



REPORT No.: SZ25040136W01

TEST REPORT

APPLICANT : Zhejiang Lierda Internet of Things
Technology Co., Ltd.

PRODUCT NAME : LP26 Series Overseas Module

MODEL NAME : L-LRNLP26-98UN4, LP26-9U

BRAND NAME : lierda

FCC ID : 2AOFD-LLRNLP2698UN4

STANDARD(S) : 47 CFR Part 15 Subpart C

RECEIPT DATE : 2025-04-09

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REPORT No.: SZ25040136W01

Change History		
Version	Date	Reason for change
1.0	2025-09-23	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	15.247(a) 15.247(h)	Hopping Mechanism	N/A	N/A	PASS	/
3	15.247(a)	Number of Hopping Frequency	Aug. 26, 2025	Lin Haoyang	PASS	/
4	ANSI C63.10	Duty Cycle	Aug. 20, 2025	Lin Haoyang	PASS	/
5	15.247(b)	Maximum Peak Conducted Output Power	Aug. 20, 2025	Lin Haoyang	PASS	/
6	15.247(b)	Maximum Average Conducted Output Power	Aug. 20, 2025	Lin Haoyang	PASS	/
7	15.247(a)	20dB Bandwidth	Aug. 20, 2025	Lin Haoyang	PASS	/
8	15.247(a)	Carrier Frequency Separation	Aug. 26, 2025	Lin Haoyang	PASS	/
9	15.247(a)	Time of Occupancy (Dwell time)	Aug. 26, 2025	Lin Haoyang	PASS	/
10	15.247(d)	Conducted Spurious Emission	Aug. 26, 2025	Lin Haoyang	PASS	/
11	15.207	Conducted Emission	Aug. 11, 2025	Fan Zehang	PASS	/
12	15.209, 15.247(d)	Radiated Emission	Aug. 11, 2025	Wang Deyong	PASS	/

Note 1: The tests were performed according to the method of measurements prescribed in ANSI C63.10-2020, KDB 558074 D01 v05r02 and DA 00-075.

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 Analyzer	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
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	V2.5.0.0

**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	9163-274	VULB 9163	Schwarzbeck	2025.06.28	2026.06.27
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	S10M100L38 02	LUCIX CORP.	2025.05.13	2026.05.12
Preamplifier (2GHz-18GHz)	61171/61172	S020180L32 03	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
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
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FCC Designation Number	CN1192
FCC Test Firm Registration Number	226174

2. General Description

2.1. Information of Applicant and Manufacturer

Applicant	Zhejiang Lierda Internet of Things Technology Co., Ltd.
Applicant Address	Room 1402, Building 1, No.1326, Wenyi West Road, Cangqian street, Yuhang District, Hangzhou, Zhejiang Prov. China
Manufacturer	Zhejiang Lierda Internet of Things Technology Co., Ltd.
Manufacturer Address	Room 1402, Building 1, No.1326, Wenyi West Road, Cangqian street, Yuhang District, Hangzhou, Zhejiang Prov. China

2.2. Information of EUT

Product Name:	LP26 Series Overseas Module
Sample No.:	1#, 3#
Hardware Version:	V01
Software Version:	V01
Equipment Type:	FHSS
Modulation Type:	LoRa
Operating Frequency Range:	902.3MHz–914.9MHz
Antenna Type:	Rod Antenna
Antenna Gain:	4.57dBi

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.

Note 2: According to the certificate holder, they declared that the models L-LRNLP26-98UN4 and LP26-9U are accordant in both hardware and software. These two models only differ in model name and color. Their electrical circuit design, layout, components used and internal wiring are identical. The main measuring model is L-LRNLP26-98UN4, only the results for L-LRNLP26-98UN4 were recorded in this report.

2.3.Channel List of EUT

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.3	18	905.7	35	909.1	52	912.5
2	902.5	19	905.9	36	909.3	53	912.7
3	902.7	20	906.1	37	909.5	54	912.9
4	902.9	21	906.3	38	909.7	55	913.1
5	903.1	22	906.5	39	909.9	56	913.3
6	903.3	23	906.7	40	910.1	57	913.5
7	903.5	24	906.9	41	910.3	58	913.7
8	903.7	25	907.1	42	910.5	59	913.9
9	903.9	26	907.3	43	910.7	60	914.1
10	904.1	27	907.5	44	910.9	61	914.3
11	904.3	28	907.7	45	911.1	62	914.5
12	904.5	29	907.9	46	911.3	63	914.7
13	904.7	30	908.1	47	911.5	64	914.9
14	904.9	31	908.3	48	911.7		
15	905.1	32	908.5	49	911.9		
16	905.3	33	908.7	50	912.1		
17	905.5	34	908.9	51	912.3		

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

2.4.Test Configuration of EUT

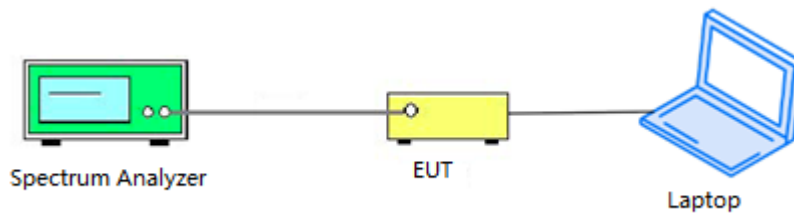
Test mode is used to control the EUT under the maximum power level during test.

2.5.Test Conditions

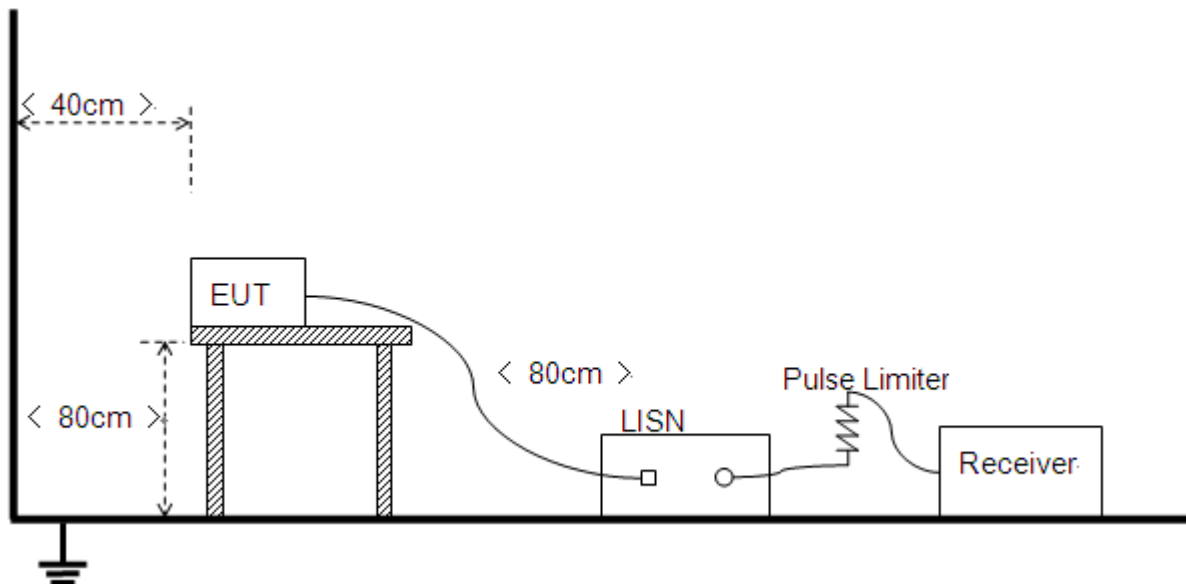
Temperature (°C)	15-35
Relative Humidity (%)	30-60
Atmospheric Pressure (kPa)	86-106

2.6. Test Setup Layout Diagram

2.6.1. Conducted Measurement

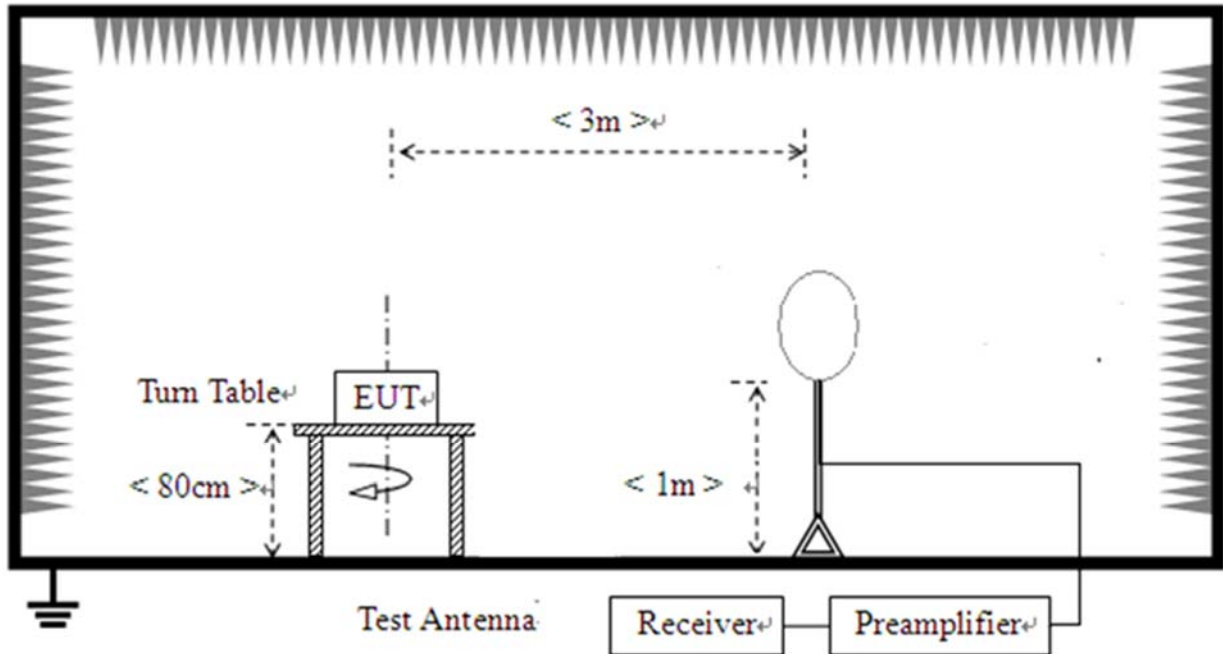


2.6.2. Conducted Emission Measurement

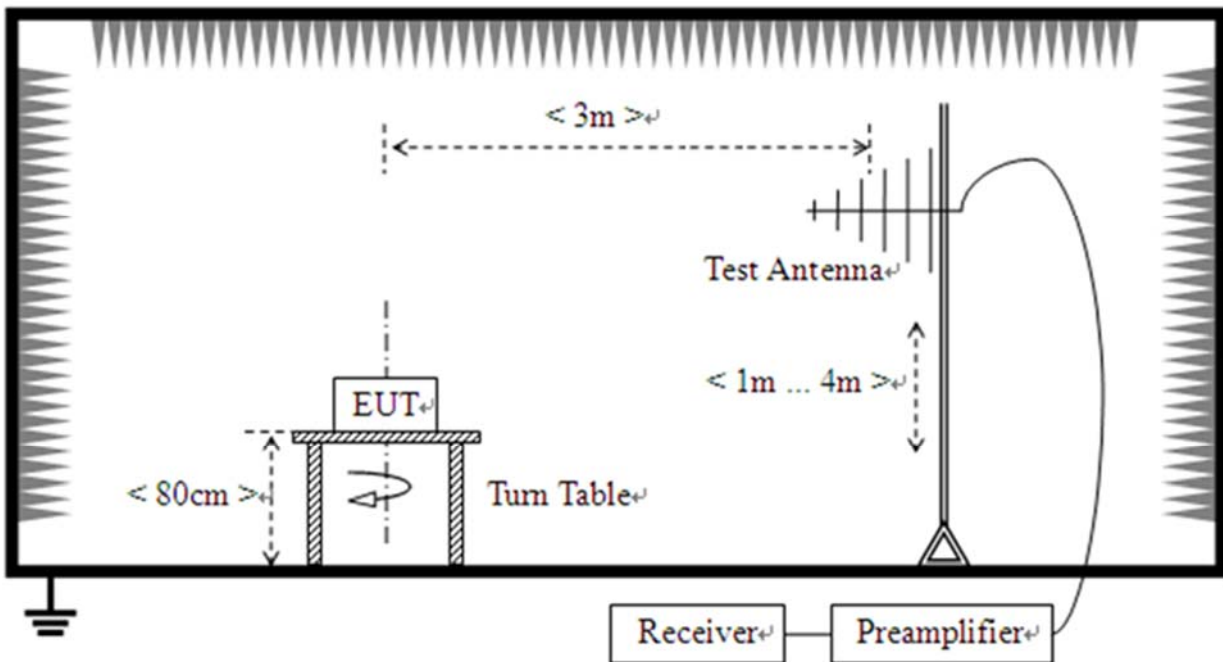


2.6.3.Radiation Measurement

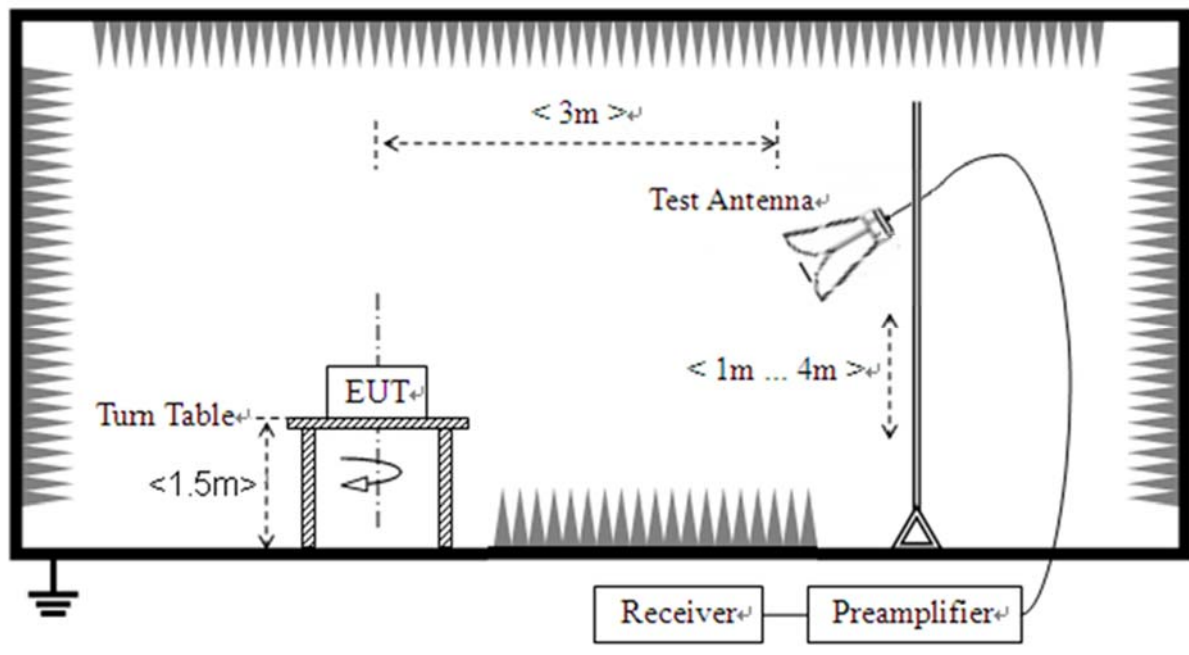
1) For radiated emissions from 9kHz to 30MHz



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

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



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 based on the protocol that "**LoRaWAN**".



3.3. Number of Hopping Frequency

3.3.1. Requirement

According to FCC section 15.247(a)(1)(i), frequency hopping systems operating in the 902MHz to 928MHz bands shall use at least 50 hopping frequencies if the 20dB bandwidth of the hopping channel is less than 250KHz; or at least 25 hopping frequencies if the 20dB bandwidth of the hopping channel is 250KHz or greater.

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 $\geq$ 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 $\pm 2\%$; 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)(2), for frequency hopping systems that operates in the 902MHz to 928MHz band employing at least 50 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt, and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

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)(2), for frequency hopping systems that operates in the 902MHz to 928MHz band employing at least 50 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt, and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

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 ($10 \cdot \log 1\% = 20 \text{ dB}$) 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 $\geq 3 \times$ 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) $\geq$ 1% of the span

Video (or Average) Bandwidth (VBW) $\geq$ 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 §15.247(a) (1) (i), frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

3.9.2. Test Procedures

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in 10 second scan, to enable resolution of each occurrence. The average time of occupancy in the specified 20 second period is equal to (# of pulses in 20s) * pulse width.

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 $\geq$ 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. Conducted Emission

3.11.1.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 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dB μ V)	
	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.

3.11.2.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.

3.11.3.Test Setup Layout

Refer to chapter 2.6.2 in this report.

3.11.4.Test Result

Refer to Annex A.10 in this report.

3.12. Radiated Emission

3.12.1.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 ($\mu\text{V/m}$)	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).



3.12.2.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.

3.12.3.Test Setup Layout

Refer to chapter 2.6.3 in this report.

3.12.4.Test Result

Refer to Annex A.11 in this report.



Annex A Test Data and Result

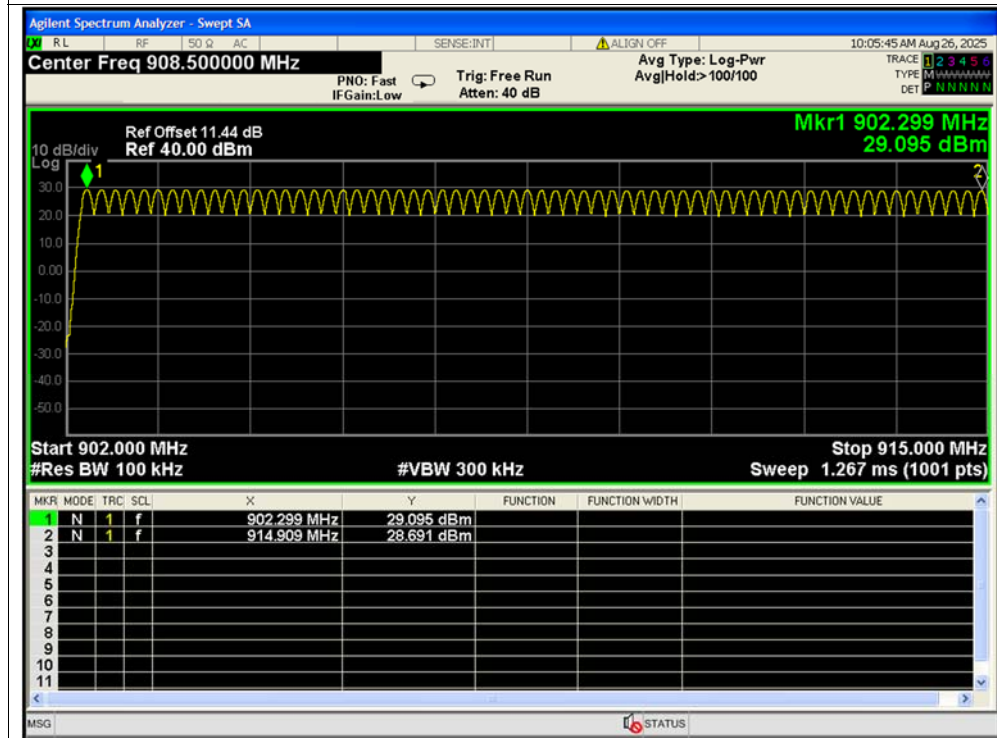
A.1. Number of Hopping Frequency

Condition	Mode/Data Rate	Antenna	Hopping Number	Limit	Verdict
NVNT	Lora-FHSS	Ant1	64	50	Pass



Test Graphs

Hopping No. NVNT Lora-FHSS 902.3MHz Ant1



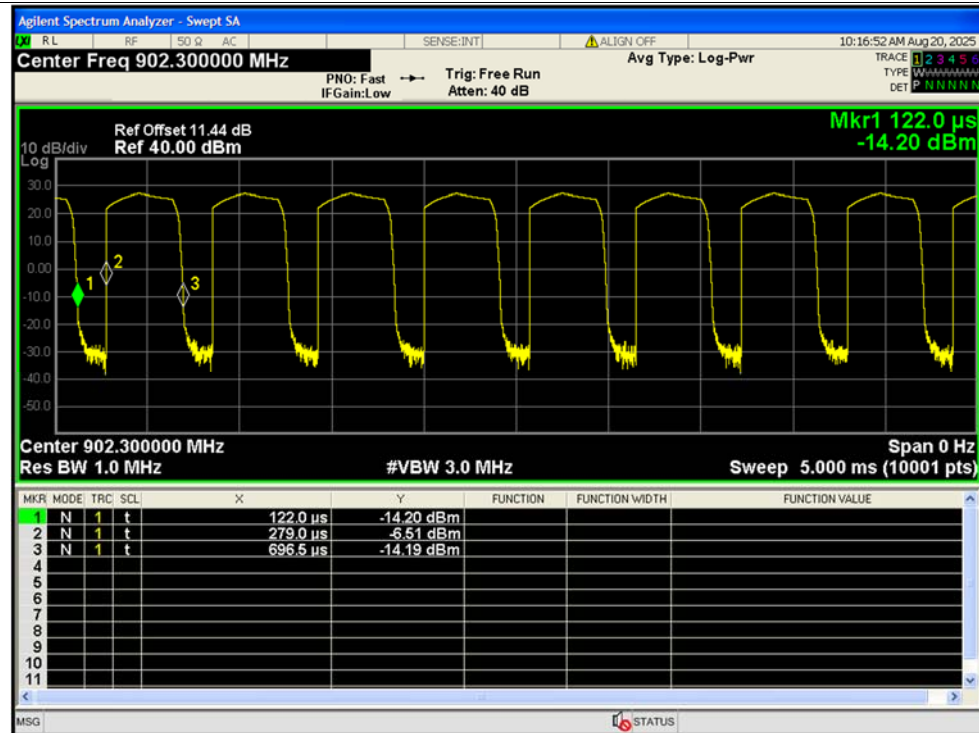
**A.2. Duty Cycle of Test Signal**

Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	Lora-FHSS	902.3	Ant1	72.67	1.39	2.4
NVNT	Lora-FHSS	908.7	Ant1	73.35	1.35	2.4
NVNT	Lora-FHSS	914.9	Ant1	75.52	1.22	2.12

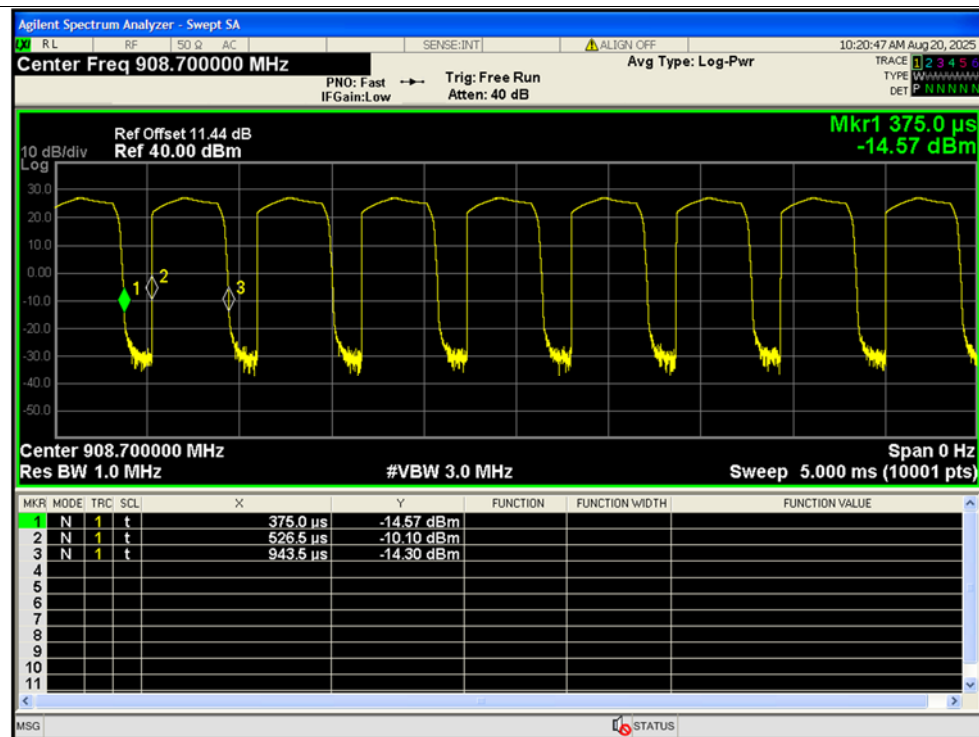


Test Graphs

Duty Cycle NVNT Lora-FHSS 902.3MHz Ant1

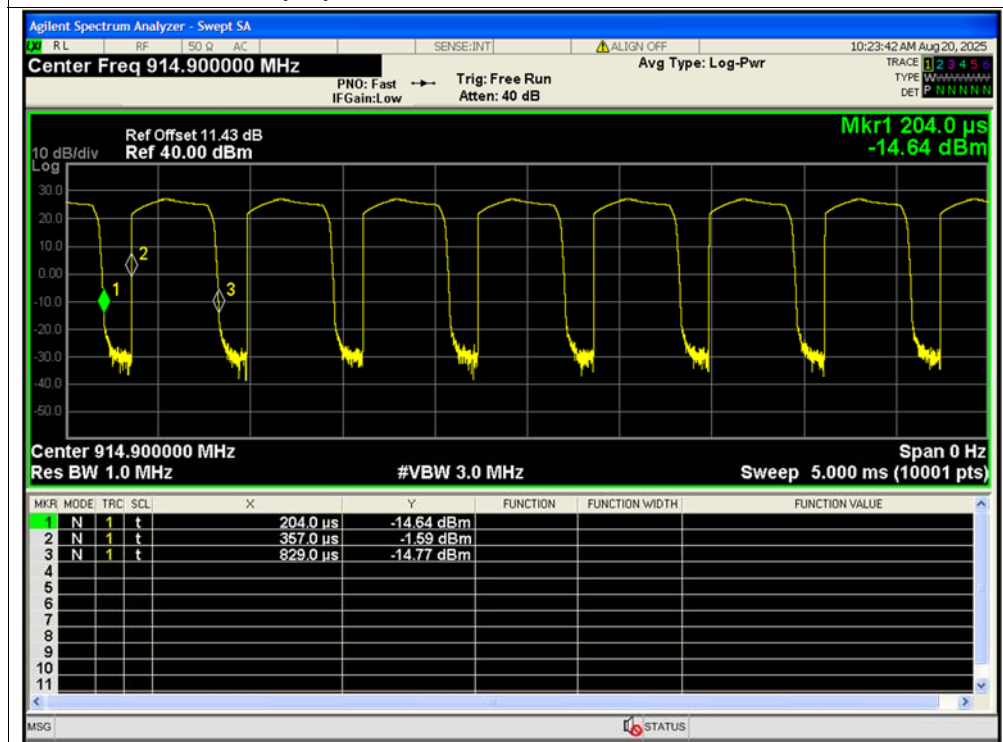


Duty Cycle NVNT Lora-FHSS 908.7MHz Ant1





Duty Cycle NVNT Lora-FHSS 914.9MHz Ant1

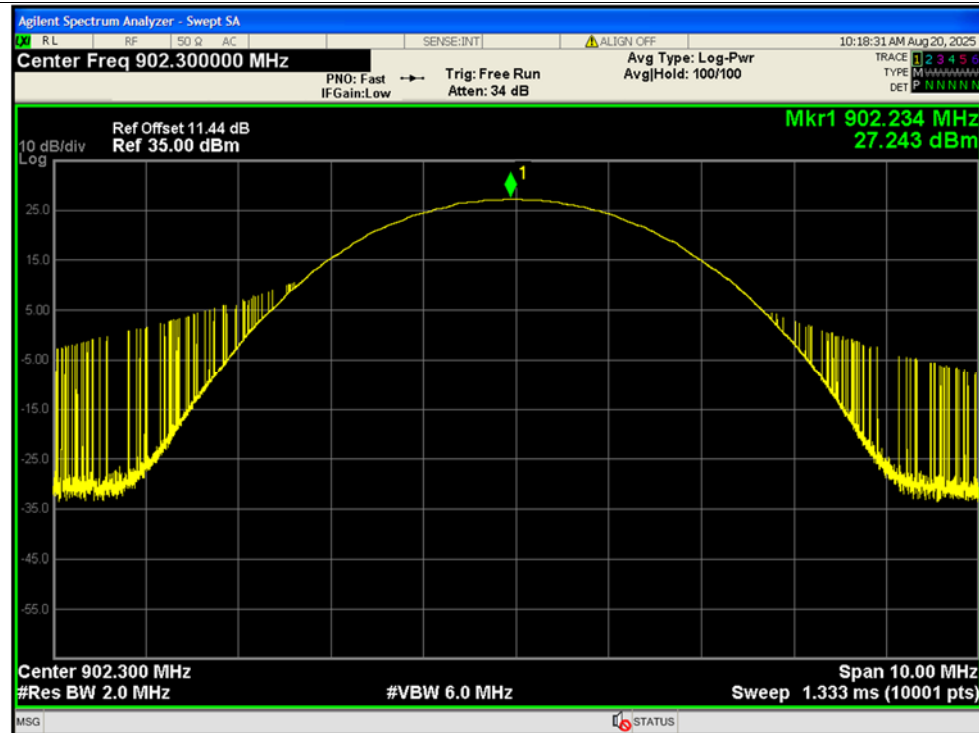


**A.3. Maximum Peak Conducted Output Power**

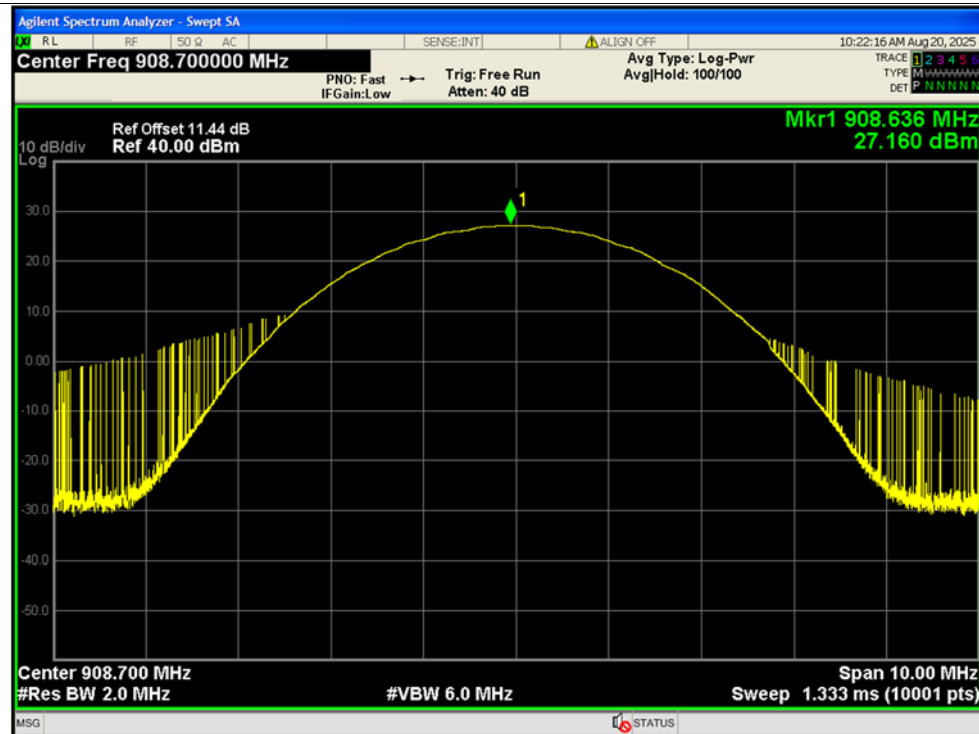
Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (W)	Limit Conducted (dBm)	Verdict
NVNT	Lora-FHSS	902.3	Ant1	27.24	0	27.24	0.52966	30	Pass
NVNT	Lora-FHSS	908.7	Ant1	27.16	0	27.16	0.52	30	Pass
NVNT	Lora-FHSS	914.9	Ant1	27.11	0	27.11	0.51404	30	Pass

Test Graphs

Peak Power NVNT Lora-FHSS 902.3MHz Ant1

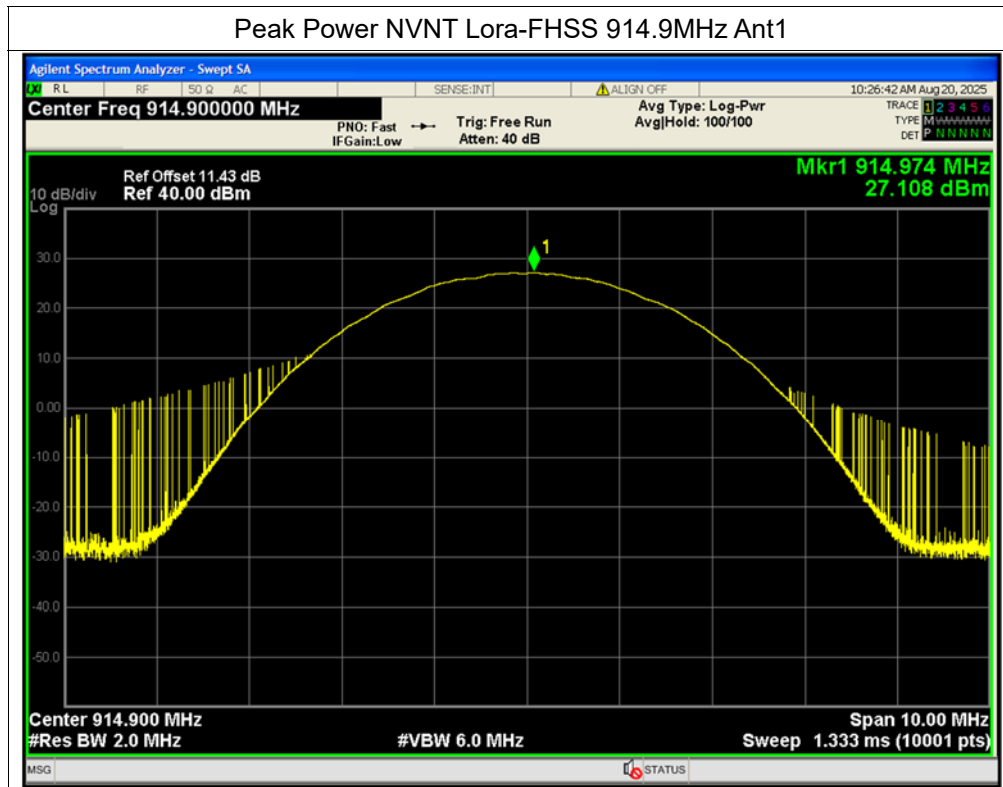


Peak Power NVNT Lora-FHSS 908.7MHz Ant1





Peak Power NVNT Lora-FHSS 914.9MHz Ant1



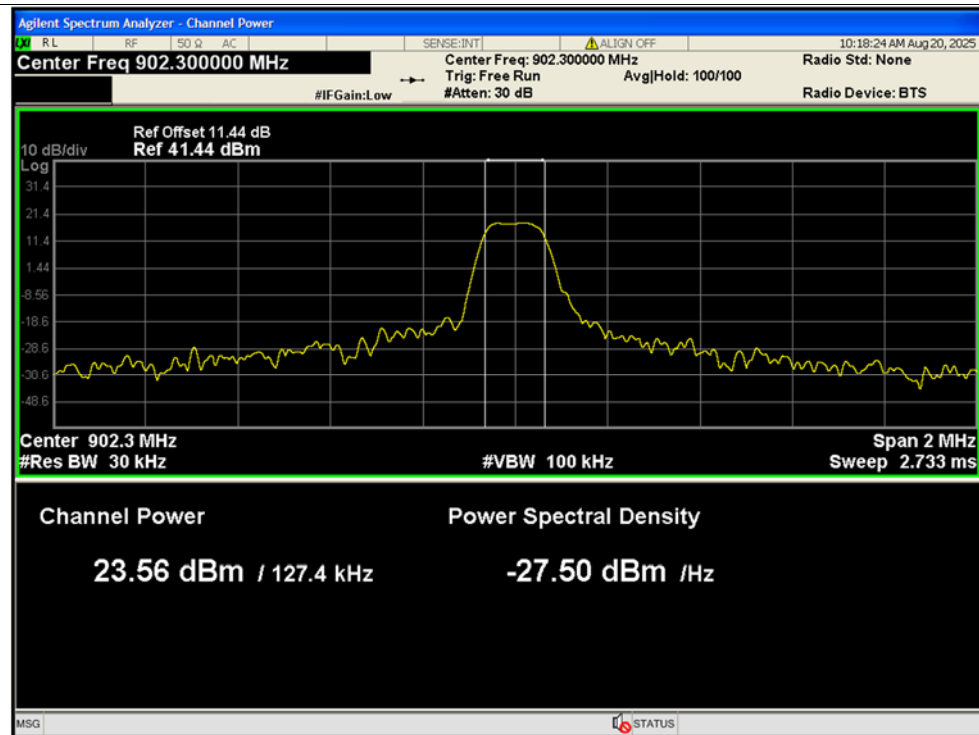
**A.4. Maximum Average Conducted Output Power**

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Conducted Power (dBm)	Total Conducted Power (W)	Limit Conducted (dBm)	Verdict
NVNT	Lora-FHSS	902.3	Ant1	23.56	1.39	24.95	0.31261	30	Pass
NVNT	Lora-FHSS	908.7	Ant1	23.57	1.35	24.92	0.31046	30	Pass
NVNT	Lora-FHSS	914.9	Ant1	23.83	1.22	25.05	0.31989	30	Pass

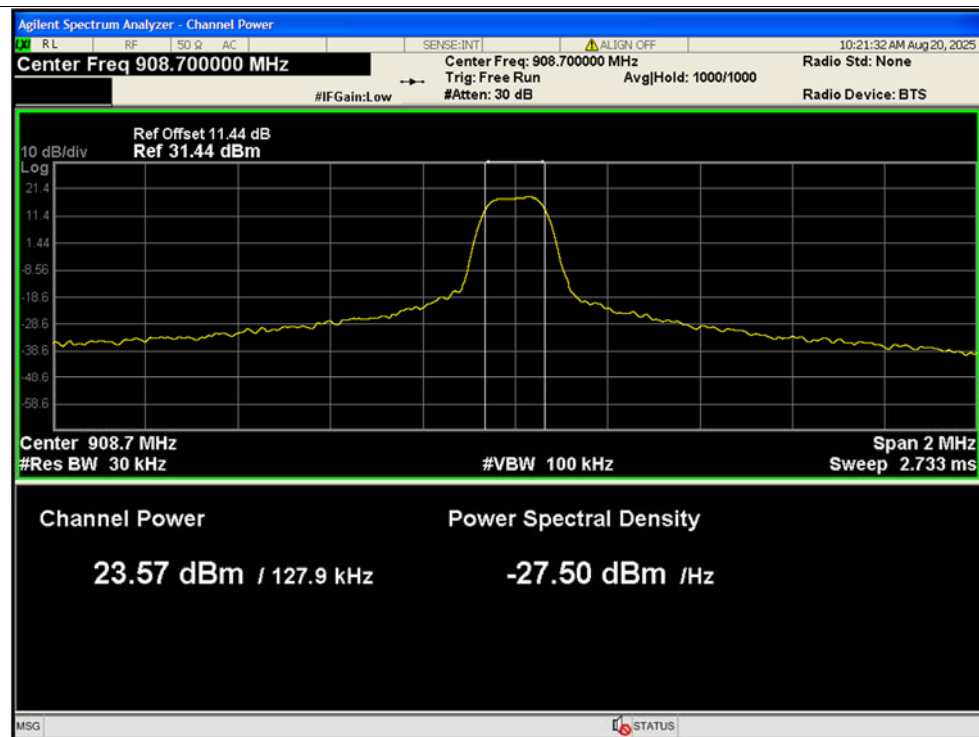


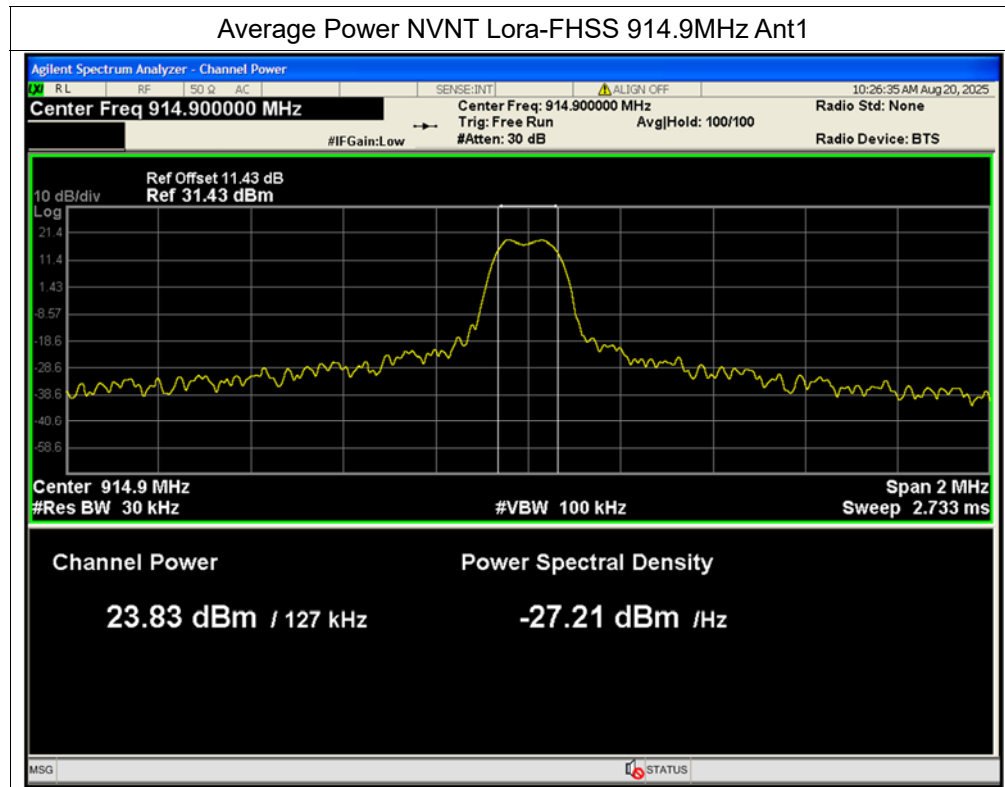
Test Graphs

Average Power NVNT Lora-FHSS 902.3MHz Ant1



Average Power NVNT Lora-FHSS 908.7MHz Ant1





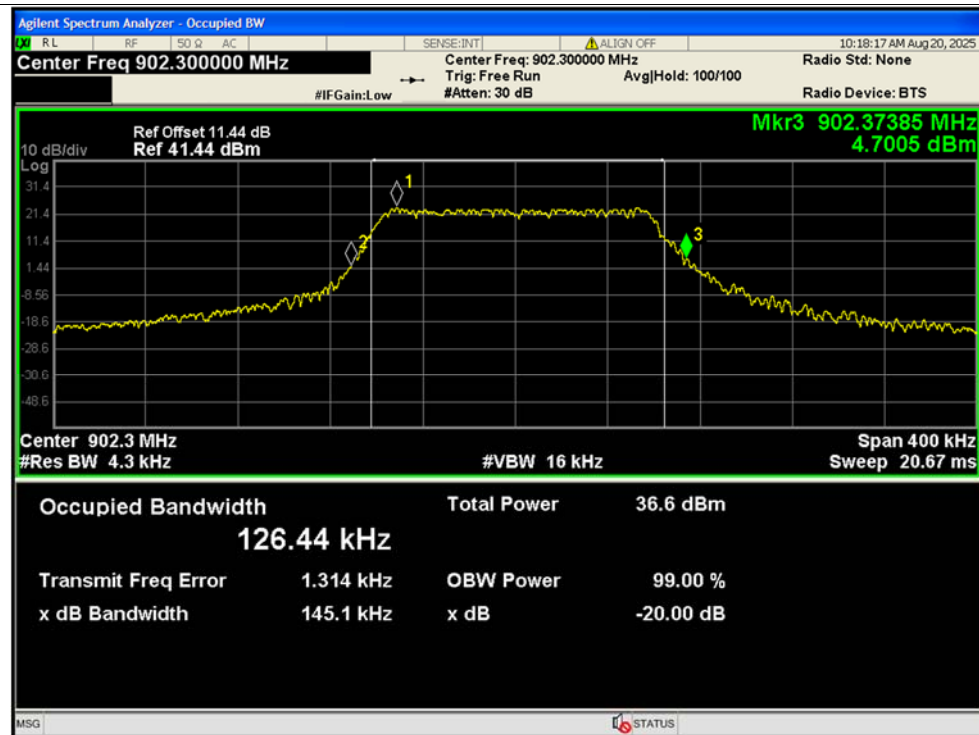
**A.5. 20 dB Bandwidth**

Condition	Mode	Frequency (MHz)	Antenna	-20 dB Bandwidth (MHz)
NVNT	Lora-FHSS	902.3	Ant1	0.1451
NVNT	Lora-FHSS	908.7	Ant1	0.1461
NVNT	Lora-FHSS	914.9	Ant1	0.1477

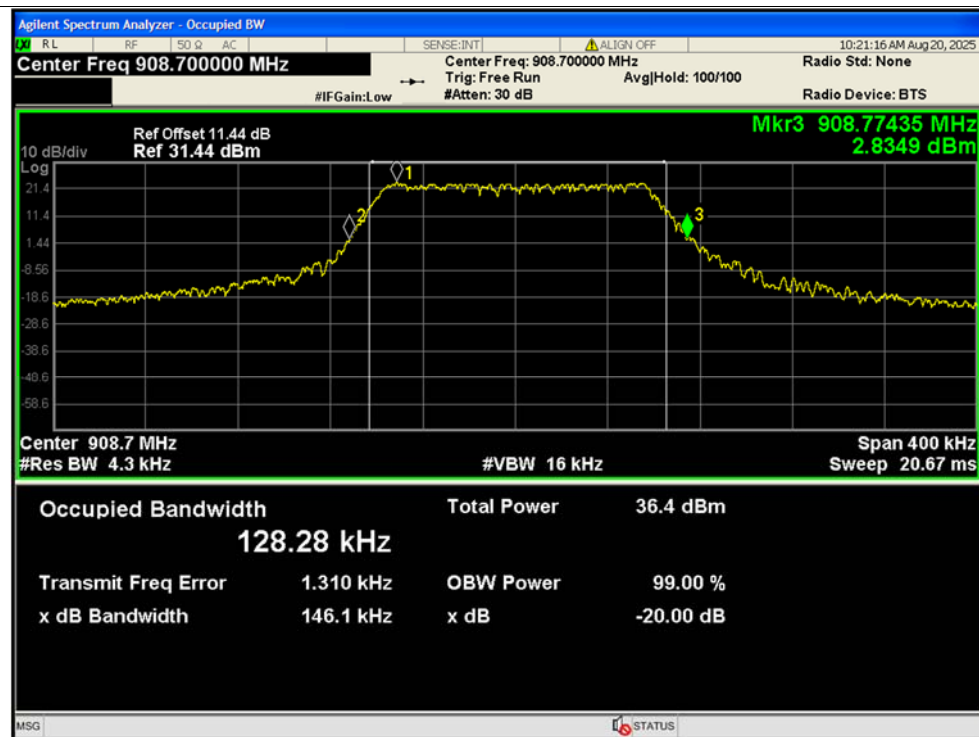


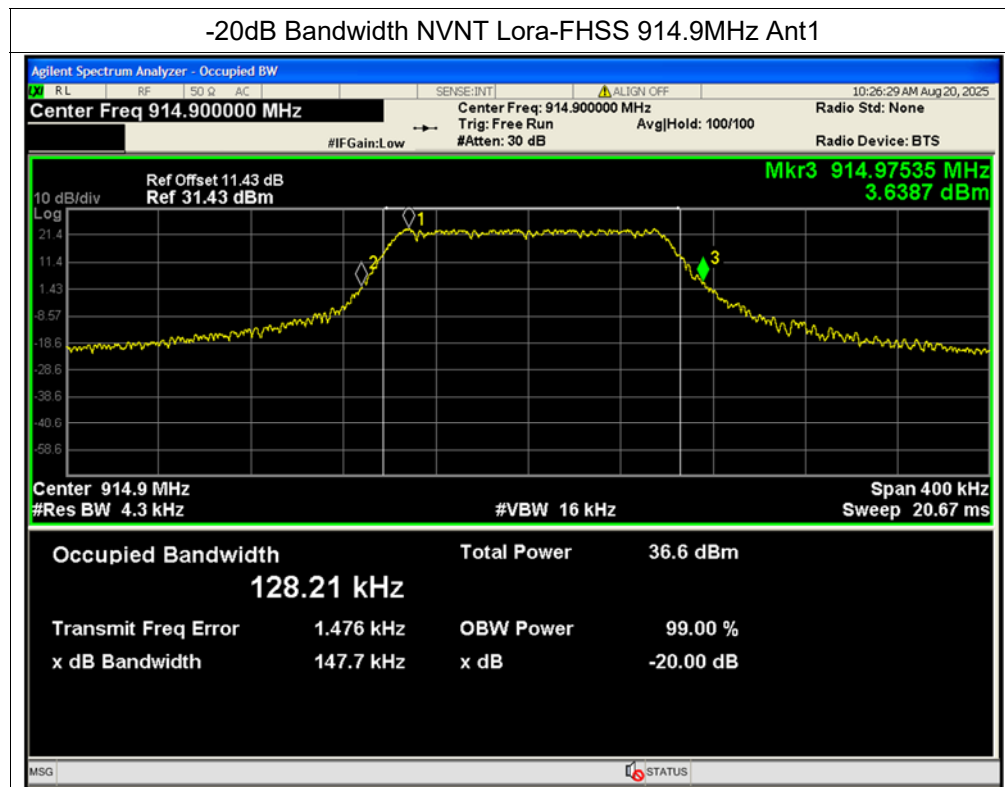
Test Graphs

-20dB Bandwidth NVNT Lora-FHSS 902.3MHz Ant1



-20dB Bandwidth NVNT Lora-FHSS 908.7MHz Ant1





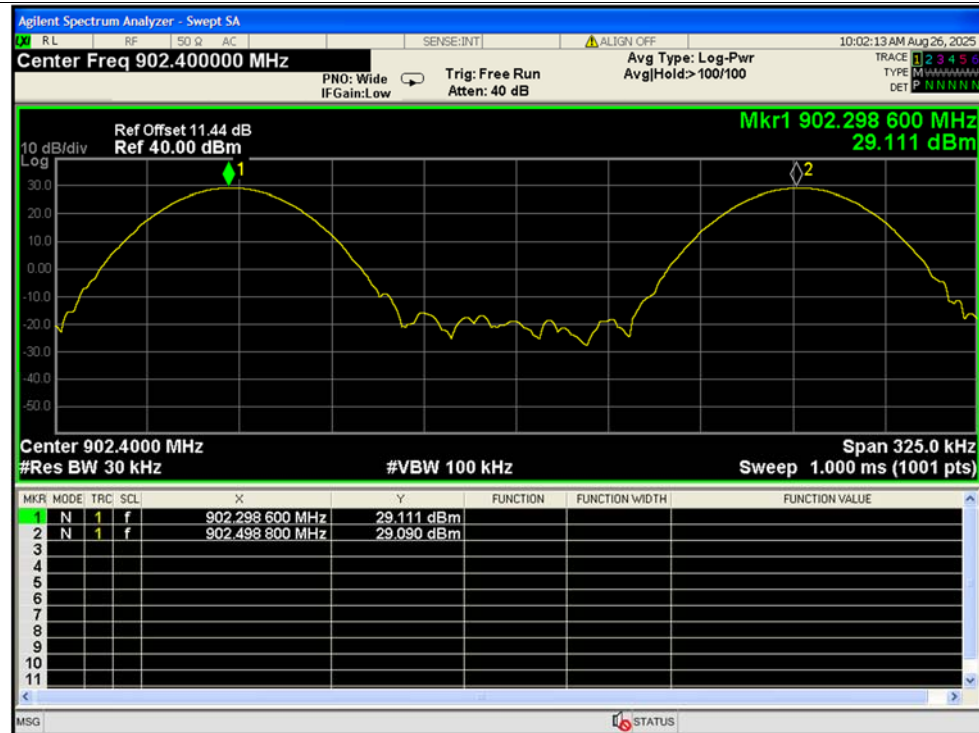
**A.6. Carried Frequency Separation**

Condition	Mode	Antenna	Hopping Freq1 (MHz)	Hopping Freq2 (MHz)	HFS (MHz)	Limit (MHz)	Verdict
NVNT	Lora-FHSS	Ant1	902.2986	902.4988	0.2002	0.1451	Pass
NVNT	Lora-FHSS	Ant1	908.6993	908.8988	0.1995	0.1461	Pass
NVNT	Lora-FHSS	Ant1	914.6989	914.8991	0.2002	0.1477	Pass

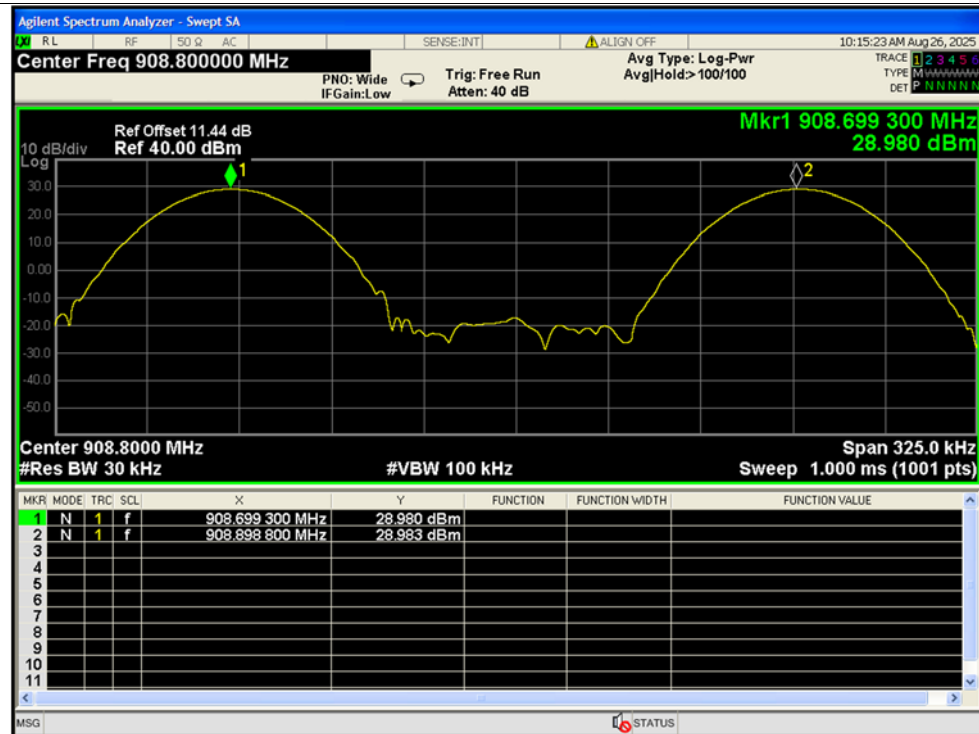


Test Graphs

CFS NVNT Lora-FHSS 902.3MHz Ant1

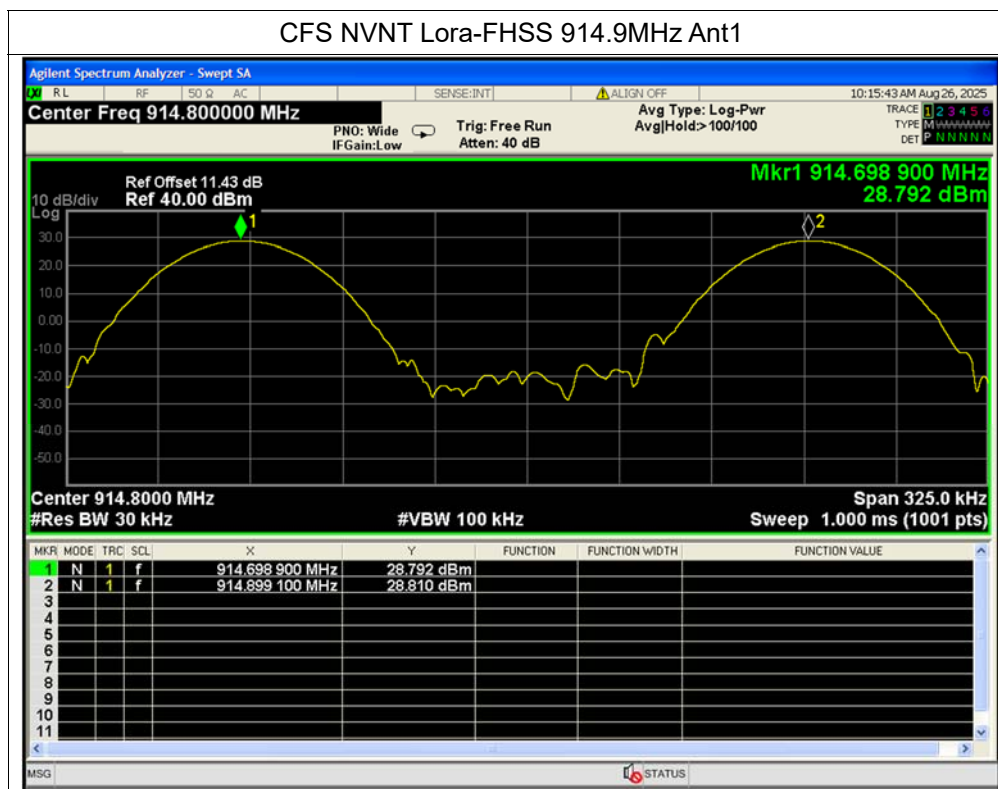


CFS NVNT Lora-FHSS 908.7MHz Ant1





CFS NVNT Lora-FHSS 914.9MHz Ant1

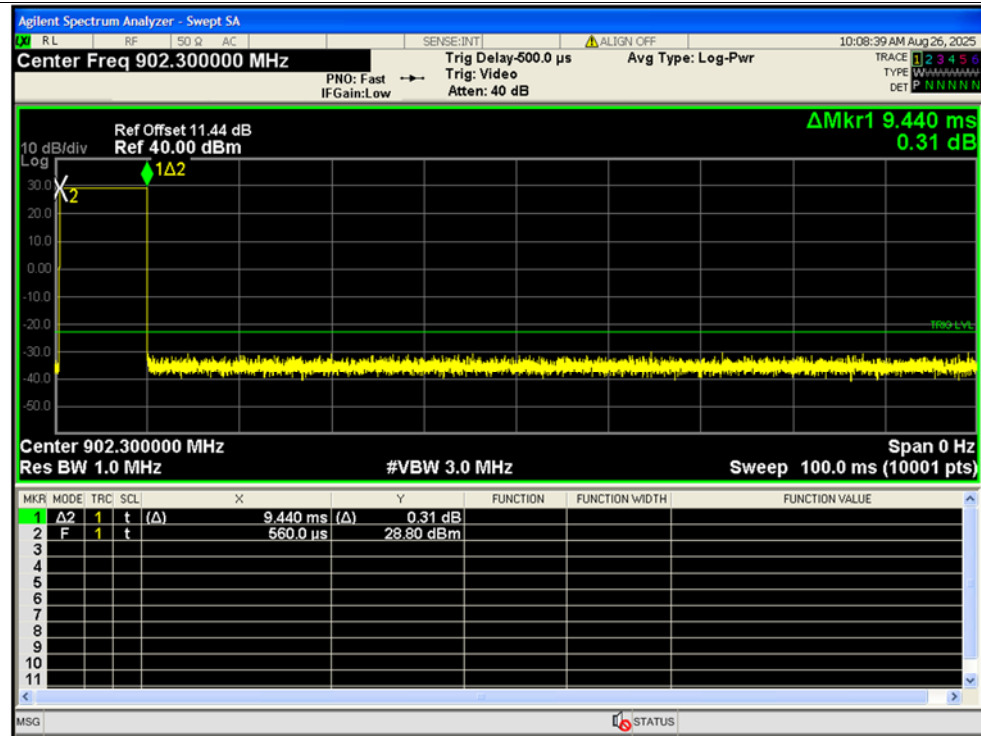


**A.7. Time of Occupancy (Dwell time)**

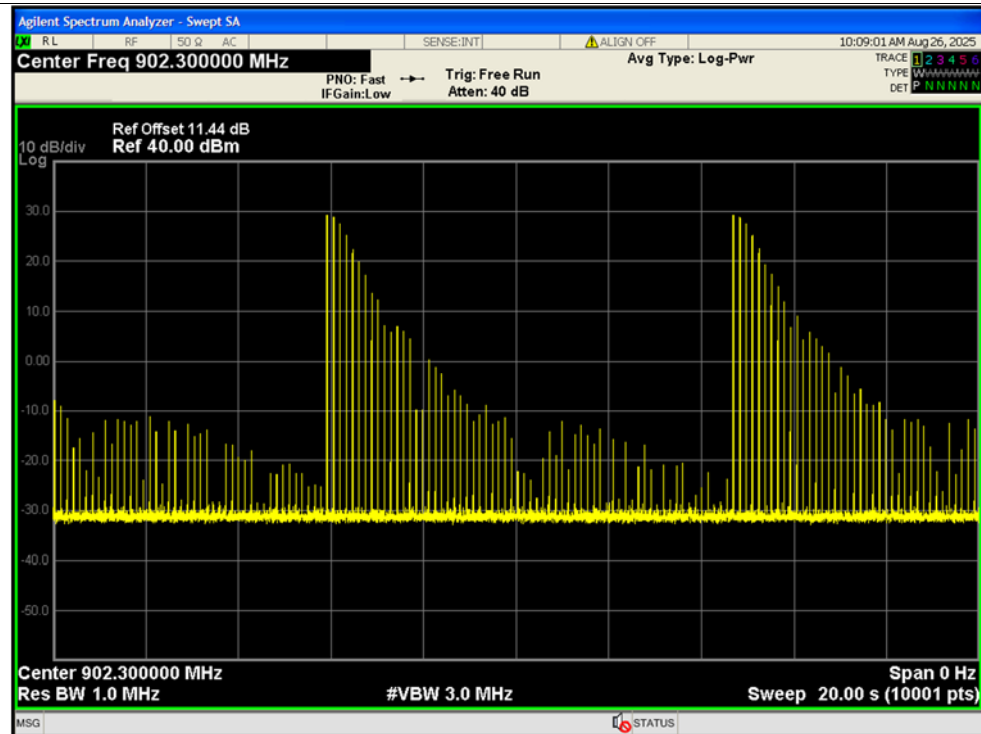
Condition	Mode	Frequency (MHz)	Antenna	Pulse Time (ms)	Total Dwell Time (ms)	Burst Count	Period Time (ms)	Limit (ms)	Verdict
NVNT	Lora-FHSS	902.3	Ant1	9.44	37.76	4	20000	400	Pass

Test Graphs

Dwell NVNT Lora-FHSS 902.3MHz Ant1 One Burst



Dwell NVNT Lora-FHSS 902.3MHz Ant1 Accumulated



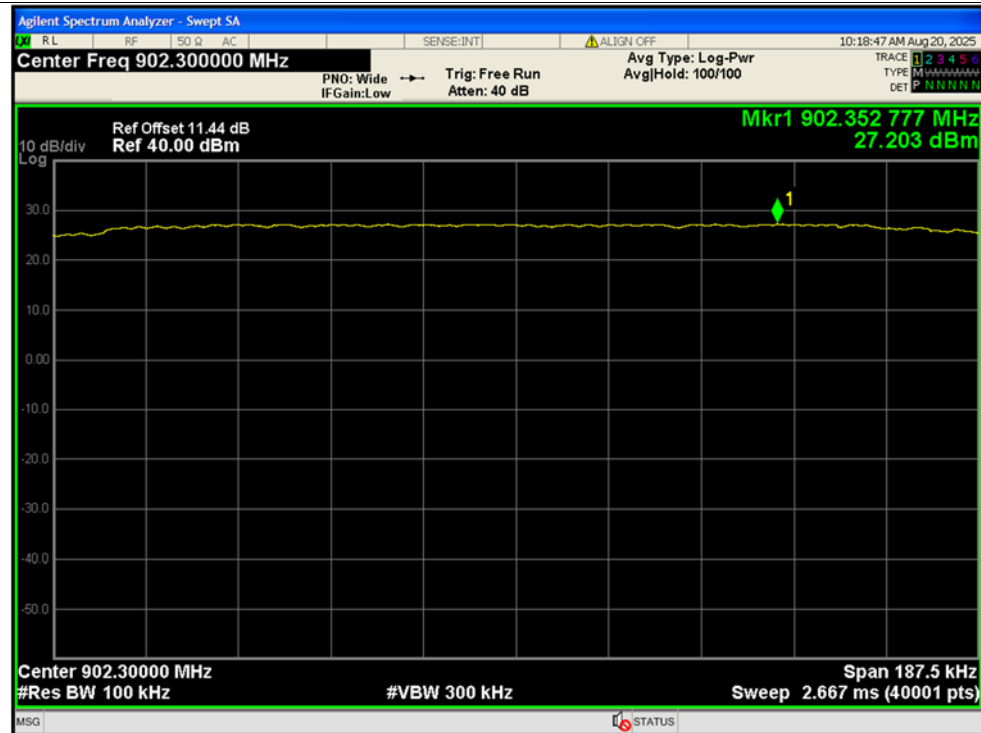
**A.8. Conducted Spurious Emissions**

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	Lora-FHSS	902.3	Ant1	-47.27	-20	Pass
NVNT	Lora-FHSS	908.7	Ant1	-47.82	-20	Pass
NVNT	Lora-FHSS	914.9	Ant1	-47.64	-20	Pass

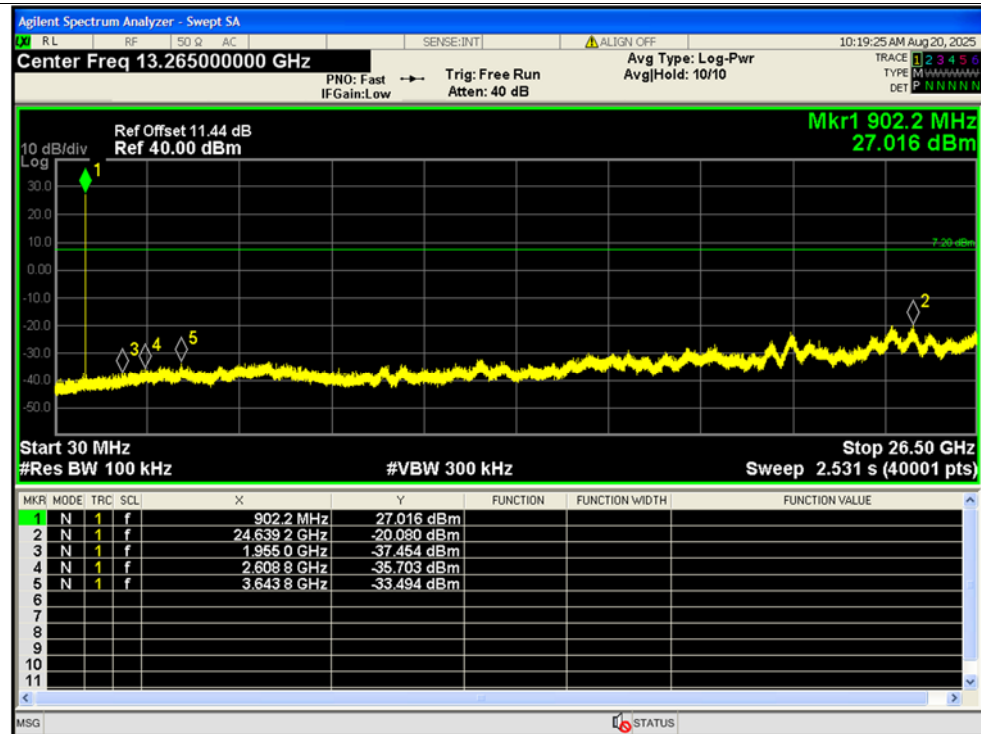


Test Graphs

Tx. Spurious NVNT Lora-FHSS 902.3MHz Ant1 Ref

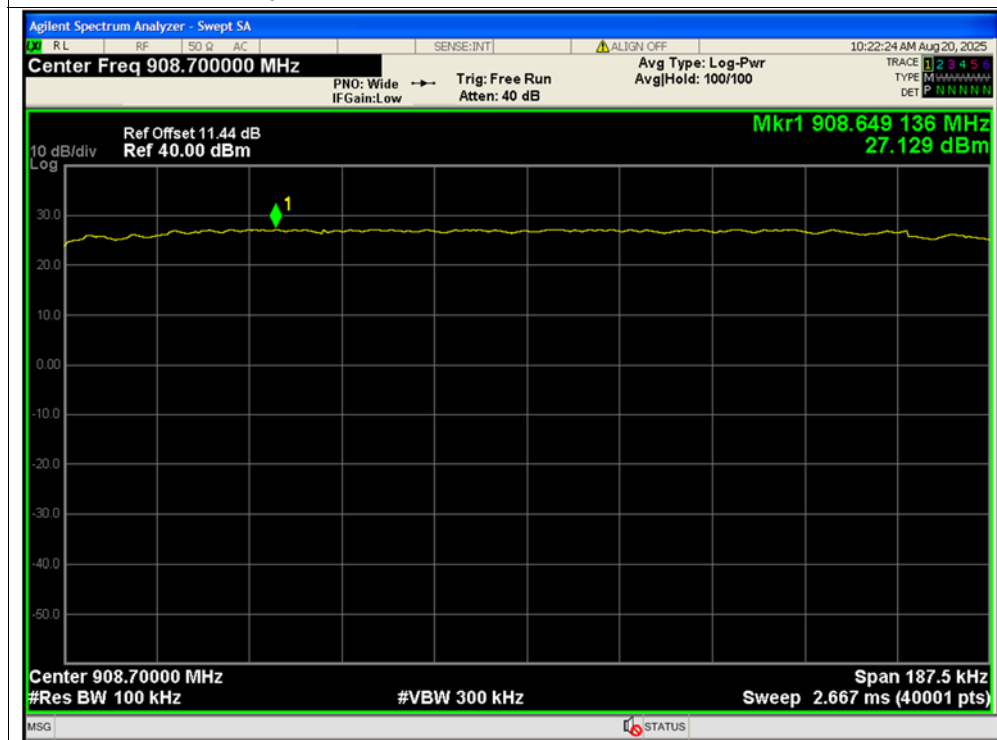


Tx. Spurious NVNT Lora-FHSS 902.3MHz Ant1 Emission

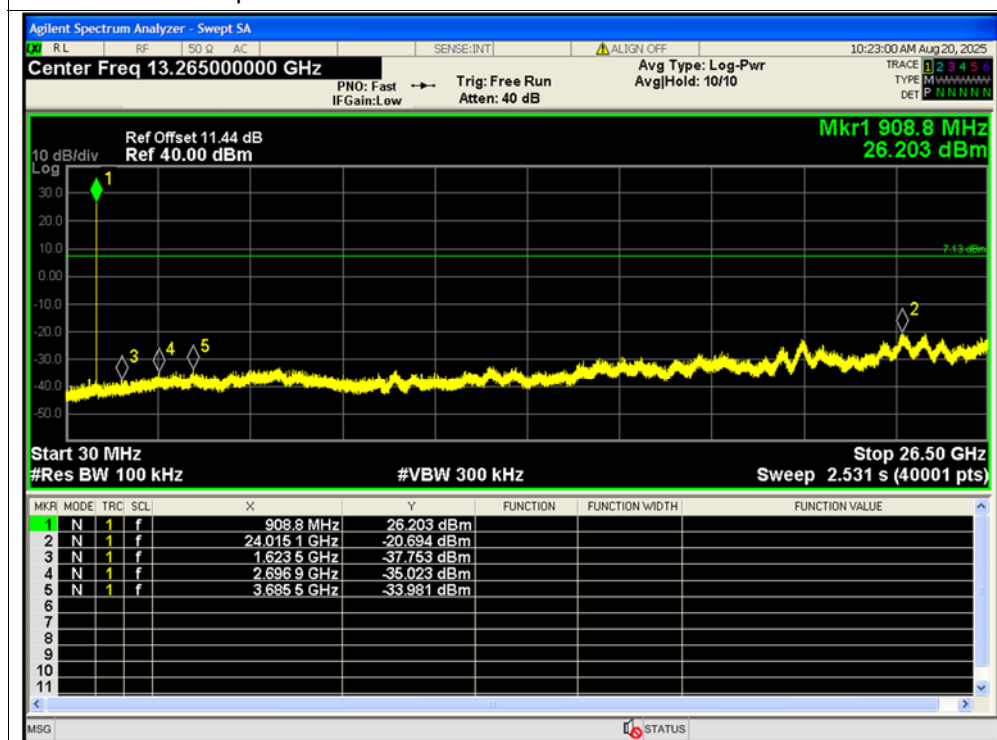




Tx. Spurious NVNT Lora-FHSS 908.7MHz Ant1 Ref

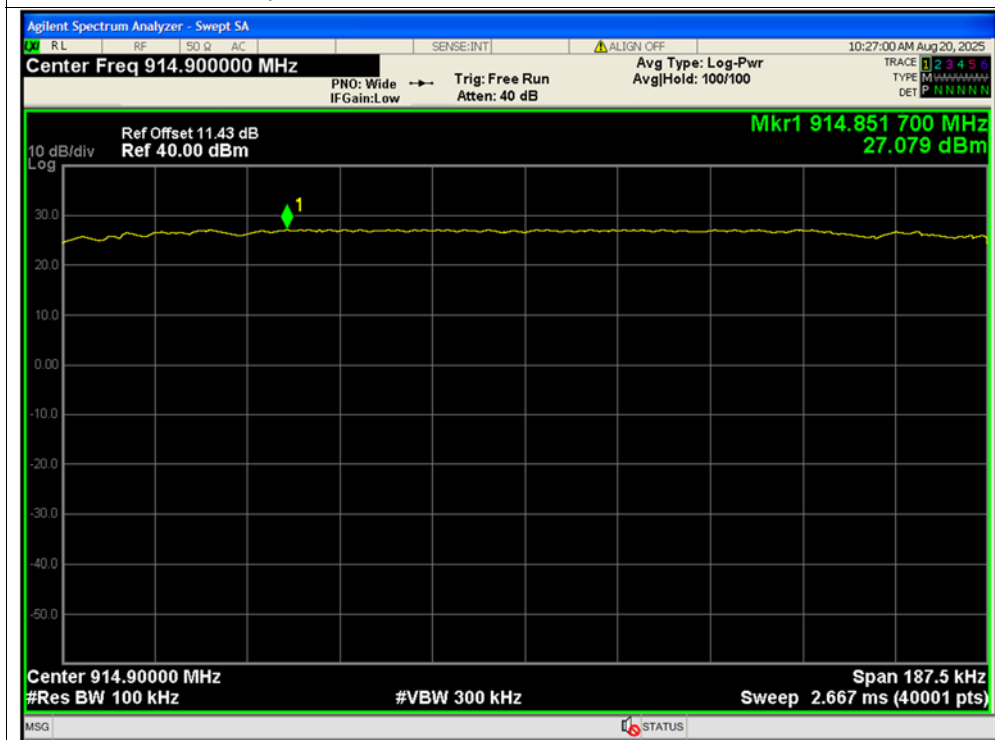


Tx. Spurious NVNT Lora-FHSS 908.7MHz Ant1 Emission

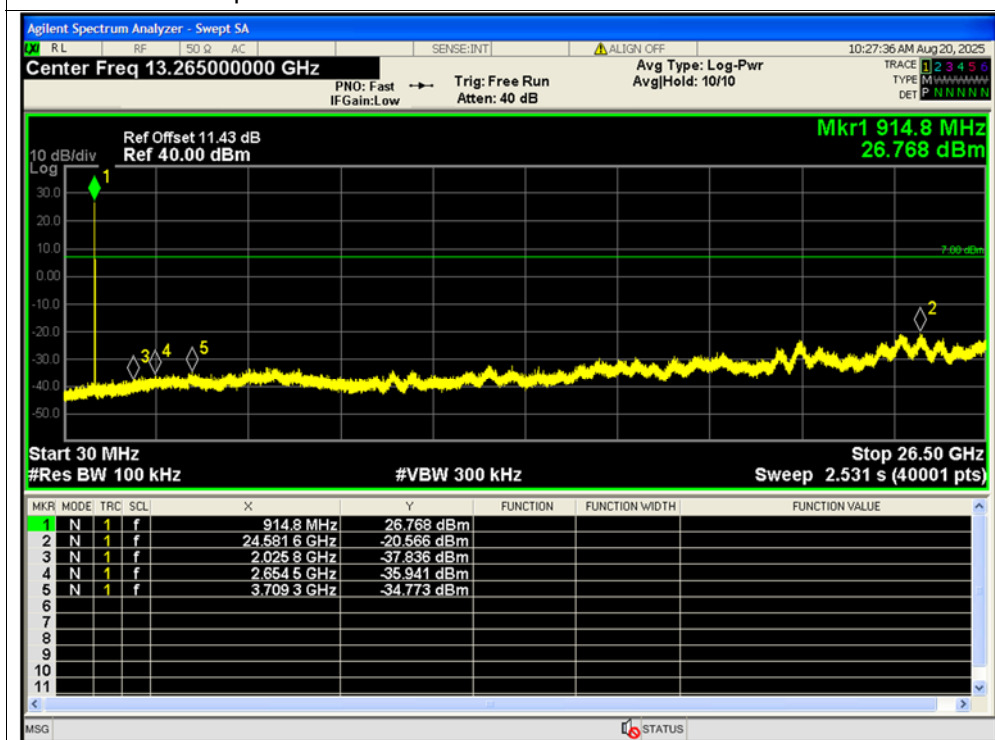




Tx. Spurious NVNT Lora-FHSS 914.9MHz Ant1 Ref



Tx. Spurious NVNT Lora-FHSS 914.9MHz Ant1 Emission

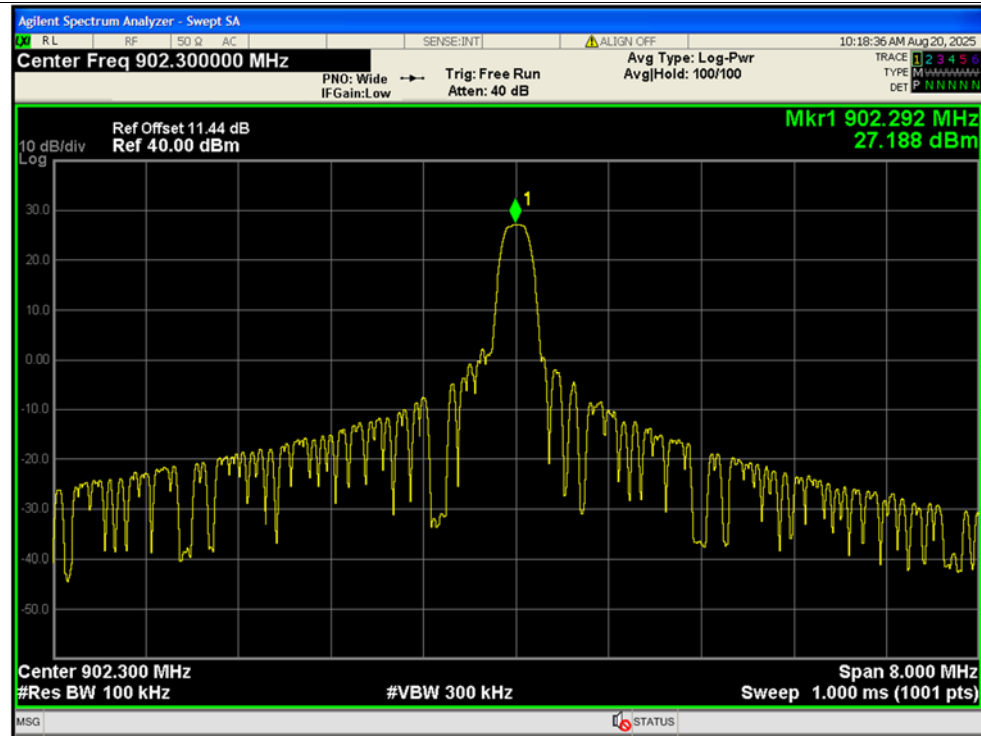


**A.9. Band Edge**

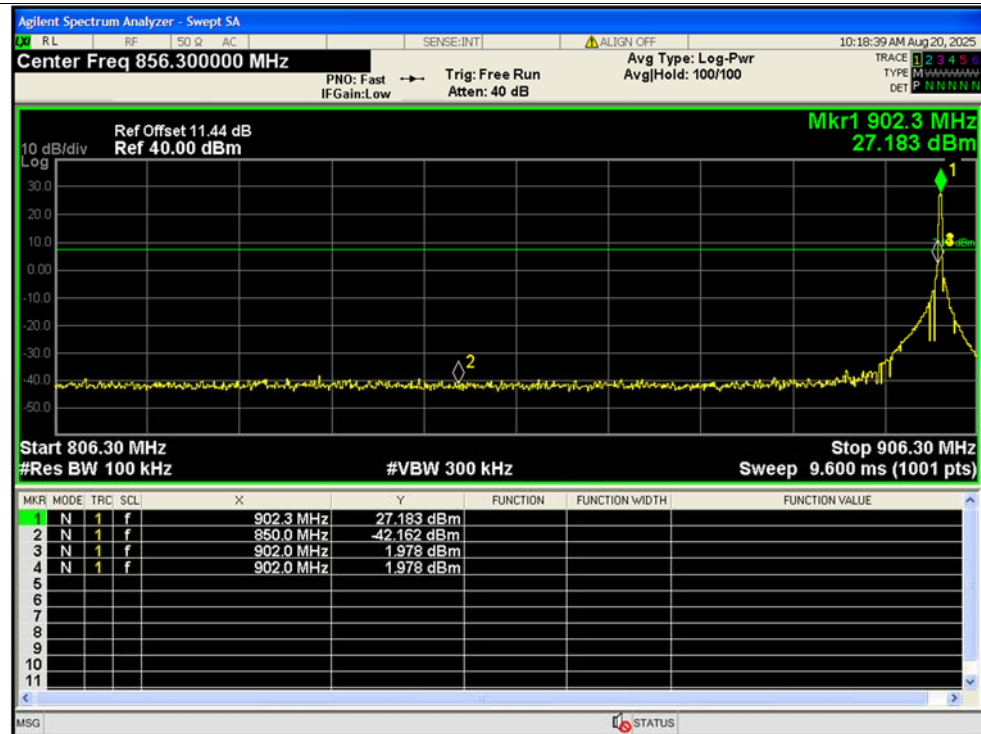
Condition	Mode	Frequency (MHz)	Antenna	Hopping Mode	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	Lora-FHSS	902.3	Ant1	No-Hopping	-25.22	-20	Pass
NVNT	Lora-FHSS	914.9	Ant1	No-Hopping	-65.72	-20	Pass
NVNT	Lora-FHSS	902.3	Ant1	Hopping	-44.09	-20	Pass
NVNT	Lora-FHSS	914.9	Ant1	Hopping	-66.43	-20	Pass

Test Graphs

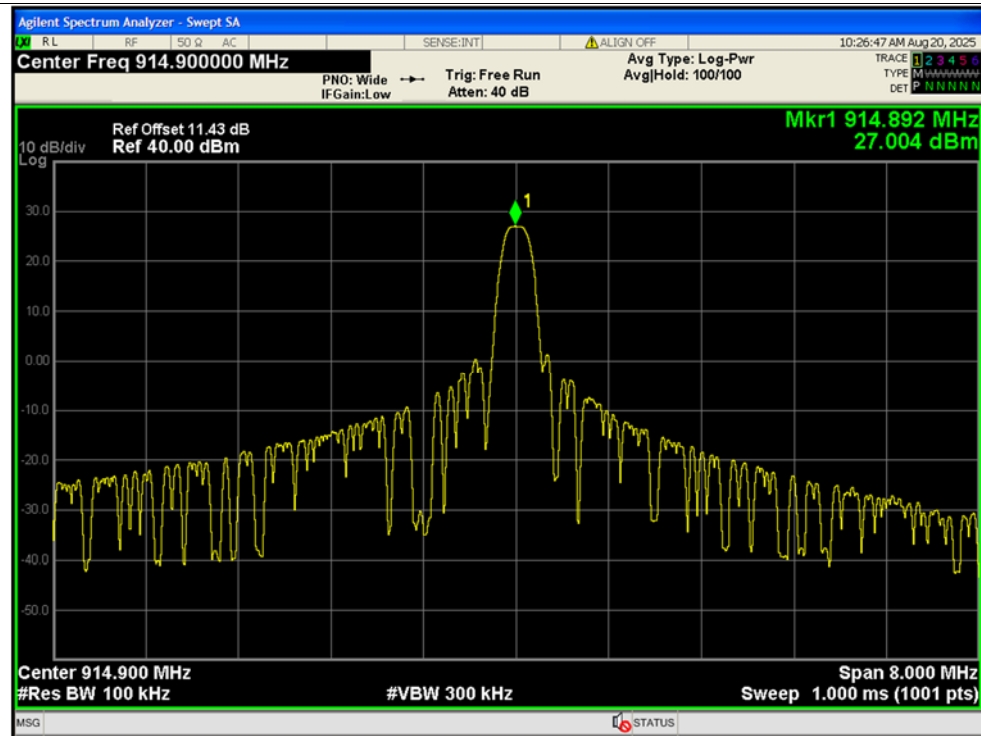
Band Edge NVNT Lora-FHSS 902.3MHz Ant1 No-Hopping Ref



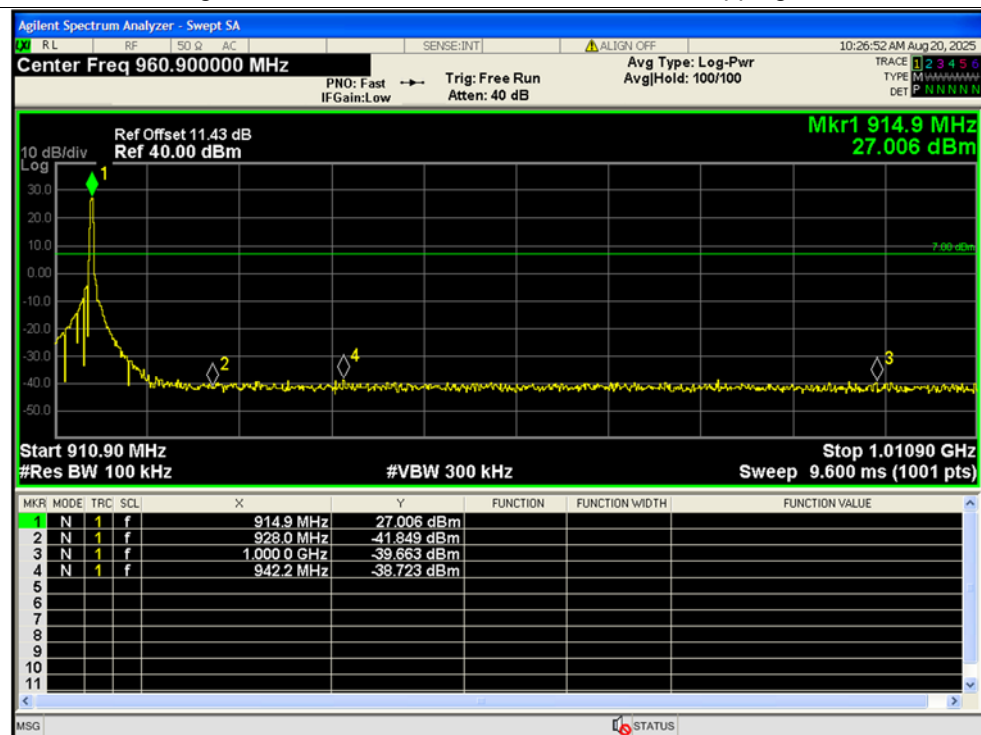
Band Edge NVNT Lora-FHSS 902.3MHz Ant1 No-Hopping Emission



Band Edge NVNT Lora-FHSS 914.9MHz Ant1 No-Hopping Ref

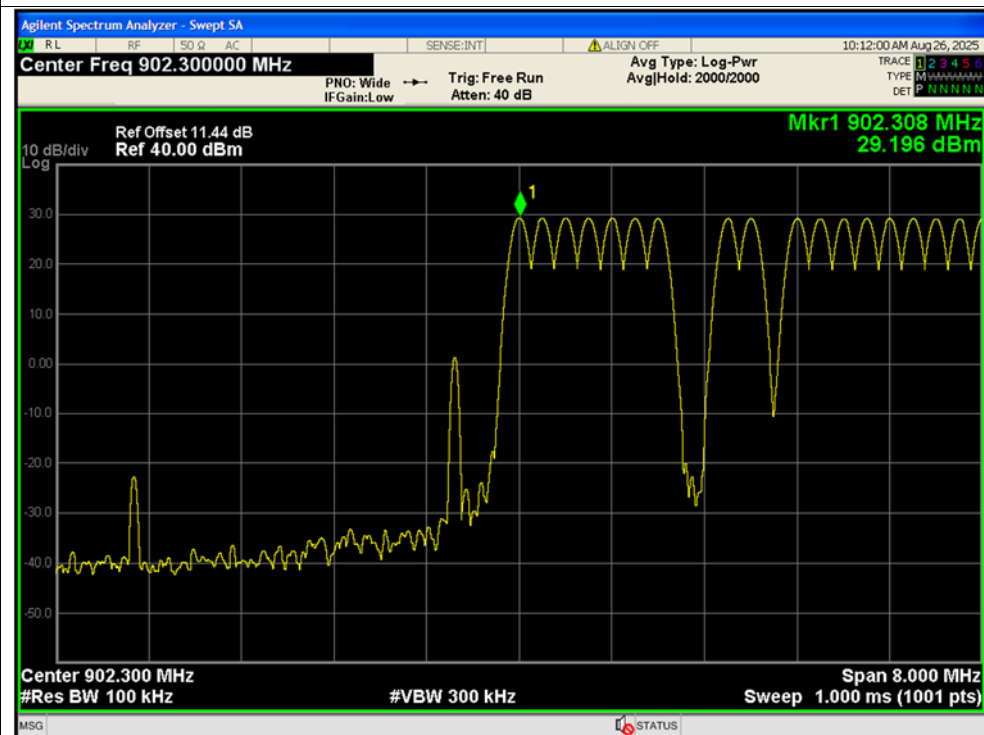


Band Edge NVNT Lora-FHSS 914.9MHz Ant1 No-Hopping Emission

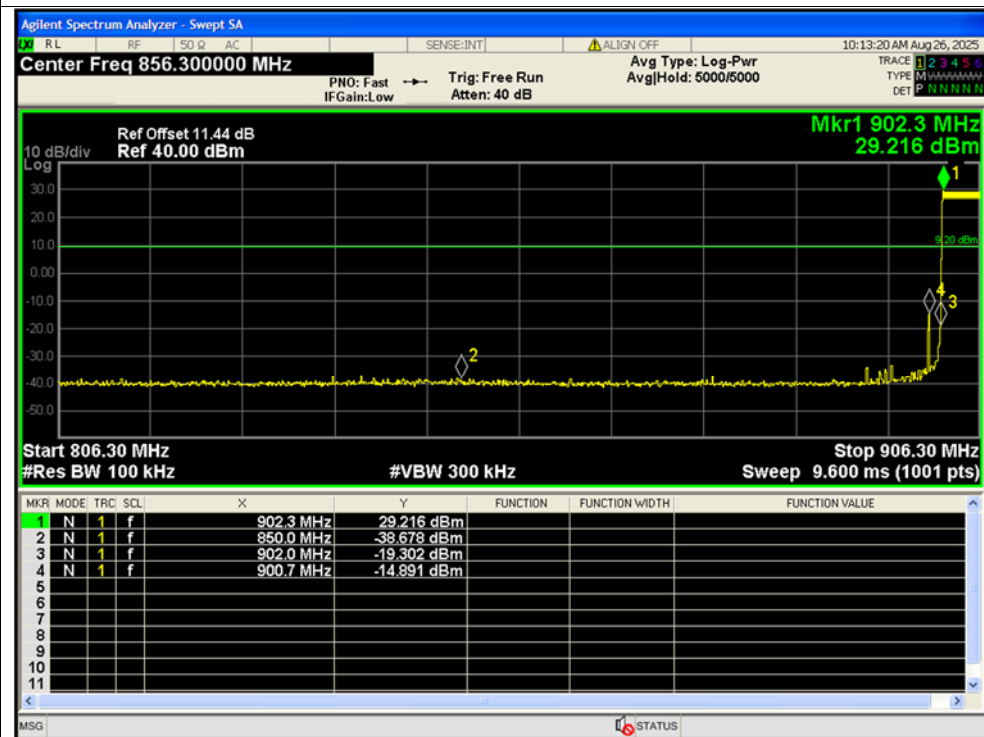


Test Graphs

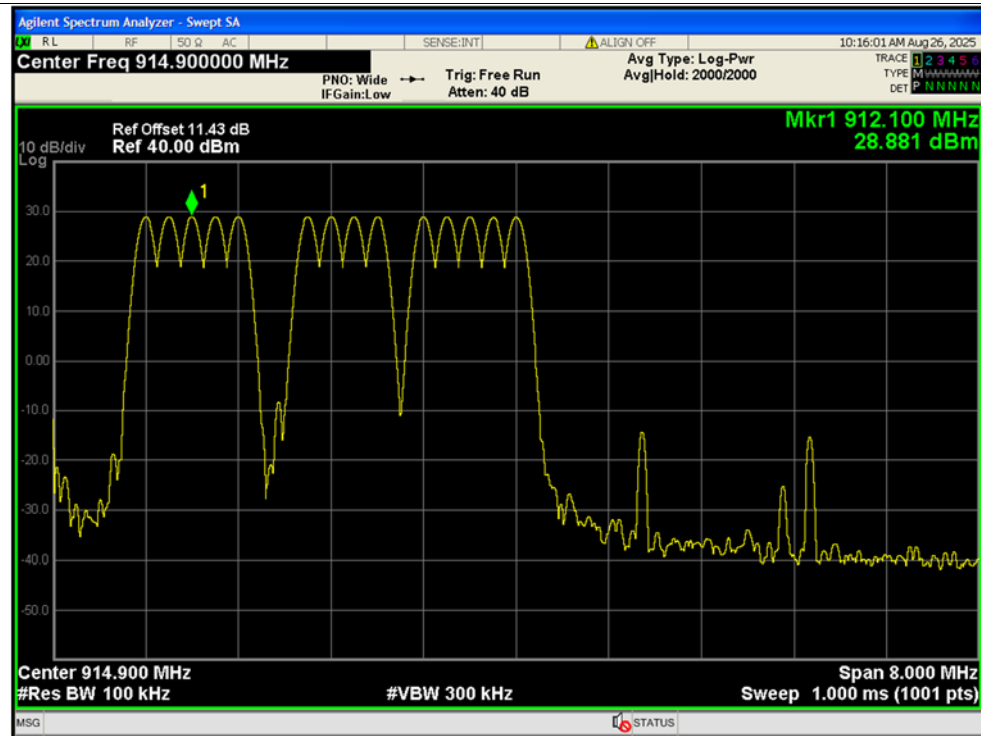
Band Edge(Hopping) NVNT Lora-FHSS 902.3MHz Ant1 Hopping Ref



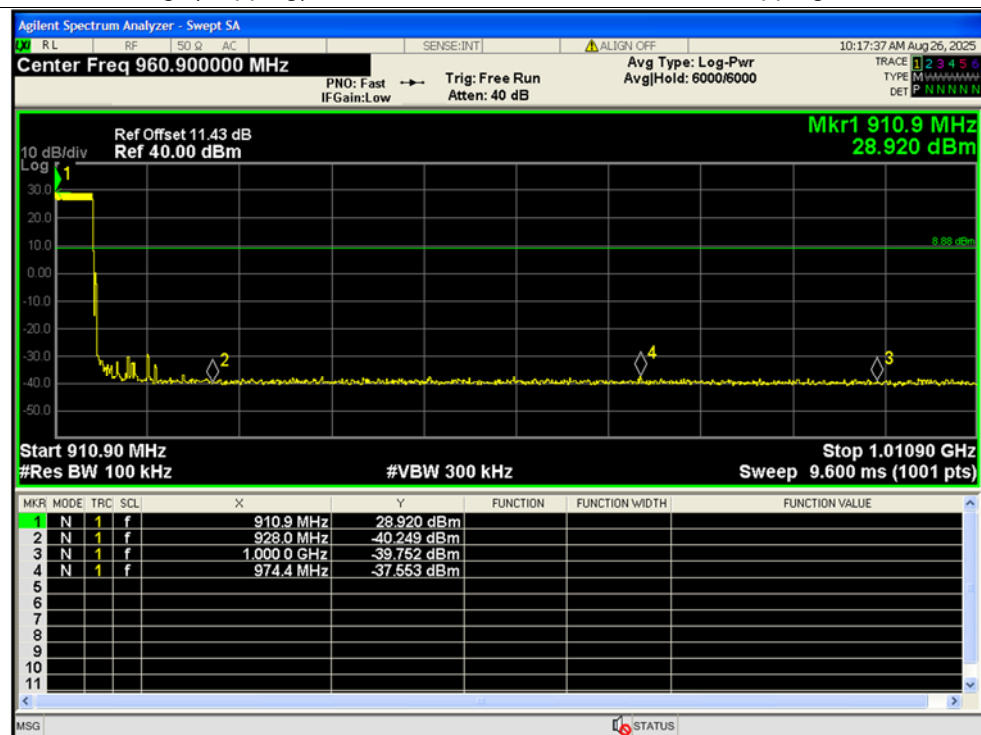
Band Edge(Hopping) NVNT Lora-FHSS 902.3MHz Ant1 Hopping Emission



Band Edge(Hopping) NVNT Lora-FHSS 914.9MHz Ant1 Hopping Ref



Band Edge(Hopping) NVNT Lora-FHSS 914.9MHz 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+Antenna+PC+PC adapter+Serial port board+LoRa TX

Test voltage: AC 120V/60Hz

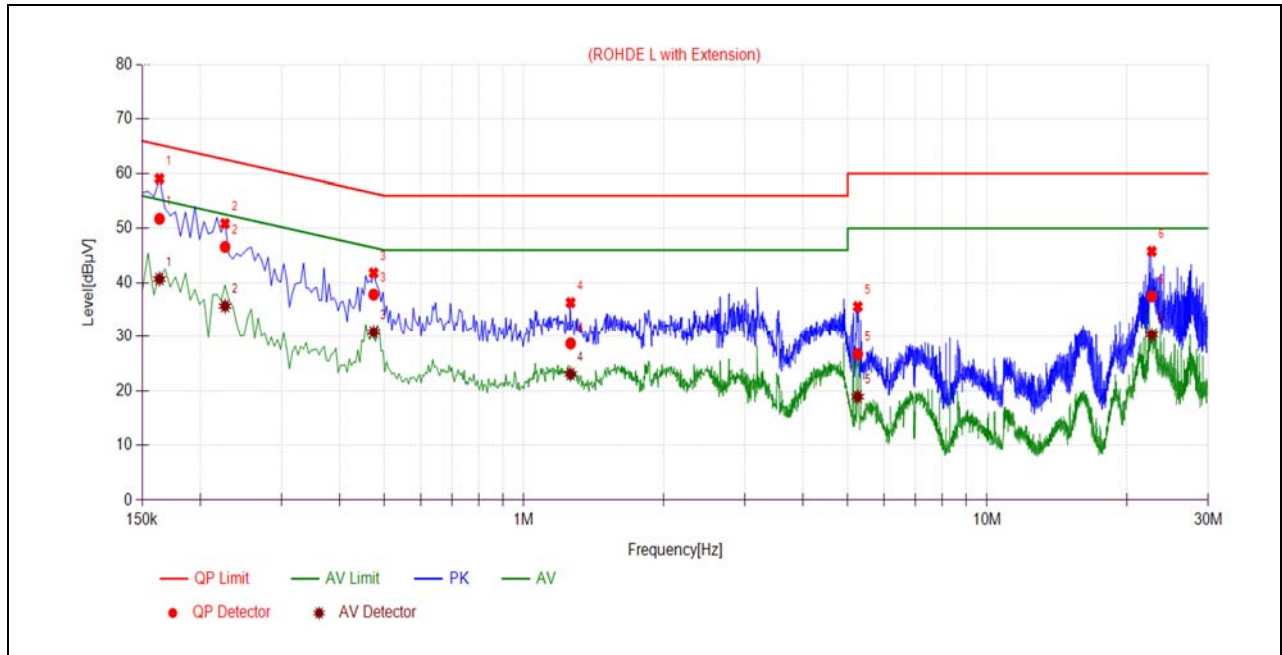
The measurement results are obtained as below:

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

U_R : Receiver Reading

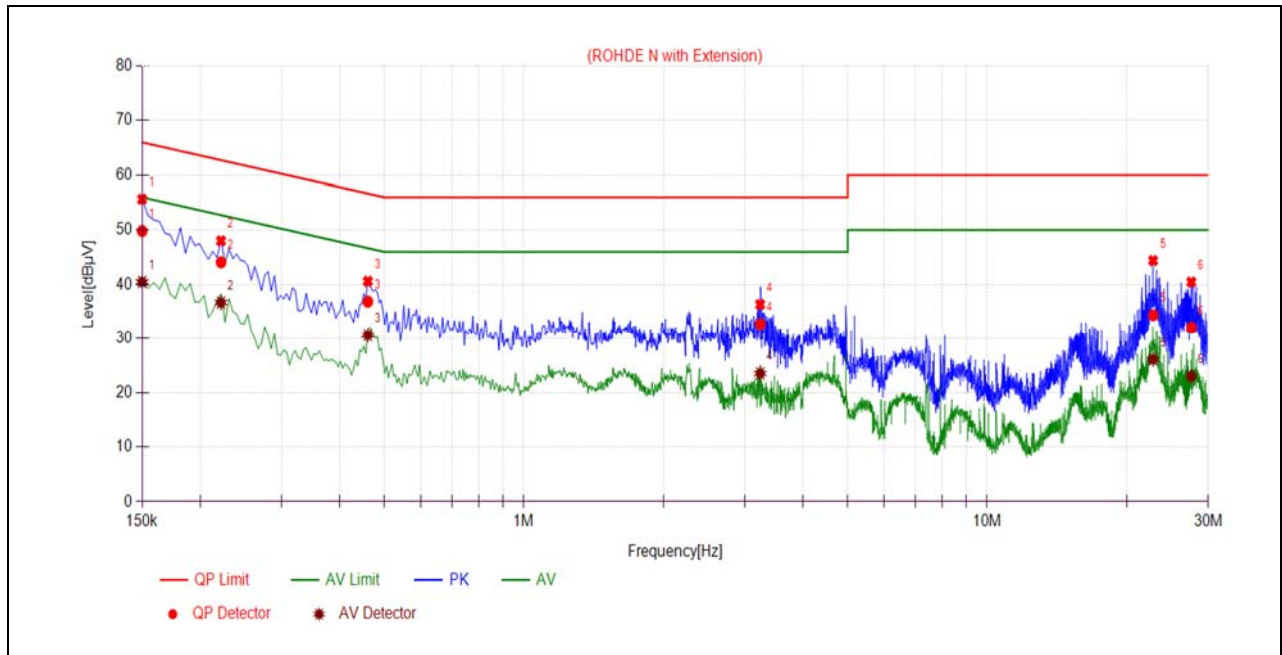
A_{Factor} : Voltage division factor of LISN

B. Test Plot:



(L Phase)

No.	Fre. (MHz)	Emission Level (dBμV)		Limit (dBμV)		Power-line	Verdict
		Quai-peak	Average	Quai-peak	Average		
1	0.1635	51.76	40.68	65.28	55.28	Line	PASS
2	0.2265	46.60	35.70	62.58	52.58		PASS
3	0.4740	37.83	30.81	56.44	46.44		PASS
4	1.2616	28.66	23.05	56.00	46.00		PASS
5	5.2571	26.70	18.88	60.00	50.00		PASS
6	22.6631	37.49	30.30	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	0.1500	49.85	40.50	66.00	56.00	Neutral	PASS
2	0.2220	44.10	36.71	62.74	52.74		PASS
3	0.4605	36.88	30.64	56.68	46.68		PASS
4	3.2370	32.73	23.50	56.00	46.00		PASS
5	22.8194	34.38	26.09	60.00	50.00		PASS
6	27.5813	32.07	22.99	60.00	50.00		PASS



A.11. 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:

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

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.

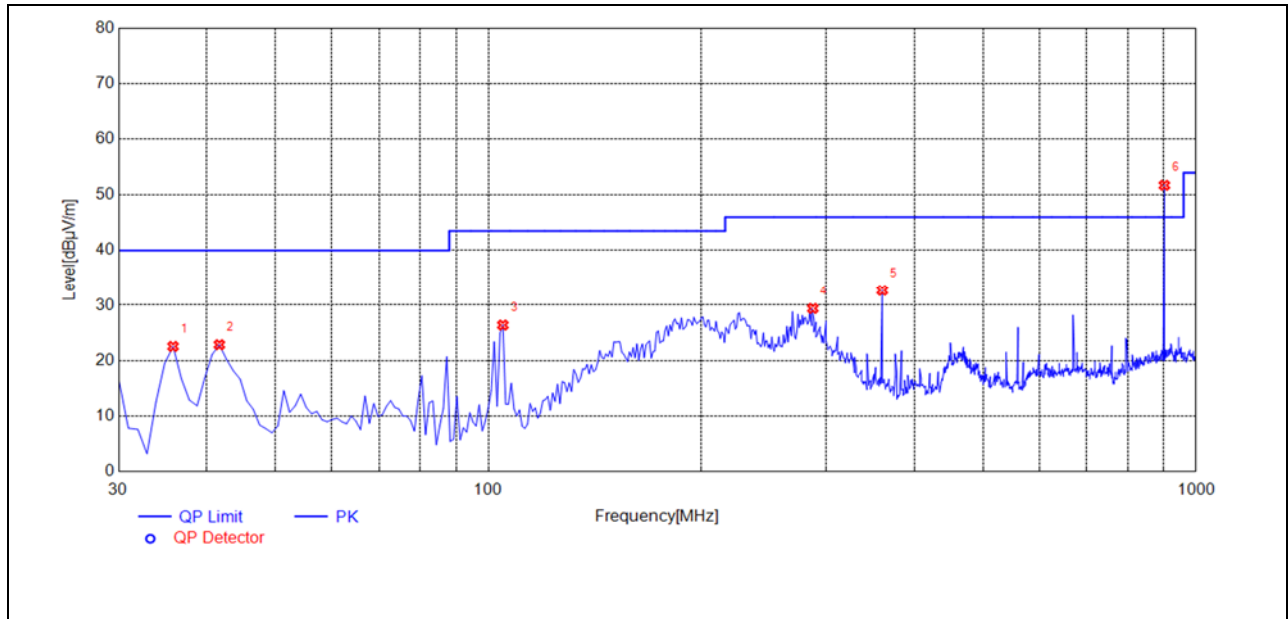
Note3: For the frequency, which started from 18GHz to 10th harmonic of the highest frequency, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Field strength of fundamental:

Frequency [MHz]	Reading [dB μ V]	Level [dB μ V/m]	Factor [dB/m]	Detector	Antenna Polarity
902.32	93.9	121.99	28.100	PK	Horizontal

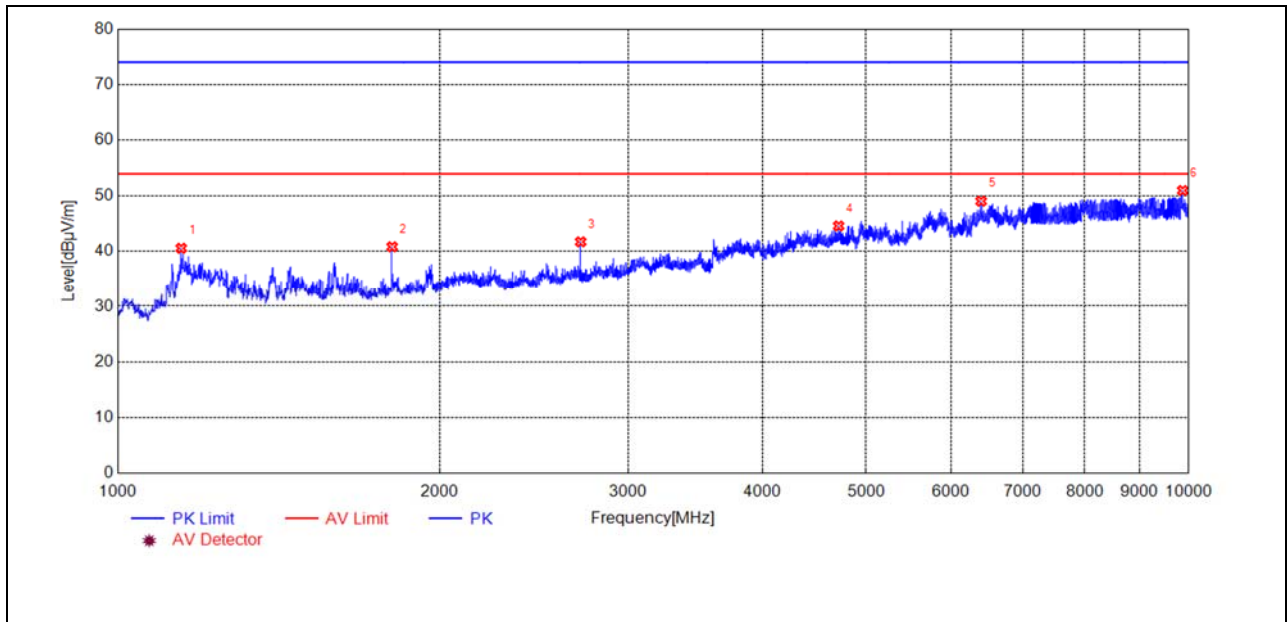
The field strength (the lowest) of fundamenta is more than 20dB higher than the unwanted emissions, in accordance with FCC part 15.215(b).

Plot for Channel 1



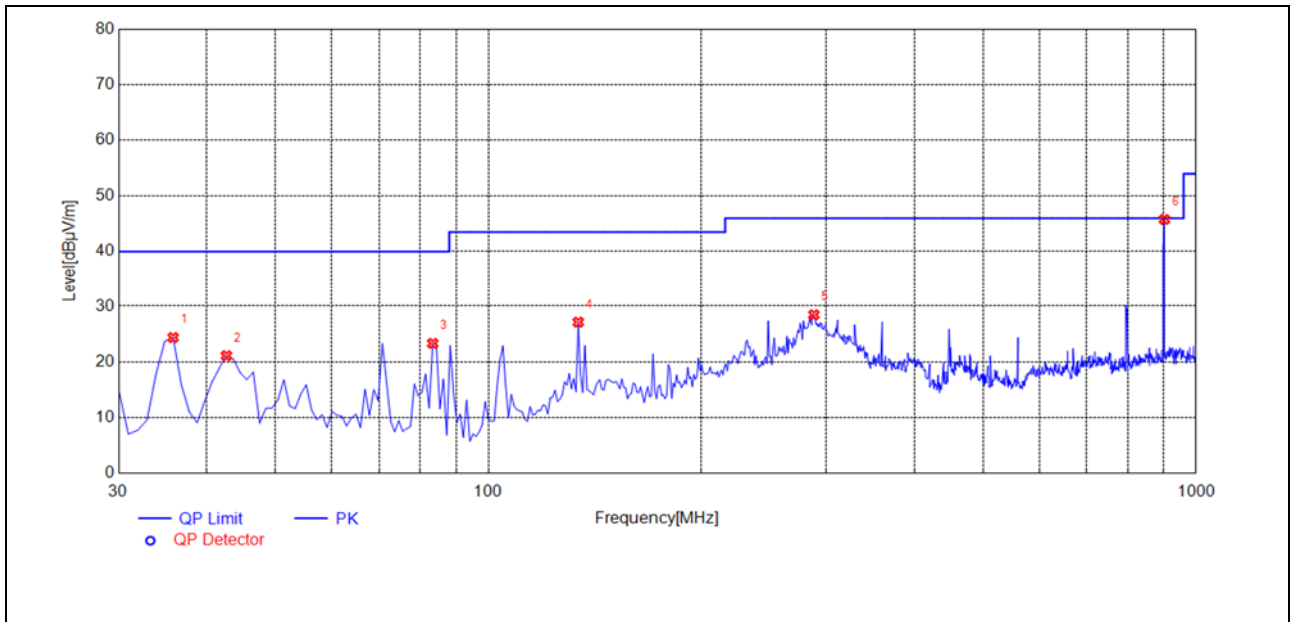
(Antenna Horizontal, 30MHz to 1GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
35.8258	22.53	-36.91	40.00	17.47	150	91	Horizontal	PASS
41.6517	22.83	-29.90	40.00	17.17	150	149	Horizontal	PASS
104.7648	26.38	-30.84	43.50	17.12	150	273	Horizontal	PASS
287.3073	29.39	-29.46	46.00	16.61	150	83	Horizontal	PASS
360.1301	32.68	-26.34	46.00	13.32	150	164	Horizontal	PASS
901.9319	51.75	-18.34	46.00	-5.75	150	18	Horizontal	NA



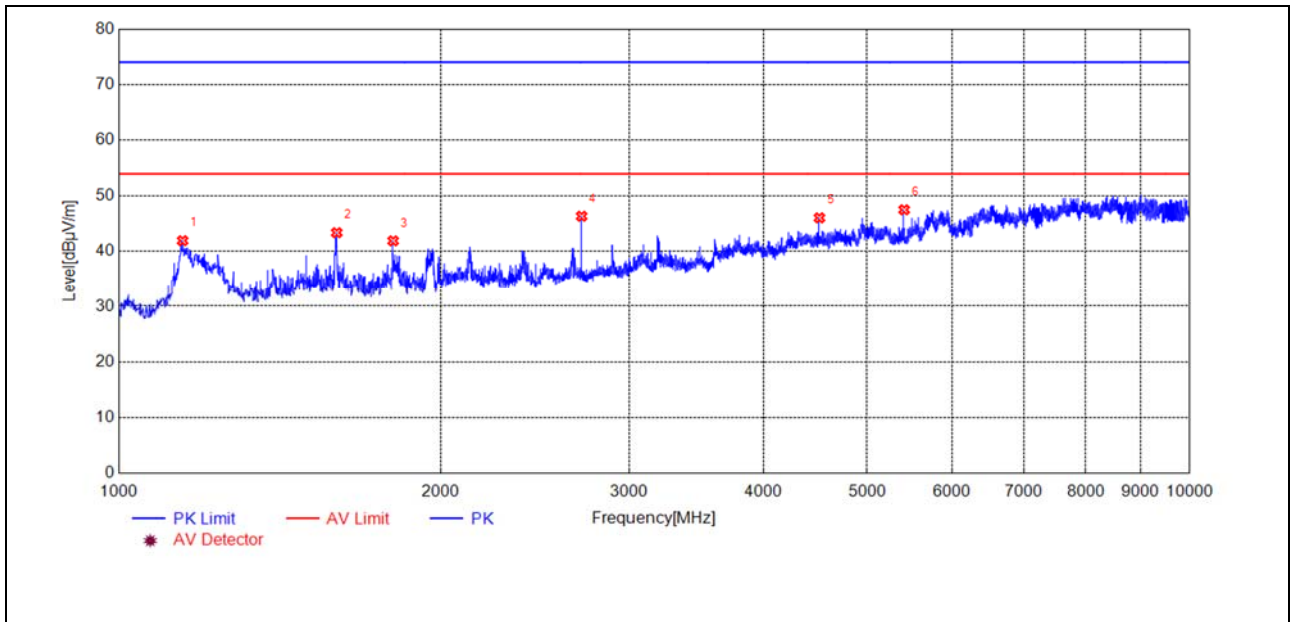
(Antenna Horizontal, 1GHz to 18GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1146.7147	40.58	-24.37	74.00	33.42	150	243	Horizontal	PASS
1804.6805	40.84	-22.66	74.00	33.16	150	232	Horizontal	PASS
2706.5707	41.74	-19.33	74.00	32.26	150	303	Horizontal	PASS
4712.8713	44.61	-11.23	74.00	29.39	150	37	Horizontal	PASS
6402.3402	49.07	-5.45	74.00	24.93	150	359	Horizontal	PASS
9873.9874	50.99	1.48	74.00	23.01	150	162	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

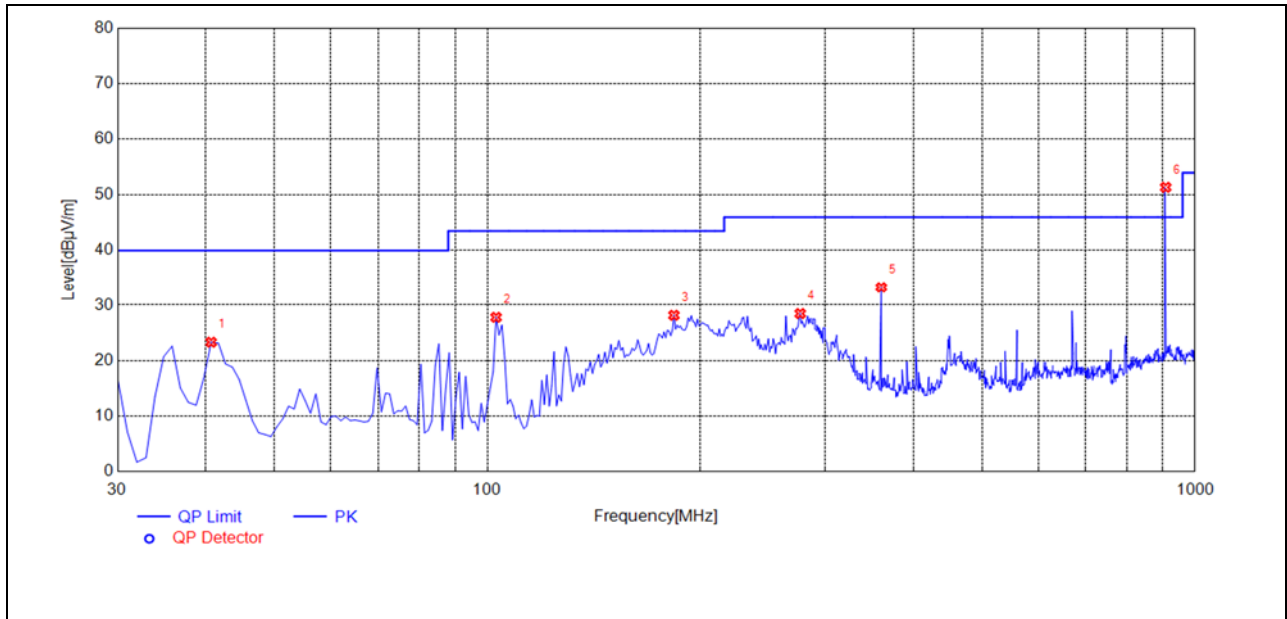
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
35.8258	24.35	-36.91	40.00	15.65	150	291	Vertical	PASS
42.6226	21.09	-29.77	40.00	18.91	150	306	Vertical	PASS
83.4034	23.31	-33.46	40.00	16.69	150	7	Vertical	PASS
133.8939	27.11	-33.59	43.50	16.39	150	276	Vertical	PASS
288.2783	28.44	-29.42	46.00	17.56	150	0	Vertical	PASS
901.9319	45.79	-18.34	46.00	0.21	150	218	Vertical	NA



(Antenna Vertical, 1GHz to 18GHz)

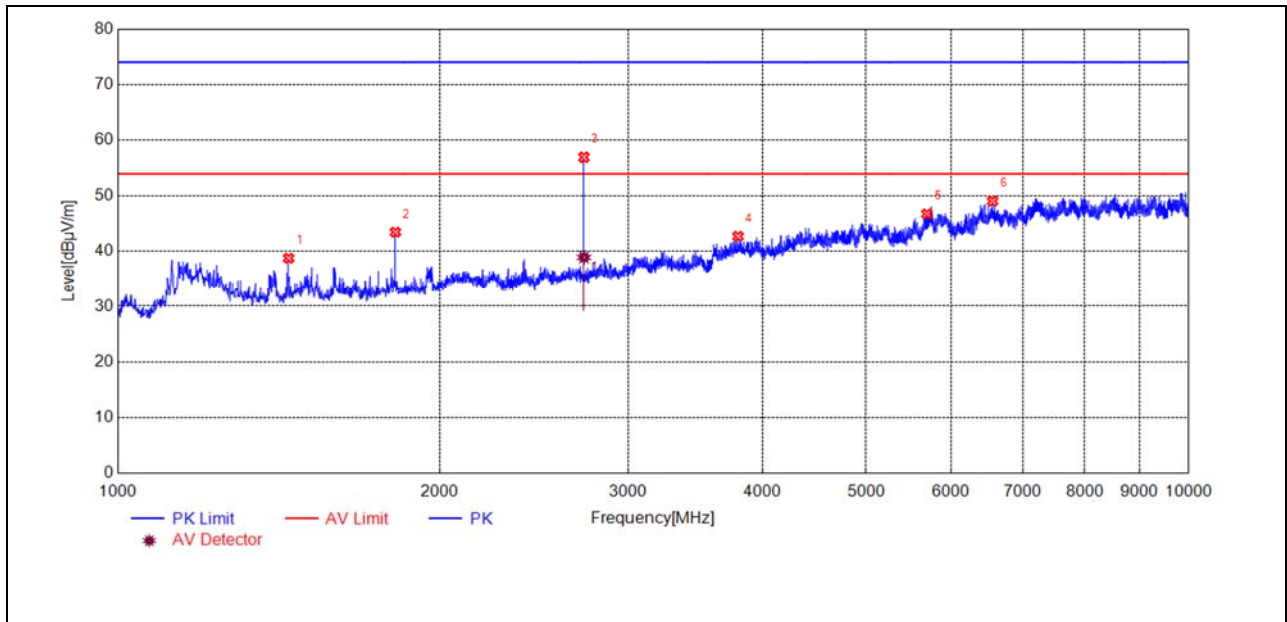
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1147.6148	41.95	-24.37	74.00	32.05	150	27	Vertical	PASS
1598.5599	43.39	-23.12	74.00	30.61	150	95	Vertical	PASS
1804.6805	41.92	-22.66	74.00	32.08	150	152	Vertical	PASS
2706.5707	46.36	-19.33	74.00	27.64	150	209	Vertical	PASS
4512.1512	46.07	-12.21	74.00	27.93	150	83	Vertical	PASS
5414.0414	47.52	-9.60	74.00	26.48	150	152	Vertical	PASS

Plot for Channel 33



(Antenna Horizontal, 30MHz to 1GHz)

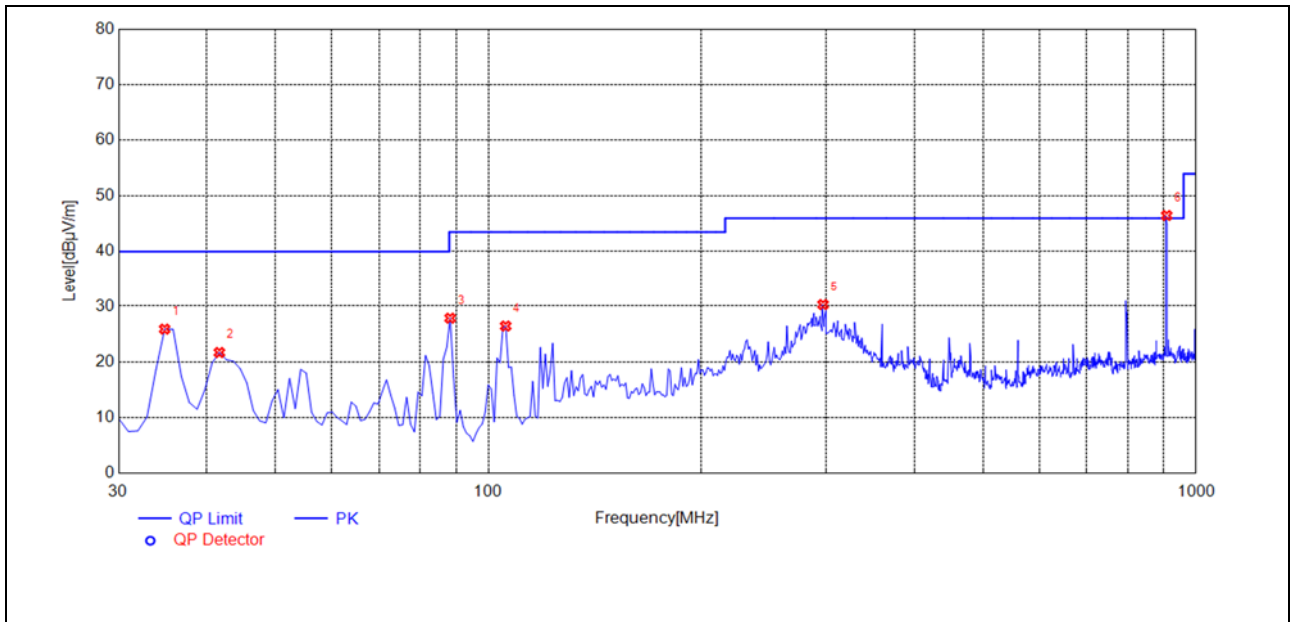
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
40.6807	23.29	-30.60	40.00	16.71	150	160	Horizontal	PASS
102.8228	27.77	-30.97	43.50	15.73	150	271	Horizontal	PASS
183.4134	28.14	-32.90	43.50	15.36	150	183	Horizontal	PASS
276.6266	28.45	-30.31	46.00	17.55	150	52	Horizontal	PASS
360.1301	33.26	-26.34	46.00	12.74	150	160	Horizontal	PASS
908.7287	51.38	-18.10	46.00	-5.38	150	168	Horizontal	NA



(Antenna Horizontal, 1GHz to 18GHz)

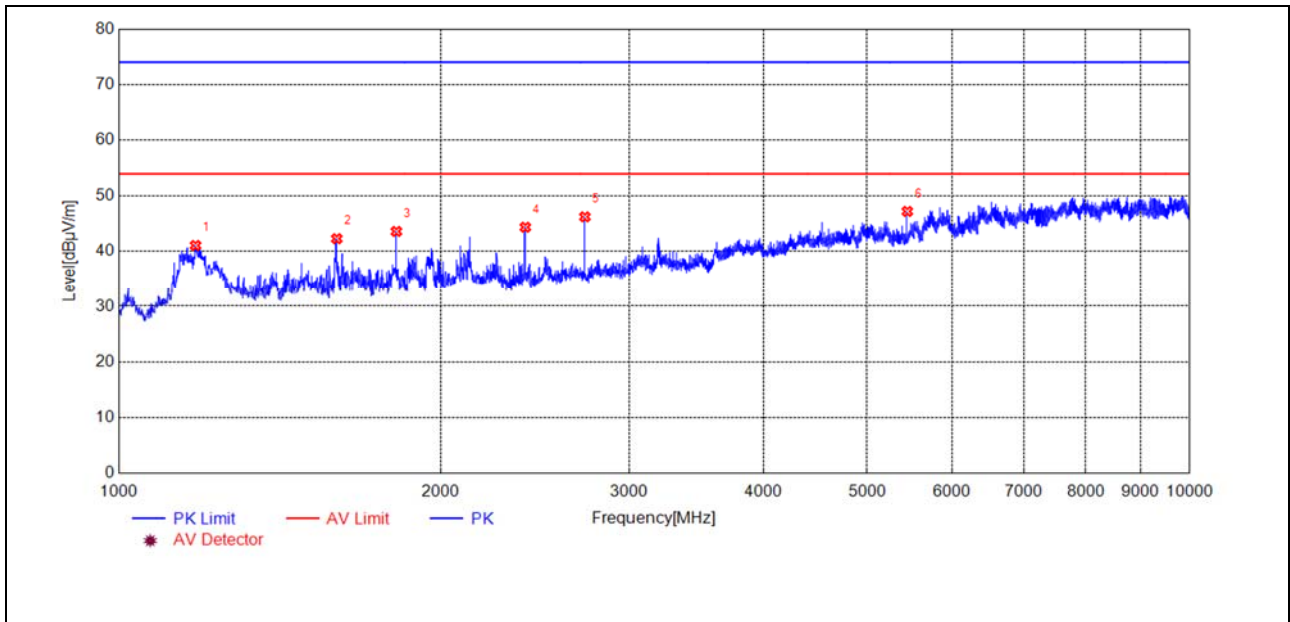
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1444.6445	38.79	-23.91	74.00	35.21	150	182	Horizontal	PASS
1817.2817	43.48	-22.67	74.00	30.52	150	288	Horizontal	PASS
2725.4725	56.94	-19.46	74.00	17.06	150	299	Horizontal	PASS
3796.5797	42.74	-14.48	74.00	31.26	150	276	Horizontal	PASS
5698.4698	46.77	-7.57	74.00	27.23	150	42	Horizontal	PASS
6562.5563	49.08	-4.82	74.00	24.92	150	76	Horizontal	PASS

Freq. [MHz]	Factor [dB]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
2725.672	-19.46	38.94	54.00	15.06	150	298	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

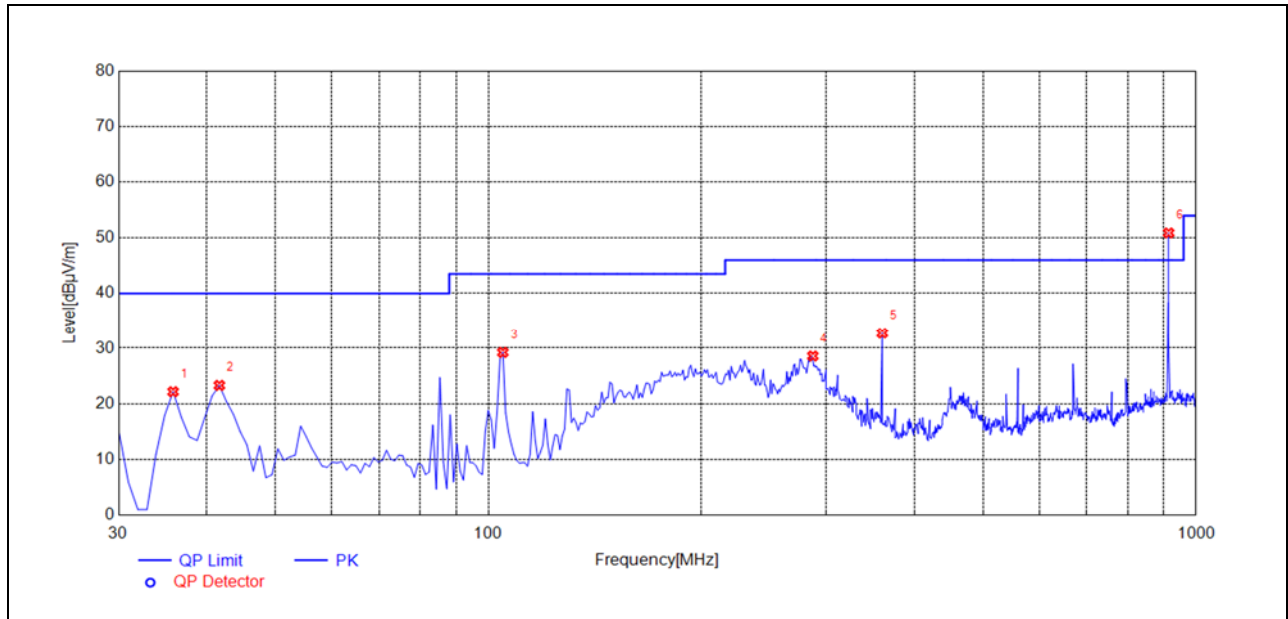
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
34.8549	25.87	-40.91	40.00	14.13	150	126	Vertical	PASS
41.6517	21.67	-29.90	40.00	18.33	150	192	Vertical	PASS
88.2583	27.83	-33.93	43.50	15.67	150	351	Vertical	PASS
105.7357	26.41	-30.76	43.50	17.09	150	177	Vertical	PASS
297.0170	30.27	-28.97	46.00	15.73	150	39	Vertical	PASS
908.7287	46.49	-18.10	46.00	-0.49	150	163	Vertical	NA



(Antenna Vertical, 1GHz to 18GHz)

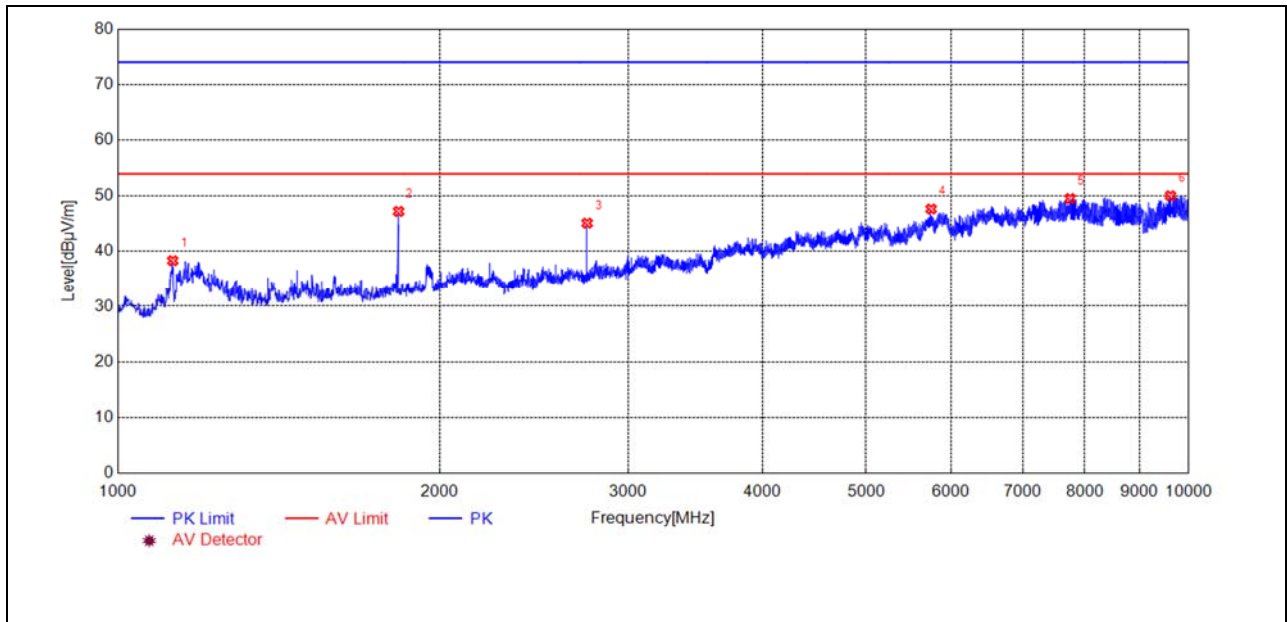
Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1180.0180	41.09	-24.52	74.00	32.91	150	187	Vertical	PASS
1598.5599	42.31	-23.12	74.00	31.69	150	118	Vertical	PASS
1817.2817	43.62	-22.67	74.00	30.38	150	278	Vertical	PASS
2397.8398	44.38	-20.17	74.00	29.62	150	346	Vertical	PASS
2725.4725	46.25	-19.46	74.00	27.75	150	346	Vertical	PASS
5450.9451	47.23	-9.57	74.00	26.77	150	187	Vertical	PASS

Plot for Channel 64



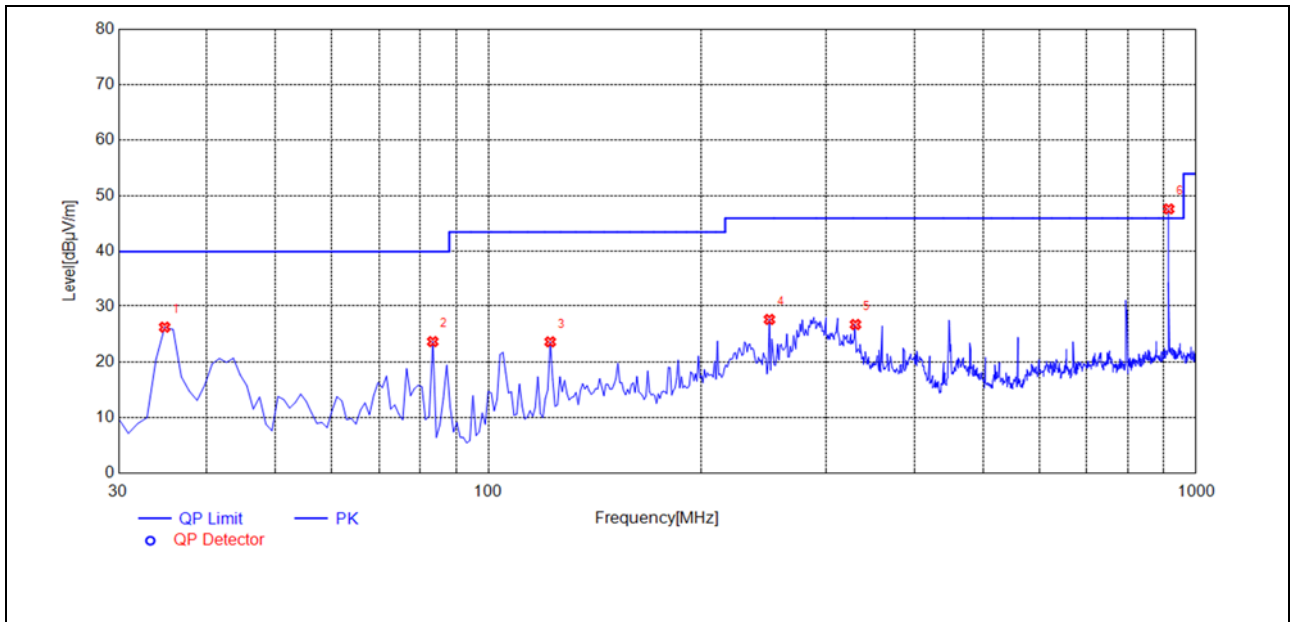
(Antenna Horizontal, 30MHz to 1GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
35.8258	22.15	-36.91	40.00	17.85	150	194	Horizontal	PASS
41.6517	23.28	-29.90	40.00	16.72	150	359	Horizontal	PASS
104.7648	29.21	-30.84	43.50	14.29	150	325	Horizontal	PASS
287.3073	28.56	-29.46	46.00	17.44	150	84	Horizontal	PASS
360.1301	32.70	-26.34	46.00	13.30	150	295	Horizontal	PASS
914.5546	50.90	-18.01	46.00	-4.90	150	244	Horizontal	NA



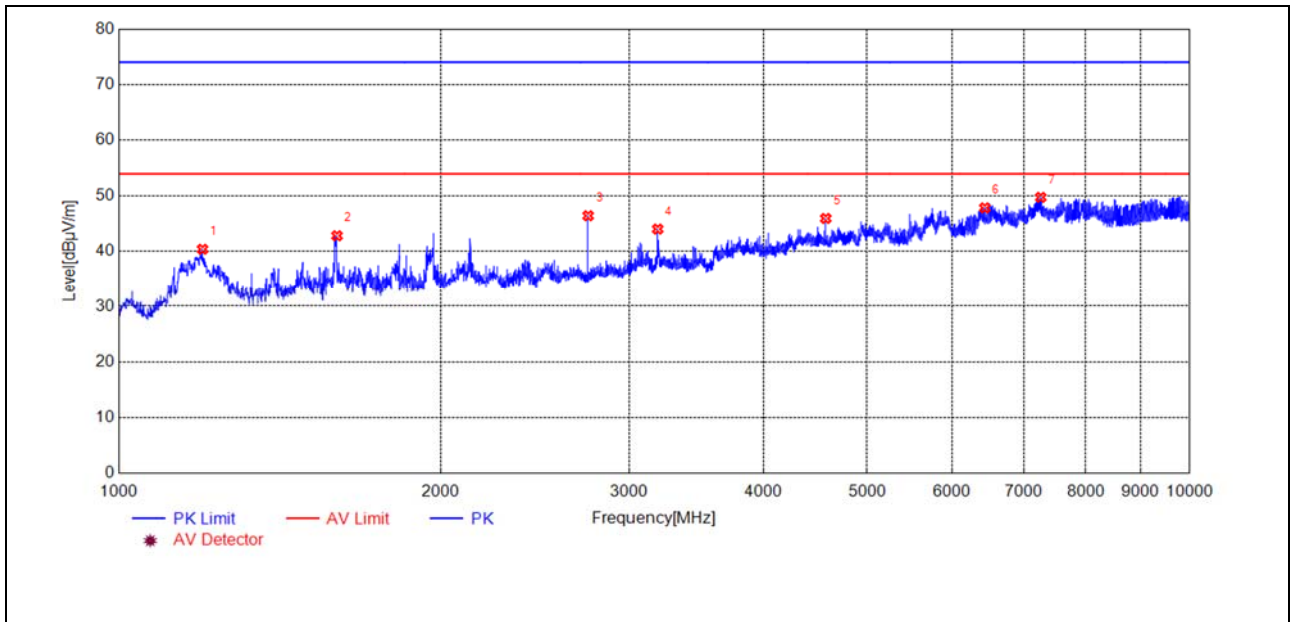
(Antenna Horizontal, 1GHz to 18GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1126.0126	38.33	-24.43	74.00	35.67	150	98	Horizontal	PASS
1829.8830	47.22	-22.69	74.00	26.78	150	41	Horizontal	PASS
2744.3744	45.11	-19.58	74.00	28.89	150	289	Horizontal	PASS
5749.7750	47.66	-6.73	74.00	26.34	150	334	Horizontal	PASS
7751.5752	49.55	-3.11	74.00	24.45	150	177	Horizontal	PASS
9618.3618	50.05	0.61	74.00	23.95	150	53	Horizontal	PASS



(Antenna Vertical, 30MHz to 1GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
34.8549	26.21	-40.91	40.00	13.79	150	292	Vertical	PASS
83.4034	23.62	-33.46	40.00	16.38	150	95	Vertical	PASS
122.2422	23.58	-32.80	43.50	19.92	150	1	Vertical	PASS
249.4394	27.60	-30.32	46.00	18.40	150	283	Vertical	PASS
330.0300	26.69	-27.95	46.00	19.31	150	343	Vertical	PASS
914.5546	47.67	-18.01	46.00	-1.67	150	306	Vertical	NA



(Antenna Vertical, 1GHz to 18GHz)

Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1198.0198	40.41	-24.61	74.00	33.59	150	256	Vertical	PASS
1599.4599	42.84	-23.10	74.00	31.16	150	98	Vertical	PASS
2744.3744	46.45	-19.58	74.00	27.55	150	234	Vertical	PASS
3187.2187	44.04	-17.29	74.00	29.96	150	109	Vertical	PASS
4574.2574	45.96	-12.03	74.00	28.04	150	109	Vertical	PASS
6439.2439	47.87	-5.83	74.00	26.13	150	98	Vertical	PASS
7261.9262	49.77	-2.78	74.00	24.23	150	279	Vertical	PASS

————— END OF REPORT —————