



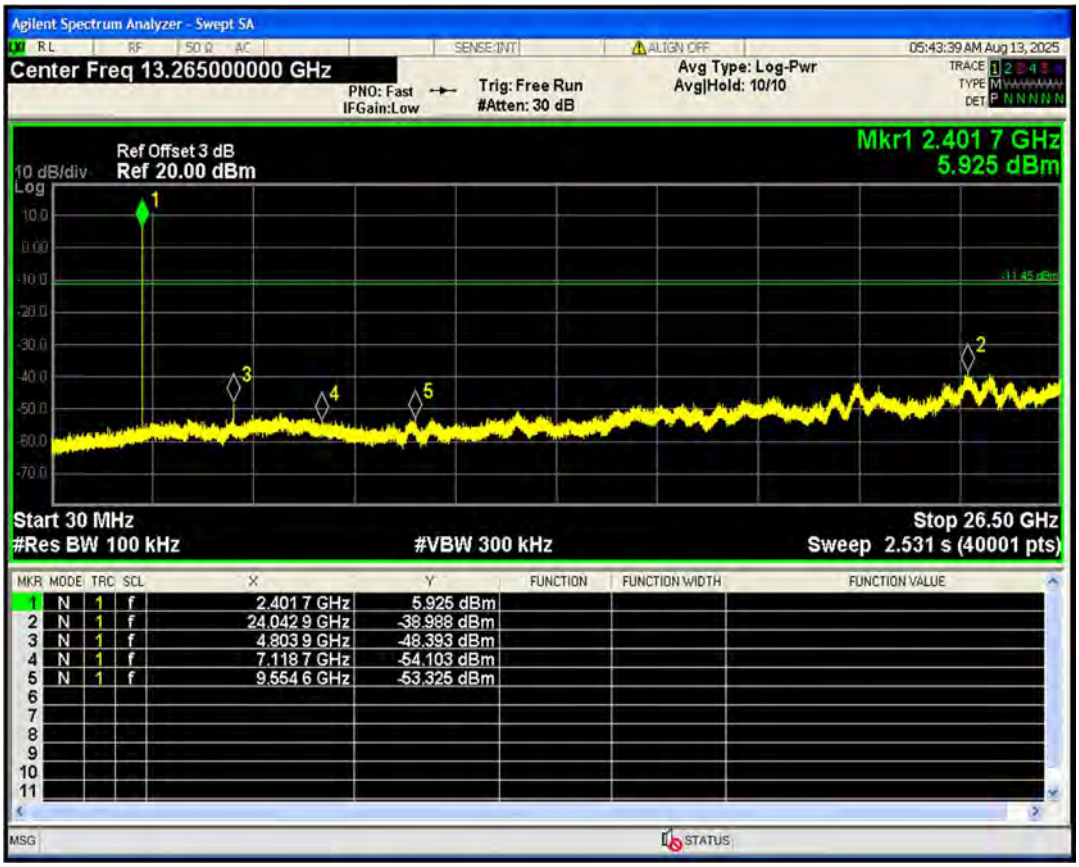
Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Emission

Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Ref



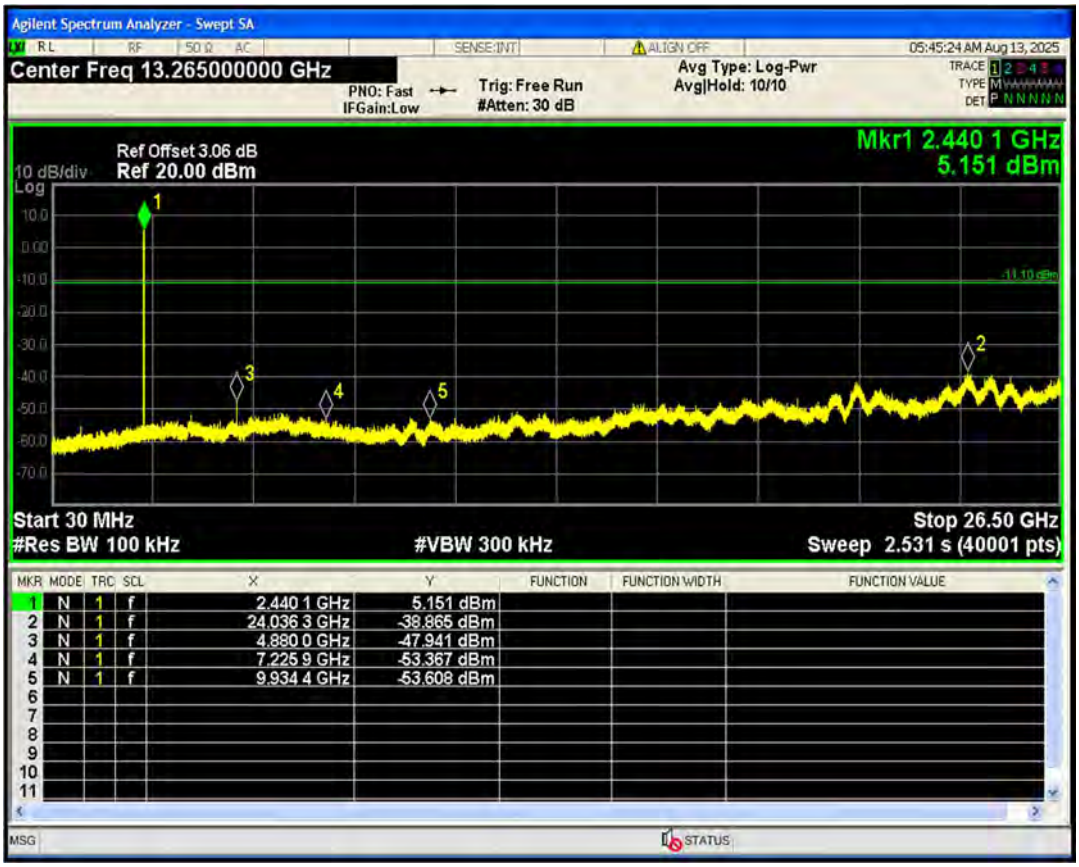
Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Emission

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Ref



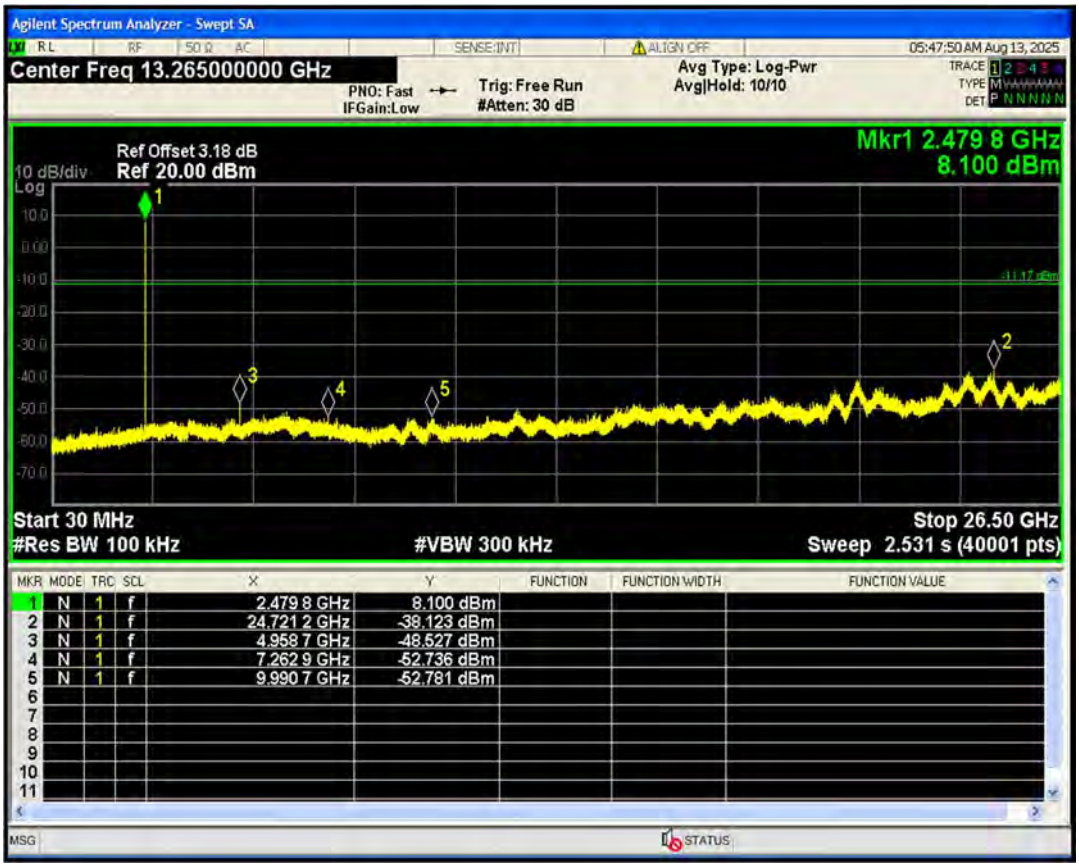
Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Emission

Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Ref



Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Emission

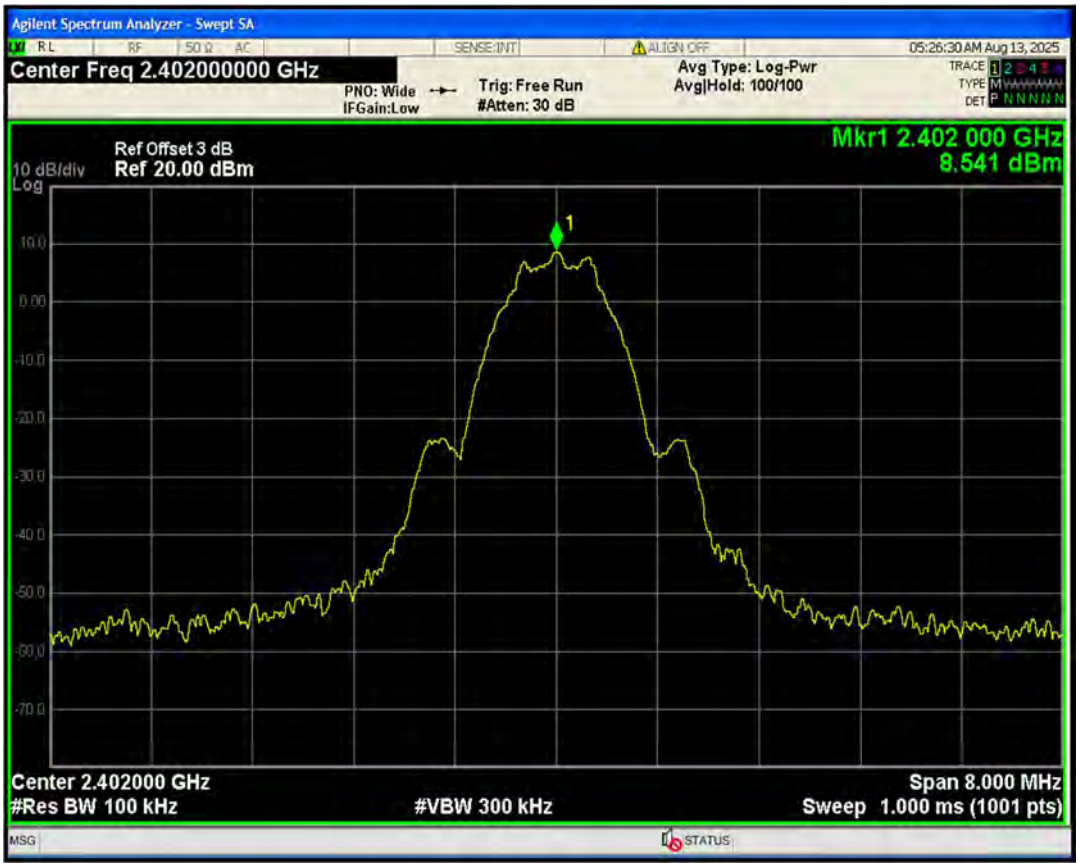
Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Ref



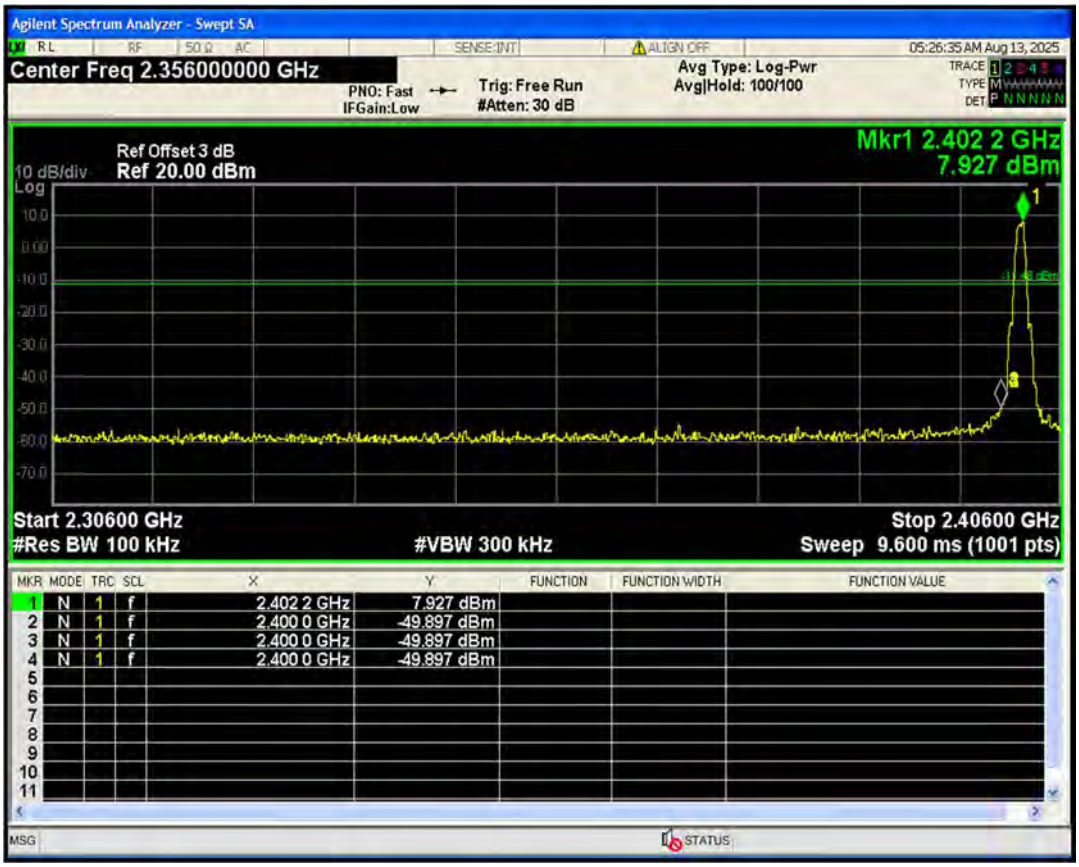
Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Emission

A.6. Band Edge

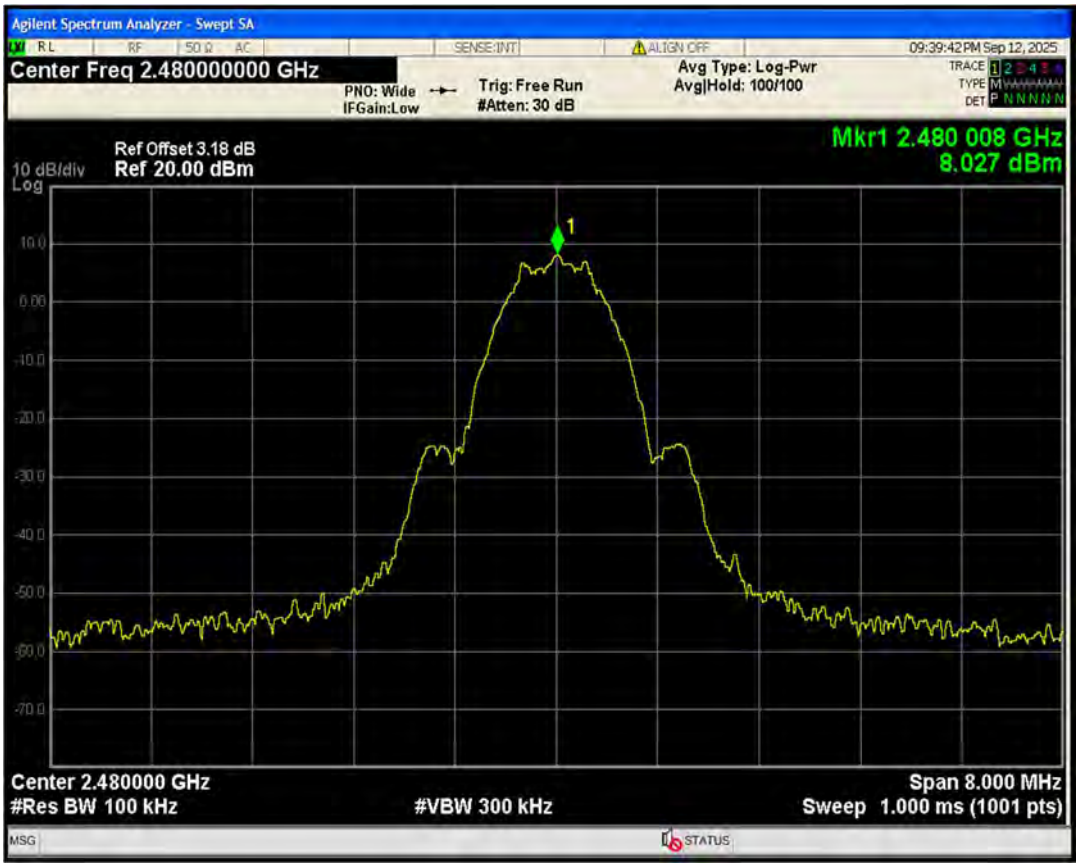
Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-58.43	-20	Pass
NVNT	BLE 1M	2480	Ant1	-62.68	-20	Pass
NVNT	BLE 2M	2402	Ant1	-32.54	-20	Pass
NVNT	BLE 2M	2480	Ant1	-60.7	-20	Pass



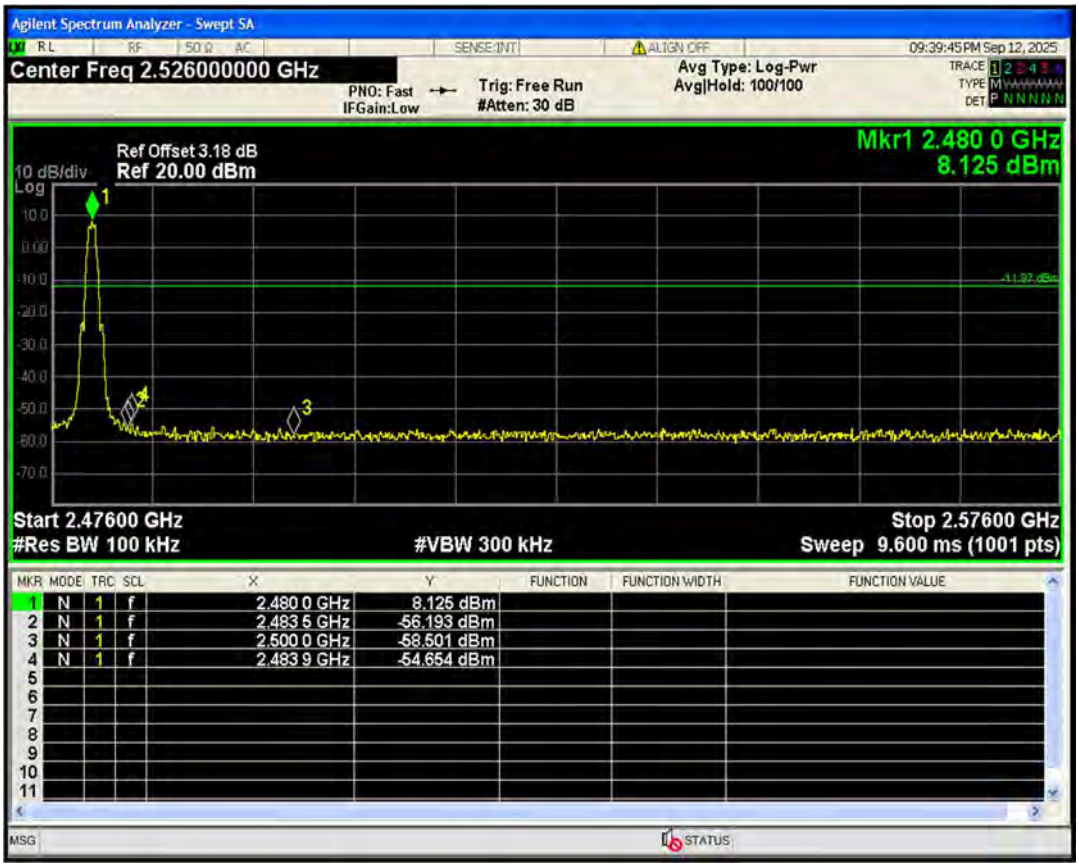
Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



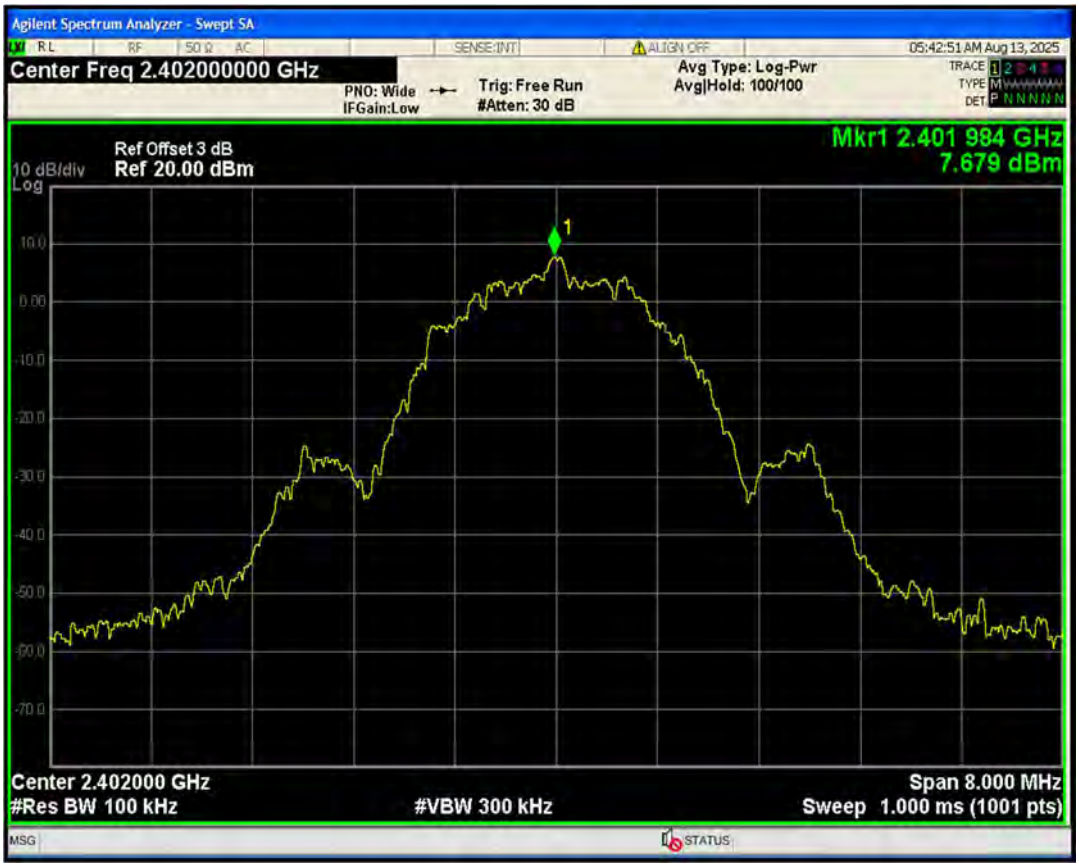
Band Edge NVNT BLE 1M 2402MHz Ant1 Emission



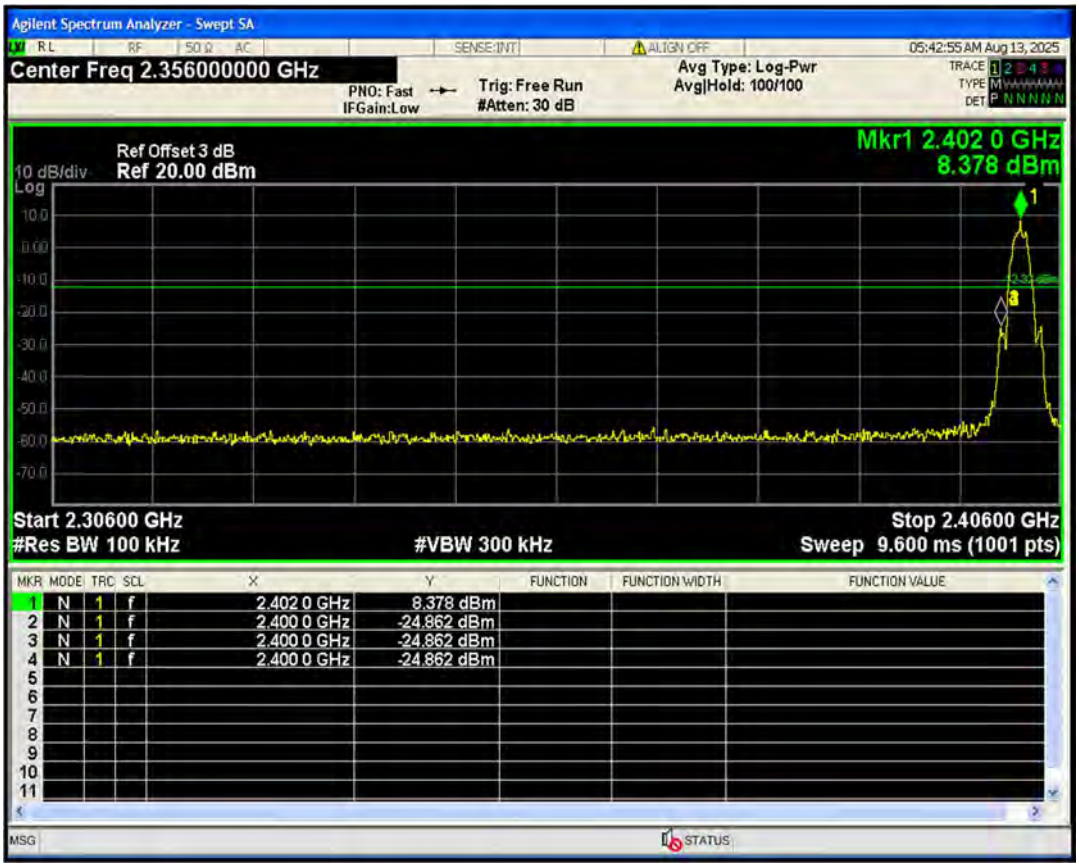
Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



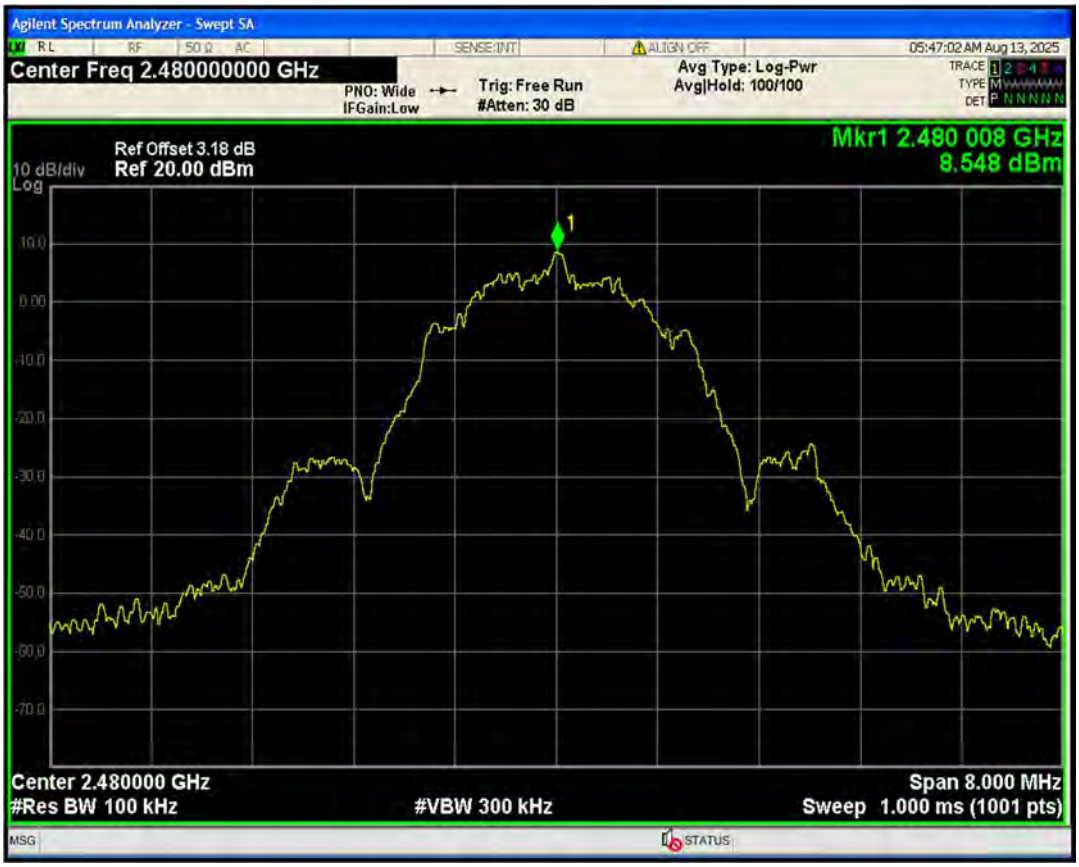
Band Edge NVNT BLE 1M 2480MHz Ant1 Emission



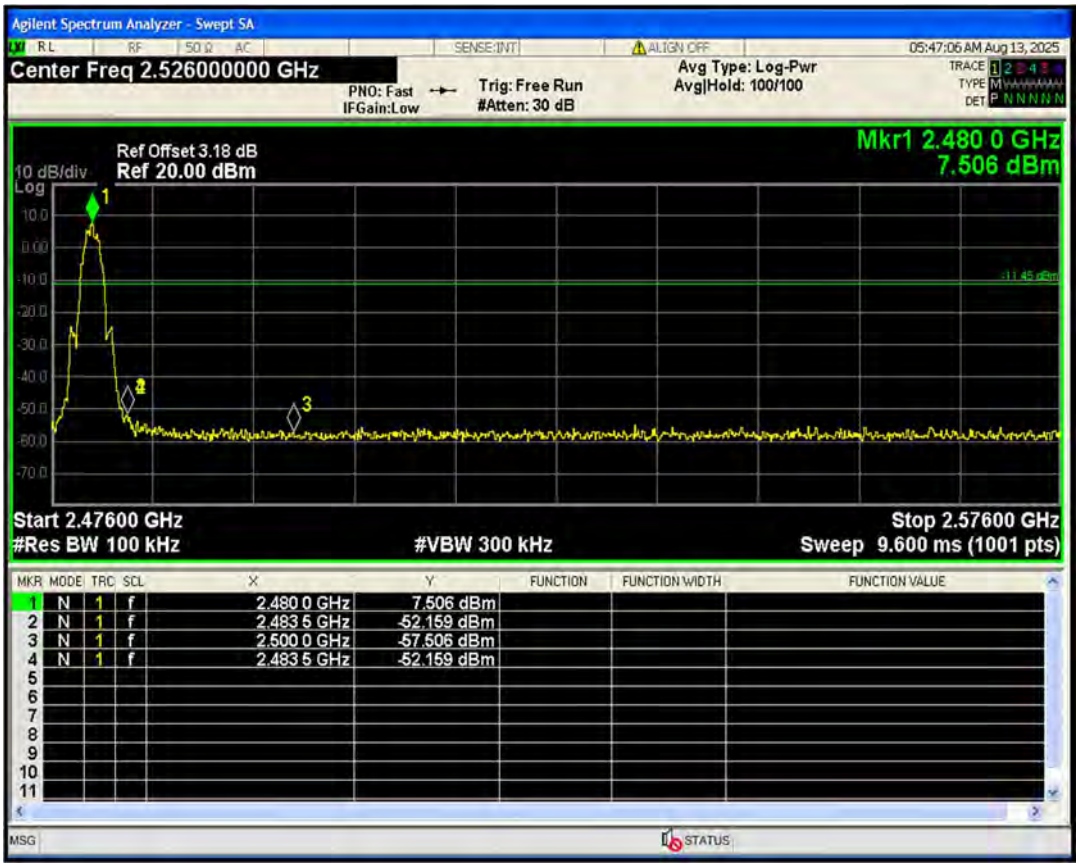
Band Edge NVNT BLE 2M 2402MHz Ant1 Ref



Band Edge NVNT BLE 2M 2402MHz Ant1 Emission



Band Edge NVNT BLE 2M 2480MHz Ant1 Ref

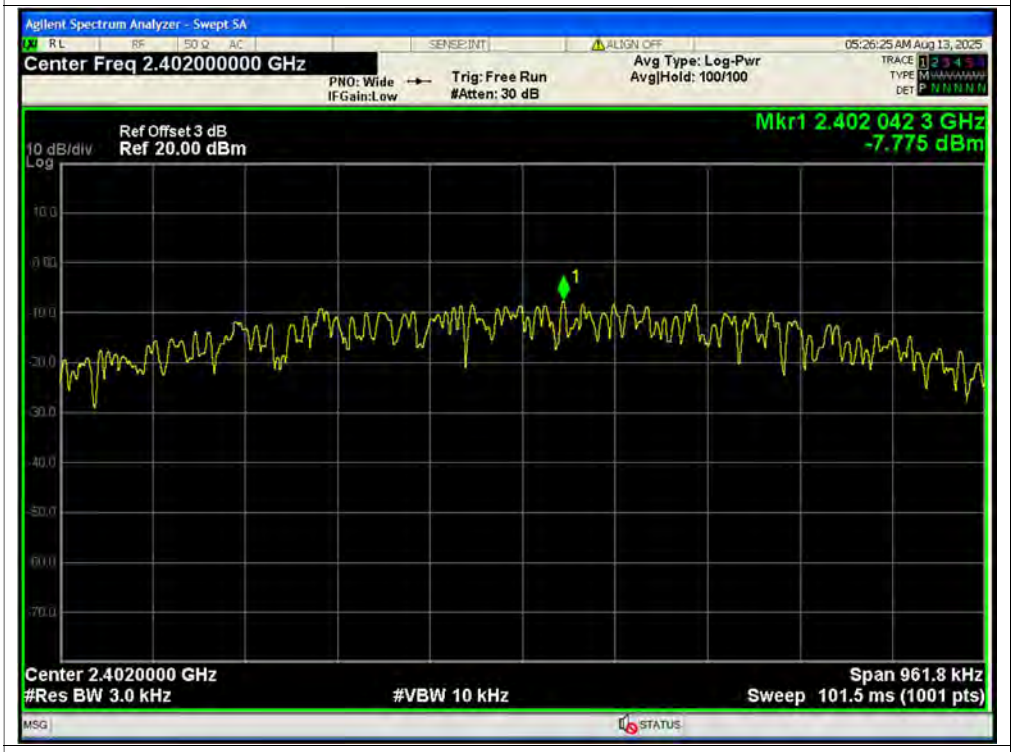


Band Edge NVNT BLE 2M 2480MHz Ant1 Emission

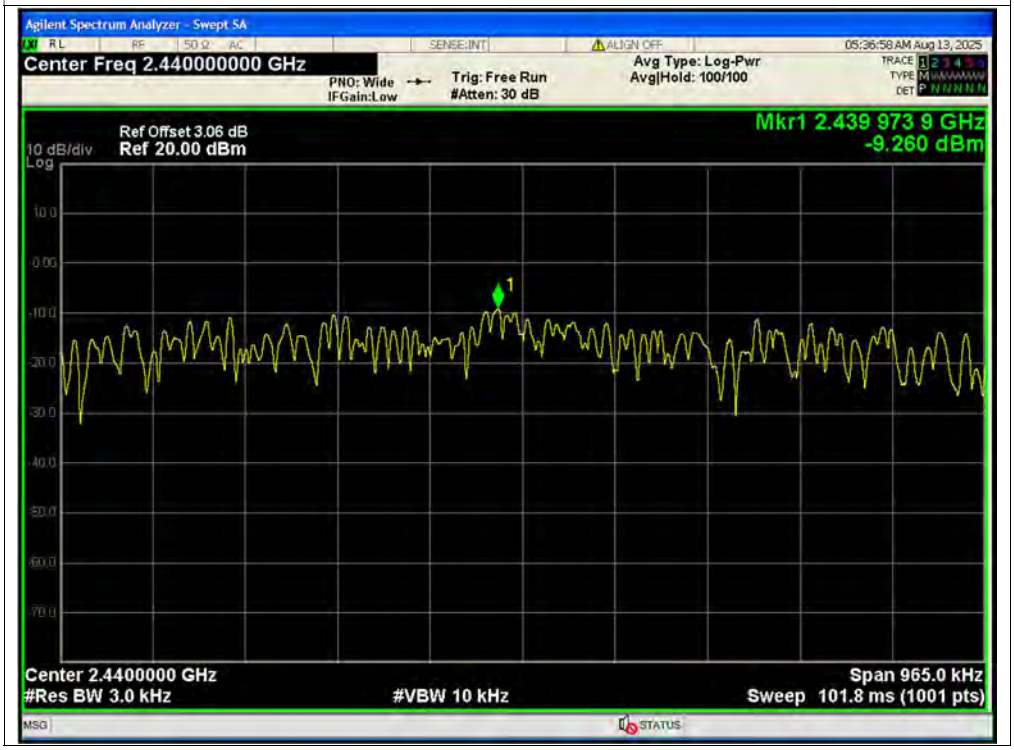
A.7. Power Spectral Density

Condition	Mode	Frequency (MHz)	Antenna	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE 1M	2402	Ant1	-7.78	0	-7.78	8	Pass
NVNT	BLE 1M	2440	Ant1	-9.26	0	-9.26	8	Pass
NVNT	BLE 1M	2480	Ant1	-9.12	0	-9.12	8	Pass
NVNT	BLE 2M	2402	Ant1	-9	0	-9	8	Pass
NVNT	BLE 2M	2440	Ant1	-17.73	0	-17.73	8	Pass
NVNT	BLE 2M	2480	Ant1	-8.08	0	-8.08	8	Pass

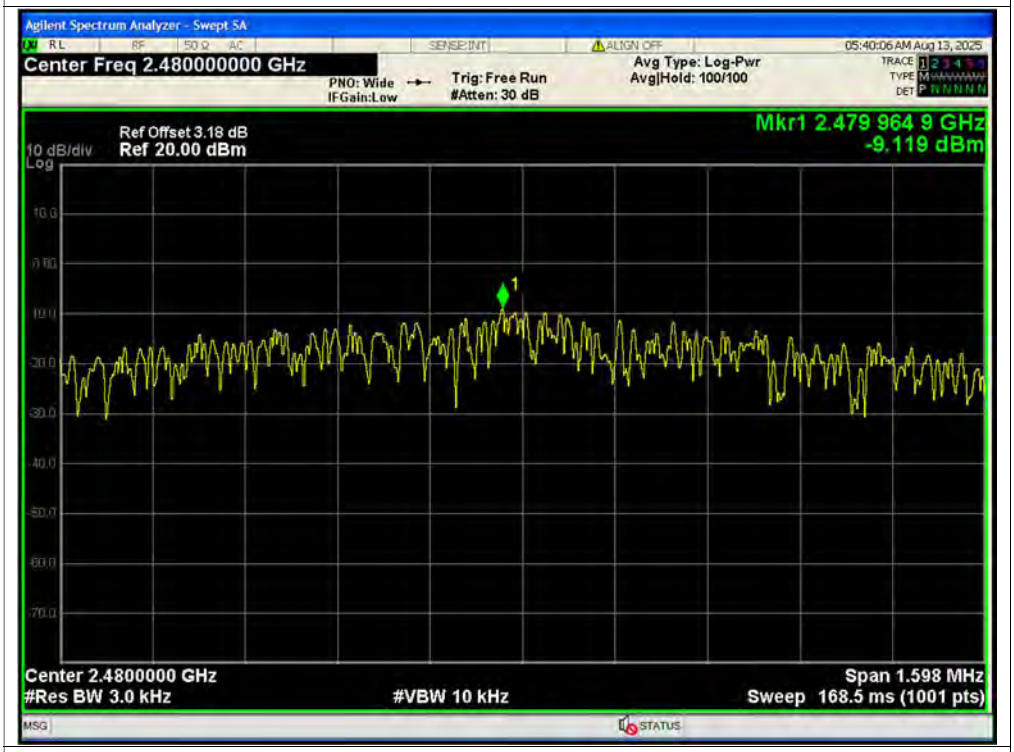
Test Graphs
PSD NVNT BLE 1M 2402MHz Ant1



PSD NVNT BLE 1M 2440MHz Ant1

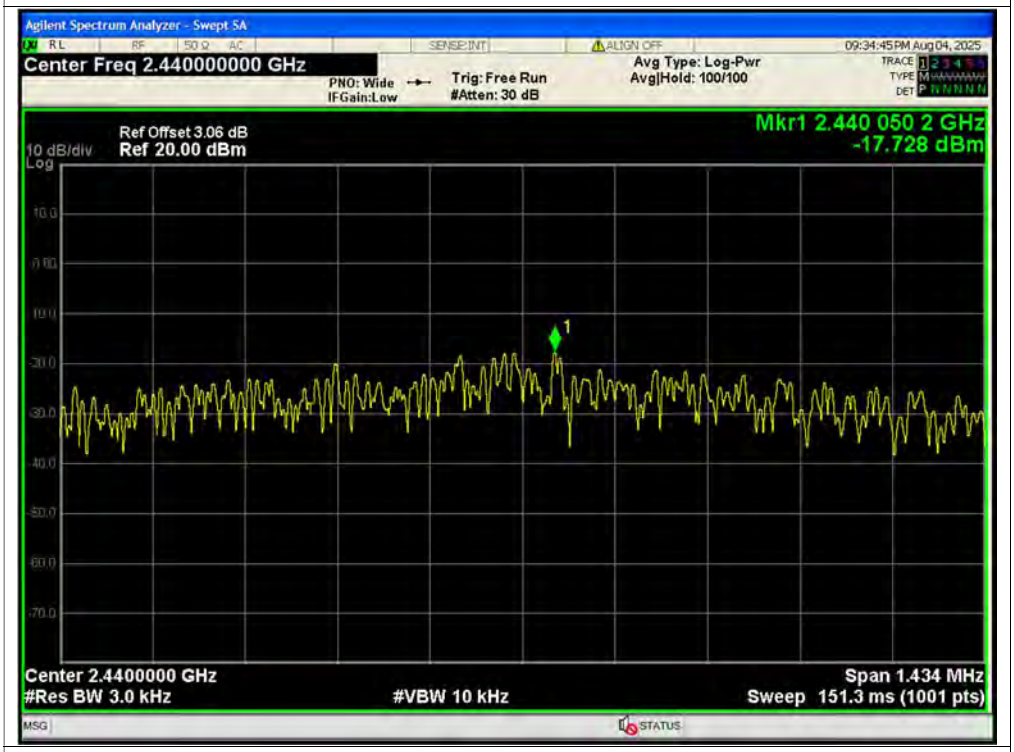


PSD NVNT BLE 1M 2480MHz Ant1

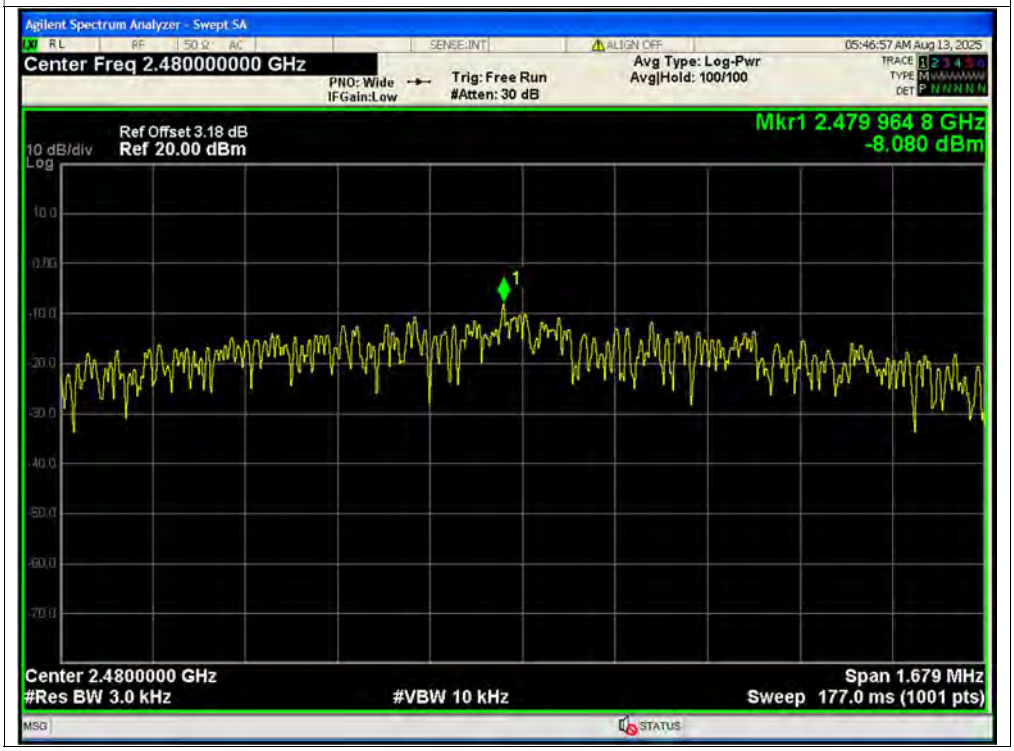


PSD NVNT BLE 2M 2402MHz Ant1

PSD NVNT BLE 2M 2440MHz Ant1



PSD NVNT BLE 2M 2480MHz Ant1



A.8. 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+Data cable+Mobile phone+BLE TX

Test voltage: AC 120V/60Hz

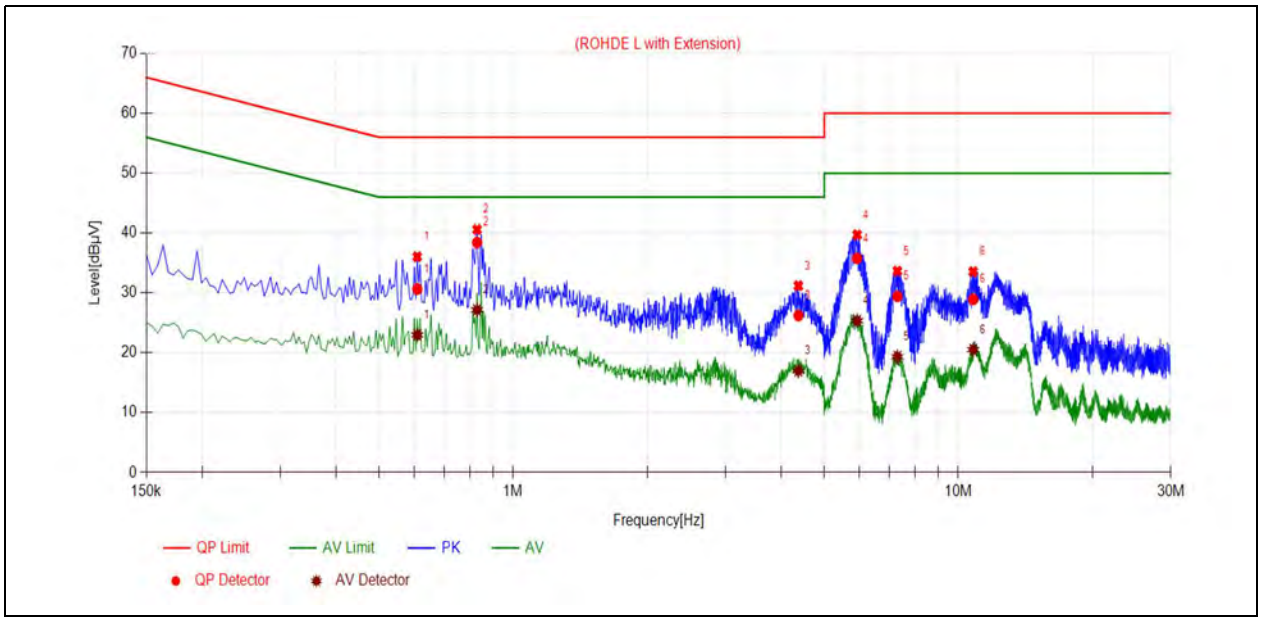
The measurement results are obtained as below:

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

U_R: Receiver Reading

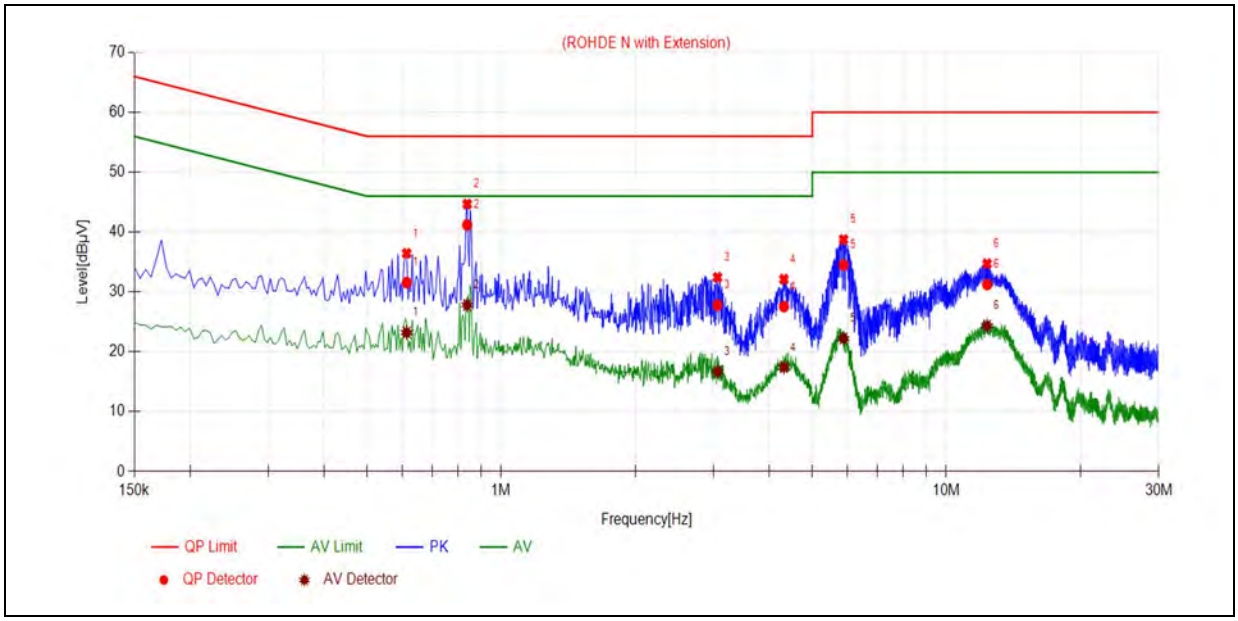
A_{Factor}: Voltage division factor of LISN

B. Test Plot:



(L Phase)

No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.6090	30.66	22.99	56.00	46.00	Line	PASS
2	0.8295	38.43	27.17	56.00	46.00		PASS
3	4.3708	26.23	17.01	56.00	46.00		PASS
4	5.9237	35.79	25.37	60.00	50.00		PASS
5	7.2959	29.43	19.36	60.00	50.00		PASS
6	10.7966	28.93	20.53	60.00	50.00		PASS



(N Phase)

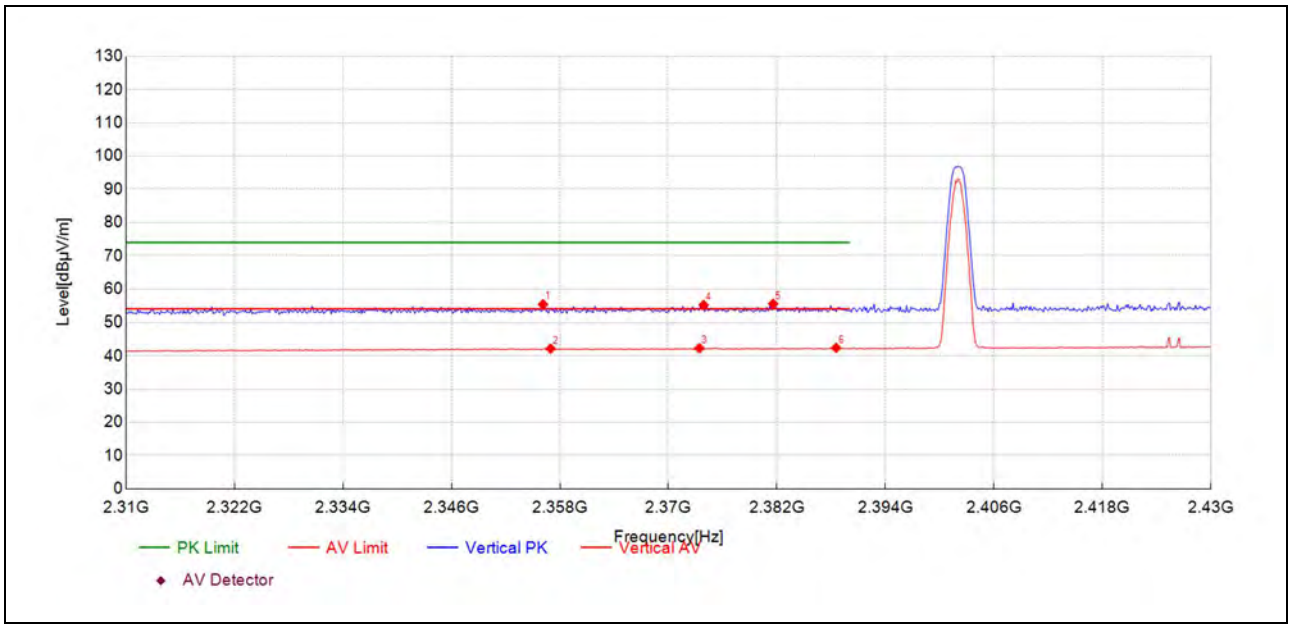
No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.6135	31.58	23.23	56.00	46.00	Neutral	PASS
2	0.8384	41.21	27.85	56.00	46.00		PASS
3	3.0614	27.81	16.71	56.00	46.00		PASS
4	4.3171	27.57	17.43	56.00	46.00		PASS
5	5.8741	34.52	22.24	60.00	50.00		PASS
6	12.3449	31.26	24.36	60.00	50.00		PASS

A.9. Restricted Frequency Bands

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.

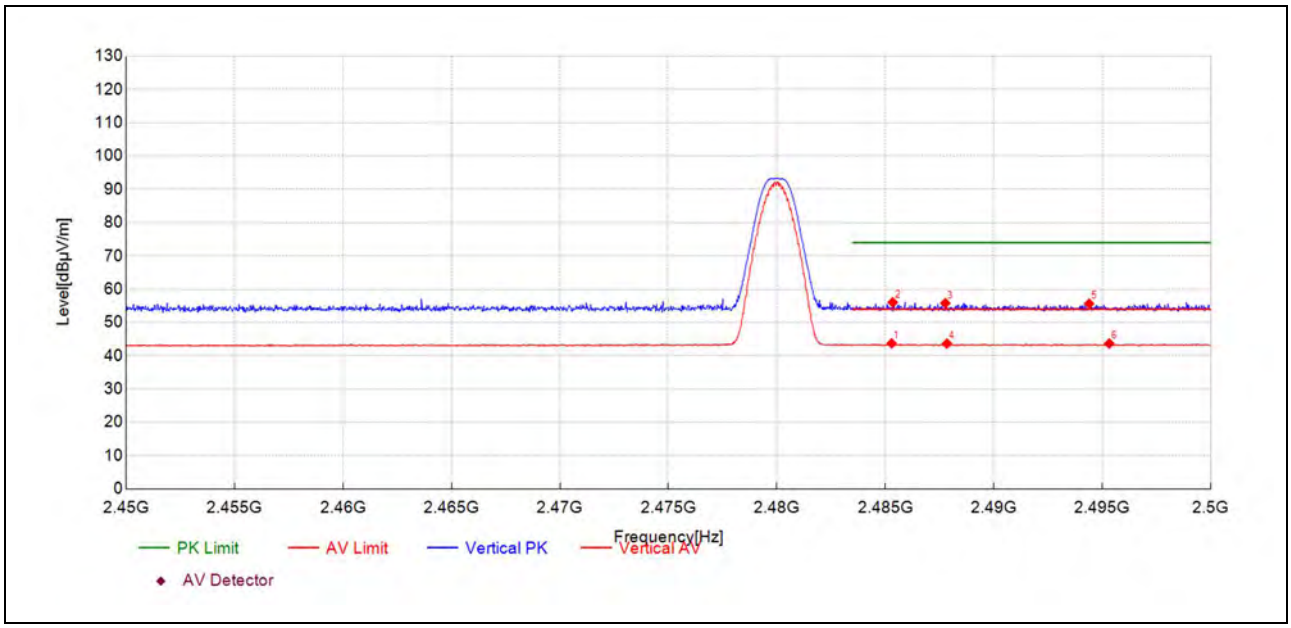
1Mbps

Plot for Channel 0



Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Angle [°]	Detector	Polarity	Verdict
2356.13	22.9	55.35	32.420	74.00	18.65	0	PK	Vertical	PASS
2356.97	9.8	42.20	32.420	54.00	11.80	349	AV	Vertical	PASS
2373.42	9.9	42.34	32.490	54.00	11.66	6	AV	Vertical	PASS
2373.90	22.7	55.14	32.490	74.00	18.86	338	PK	Vertical	PASS
2381.59	23.0	55.50	32.510	74.00	18.50	201	PK	Vertical	PASS
2388.56	9.9	42.45	32.540	54.00	11.55	122	AV	Vertical	PASS

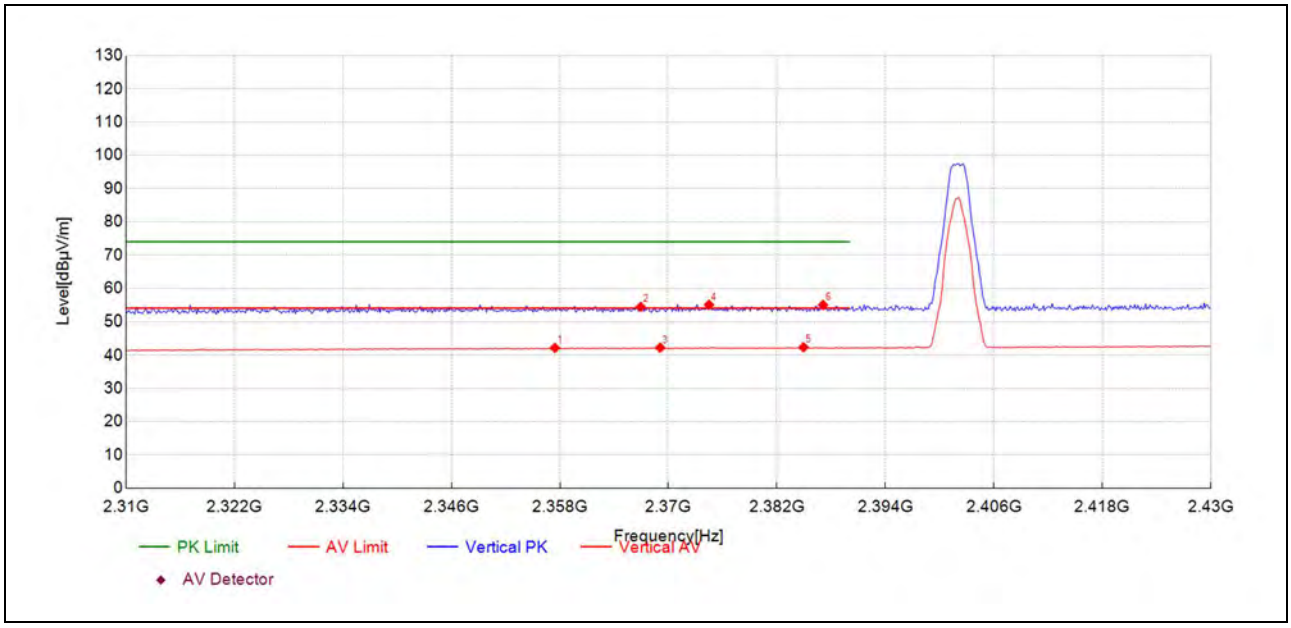
Plot for Channel 39



Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Angle [°]	Detector	Polarity	Verdict
2485.29	10.7	43.74	33.030	54.00	10.26	0	AV	Vertical	PASS
2485.34	23.0	56.04	33.030	74.00	17.96	90	PK	Vertical	PASS
2487.77	22.8	55.80	33.020	74.00	18.20	0	PK	Vertical	PASS
2487.84	10.6	43.65	33.020	54.00	10.35	297	AV	Vertical	PASS
2494.40	22.6	55.64	33.010	74.00	18.36	214	PK	Vertical	PASS
2495.32	10.7	43.68	33.010	54.00	10.32	59	AV	Vertical	PASS

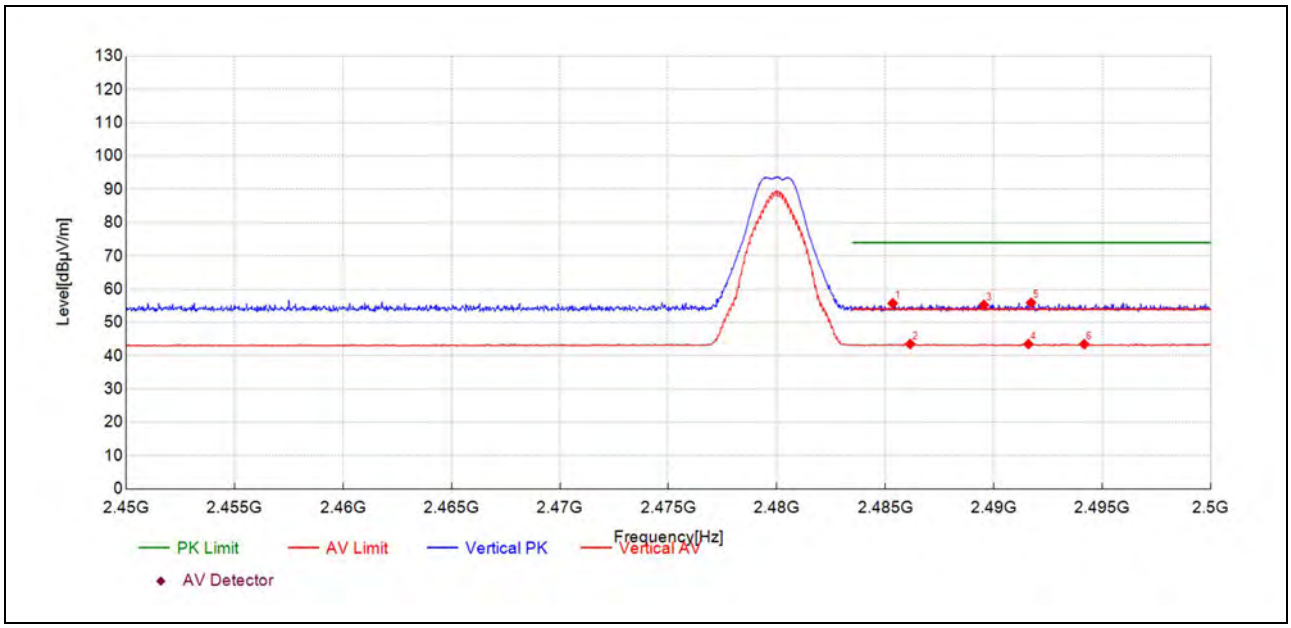
2Mbps

Plot for Channel 0



Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Angle [°]	Detector	Polarity	Verdict
2357.45	9.8	42.19	32.420	54.00	11.81	166	AV	Vertical	PASS
2366.94	21.9	54.37	32.460	74.00	19.63	359	PK	Vertical	PASS
2369.10	9.8	42.27	32.470	54.00	11.73	330	AV	Vertical	PASS
2374.50	22.5	55.00	32.490	74.00	19.00	360	PK	Vertical	PASS
2384.95	9.9	42.40	32.530	54.00	11.60	320	AV	Vertical	PASS
2387.12	22.4	54.96	32.530	74.00	19.04	214	PK	Vertical	PASS

Plot for Channel 39



Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Angle [°]	Detector	Polarity	Verdict
2485.34	22.7	55.75	33.030	74.00	18.25	92	PK	Vertical	PASS
2486.14	10.5	43.52	33.030	54.00	10.48	246	AV	Vertical	PASS
2489.54	22.3	55.28	33.020	74.00	18.72	102	PK	Vertical	PASS
2491.60	10.5	43.53	33.020	54.00	10.47	144	AV	Vertical	PASS
2491.72	22.9	55.93	33.020	74.00	18.07	246	PK	Vertical	PASS
2494.17	10.5	43.49	33.010	54.00	10.51	153	AV	Vertical	PASS

A.10. 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.

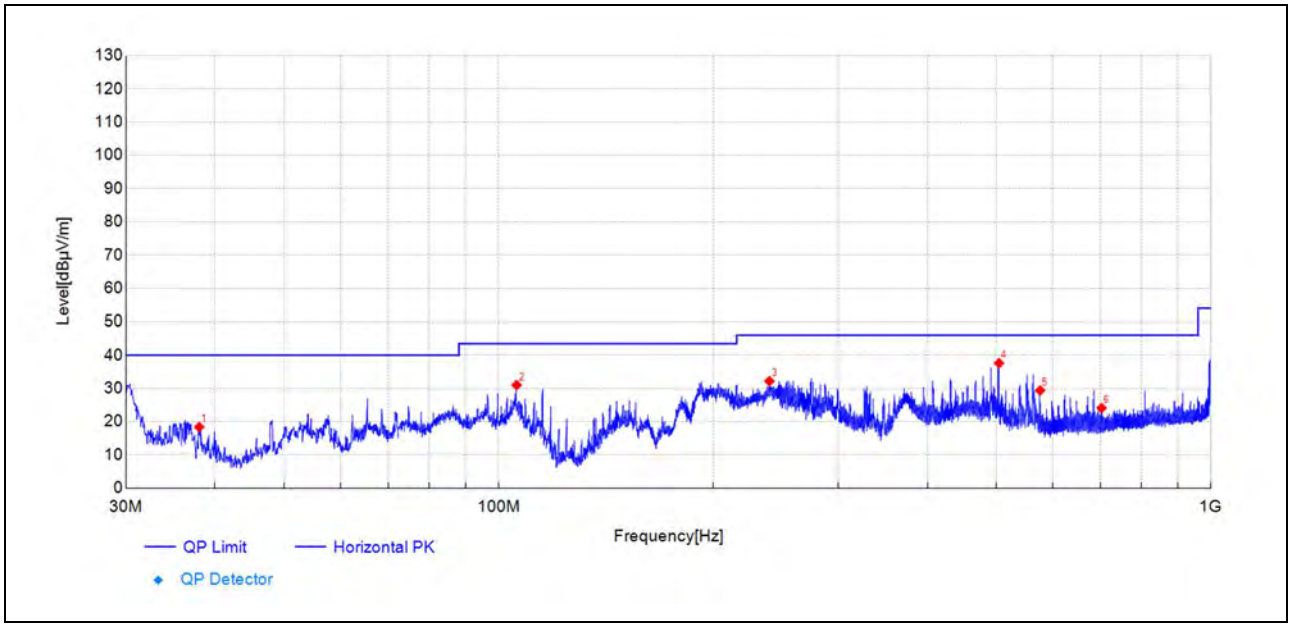
Note2: For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

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.

Note 4: All test modes were considered and evaluated respectively by performing full test, only the worst data were recorded.

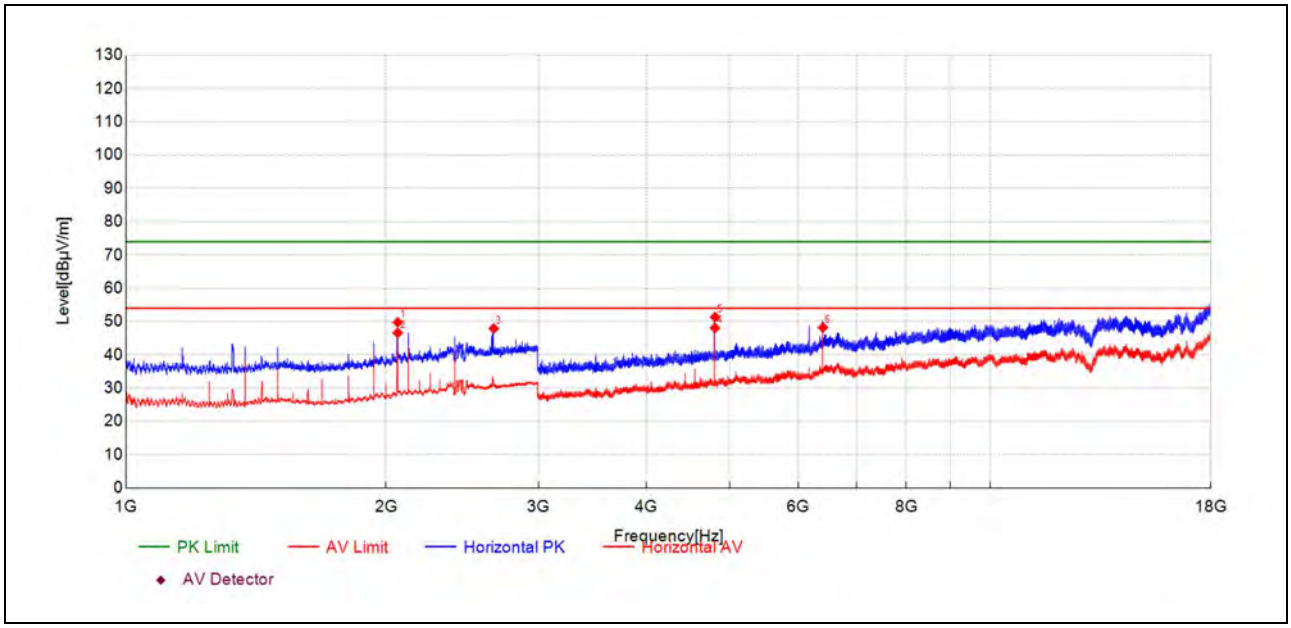
1Mbps

Plot for Channel 0



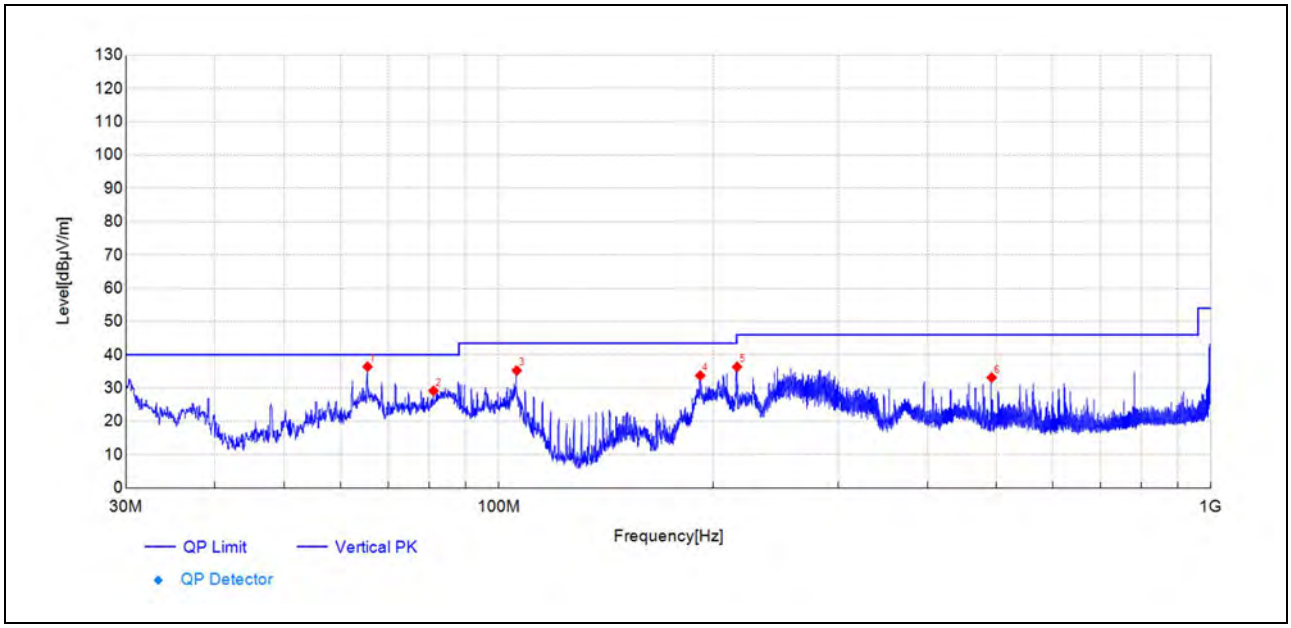
(Antenna Horizontal, 30MHz to 1GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
38.00	48.1	18.38	-29.730	40.00	21.62	150	9	Horizontal	PASS
106.05	61.4	31.02	-30.420	43.50	12.48	150	63	Horizontal	PASS
240.16	60.6	32.19	-28.410	46.00	13.81	150	360	Horizontal	PASS
504.45	59.2	37.60	-21.550	46.00	8.40	150	49	Horizontal	PASS
576.14	49.9	29.39	-20.520	46.00	16.61	150	23	Horizontal	PASS
702.73	42.4	24.11	-18.270	46.00	21.89	150	103	Horizontal	PASS



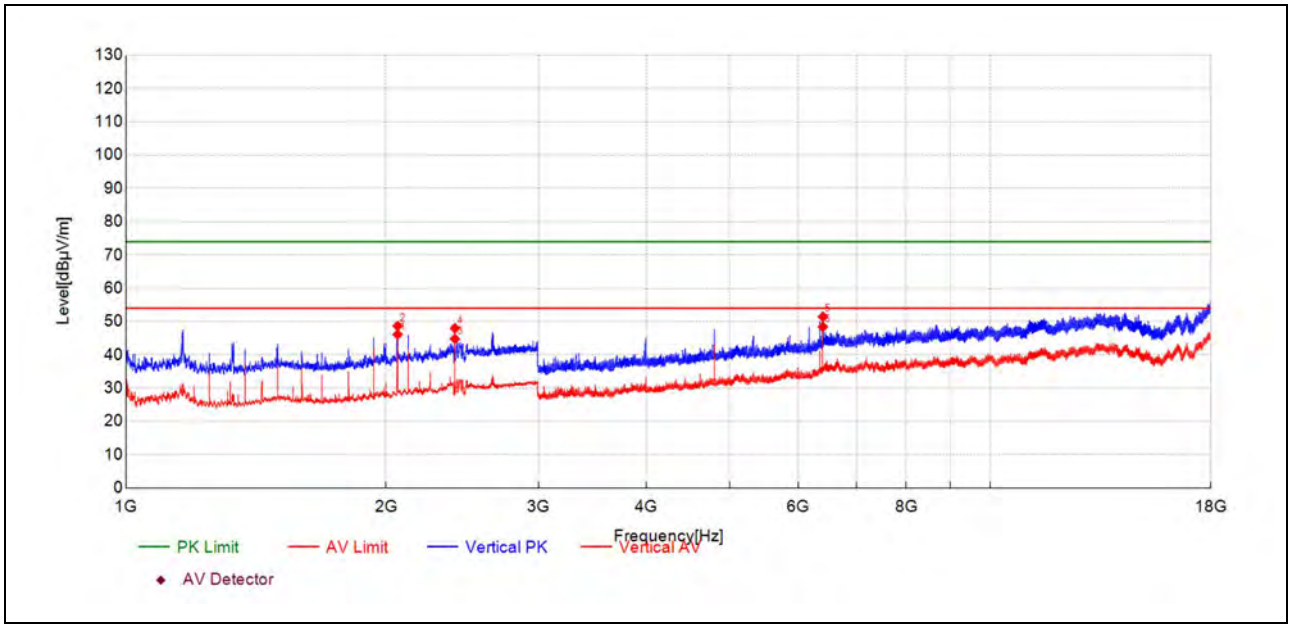
(Antenna Horizontal, 1GHz to 18GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2062.46	51.3	49.73	-1.560	74.00	24.27	150	0	Horizontal	PASS
2062.46	48.1	46.58	-1.560	54.00	7.42	150	144	Horizontal	PASS
2663.93	47.2	47.91	0.730	74.00	26.09	150	120	Horizontal	PASS
4803.56	58.8	48.08	-10.720	54.00	5.92	150	128	Horizontal	PASS
4804.56	62.1	51.34	-10.710	74.00	22.66	150	150	Horizontal	PASS
6405.11	53.3	48.21	-5.130	54.00	5.79	150	128	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

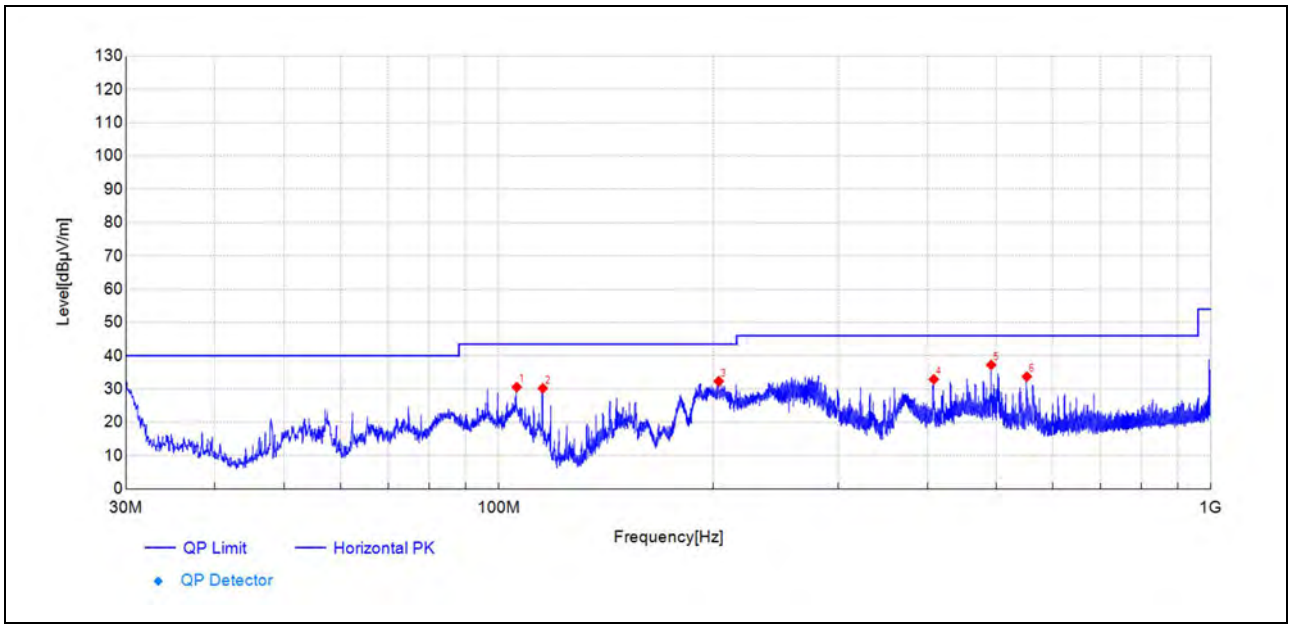
Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
65.50	69.3	36.41	-32.840	40.00	3.59	150	295	Vertical	PASS
81.07	64.2	29.15	-35.040	40.00	10.85	150	0	Vertical	PASS
106.10	65.7	35.28	-30.420	43.50	8.22	150	38	Vertical	PASS
192.00	63.4	33.75	-29.600	43.50	9.75	150	38	Vertical	PASS
216.30	65.8	36.37	-29.470	46.00	9.63	150	7	Vertical	PASS
492.52	55.2	33.16	-21.990	46.00	12.84	150	91	Vertical	PASS



(Antenna Vertical, 1GHz to 18GHz)

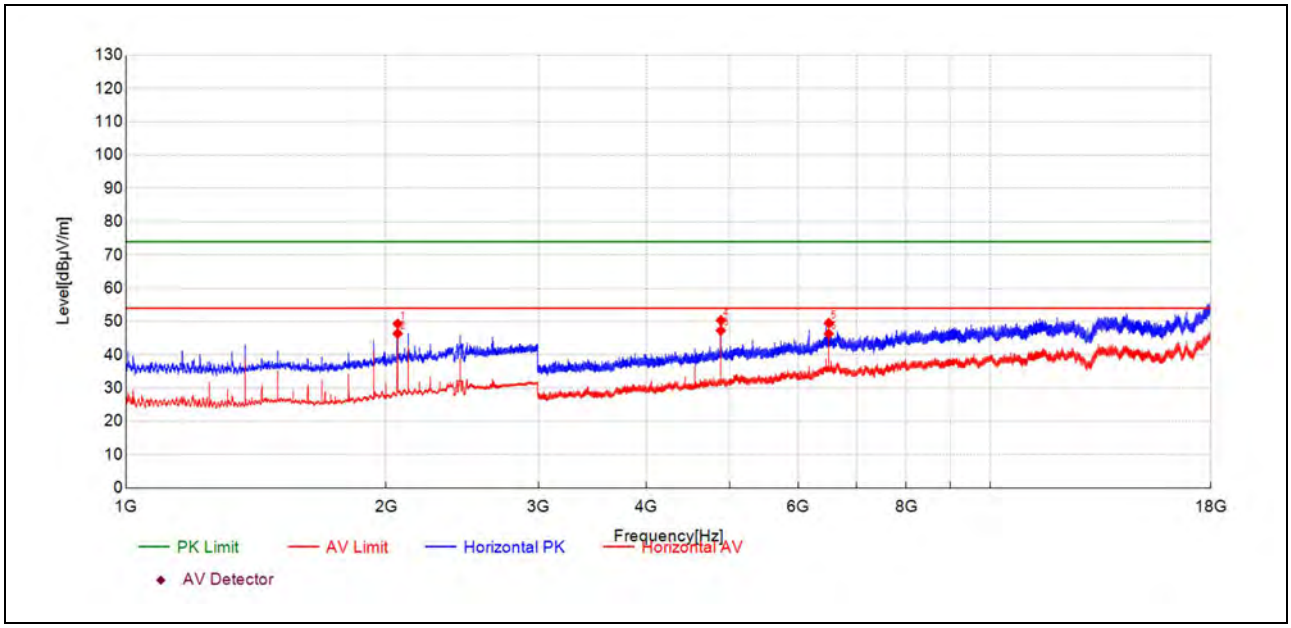
Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2062.46	47.7	46.12	-1.560	54.00	7.88	150	350	Vertical	PASS
2062.46	50.2	48.67	-1.560	74.00	25.33	150	293	Vertical	PASS
2402.09	44.0	44.79	0.750	54.00	9.21	150	121	Vertical	PASS
2402.53	47.2	47.99	0.760	74.00	26.01	150	121	Vertical	PASS
6405.11	56.6	51.44	-5.130	74.00	22.56	150	360	Vertical	PASS
6405.11	53.5	48.41	-5.130	54.00	5.59	150	10	Vertical	PASS

Plot for Channel 19



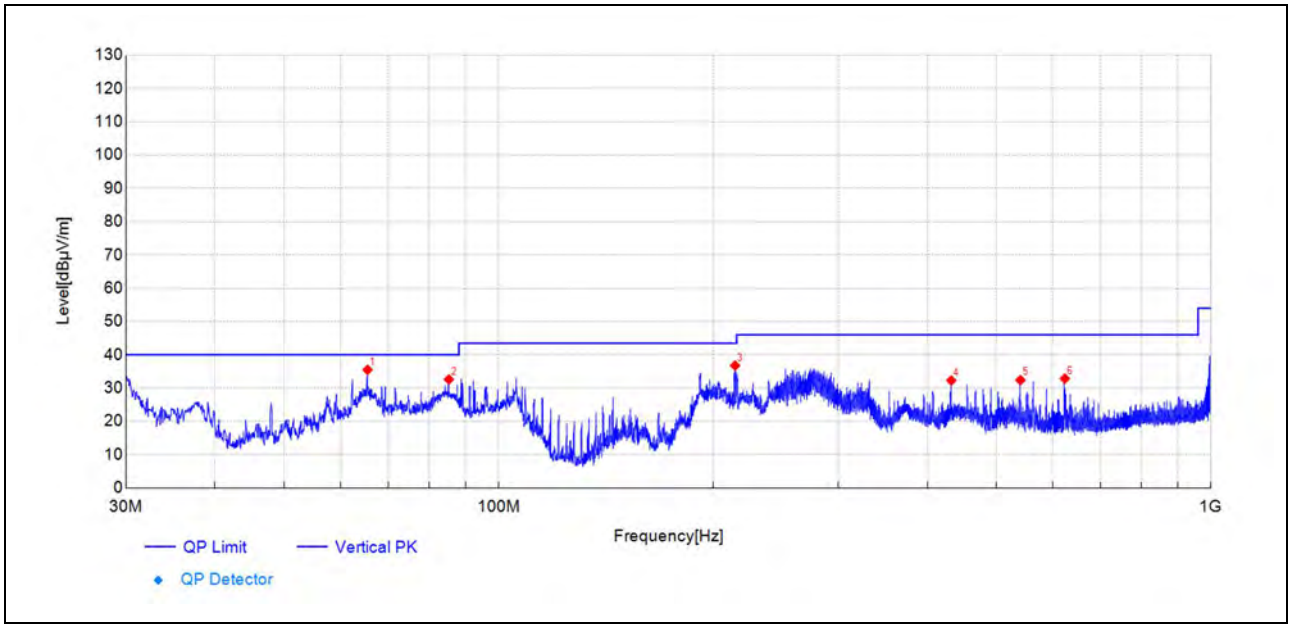
(Antenna Horizontal, 30MHz to 1GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
106.10	61.0	30.57	-30.420	43.50	12.93	150	66	Horizontal	PASS
115.41	61.7	30.20	-31.510	43.50	13.30	150	7	Horizontal	PASS
203.83	62.5	32.33	-30.190	43.50	11.17	150	53	Horizontal	PASS
408.61	56.8	32.91	-23.860	46.00	13.09	150	14	Horizontal	PASS
491.89	59.3	37.24	-22.010	46.00	8.76	150	40	Horizontal	PASS
551.89	54.7	33.74	-20.930	46.00	12.26	150	25	Horizontal	PASS



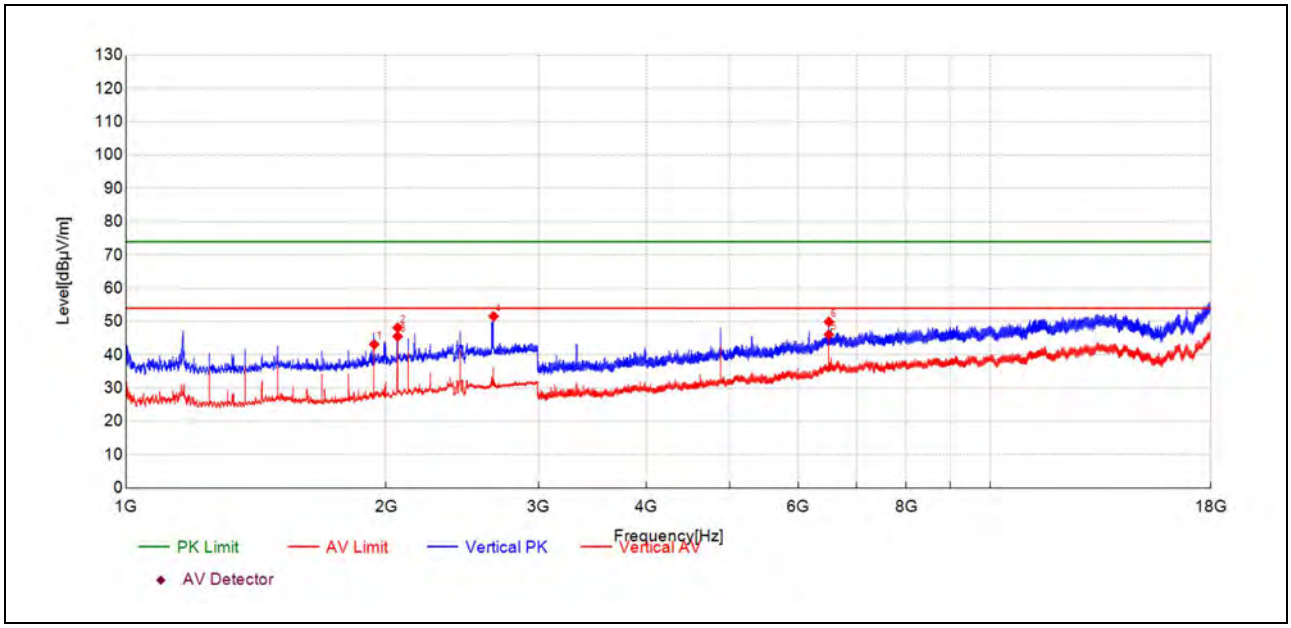
(Antenna Horizontal, 1GHz to 18GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2062.46	50.9	49.30	-1.560	74.00	24.70	150	177	Horizontal	PASS
2062.46	48.0	46.41	-1.560	54.00	7.59	150	177	Horizontal	PASS
4879.56	57.3	47.31	-10.010	54.00	6.69	150	175	Horizontal	PASS
4879.56	60.4	50.36	-10.010	74.00	23.64	150	196	Horizontal	PASS
6506.62	54.1	49.54	-4.520	74.00	24.46	150	337	Horizontal	PASS
6506.62	50.8	46.32	-4.520	54.00	7.68	150	196	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

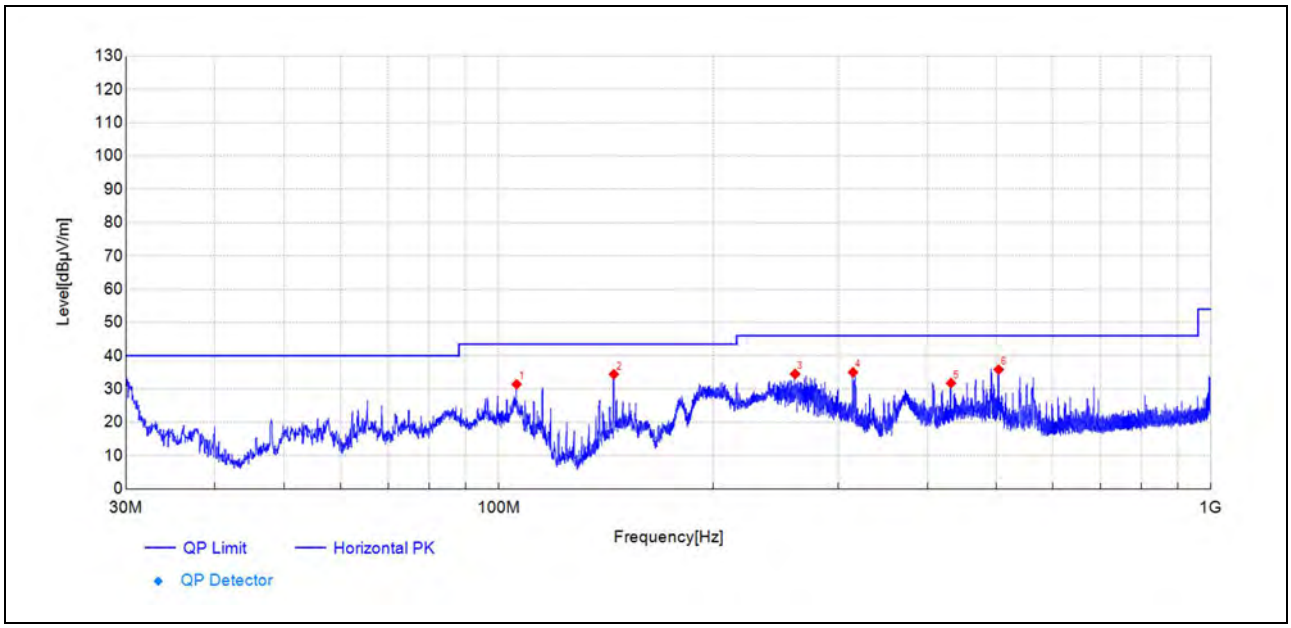
Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
65.50	68.3	35.48	-32.840	40.00	4.52	150	26	Vertical	PASS
85.20	66.5	32.60	-33.900	40.00	7.40	150	11	Vertical	PASS
214.89	66.3	36.75	-29.570	43.50	6.75	150	360	Vertical	PASS
432.33	55.6	32.28	-23.300	46.00	13.72	150	106	Vertical	PASS
540.63	53.6	32.39	-21.210	46.00	13.61	150	147	Vertical	PASS
624.01	52.2	32.85	-19.360	46.00	13.15	150	133	Vertical	PASS



(Antenna Vertical, 1GHz to 18GHz)

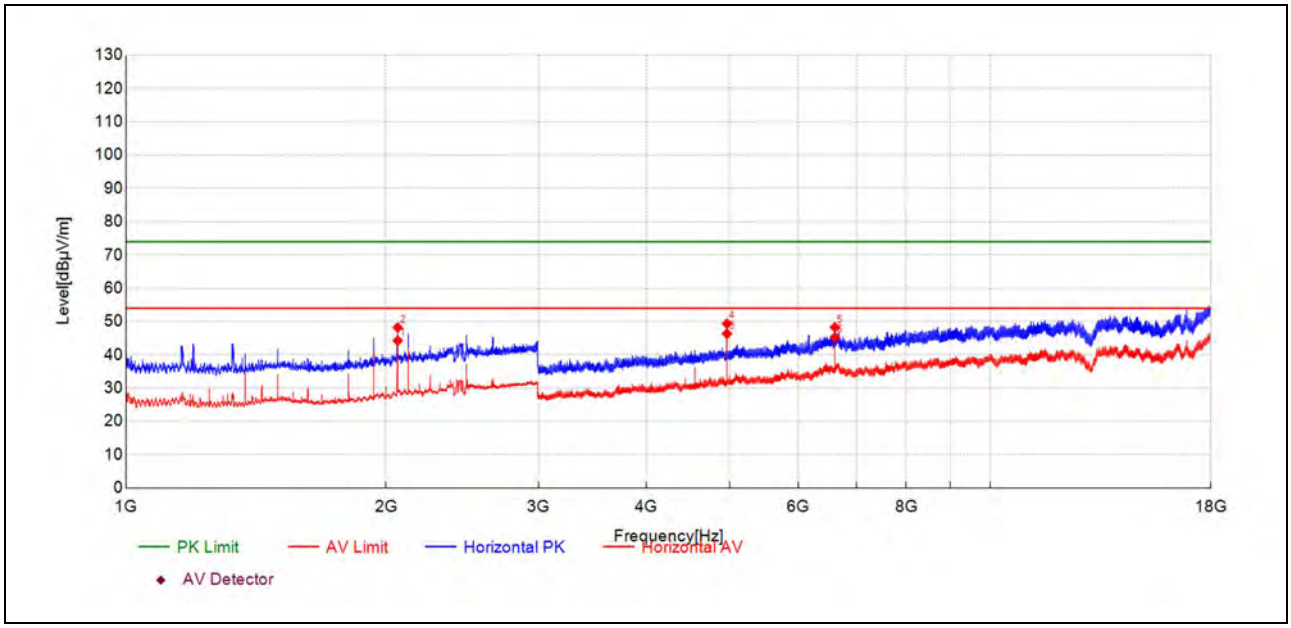
Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1937.54	45.7	43.12	-2.550	54.00	10.88	150	190	Vertical	PASS
2062.46	49.7	48.14	-1.560	74.00	25.86	150	340	Vertical	PASS
2062.46	47.1	45.51	-1.560	54.00	8.49	150	133	Vertical	PASS
2663.04	50.8	51.56	0.730	74.00	22.44	150	122	Vertical	PASS
6506.62	50.6	46.06	-4.520	54.00	7.94	150	99	Vertical	PASS
6506.62	54.4	49.91	-4.520	74.00	24.09	150	351	Vertical	PASS

Plot for Channel 39



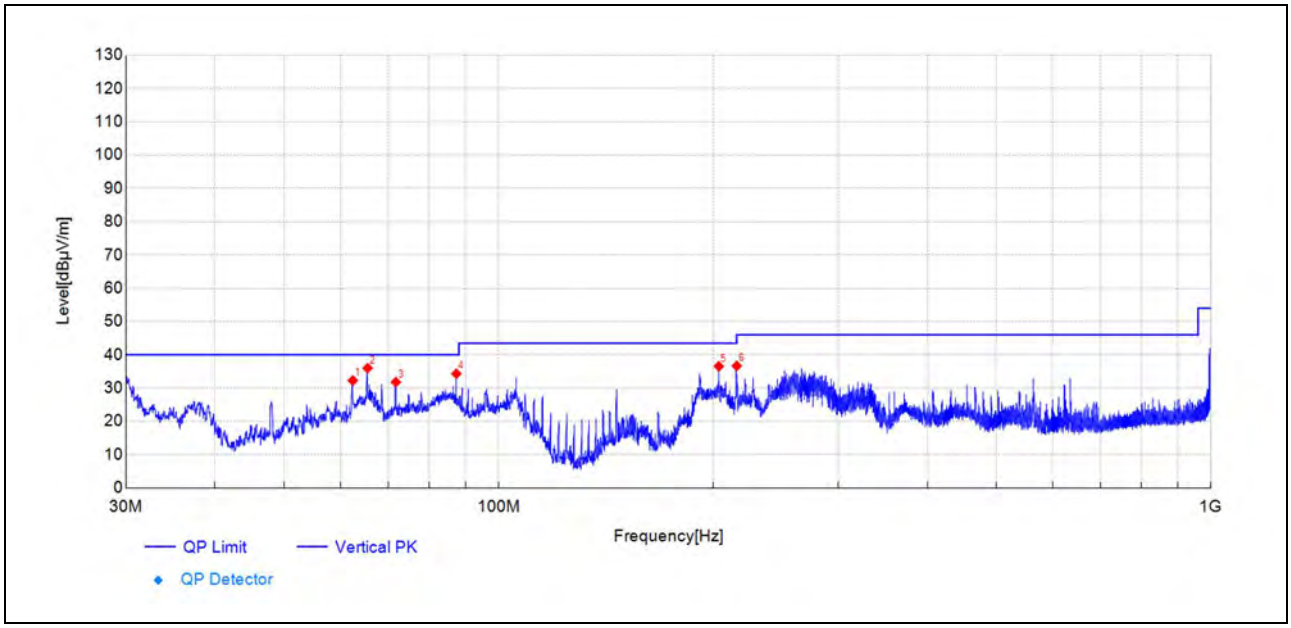
(Antenna Horizontal, 30MHz to 1GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
106.05	61.9	31.44	-30.420	43.50	12.06	150	105	Horizontal	PASS
145.24	68.0	34.43	-33.540	43.50	9.07	150	359	Horizontal	PASS
260.87	62.5	34.51	-27.950	46.00	11.49	150	145	Horizontal	PASS
314.61	61.6	35.01	-26.600	46.00	10.99	150	345	Horizontal	PASS
431.89	55.1	31.78	-23.290	46.00	14.22	150	25	Horizontal	PASS
503.92	57.4	35.85	-21.560	46.00	10.15	150	51	Horizontal	PASS



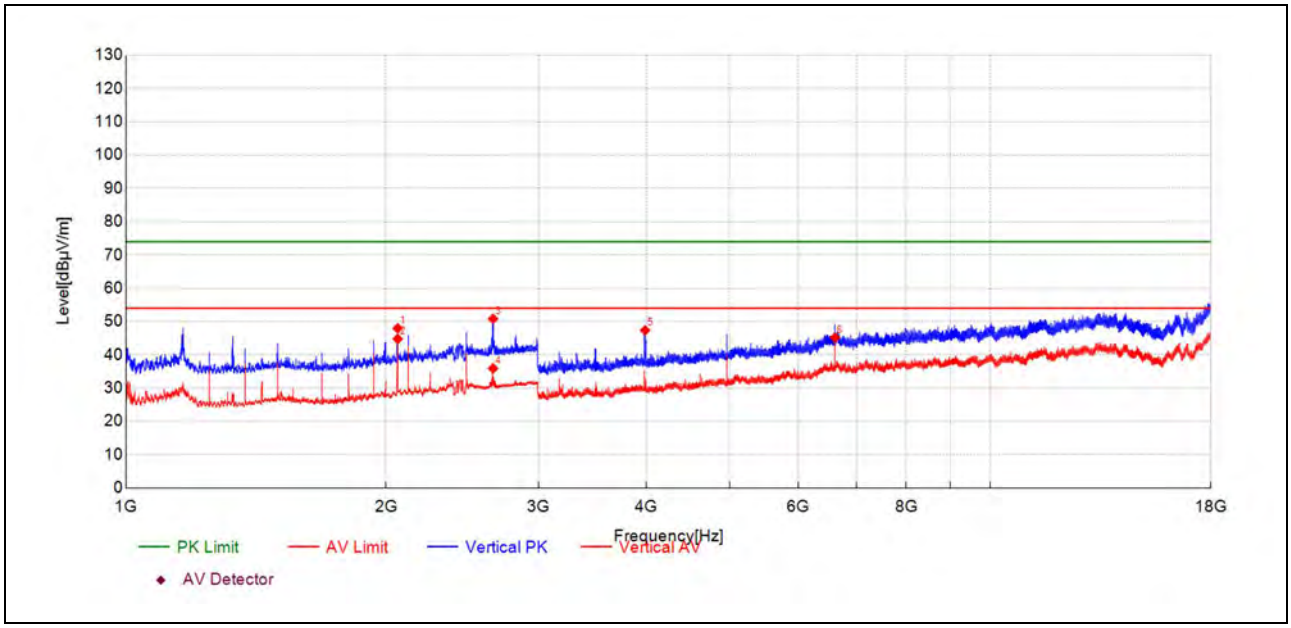
(Antenna Horizontal, 1GHz to 18GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2062.46	45.8	44.27	-1.560	54.00	9.73	150	269	Horizontal	PASS
2062.90	49.7	48.17	-1.550	74.00	25.83	150	176	Horizontal	PASS
4959.57	56.5	46.32	-10.130	54.00	7.68	150	130	Horizontal	PASS
4959.57	59.5	49.36	-10.130	74.00	24.64	150	152	Horizontal	PASS
6613.12	52.8	48.24	-4.520	74.00	25.76	150	318	Horizontal	PASS
6613.12	49.8	45.28	-4.520	54.00	8.72	150	318	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
62.45	64.1	32.27	-31.790	40.00	7.73	150	0	Vertical	PASS
65.50	68.8	36.00	-32.840	40.00	4.00	150	350	Vertical	PASS
71.76	66.6	31.79	-34.810	40.00	8.21	150	324	Vertical	PASS
87.28	67.4	34.31	-33.040	40.00	5.69	150	350	Vertical	PASS
203.88	66.7	36.55	-30.190	43.50	6.95	150	67	Vertical	PASS
216.06	66.2	36.67	-29.500	46.00	9.33	150	15	Vertical	PASS



(Antenna Vertical, 1GHz to 18GHz)

Freq. [MHz]	Reading [dBµV]	Level [dBµV/m]	Factor [dB/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2062.46	49.5	47.98	-1.560	74.00	26.02	150	190	Vertical	PASS
2062.46	46.3	44.78	-1.560	54.00	9.22	150	270	Vertical	PASS
2659.48	50.1	50.82	0.730	74.00	23.18	150	122	Vertical	PASS
2659.48	35.2	35.92	0.730	54.00	18.08	150	122	Vertical	PASS
3988.03	60.8	47.36	-13.390	74.00	26.64	150	130	Vertical	PASS
6613.12	49.7	45.15	-4.520	54.00	8.85	150	318	Vertical	PASS

END OF REPORT