RF Test Report

Applicant	:	Droople SA
Product Name	:	LoRa communication device for smart sensors
Trade Name	:	iLink
Model Number	:	iLink V4.1
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Received Date	:	Dec. 08, 2022
Test Period	:	Dec. 14 ~ Dec. 29, 2022
Issued Date	:	Apr. 26, 2023

Issued by

Eurofins E&E Wireless Taiwan Co., Ltd.
No. 140-1, Changan Street, Bade District,
Taoyuan City 334025, Taiwan (R.O.C.)
Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range: 9 kHz to 325 GHz (Bade test site)
Frequency Range: 9 kHz to 40 GHz (Wugu test site)
Test Firm MRA designation number: TW0010 (Bade test site)
Test Firm MRA designation number: TW0034 (Wugu test site)

Note:
1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
2.This report shall not be reproduced except in full, without the written approval of Eurofins E&E Wireless Taiwan Co., Ltd.
3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Version	Issued Date	Revisions	Revised By
00	Apr. 26, 2023	Initial Issue	Emma Chao

Verification of Compliance

Applicant	:	Droople SA
Product Name	:	LoRa communication device for smart sensors
Trade Name	:	iLink
Model Number	:	iLink V4.1
FCC ID	:	2A9M4DRP-ILK-V4-1
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	Eurofins E&E Wireless Taiwan Co., Ltd. No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330

Testing Laboratory 1330

Eurofins E&E Wireless Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Eurofins E&E Wireless Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Kai Yu Yang

TABLE OF CONTENTS

1 General Information

1.1. Summary of Test Result

Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	N/A	Note
15.203	Antenna Requirement	PASS	-----
15.247(b)(2)	Max. Output Power	PASS	-----
15.247(f)	Power Spectral Density	PASS	-----
15.247(a)(1)	20 dB Bandwidth	PASS	-----
15.247(d)	Transmitter Radiated Emissions	PASS	-----
15.247(a)(1)	Carrier Frequency Separation	PASS	-----
15.247(f)	Time of Occupancy (Dwell Time)	PASS	-----
15.247(d)	Out of Band Conducted Spurious Emission	PASS	-----

Note. The device power was from battery.

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074 D01 15.247 Meas Guidance v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

Decision Rule

■ Uncertainty is not included.

☐ Uncertainty is included.

1.2. Testing Location

Lab Name: Eurofins E&E Wireless Taiwan Co., Ltd.

Site Address: ☐ No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.)

Site Address: ■ No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan (R.O.C.)

1.3. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	150 kHz ~ 30 MHz	2.7 dB
Radiated Emission	9 kHz ~ 30 MHz	1.9 dB
	30 MHz ~ 1000 MHz	4.9 dB
	1000 MHz ~ 18000 MHz	5.0 dB
	18000 MHz ~ 26500 MHz	4.4 dB
	26500 MHz ~ 40000 MHz	4.4 dB
Conducted Output Power	1.1 dB	
RF Bandwidth	4.7 %	
Power Spectral Density	1.1 dB	

2 EUT Description

Applicant	Droople SA Route du Verney 18, 1070 Puidoux, Switzerland	
Product Name	LoRa communication device for smart sensors	
Trade Name	iLink	
Model Number	iLink V4.1	
FCC ID	2A9M4DRP-ILK-V4-1	
Frequency Range	LoRa : 903.9 ~ 905.3 MHz	
Channel Numbers	8	
Modulation Type	Hybrid System (CSS + FHSS)	
Operate Temp. Range	-20 ~ +60 ℃	
EUT Power Rating	DC 3.3 V – 5 V	
Antenna information	Type	Max. Gain (dBi)
	ISM Antenna	1
RF Output Power	0.03273 W	
Blockchain verified QR code	BLOCKCHAIN VERIFIED	

3 Test Methodology

3.1. Mode of Operation

Decision of Test Eurofins has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Pre-Test Mode
Mode 1: Continuous TX mode (in LoRa spreading factor SF7 and coding rate 4/5)
Mode 2: Continuous TX mode (in LoRa spreading factor SF7 and coding rate 4/6)
Mode 3: Continuous TX mode (in LoRa spreading factor SF7 and coding rate 4/7)
Mode 4: Continuous TX mode (in LoRa spreading factor SF7 and coding rate 4/8)
Mode 5: Continuous TX mode (in LoRa spreading factor SF8 and coding rate 4/5)
Mode 6: Continuous TX mode (in LoRa spreading factor SF8 and coding rate 4/6)
Mode 7: Continuous TX mode (in LoRa spreading factor SF8 and coding rate 4/7)
Mode 8: Continuous TX mode (in LoRa spreading factor SF8 and coding rate 4/8)
Mode 9: Continuous TX mode (in LoRa spreading factor SF9 and coding rate 4/5)
Mode 10: Continuous TX mode (in LoRa spreading factor SF9 and coding rate 4/6)
Mode 11: Continuous TX mode (in LoRa spreading factor SF9 and coding rate 4/7)
Mode 12: Continuous TX mode (in LoRa spreading factor SF9 and coding rate 4/8)
Mode 13: Continuous TX mode (in LoRa spreading factor SF10 and coding rate 4/5)
Mode 14: Continuous TX mode (in LoRa spreading factor SF10 and coding rate 4/6)
Mode 15: Continuous TX mode (in LoRa spreading factor SF10 and coding rate 4/7)
Mode 16: Continuous TX mode (in LoRa spreading factor SF10 and coding rate 4/8)

Final-Test Mode
Mode 1: Continuous TX mode (in LoRa spreading factor SF7 and coding rate 4/5)

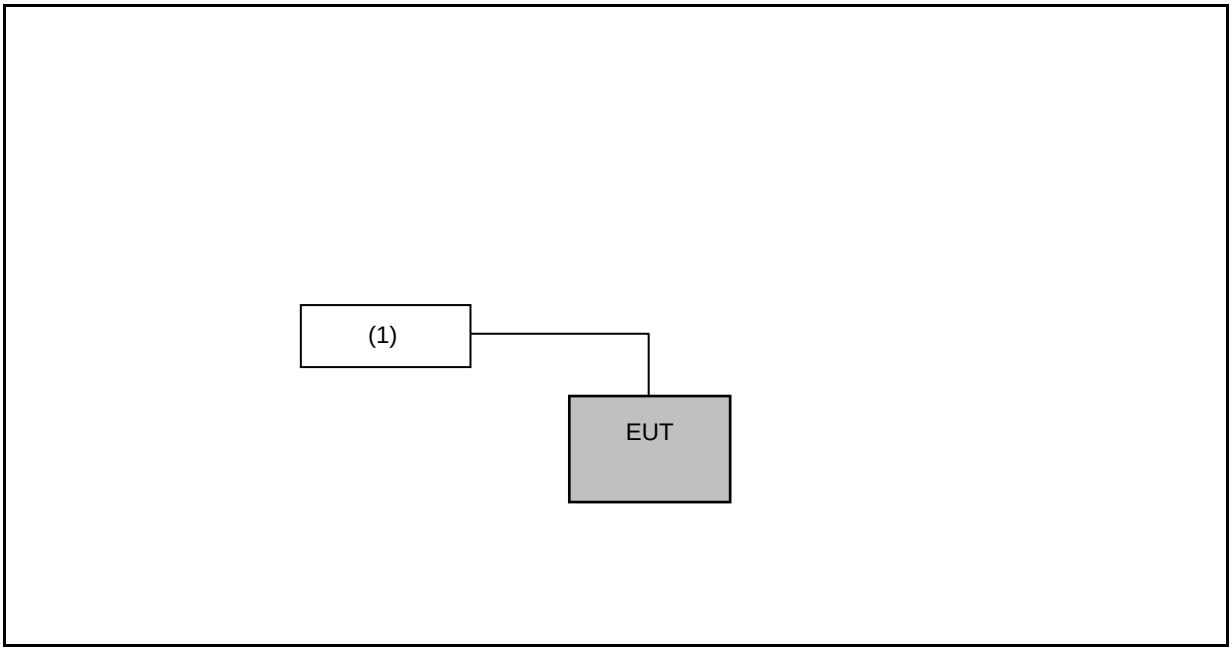
After verification, all tests were carried out with the worst case test modes.
By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Y axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

Channel List
903.9 MHz
904.1 MHz
904.3 MHz
904.5 MHz
904.7 MHz
904.9 MHz
905.1 MHz
905.3 MHz

3.2. EUT Test Step

1	Setup the EUT shown on “Configuration of Test System Details”.
2	Turn on the power of all equipment.
3	Turn on TX function.
4	EUT run test program.

3.3. Configuration of Test System Details



Devices Description					
Product		Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	GIGABYTE	AERO 15 OLED	---	---

3.4. Test Site Environment

Items	Required (IEC 60068-1)	Actual
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

3.5. Test Instruments

For Radiated Emissions

Test Period: Dec. 19 ~ Dec. 29, 2022

Testing Engineer: Jason Yeh

Radiation test sites		Semi Anechoic Room 96603-WG				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Trilog Broadband Antenna (30 kHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	1276	Jan. 05, 2022	1 year
☒	Broadband Horn Antenna (1 GHz~18 GHz)	RF SPIN	DRH18-E	210308A18ES	Mar. 07, 2022	1 year
☒	Spectrum Analyzer (2 Hz~50 GHz)	KEYSIGHT	N9030B	MY57143537	Apr. 14, 2022	1 year
☒	Pre-Amplifier	EMCI	EMC001330	980859	Dec. 01, 2022	1 year
☒	Pre-Amplifier	EMCI	EMC118A45SE	980818	Dec. 15, 2022	1 year
☒	Coaxial Cable (10kHz~3000mHz)	EMCI	EMCCFD400-NM-NM-2000	211009	Jan. 18, 2022	1 year
☒	Coaxial Cable (10kHz~3000mHz)	EMCI	EMCCFD400-NM-NM-2000	211010	Jan. 18, 2022	1 year
☒	Coaxial Cable (10kHz~3000mHz)	EMCI	EMCCFD400-NM-NM-6000	211018	Jan. 18, 2022	1 year
☒	Coaxial Cable (1GHz~18GHz)	EMCI	EMC104-SM-SM-1000	211029	Jan. 18, 2022	1 year
☒	Coaxial Cable (1GHz~18GHz)	EMCI	EMC104-SM-SM-2000	211033	Jan. 18, 2022	1 year
☒	Coaxial Cable (1GHz~18GHz)	EMCI	EMC104-SM-SM-8000	211038	Jan. 18, 2022	1 year
☒	Highpass Filter	Warison	STI15-9796	001	Nov. 12, 2022	1 year
☒	Software	RF automation	V1.2	N/A	N.C.R.	---

For Conducted

Test Period: Dec. 14 ~ Dec. 20, 2022

Testing Engineer: An Wu

Test Site		RF01-WG				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Switch Box	R&S	OSP-B157W8	100850	Dec. 20, 2021	1 year
☒	Spectrum Analyzer (10 Hz~44 GHz)	Agilent	N9020B	MY53120541	Feb. 17, 2022	1 year

Note: N.C.R. = No Calibration Request.

4 Measurement Procedure

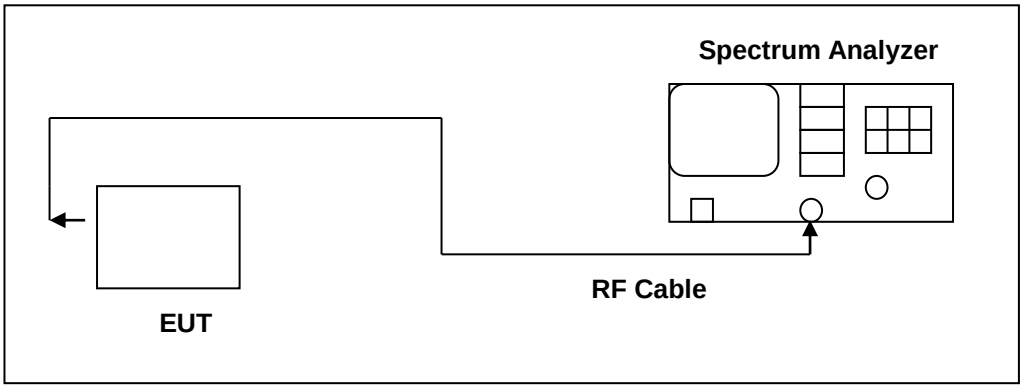
4.1. Maximum Conducted Output Power Measurement

■ **Limit**

For systems using digital modulation in the 902-928 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

■ **Test Setup**



■ **Test Procedure**

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The tests below are run with the EUT's transmitter set at high power in Transmit mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to spectrum analyzer.
Use a direct connection between the antenna port of transmitter and the spectrum analyzer, for prevent the spectrum analyzer input attenuation 40-50 dB. Set the RBW Bandwidth of the emission or use a channel power function.
For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6)/3 dBm.
The antenna port of the EUT was connected to the input of a power sensor. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

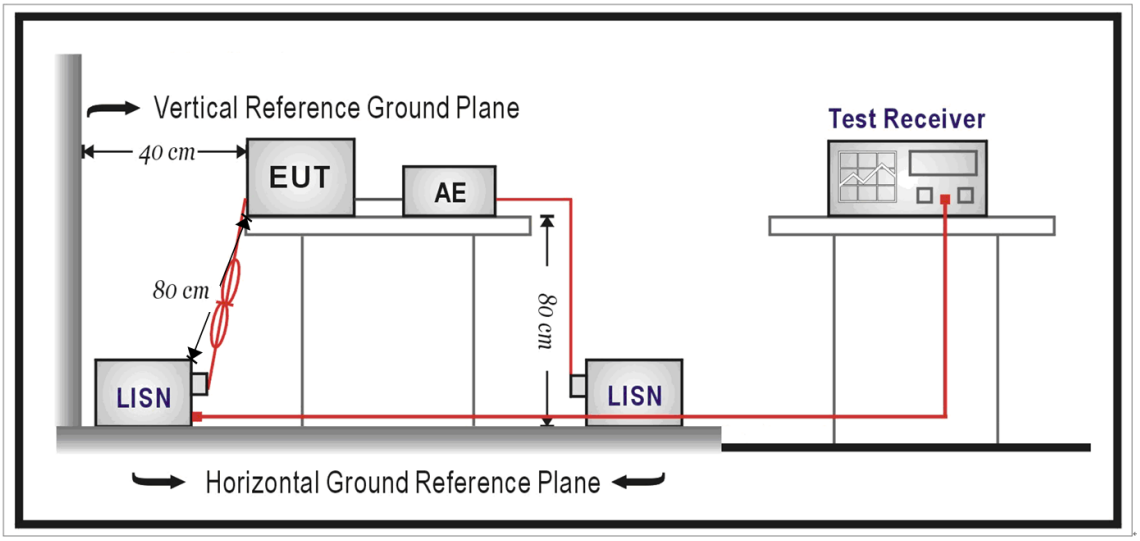
The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:
a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = No faster than coupled (auto) time.
e) Detector = peak.
f) Trace mode = max-hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

4.2. AC Power Line Conducted Emission Measurement

■ **Limit**

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

■ **Test Setup**



■ **Test Procedure**

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 Ω// 50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 Ω// 50 uH coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.3. Radiated Emission Measurement

■ **Limit**

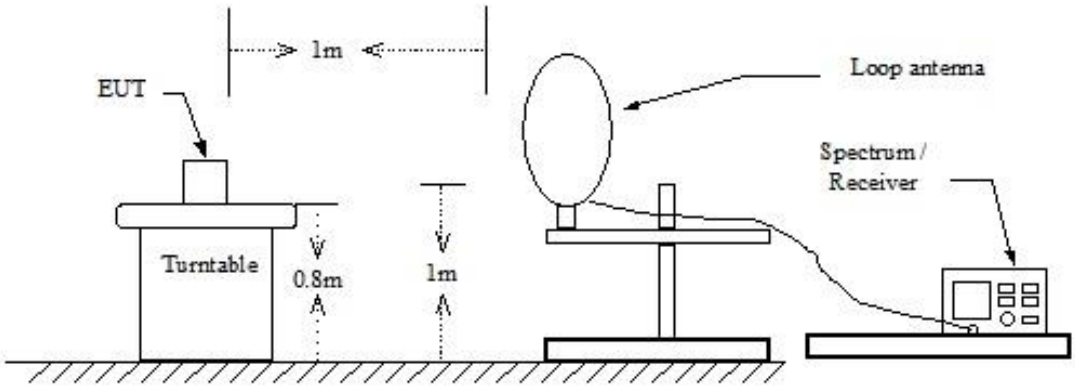
According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meters)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

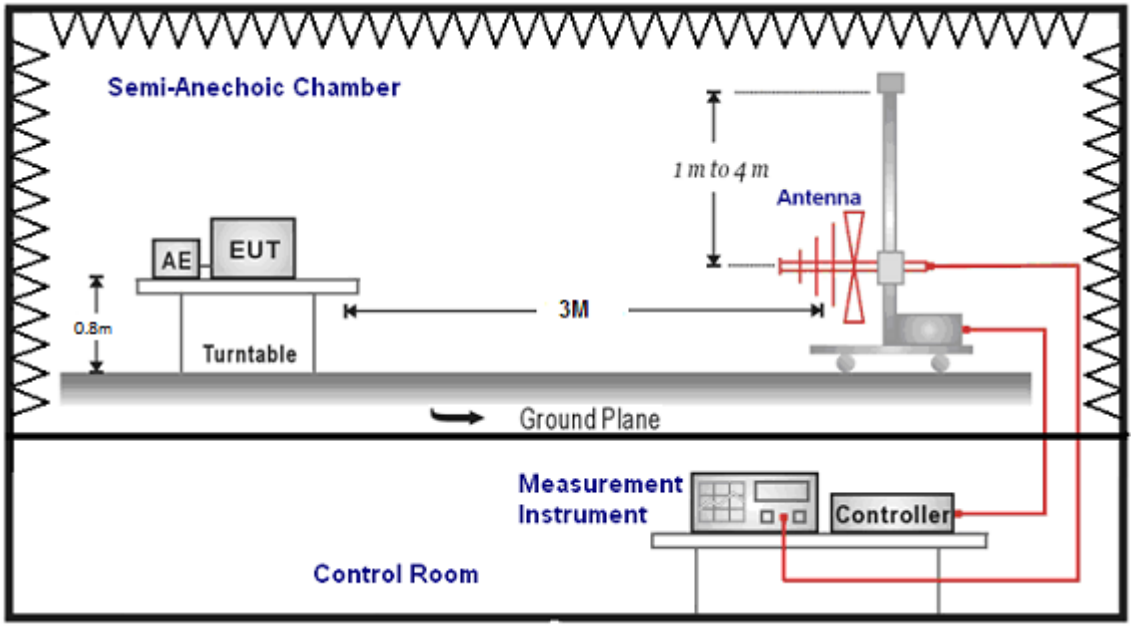
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

■ **Setup**

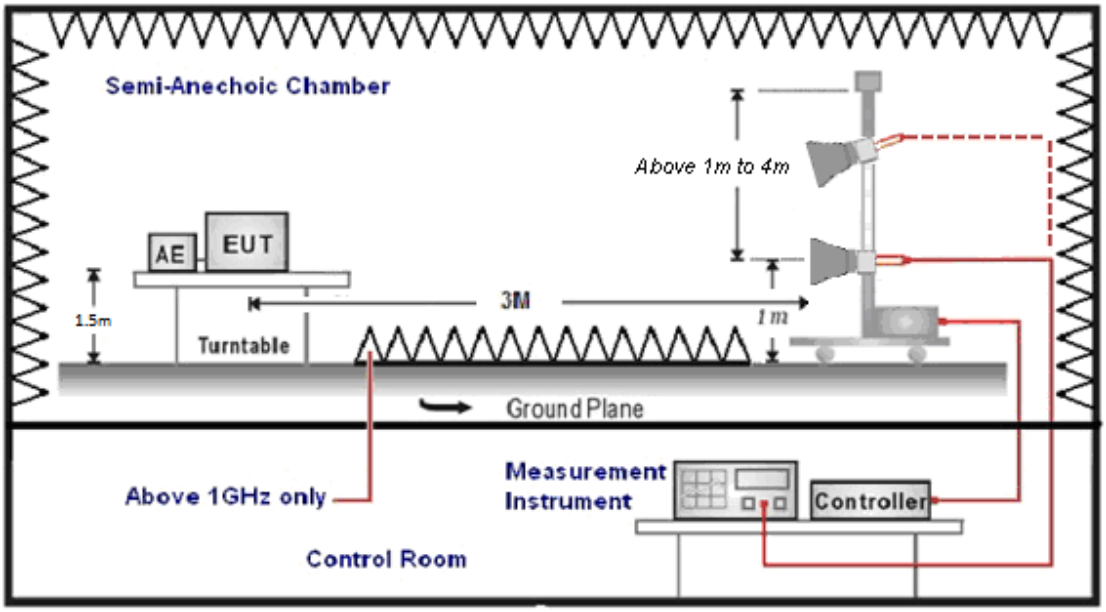
9 kHz ~ 30 MHz



Below 1 GHz



Above 1 GHz


Semi-Anechoic Chamber
Above 1m to 4m
AE
EUT
3M
1.5m
Turntable
1 m
Ground Plane
Above 1GHz only
Measurement
Instrument
Controller
Control Room

■ **Test Procedure**

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 or 1.5 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 30 MHz the resolution bandwidth is set to 10 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements. The video bandwidth is 3 times of the resolution bandwidth.

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

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and according to C63.10:2013 Section 7.5 procedure fo determining the average value of pulsed emissions with duty cycle correction factor. A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna was used in frequencies 1 – 26.5 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)
FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.
P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)
The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:
(a) For fundamental frequency : Transmitter Output < +30 dBm
(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

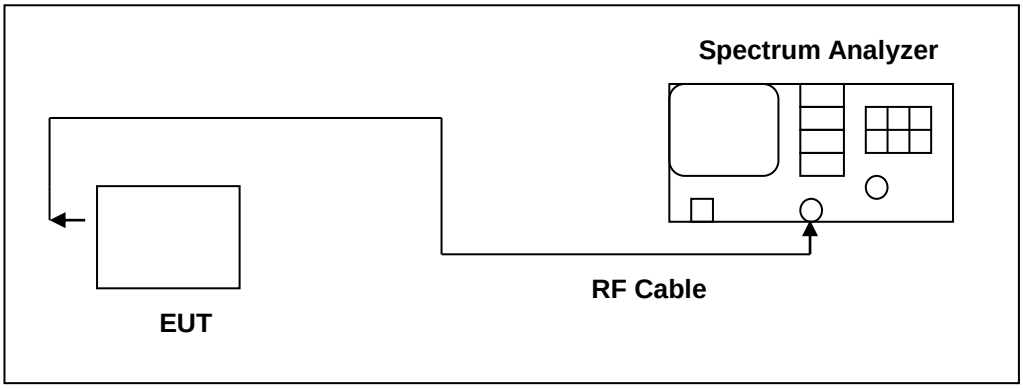
Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

4.4. 20 dB RF Bandwidth Measurement

■ **Limit**

N/A

■ **Test Setup**



■ **Test Procedure**

20 dB RF Bandwidth

1. Span = approx. 2 to 3 times the 20 dB bandwidth, centered on a hopping frequency
2. RBW ≥ 1 % of the 20 dB span
3. VBW ≥ RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

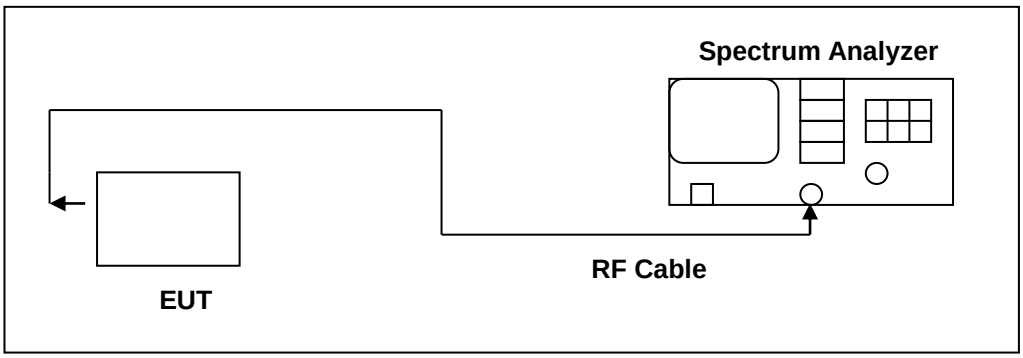
The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function and marker was moved to the other side of the emission until it was even with the reference marker. The marker-delta reading at this point was the 20 dB bandwidth of the emission.

4.5. Carrier Frequency Separation Measurement

■ **Limit**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

■ **Test Setup**



■ **Test Procedure**

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10 dB passive attenuator. A fully charged battery was used for the supply voltage. The following spectrum analyzer settings were used:

1. Span = wide enough to capture the peaks of two adjacent channels
2. Resolution (or IF) Bandwidth (RBW) ≥ 1 % of the span
3. Video (or Average) Bandwidth (VBW) ≥ RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

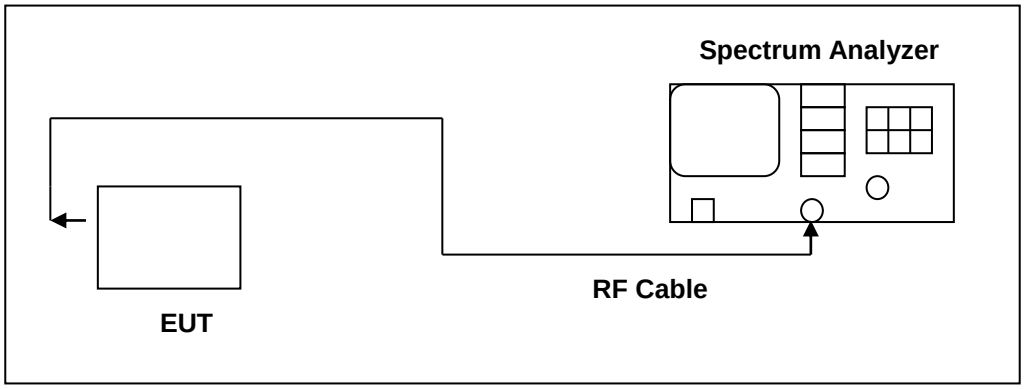
The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

4.6. Maximum Power Density Measurement

■ **Limit**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

■ **Test Setup**



■ **Test Procedure**

The EUT tested to DTS test procedure of ANSI C63.10:2013 section 11.10.2 for compliance to FCC 47CFR 15.247 requirements.

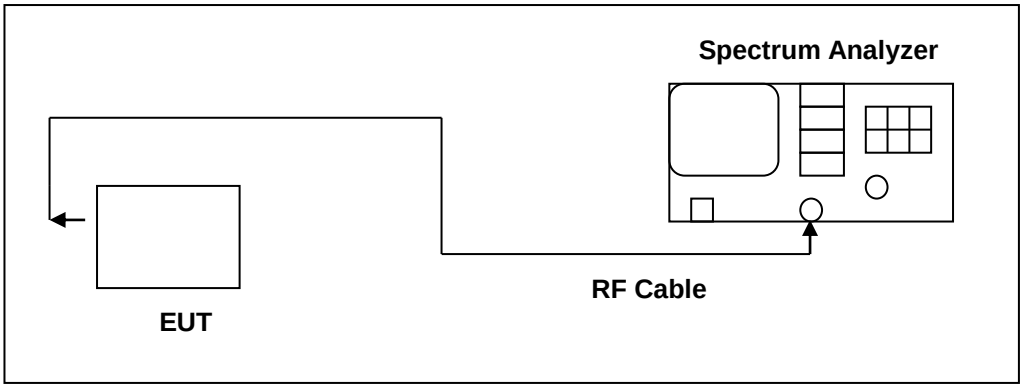
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 × RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.7. Time of Occupancy (Dwell Time) Measurement

■ **Limit**

The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

■ **Test Setup**



■ **Test Procedure**

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the spectrum through a specialized RF connector and a 10 dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth hopping function of the EUT was enabled. The following spectrum analyzer settings were used:

1. Span = zero span, centered on a hopping channel
2. RBW = 1 MHz
3. VBW ≥ RBW
4. Sweep = as necessary to capture the entire dwell time per hopping channel
5. Detector function = peak
6. Trace = max hold

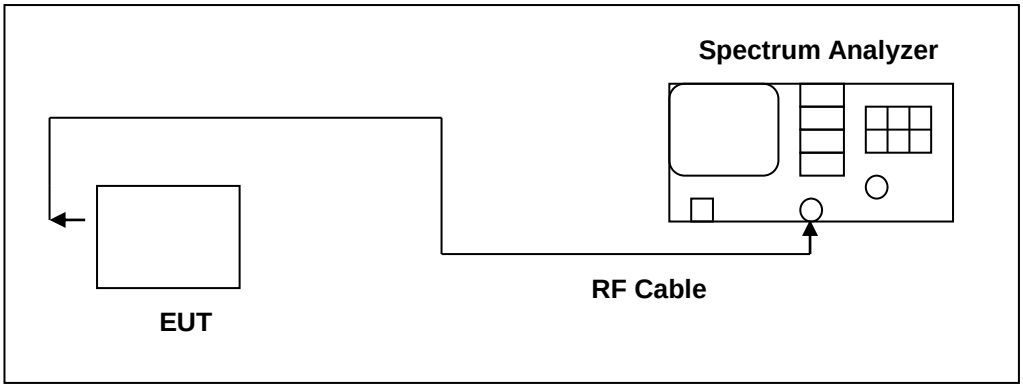
The marker-delta function was used to determine the dwell time.

4.8. Out of Band Conducted Emissions Measurement

■ **Limit**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

■ **Test Setup**



■ **Test Procedure**

Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band.

4.9. Antenna Measurement

■ **Limit**

For intentional device, according to 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.

And According to 15.247 (b)(4), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

■ **Antenna Connector Construction**

See section 2 – antenna information.

5 Test Results

5.1. Conducted Test Results

Maximum Conducted Output Power Measurement

Test Mode	Frequency (MHz)	RF Power setting in Test Software	Test Software Version
Mode 1	903.9	4	CoolTerm Version2.0.0
	905.3	4	

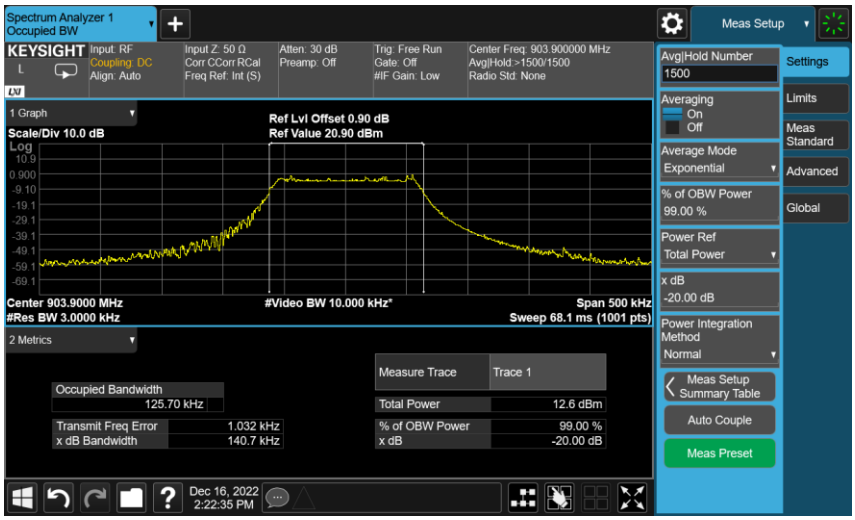
Test Mode	Mode 1				
Frequency (MHz)	Average Power		Peak Power		Limit (W)
	(dBm)	(W)	(dBm)	(W)	
903.9	14.59	0.02877	15.15	0.03273	≤ 0.25
905.3	14.58	0.02871	15.13	0.03258	≤ 0.25

Note: The relevant measured result has the offset with cable loss already.

20 dB RF Bandwidth Measurement

Test Mode	Mode 1
Frequency (MHz)	Measurement Results (kHz)
903.9	140.70
905.3	137.80

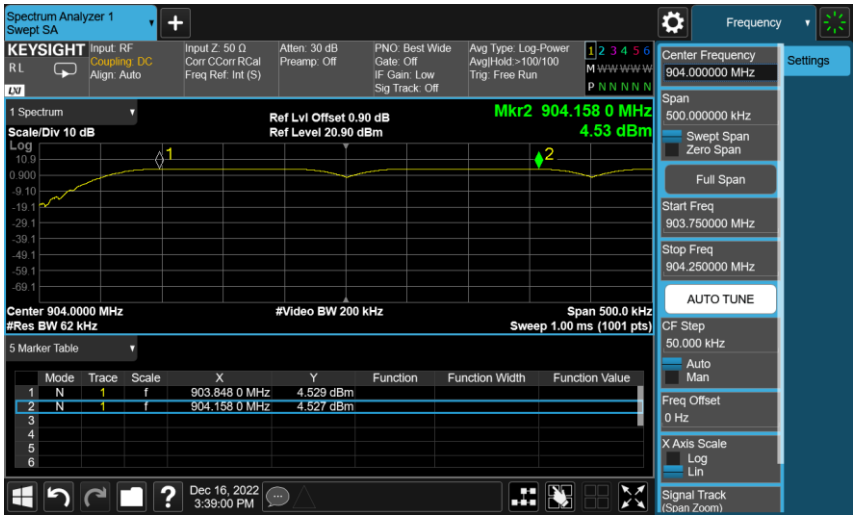
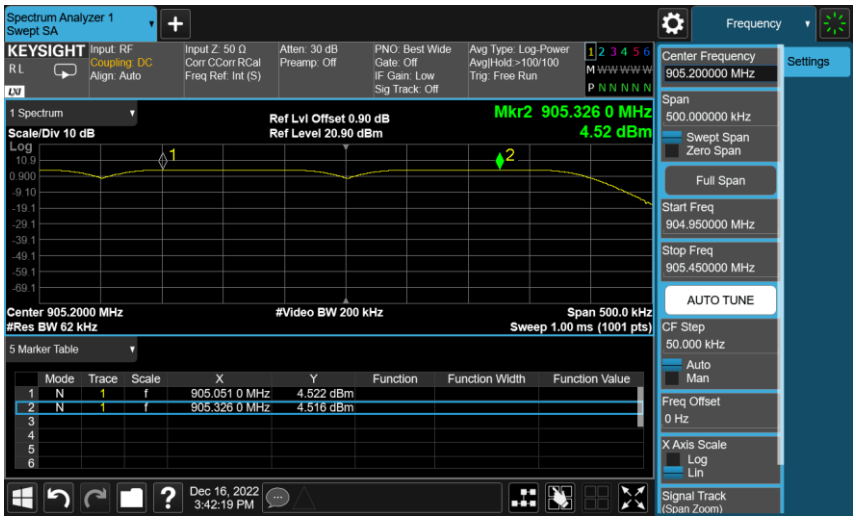
■ **Test Graphs**

Mode 1	
903.9 MHz	
905.3 MHz	

Carrier Frequency Separation Measurement

Test Mode	Mode 1	
Frequency (MHz)	Measurement Results (kHz)	Limit (kHz)
903.9	310	≥ 140.7
905.3	275	≥ 140.7

■ **Test Graphs**

Mode 1	
903.9 MHz	
905.3 MHz	

Time of Occupancy (Dwell Time) Measurement

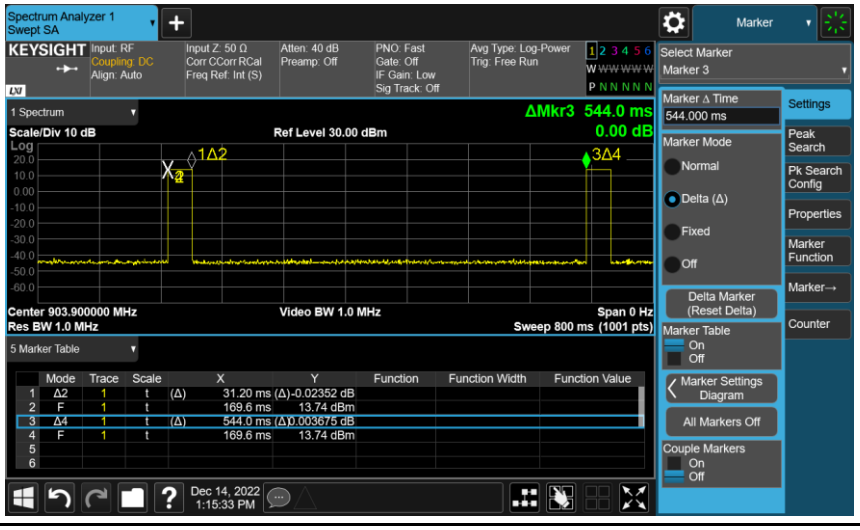
Test Mode	Mode 1
Captured Burst (ms)	31.2
Pulse Number	6
Dwell Time (ms)	187.20
Limit (ms)	< = 400

Note :

Dwell Time = Pulse x Pulse number in Period

Period = 0.4 (seconds / channel) x 8 (channel) = 3.2 seconds

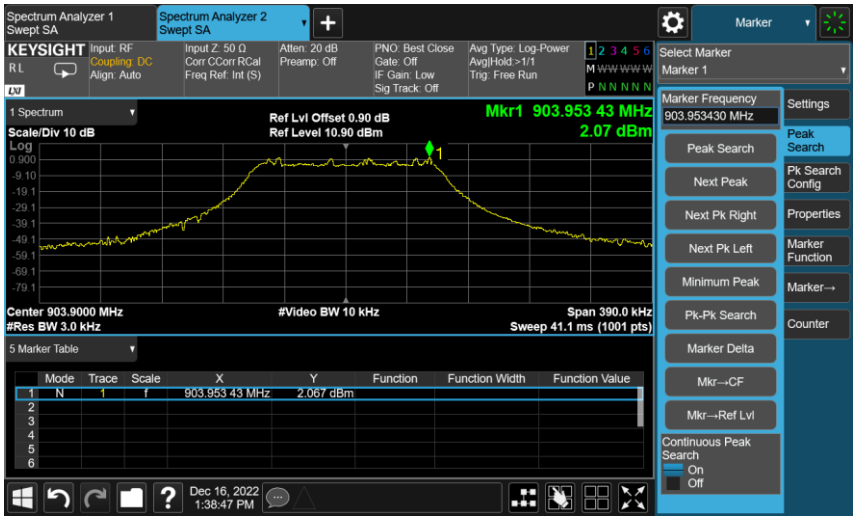
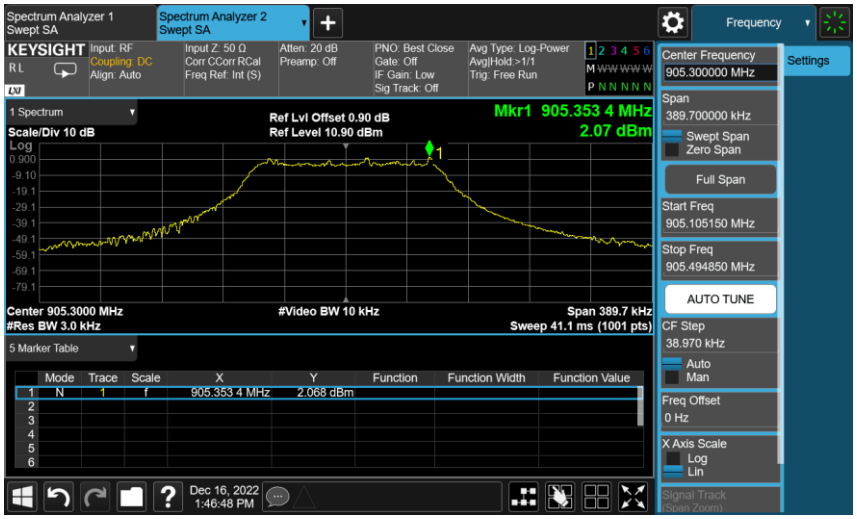
■ **Test Graphs**

Mode 1	
Pulse Number	
Captured Burst	

Maximum Power Density Measurement

Test Mode	Mode 1	
Frequency (MHz)	Measurement Results (dBm/3 kHz)	Limit (dBm)
903.9	2.07	≤ 8
905.3	2.07	≤ 8

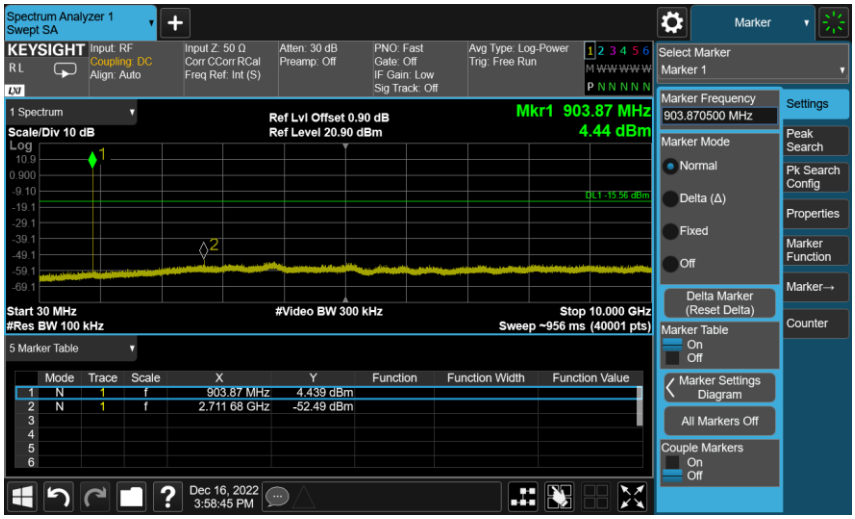
■ **Test Graphs**

Mode 1	
903.9 MHz	
905.3 MHz	

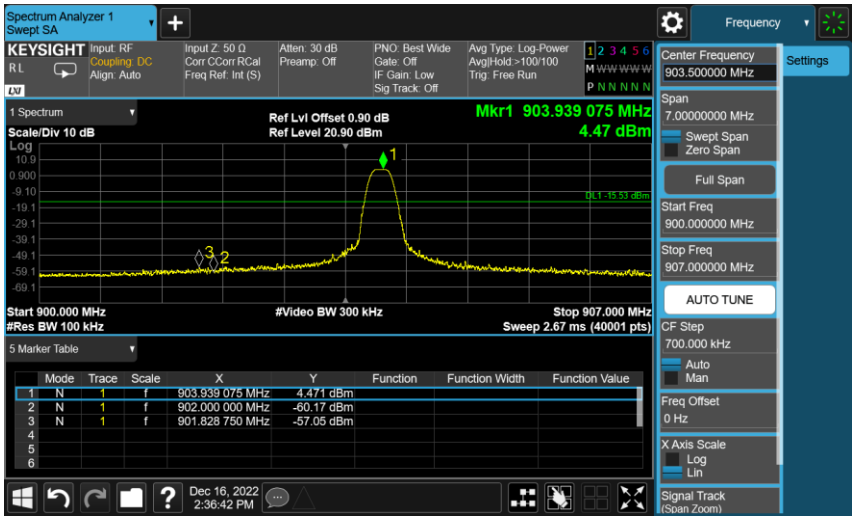
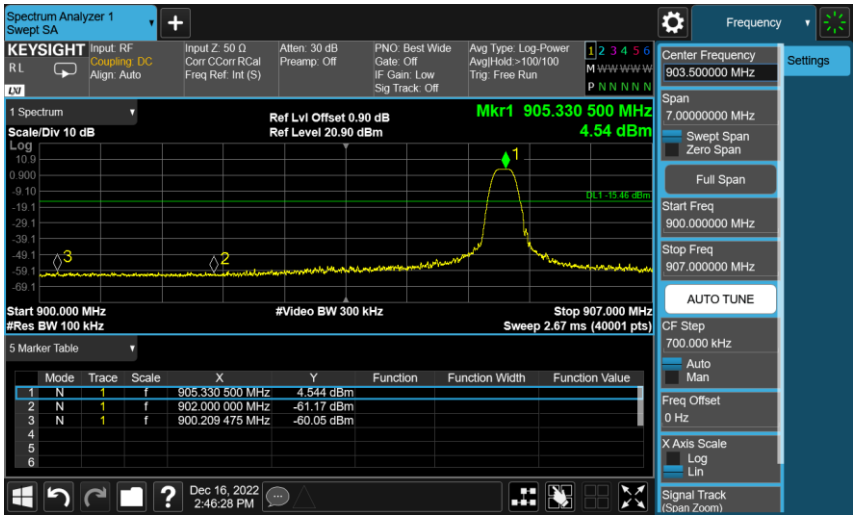
Out of Band Conducted Emissions Measurement

■ **Test Graphs**

Conducted Spurious Emission

Mode 1	
903.9 MHz	
905.3 MHz	

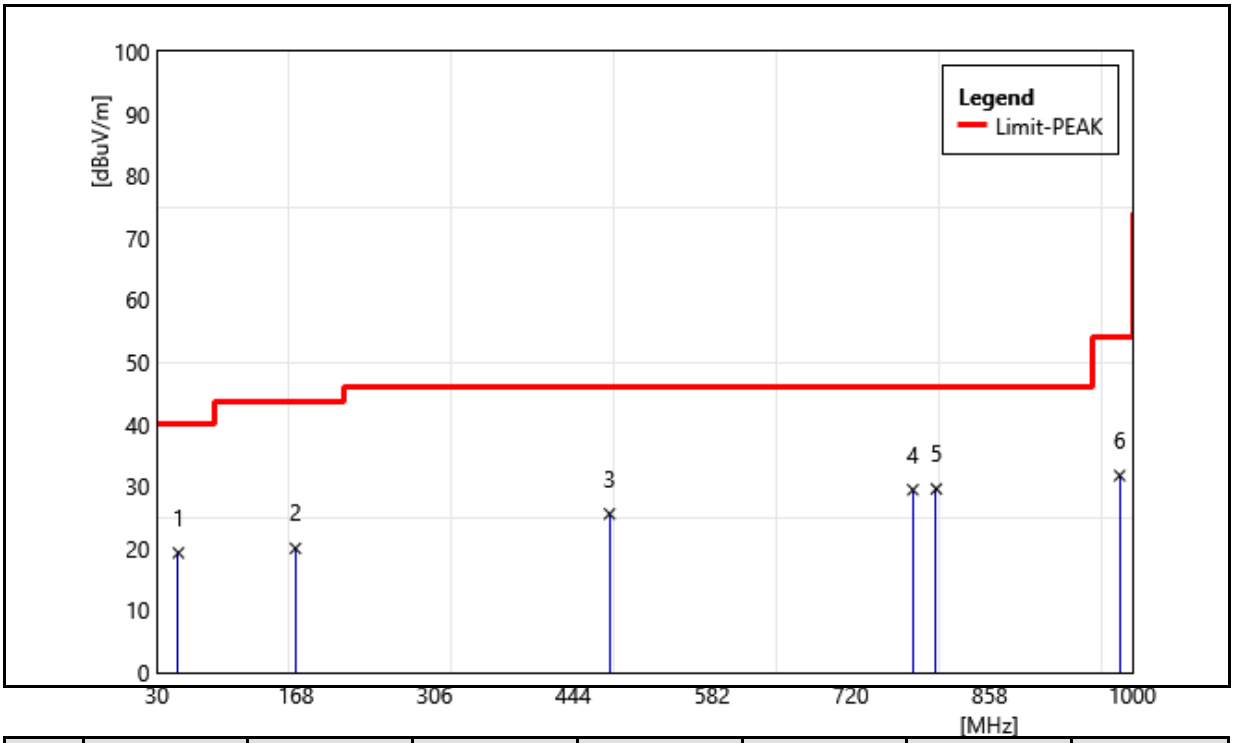
Conducted Band Edge

Mode 1	
903.9 MHz	
905.3 MHz	

5.2. Radiated Emission Measurement

Below 1 GHz

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	903.9 MHz		
Mode:	Mode 1		
Ant.Polar.:	Horizontal		

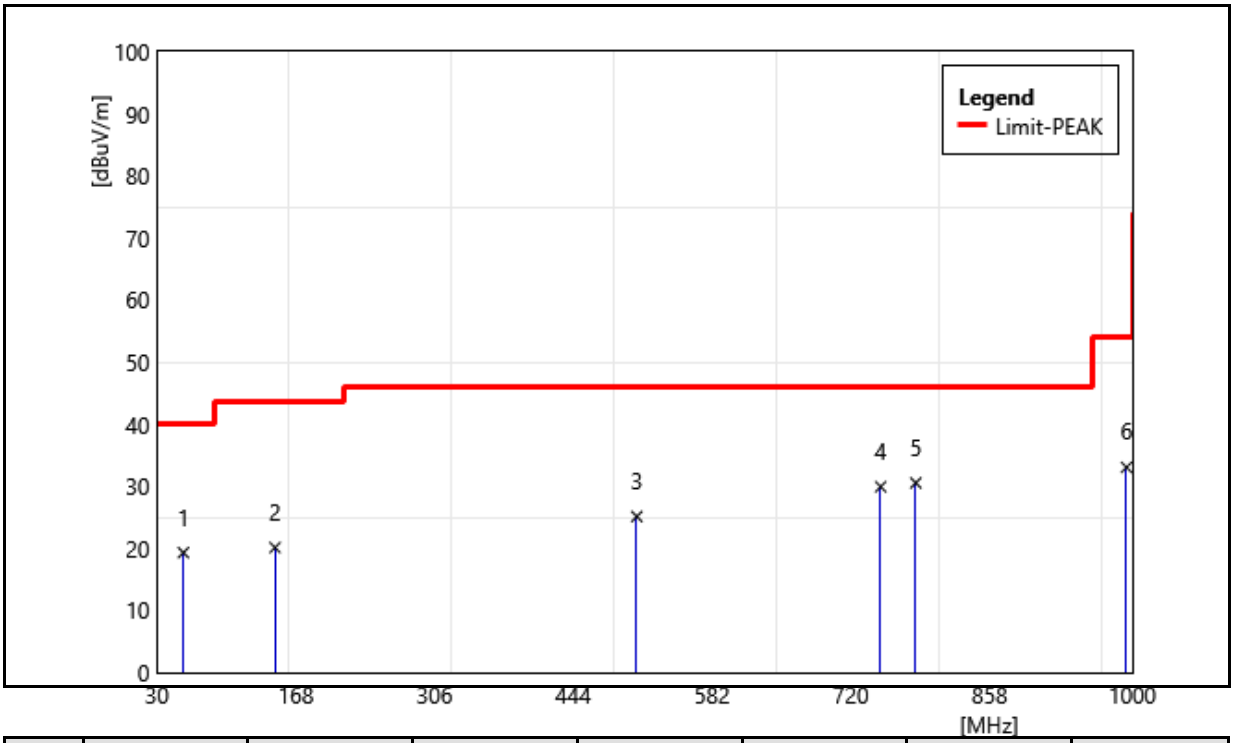


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	51.34	31.1	-11.83	19.27	40	-20.73	QP
2	167.74	32.24	-12.24	20	43.5	-23.5	QP
3	480.08	32.89	-7.35	25.54	46	-20.46	QP
4	781.75	31.76	-2.33	29.43	46	-16.57	QP
5	805.03	31.96	-2.39	29.57	46	-16.43	QP
6	987.39	31.93	-0.21	31.72	54	-22.28	QP

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

2.Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	903.9 MHz		
Mode:	Mode 1		
Ant.Polar.:	Vertical		

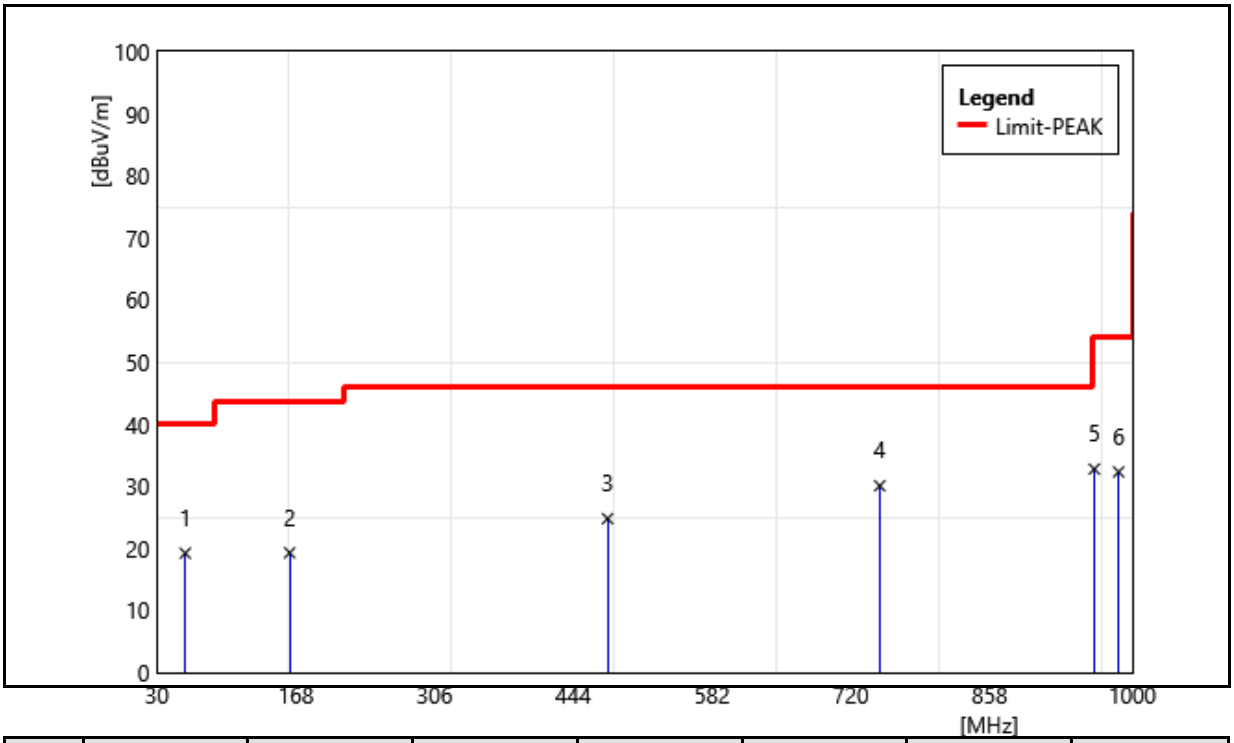


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	56.19	31.4	-12.09	19.31	40	-20.69	QP
2	147.37	32.05	-11.91	20.14	43.5	-23.36	QP
3	507.24	32.03	-6.9	25.13	46	-20.87	QP
4	749.74	32.44	-2.53	29.91	46	-16.09	QP
5	784.66	32.88	-2.34	30.54	46	-15.46	QP
6	994.18	33.17	-0.13	33.04	54	-20.96	QP

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

2.Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	905.3 MHz		
Mode:	Mode 1		
Ant.Polar.:	Horizontal		

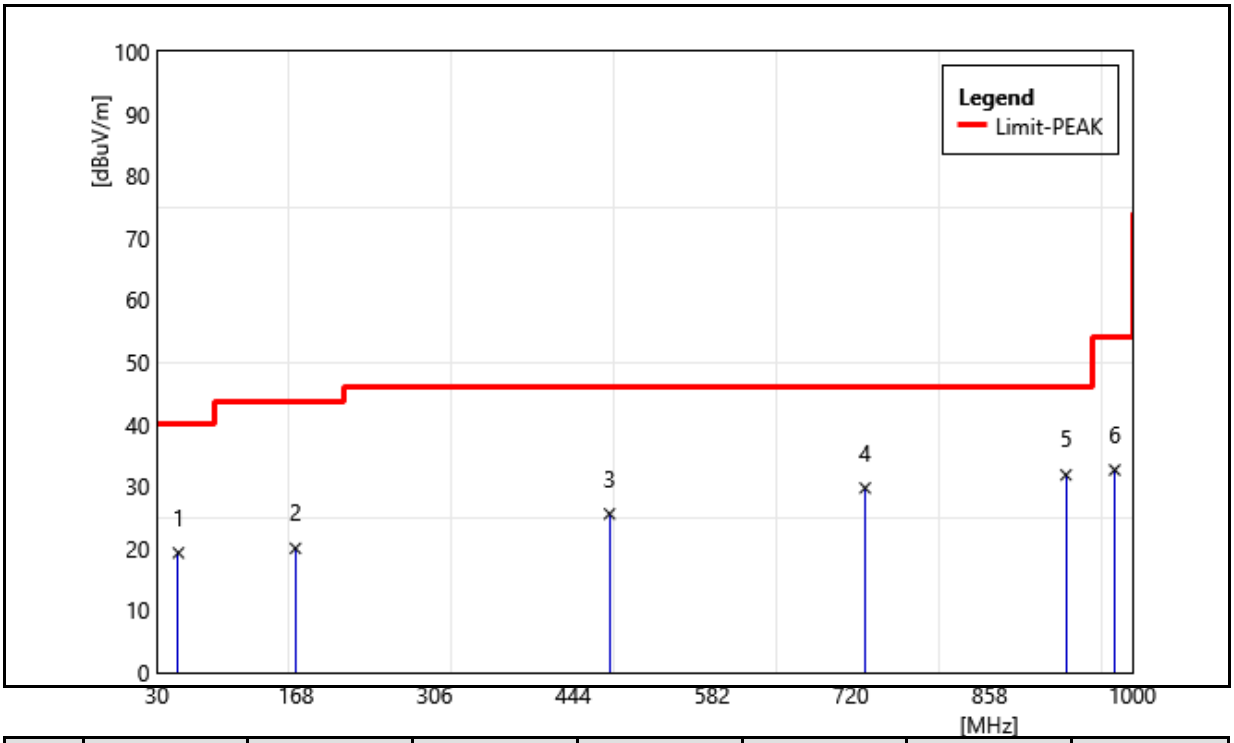


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	58.13	31.6	-12.37	19.23	40	-20.77	QP
2	161.92	31.37	-12.09	19.28	43.5	-24.22	QP
3	478.14	32.18	-7.39	24.79	46	-21.21	QP
4	748.77	32.63	-2.55	30.08	46	-15.92	QP
5	962.17	33.16	-0.39	32.77	54	-21.23	QP
6	986.42	32.56	-0.24	32.32	54	-21.68	QP

Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

2.Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	905.3 MHz		
Mode:	Mode 1		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	51.34	31.1	-11.83	19.27	40	-20.73	QP
2	167.74	32.24	-12.24	20	43.5	-23.5	QP
3	480.08	32.89	-7.35	25.54	46	-20.46	QP
4	734.22	32.79	-3.07	29.72	46	-16.28	QP
5	934.04	31.99	-0.16	31.83	46	-14.17	QP
6	982.54	32.9	-0.28	32.62	54	-21.38	QP

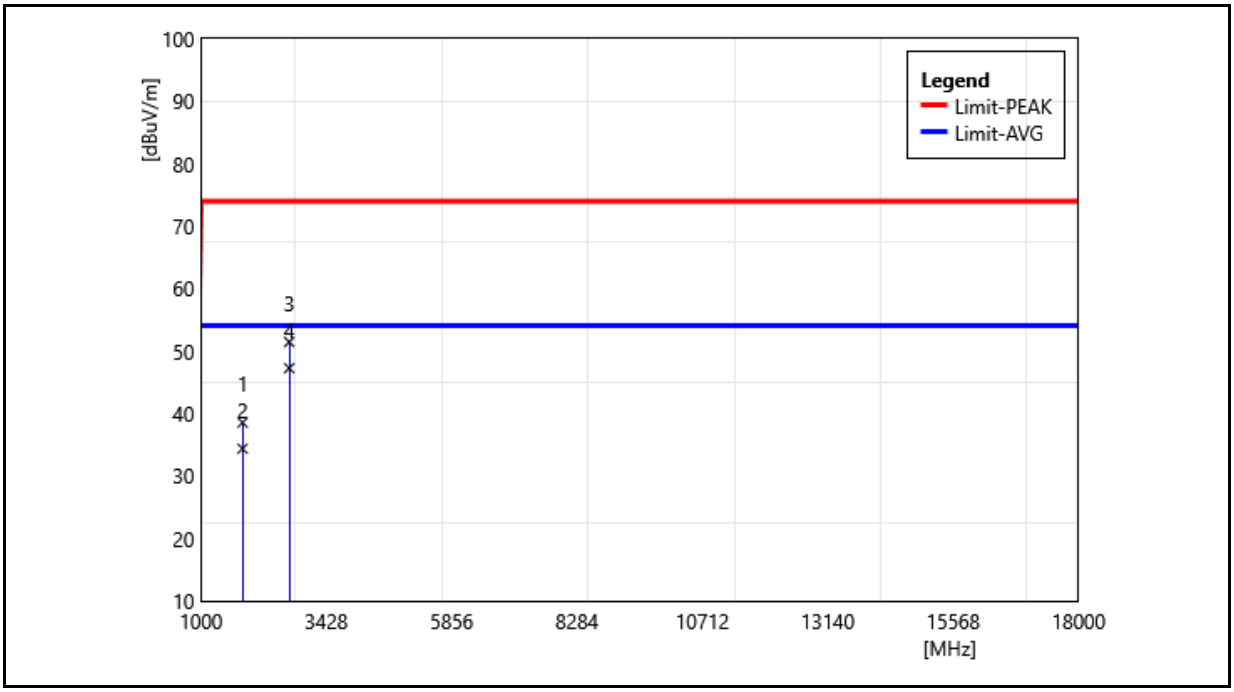
Note:1.Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

2.Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

Harmonic

Above 1 GHz

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	903.9 MHz		
Mode:	Mode 1		
Ant.Polar.:	Horizontal		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1807.8	58.47	-19.92	38.55	74	-35.45	peak
2	1807.8	54.28	-19.92	34.36	54	-19.64	AVG
3	2711.7	67.44	-15.98	51.46	74	-22.54	peak
4	2711.7	63.28	-16.01	47.27	54	-6.73	AVG

Note : 1. Peak Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

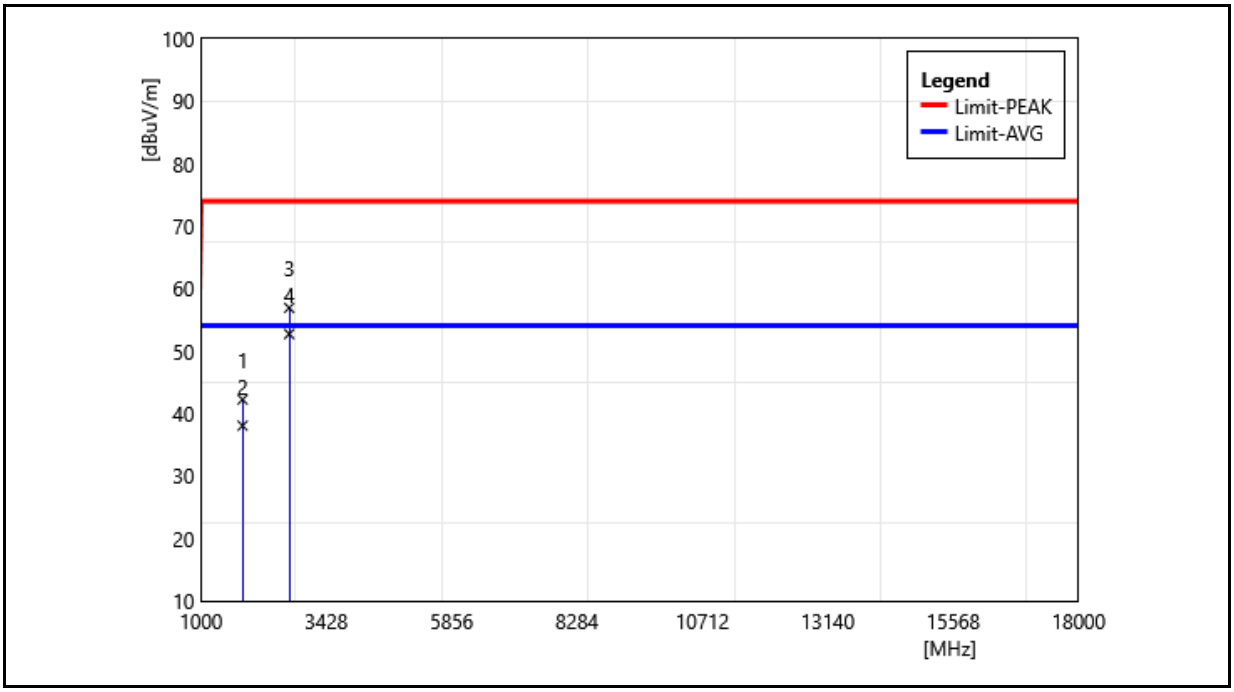
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. Average Result (dBuV/m) = Duty Cycle Correction Factor (dB/m) + Peak Result (dBuV/m).

4. Duty Cycle Correction factor (dB) = 20 log (Ton/100 ms) = 20 log (0.617/100 ms) = -4.19(dB).

5. When the peak results are less than average limit, so not need to evaluate the average.

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	903.9 MHz		
Mode:	Mode 1		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1807.8	62.17	-19.92	42.25	74	-31.75	peak
2	1807.8	57.98	-19.92	38.06	54	-15.94	AVG
3	2711.7	72.90	-15.98	56.92	74	-17.08	peak
4	2711.7	68.74	-16.01	52.73	54	-1.27	AVG

Note : 1. Peak Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

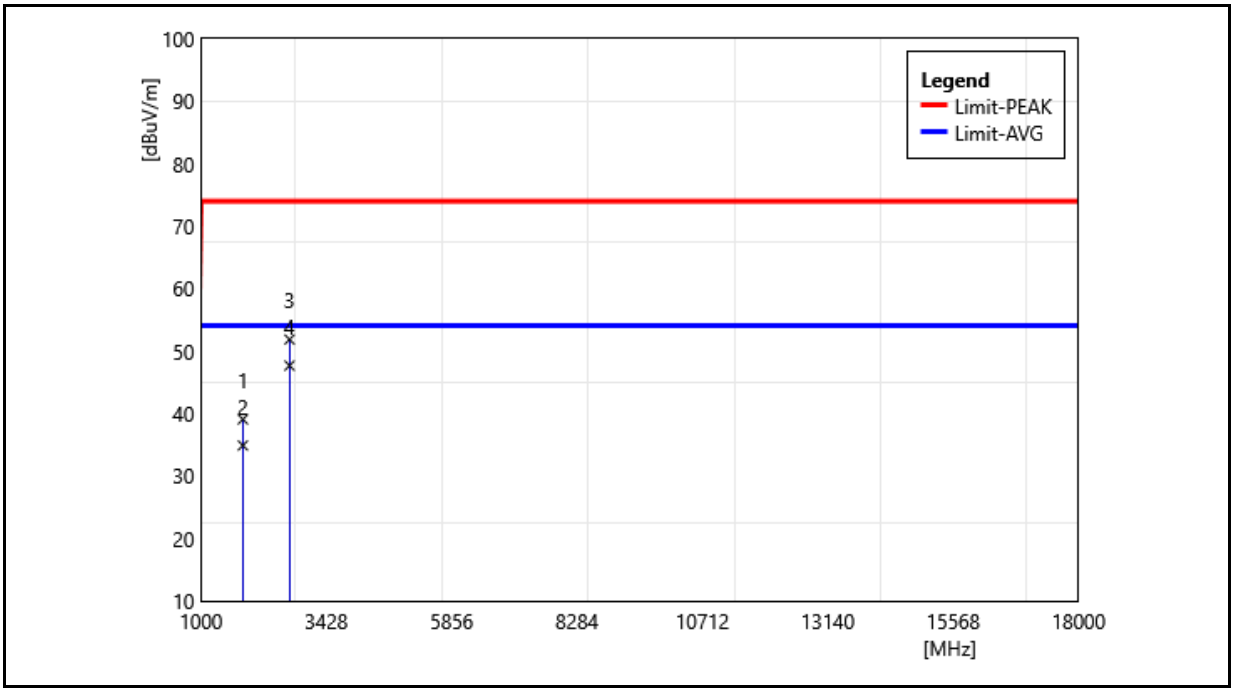
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. Average Result (dBuV/m) = Duty Cycle Correction Factor (dB/m) + Peak Result (dBuV/m).

4. Duty Cycle Correction factor (dB) = 20 log (Ton/100 ms) = 20 log (0.617/100 ms) = -4.19(dB).

5. When the peak results are less than average limit, so not need to evaluate the average.

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	905.3 MHz		
Mode:	Mode 1		
Ant.Polar.:	Horizontal		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1810.6	58.98	-19.91	39.07	74	-34.93	peak
2	1810.6	54.80	-19.92	34.88	54	-19.12	AVG
3	2715.9	67.89	-16.03	51.86	74	-22.14	peak
4	2715.9	63.68	-16.01	47.67	54	-6.33	AVG

Note : 1. Peak Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

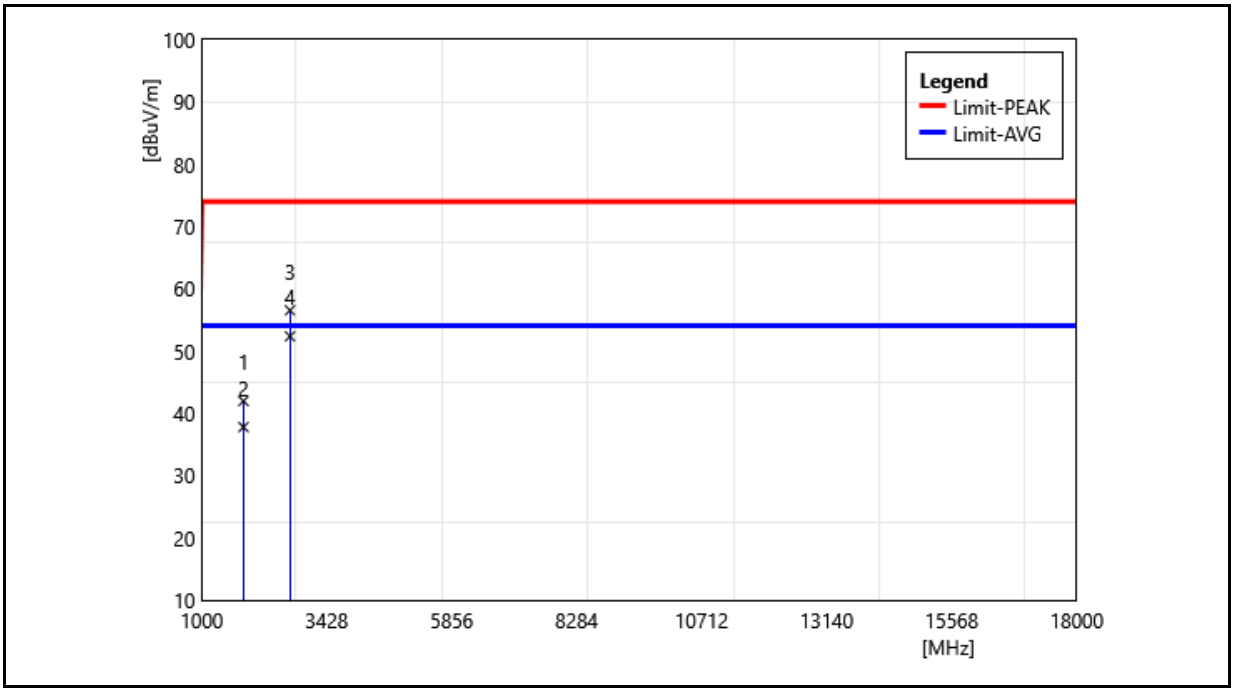
2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. Average Result (dBuV/m) = Duty Cycle Correction Factor (dB/m) + Peak Result (dBuV/m).

4. Duty Cycle Correction factor (dB) = 20 log (Ton/100 ms) = 20 log (0.617) = -4.19(dB).

5. When the peak results are less than average limit, so not need to evaluate the average.

Standard:	Part 15.247	Test Distance:	3 m
Test item:	Harmonic		
Frequency:	905.3 MHz		
Mode:	Mode 1		
Ant.Polar.:	Vertical		



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1810.6	61.90	-19.92	41.98	74	-32.02	peak
2	1810.6	57.71	-19.92	37.79	54	-16.21	AVG
3	2715.9	72.59	-16.03	56.56	74	-17.44	peak
4	2715.9	68.40	-16.03	52.37	54	-1.63	AVG

Note : 1. Peak Result (dBuV/m) = Correct Factor (dB/m) + Reading(dBuV).

2. Correction factor (dB/m) = Antenna Factor (dB/m) + Cable loss (dB) – Pre-Amplifier gain (dB).

3. Average Result (dBuV/m) = Duty Cycle Correction Factor (dB/m) + Peak Result (dBuV/m).

4. Duty Cycle Correction factor (dB) = 20 log (Ton/100 ms) = 20 log (0.617) = -4.19(dB).

5. When the peak results are less than average limit, so not need to evaluate the average.

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