

Prüfbericht-Nr.: <i>Test Report No.:</i>	50337535 001	Auftrags-Nr.: <i>Order No.:</i>	244134952	Seite 1 von 21 <i>Page 1 of 21</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	389494	Auftragsdatum: <i>Order date.:</i>	15.04.2019	
Auftraggeber: <i>Client:</i>	Alpine Electronics, Inc. 20-1, Yoshima Industrial Park, Iwaki, Fukushima, Japan			
Prüfgegenstand: <i>Test item:</i>	Smartphone Link Display Audio			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	SDA3UM FCC ID: A269ZUA161 IC:700B-UA161			
Auftrags-Inhalt: <i>Order content:</i>	EMC test			
Prüfgrundlage: <i>Test specification:</i>	FCC 47 CFR Part 15, Subpart B:2018 Class B ICES-003:2016			
Wareneingangsdatum: <i>Date of receipt:</i>	20.01.2020			
Prüfmuster-Nr.: <i>Test sample No.:</i>	A001058466-002			
Prüfzeitraum: <i>Testing period:</i>	Refer to test report			
Ort der Prüfung: <i>Place of testing:</i>	EMC laboratory			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von / tested by: <i>Jessie Xu</i>		kontrolliert von / reviewed by: <i>Jiayi Zhou</i>		
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>
17.02.2020	Jessie Xu/Senior project engineer		17.02.2020	Jiayi Zhou/Senior manager
Sonstiges / Other:				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specifications(s) F(ail) = failed a.m. test specifications(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

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TEST SUMMARY

4.1.1 RADIATED EMISSION IN THE FREQUENCY RANGE UP 1 GHz

Result:

Passed

4.1.2 RADIATED EMISSION IN THE FREQUENCY RANGE ABOVE 1 GHz

Result:

Passed

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1 Test Sites

1.1 Test Facilities

Laboratory: TÜV Rheinland (Shanghai) Co., Ltd.

Address: No.177, 178, Lane 777 West Guangzhong Road, Jing'an District, Shanghai, China

The used test equipment is in accordance with CISPR 16-1 series standards for measurement of radio interference.

Refer to Clause 6 for test and measurement instruments.

2 General Product Information

2.1 Product Function and Intended Use

The EUT (equipment under test) is an ordinary smartphone link display audio. For the further information, refer to the user's manual.

2.2 Ratings and System Details

Rated input : DC 13.5 V
Frequency 2402-2480 MHz
Protection class : III

2.3 Independent Operation Modess

The basic operation modes are "BT operation" "USB operation" and "FM/AM operation" etc.

2.4 Description of interconnecting cables

No.	Interface and name	Shielded or not	Specified length (m)
1	DC power line	Unshielded	0.4m
2	Camera line	UnShielded	0.6m
3	Mic line	Unshielded	0.6m
4	USB line	Shielded	1.0m

2.5 Noise Generating and Noise Suppressing Parts

Refer to the circuit diagram for further information.

2.6 Highest frequency generated or used in the device or on which the device operates or tunes

The highest frequency used in the EUT is 1000 MHz.

2.7 Submitted Documents

User's manual and rating label.

3 Test Set-up and Operation Modes

3.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible emission level. The test conditions were adapted accordingly in reference to the instructions for use.

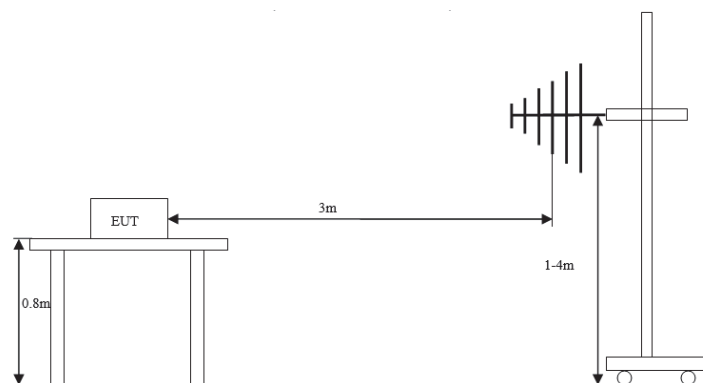
Refer to the related paragraph of this report.

The sequence of testing:

Radiated emission tests were performed on 14.02.2020.

3.2 Equipment and cable arrangement

Block diagram for both conducted emission and radiated emission tests is as follows:



(Radiated emission)

Also refer to photographs on clause 5 for test setup for radiated emission test.

3.3 Test Software

No special test software was used during the tests.

3.4 Special Accessories and Auxiliary Equipment

During the test, camera, USB load and MIC were used during the tests.

3.5 Countermeasures to achieve EMC Compliance

No other special measure is employed to achieve the requirement.

4 Test Results EMISSION

4.1 Emission in the Frequency Range above 30 MHz

4.1.1 Radiated emission in the frequency range up 1 GHz

Result:		Passed
Date of testing	: 14.02.2020	
Test procedure	: FCC 47 CFR Part 15, Subpart B:2018, ICES-003:2016, ANSI C63.4-2014 and CISPR 16-1 series standards	
Product classification	: Class B	
Frequency range	: 30 – 1000 MHz	
Limits	: Quasi-peak limits (3 m distance): 30 – 88 MHz, 40 dB μ V/m; 88 – 216 MHz, 43.5 dB μ V/m; 216 – 960 MHz, 46 dB μ V/m; 960-1000 MHz, 54 dB μ V/m.	
Bandwidth of EMI receiver for final measurement	: 120 kHz	
Measurement time for final measurement	: 1 s	
Kind of test site	: Semi-anechoic chamber	
Input voltage	: DC 13.5 V	
Operational mode	: Mode 1: power on with camera, USB functions Mode 2: power on with radio playing, USB functions	
Ambient condition	: Temperature: 21.3 °C; Relative humidity: 37.2 %	
Expanded measurement uncertainty ($k=2$)	: 5.49 dB	

The radiated disturbance test was carried out in a semi-anechoic chamber. The test distance from the receiving antenna to the EUT is 3 m. The normalized site attenuation of the semi-anechoic chamber is regularly calibrated to ensure the radiated disturbance test results are valid. During the test, the EUT was placed on a 80 cm wooden support above the reference ground plane. The wooden support was rotated 360° around and the height of the antenna was varied from 1 m to 4 m to find the maximum disturbance. The test was performed with the antenna both in its horizontal and vertical polarizations.

The following figures and tables were those measured by an automatic measurement system. A preview test was firstly performed with peak detector. The final test was performed with quasi-peak at those critical frequencies during the preview test. In the following spectral diagram, “×” means quasi-peak test results.

Notes on following tables of radiated emission results and conversions:

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QuasiPeak (dB μ V/m): final measurement results by using quasi-peak detector

Corr. (dB): correction factor including: antenna factor, cable loss, and gain of pre-amplifier (if used)

Margin: Limit (dB μ V/m) - QuasiPeak (dB μ V/m)

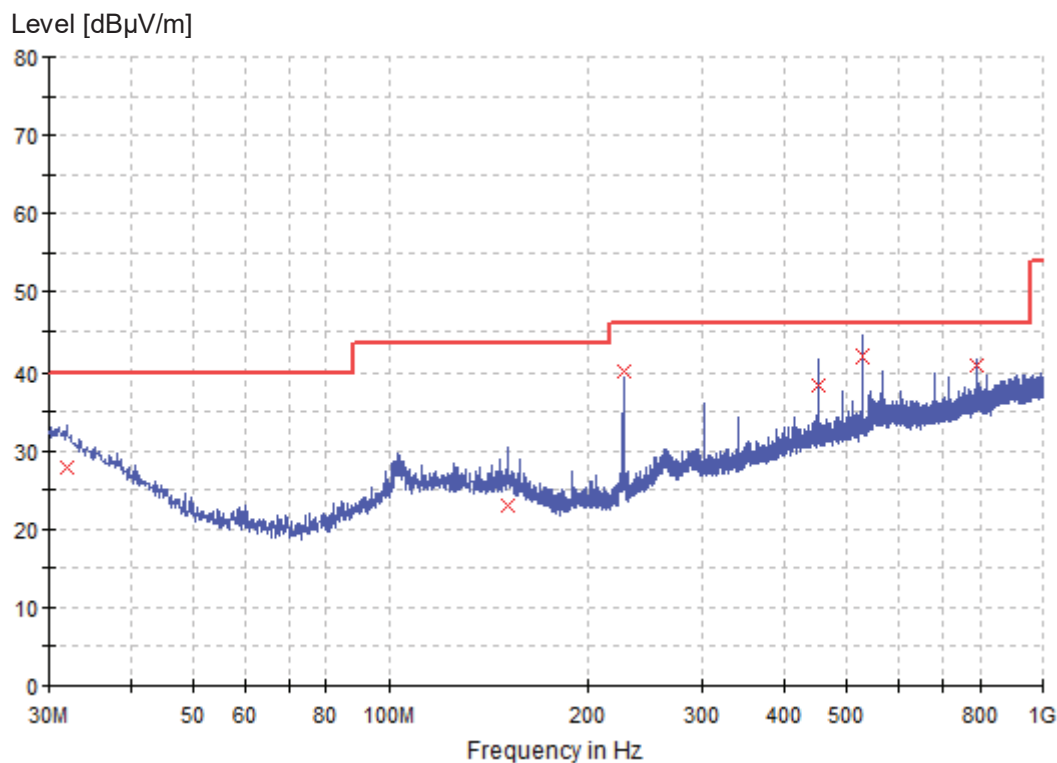
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Figure 1: Spectral Diagrams, Radiated Emission, 30 MHz-1000 MHz, Horizontal polarization for mode 1



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
31.940000	27.9	1000.0	120.000	300.0	H	180.0	24.3	12.1	40.0
151.128750	22.9	1000.0	120.000	100.0	H	180.0	17.3	20.6	43.5
226.788750	40.3	1000.0	120.000	100.0	H	-106.0	17.1	5.8	46.0
453.647500	38.4	1000.0	120.000	100.0	H	0.0	24.2	7.7	46.0
529.188350	41.9	1000.0	120.000	100.0	H	-90.0	25.4	4.1	46.0
792.019350	40.8	1000.0	120.000	100.0	H	0.0	28.2	5.2	46.0

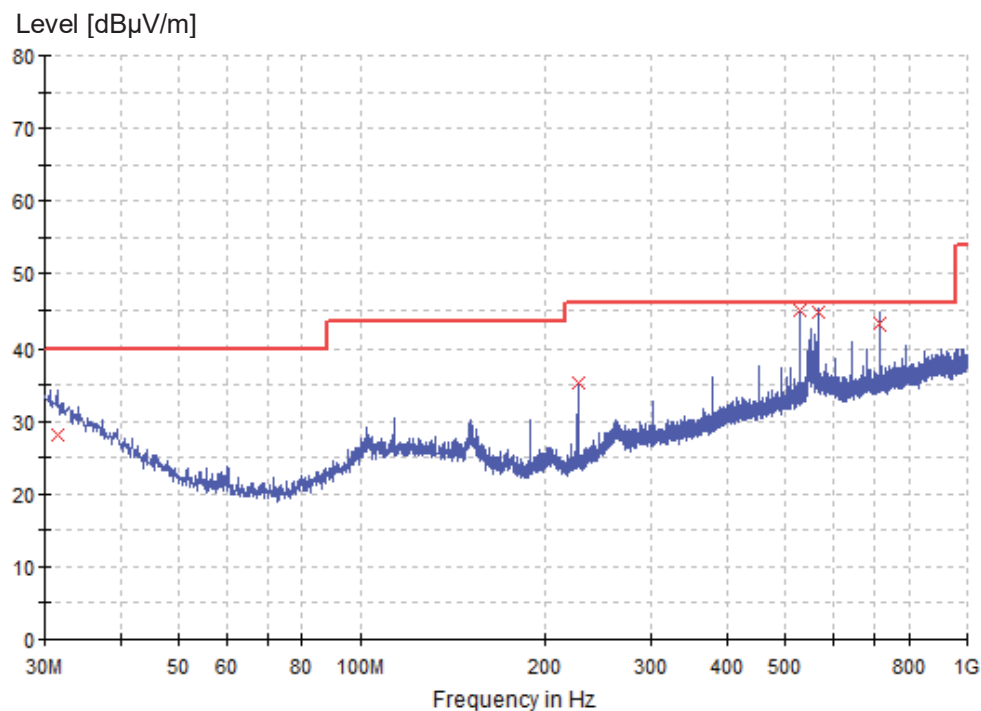
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Figure 2: Spectral Diagrams, Radiated Emission, 30 MHz-1000 MHz, Vertical polarization for mode 1



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
31.455000	28.2	1000.0	120.000	200.0	V	180.0	24.6	11.8	40.0
226.788750	35.4	1000.0	120.000	100.0	V	22.0	17.1	10.6	46.0
529.186250	45.0	1000.0	120.000	100.0	V	180.0	25.4	1.0	46.0
567.016250	44.6	1000.0	120.000	200.0	V	180.0	26.6	1.4	46.0
718.215000	43.2	1000.0	120.000	100.0	V	156.0	27.3	2.8	46.0

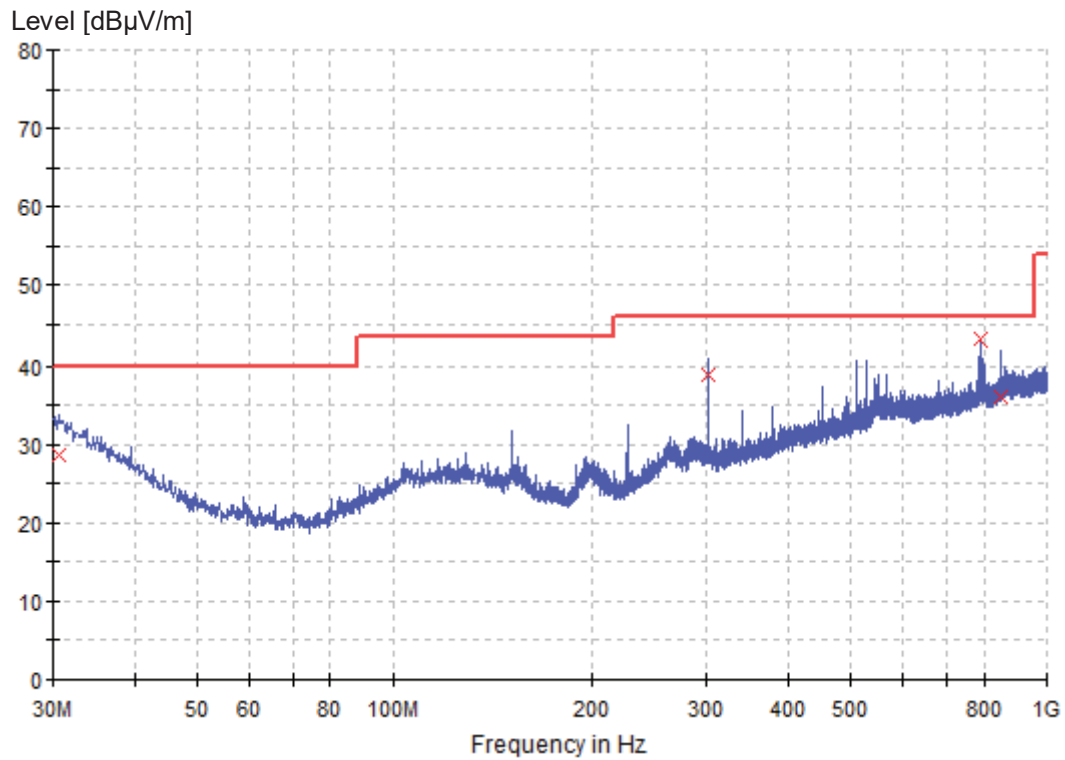
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Figure 3: Spectral Diagrams, Radiated Emission, 30 MHz-1000 MHz, Horizontal polarization for mode 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
30.606250	28.6	1000.0	120.000	200.0	H	-180.0	25.1	11.4	40.0
302.402700	38.9	1000.0	120.000	100.0	H	90.0	20.5	7.1	46.0
792.004200	43.1	1000.0	120.000	100.0	H	0.0	28.2	2.9	46.0
850.000300	36.0	1000.0	120.000	150.0	H	30.0	28.2	10.1	46.0

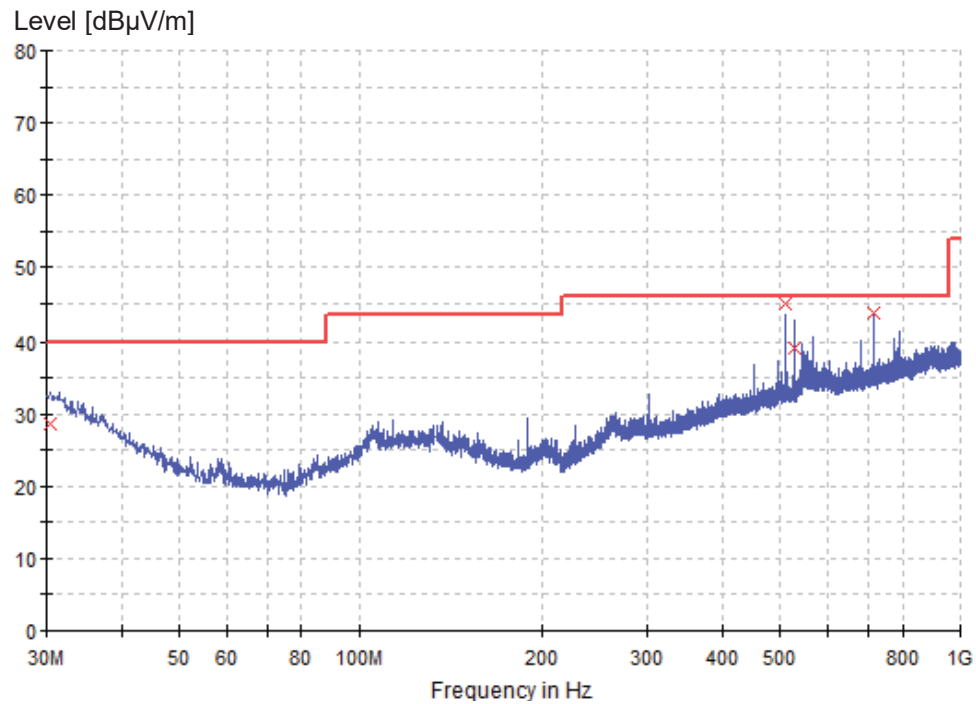
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Figure 4: Spectral Diagrams, Radiated Emission, 30 MHz-1000 MHz, Vertical polarization for mode 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
30.485000	28.7	1000.0	120.000	100.0	V	180.0	25.1	11.3	40.0
510.028750	44.9	1000.0	120.000	100.0	V	-180.0	25.1	1.1	46.0
529.206050	39.2	1000.0	120.000	100.0	V	0.0	25.4	6.8	46.0
718.215000	43.7	1000.0	120.000	100.0	V	-126.0	27.3	2.3	46.0

4.1.2 Radiated Emission in the frequency range above 1 GHz

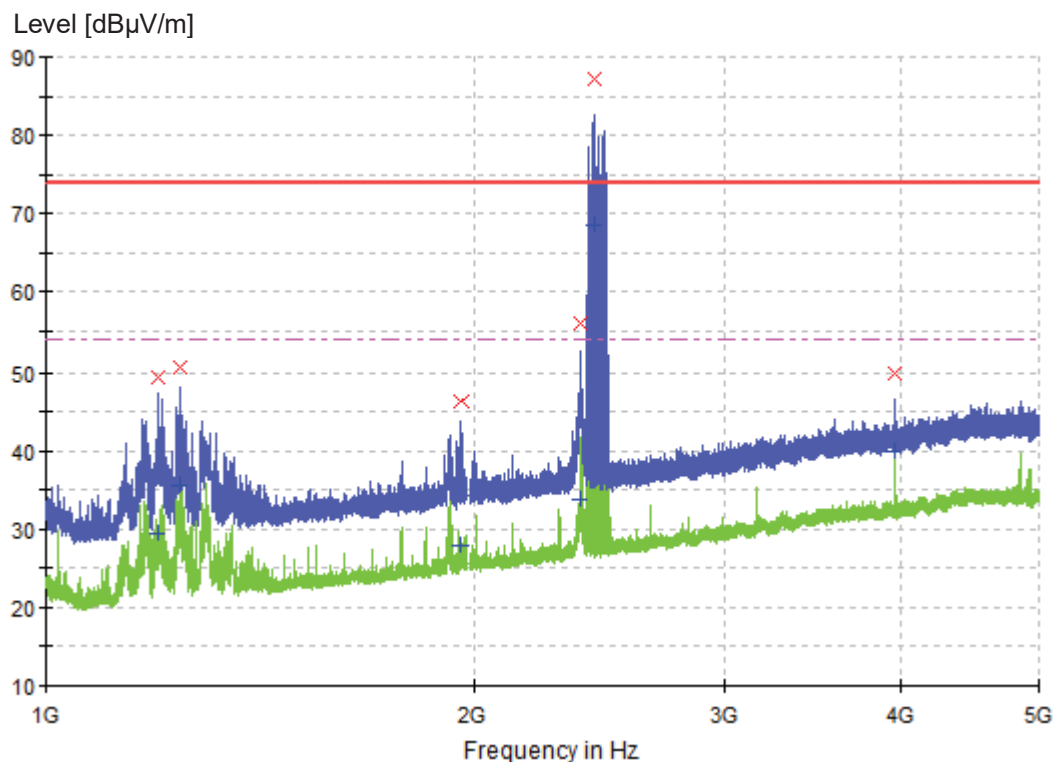
Result:	Passed
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Date of testing	: 14.02.2020
Port	: Enclosure
Test procedure	: FCC 47 CFR Part 15, Subpart B:2018, ICES-003:2016, ANSI C63.4-2014 and CISPR 16-1 series standards
Product classification	: Class B
Limit	: MaxPeak limits (3 m distance): 1-5 GHz, 74 dB μ V/m CAverage limits (3 m distance): 1-5 GHz, 54 dB μ V/m
Frequency range	: 1 GHz-5 GHz (Note: The highest frequency in the EUT is 1000 MHz. According to FCC Part 15 subpart B §15.33 (b) (1), the upper frequency for radiated emission measurement is 5000 MHz.
Kind of test site	: Fully anechoic chamber
Test distance	: 3 m
Test voltage	: DC 13.5 V
Operational mode	: Mode 1: power on with camera, USB functions Mode 2: power on with radio playing, USB functions
Earthing	: No earthing
Ambient condition	: Temperature: 21.3 °C; Relative humidity: 37.2 %
Expanded measurement uncertainty ($k=2$)	: 5.17 dB (1 GHz~6 GHz)

The radiated disturbance test was carried out in a fully anechoic room. The test distance from the receiving antenna to the EUT is 3 m. The normalized site attenuation of the fully-anechoic chamber is regularly calibrated to ensure the radiated disturbance test results are valid. During the test, the EUT was placed on a wooden support, which is 80 cm high. And the wooden support was rotated 360° around. The test was performed with the antenna both in its horizontal and vertical polarizations.

The following figures and tables were those measured by an automatic measurement system. The final test was performed with peak detector and average detector at those critical frequencies during the preview test. In the following figure, “ $\times$ (red)” means measurement results with peak detector and “ $+$ (blue)” means measurement results with average detector.

Figure 5: Spectral Diagrams and measurement results, 1 GHz-5 GHz, horizontal polarization for mode 1



Final maxpeak measurement result:

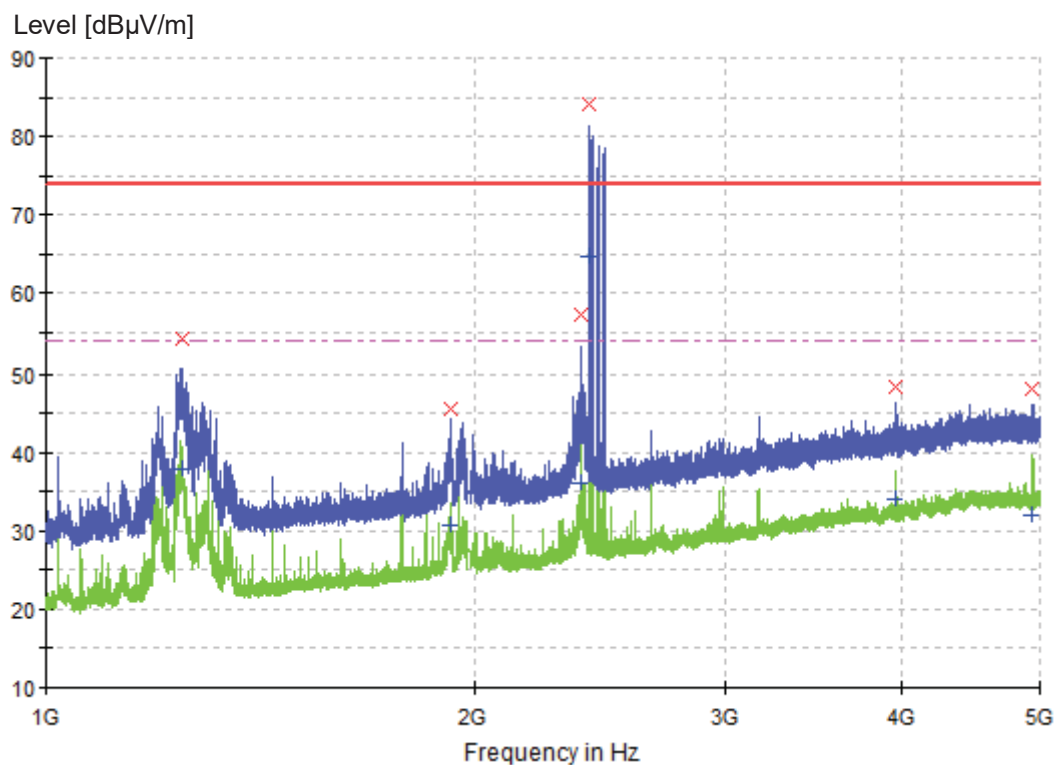
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - PK+ (dB)	Limit - PK+ (dBμV/m)
1200.250000	49.3	1000.0	1000.000	150.0	H	55.0	-21.2	24.7	74.0
1241.625000	50.6	1000.0	1000.000	150.0	H	-1.0	-20.9	23.4	74.0
1960.500000	46.2	1000.0	1000.000	150.0	H	52.0	-16.4	27.8	74.0
2374.375000	56.1	1000.0	1000.000	150.0	H	44.0	-14.5	17.9	74.0
2426.750000	87.3	1000.0	1000.000	150.0	H	24.0	-14.3	-13.3	74.0
3960.125000	49.8	1000.0	1000.000	150.0	H	-180.0	-8.4	24.2	74.0

Final average measurement result:

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)
1200.250000	29.4	1000.0	1000.000	150.0	H	55.0	-21.2	24.6	54.0
1241.625000	35.5	1000.0	1000.000	150.0	H	-1.0	-20.9	18.6	54.0
1960.500000	28.0	1000.0	1000.000	150.0	H	52.0	-16.4	26.0	54.0
2374.375000	33.8	1000.0	1000.000	150.0	H	44.0	-14.5	20.2	54.0
2426.750000	68.7	1000.0	1000.000	150.0	H	24.0	-14.3	-14.7	54.0
3960.125000	40.0	1000.0	1000.000	150.0	H	-180.0	-8.4	14.0	54.0

Note: The EUT has the BT wireless function, and the working frequency is 2402-2480 MHz. According to the standard FCC 47 CFR Part 15, Subpart B:2018 is not applicable to intentional transmissions from a radio transmitter. Therefore, the frequency 2426.75 MHz is not subject to this emission requirement.

Figure 6: Spectral Diagrams and measurement results, 1 GHz-5 GHz, vertical polarization for mode 1



Final maxpeak measurement result:

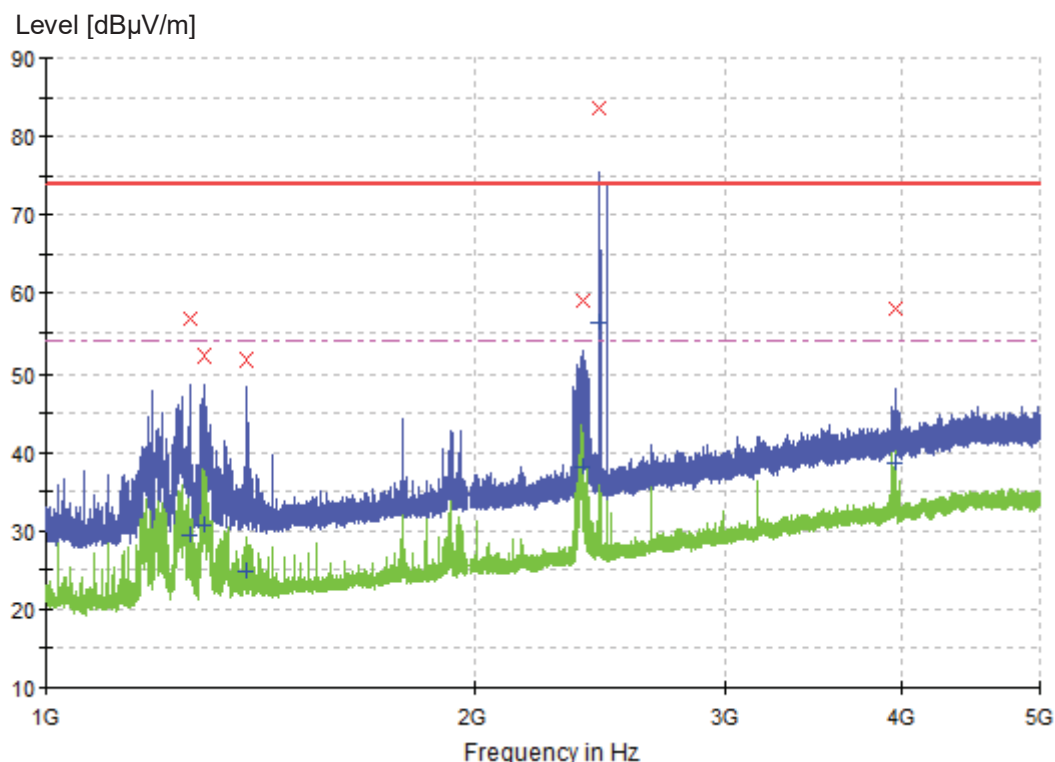
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - PK+ (dB)	Limit - PK+ (dBμV/m)
1247.375000	54.3	1000.0	1000.000	150.0	V	-163.0	-20.8	19.7	74.0
1925.875000	45.4	1000.0	1000.000	150.0	V	179.0	-16.6	28.6	74.0
2374.625000	57.2	1000.0	1000.000	150.0	V	-180.0	-14.5	16.8	74.0
2402.125000	84.1	1000.0	1000.000	150.0	V	123.0	-14.4	-10.1	74.0
3960.625000	48.3	1000.0	1000.000	150.0	V	-180.0	-8.4	25.7	74.0
4931.250000	48.2	1000.0	1000.000	150.0	V	48.0	-6.5	25.8	74.0

Final average measurement result:

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)
1247.375000	37.9	1000.0	1000.000	150.0	V	-163.0	-20.8	16.1	54.0
1925.875000	30.7	1000.0	1000.000	150.0	V	179.0	-16.6	23.3	54.0
2374.625000	36.1	1000.0	1000.000	150.0	V	-180.0	-14.5	17.9	54.0
2402.125000	64.7	1000.0	1000.000	150.0	V	123.0	-14.4	-10.7	54.0
3960.625000	34.1	1000.0	1000.000	150.0	V	-180.0	-8.4	19.9	54.0
4931.250000	31.9	1000.0	1000.000	150.0	V	48.0	-6.5	22.1	54.0

Note: The EUT has the BT wireless function, and the working frequency is 2402-2480 MHz. According to the standard FCC 47 CFR Part 15, Subpart B:2018 is not applicable to intentional transmissions from a radio transmitter. Therefore, the frequency 2402.125 MHz is not subject to this emission requirement.

Figure 7: Spectral Diagrams and measurement results, 1 GHz-5 GHz, horizontal polarization for mode 2



Final maxpeak measurement result:

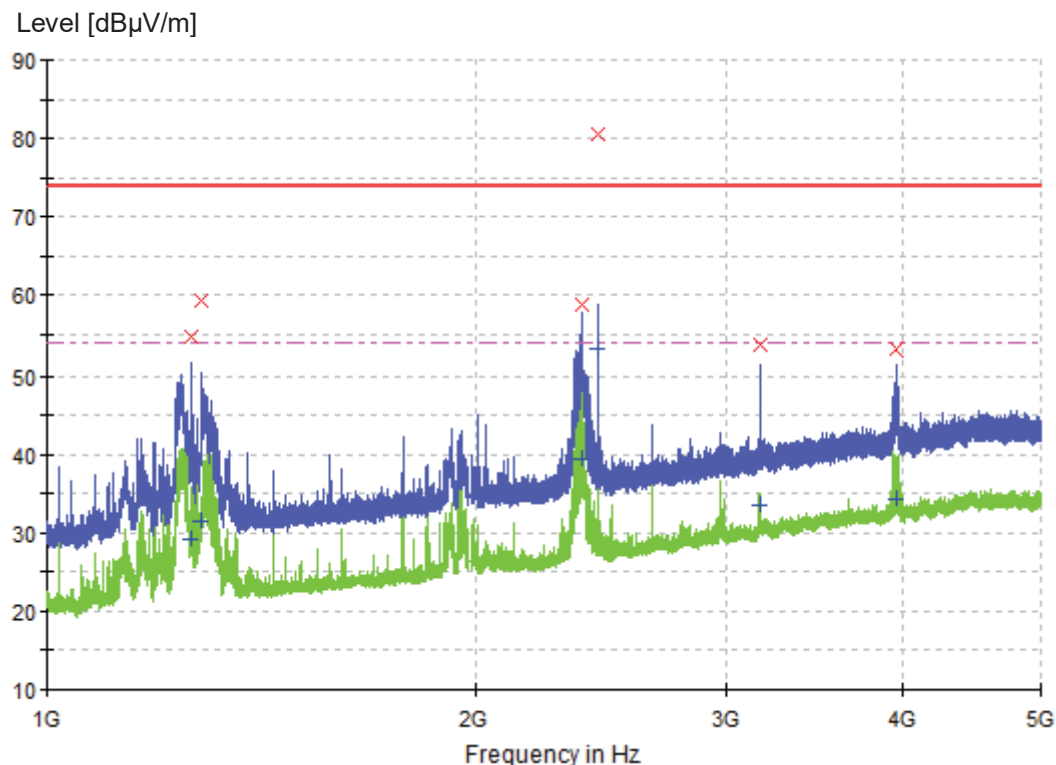
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - PK+ (dB)	Limit - PK+ (dBμV/m)
1262.500000	56.9	1000.0	1000.000	150.0	H	-125.0	-20.7	17.1	74.0
1291.875000	52.3	1000.0	1000.000	150.0	H	178.0	-20.5	21.7	74.0
1385.750000	51.7	1000.0	1000.000	150.0	H	4.0	-19.7	22.3	74.0
2385.875000	59.1	1000.0	1000.000	150.0	H	77.0	-14.5	14.9	74.0
2447.625000	83.6	1000.0	1000.000	150.0	H	-35.0	-14.2	-9.6	74.0
3960.875000	58.0	1000.0	1000.000	150.0	H	180.0	-8.4	16.1	74.0

Final average measurement result:

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)
1262.500000	29.5	1000.0	1000.000	150.0	H	-125.0	-20.7	24.5	54.0
1291.875000	30.7	1000.0	1000.000	150.0	H	178.0	-20.5	23.4	54.0
1385.750000	24.8	1000.0	1000.000	150.0	H	4.0	-19.7	29.2	54.0
2385.875000	38.0	1000.0	1000.000	150.0	H	77.0	-14.5	16.0	54.0
2447.625000	56.2	1000.0	1000.000	150.0	H	-35.0	-14.2	-2.2	54.0
3960.875000	38.7	1000.0	1000.000	150.0	H	180.0	-8.4	15.3	54.0

Note: The EUT has the BT wireless function, and the working frequency is 2402-2480 MHz. According to the standard FCC 47 CFR Part 15, Subpart B:2018 is not applicable to intentional transmissions from a radio transmitter. Therefore, the frequency 2447.625 MHz is not subject to this emission requirement.

Figure 8: Spectral Diagrams and measurement results, 1 GHz-5 GHz, vertical polarization for mode 2



Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - PK+ (dB)	Limit - PK+ (dBμV/m)
1263.000000	54.8	1000.0	1000.000	150.0	V	178.0	-20.7	19.2	74.0
1286.500000	59.2	1000.0	1000.000	150.0	V	180.0	-20.5	14.8	74.0
2373.500000	58.8	1000.0	1000.000	150.0	V	-34.0	-14.5	15.2	74.0
2438.875000	80.6	1000.0	1000.000	150.0	V	180.0	-14.2	-6.6	74.0
3167.500000	53.8	1000.0	1000.000	150.0	V	-135.0	-10.8	20.2	74.0
3959.125000	53.2	1000.0	1000.000	150.0	V	-180.0	-8.4	20.9	74.0

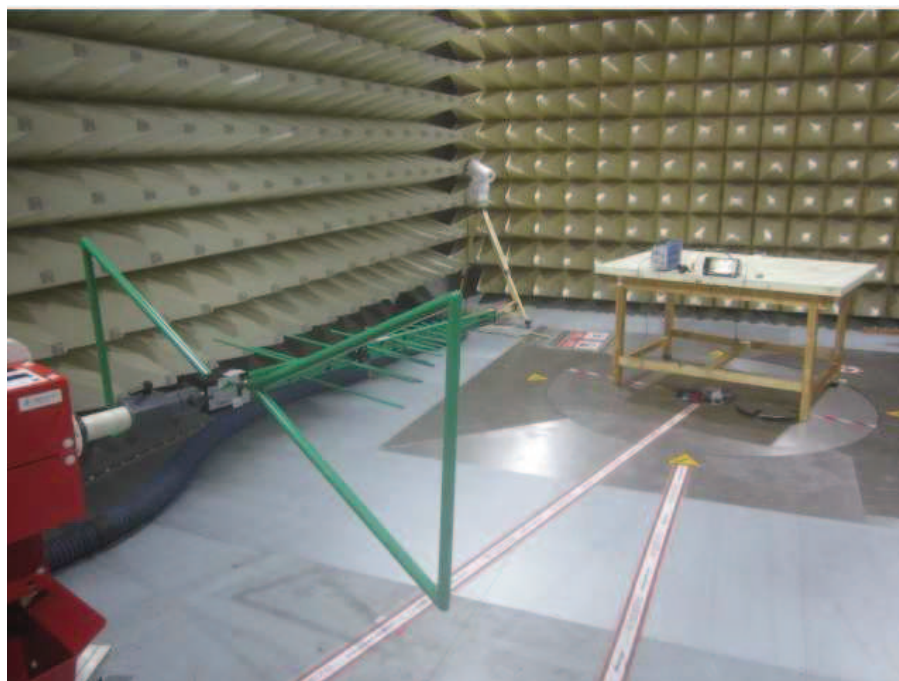
Final average measurement result:

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - AVG (dB)	Limit - AVG (dBμV/m)
1263.000000	54.8	1000.0	1000.000	150.0	V	178.0	-20.7	24.8	54.0
1286.500000	59.2	1000.0	1000.000	150.0	V	180.0	-20.5	22.6	54.0
2373.500000	58.8	1000.0	1000.000	150.0	V	-34.0	-14.5	14.5	54.0
2438.875000	80.6	1000.0	1000.000	150.0	V	180.0	-14.2	0.8	54.0
3167.500000	53.8	1000.0	1000.000	150.0	V	-135.0	-10.8	20.4	54.0
3959.125000	53.2	1000.0	1000.000	150.0	V	-180.0	-8.4	19.6	54.0

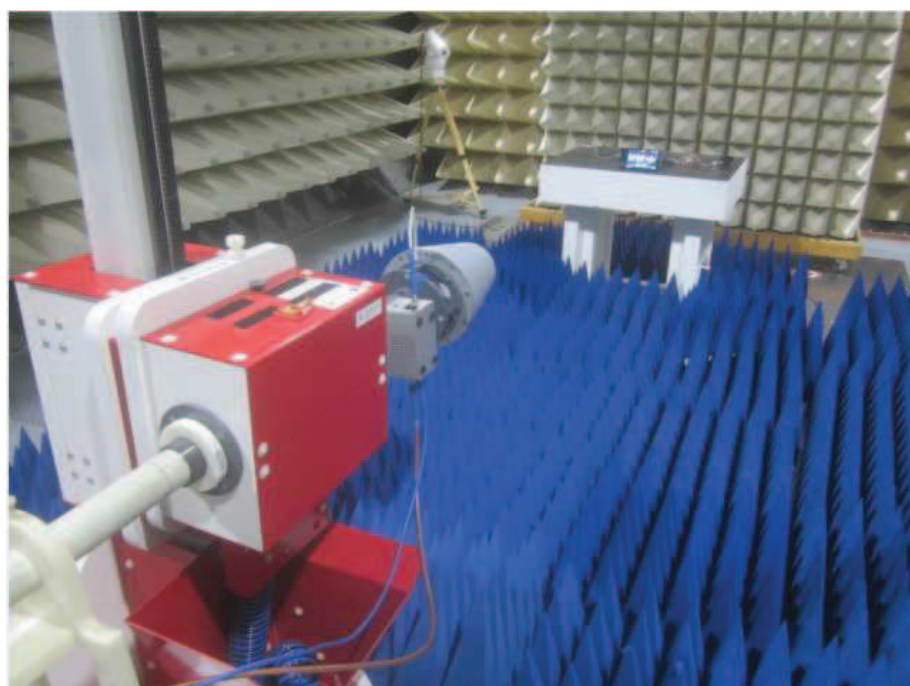
Note: The EUT has the BT wireless function, and the working frequency is 2402-2480 MHz. According to the standard FCC 47 CFR Part 15, Subpart B:2018 is not applicable to intentional transmissions from a radio transmitter. Therefore, the frequency 2438.875 MHz is not subject to this emission requirement.

5 Photographs of the Test Set-Up

Photograph 1: Set-up for measurement of radiated emission



(30-1000 MHz)



(1-5 GHz)

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6 List of Test and Measurement Instruments

Equip.	Description	Model	Manufacturer	Last Date DD.MM.YYYY	Cal. interval
1811378	3m modified semi-anechoic chamber	SAC3	Frankonia	14.05.2019	3 years
1811391	EMI test receiver	ESCI	Rohde&Schwarz	01.11.2019	1 year
1811425	Bilog antenna	CBL 6112D	Teseq	14.02.2017	3 years
1825371	Preamplifier	EMC051845SE	Taiwan EMCI	06.03.2019	3 years
1811417	Log periodic antenna	HL050	Rohde&Schwarz	17.02.2017	3 years
1822702	Spectrum analyser	FSV40	Rohde&Schwarz	01.11.2019	1 year

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End of test report