



TESTING LABORATORY
CERTIFICATE # 4821.01



FCC PART 15.247

TEST REPORT

For

Amazonen Werke H.Dreyer GmbH & Co. KG

Heinrich-Dreyer-Strasse 7, Hude 27798, Germany

FCC ID: 2ATZZ-CAN2BT

Report Type: Original Report	Product Type: CAN2BT Adapter
Report Number:	<u>RSZ190702006-00A</u>
Report Date:	<u>2019-09-16</u>
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TABLE OF CONTENTS

GENERAL INFORMATION	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY.....	4
SYSTEM TEST CONFIGURATION	5
DESCRIPTION OF TEST CONFIGURATION	5
EQUIPMENT MODIFICATIONS	5
EUT EXERCISE SOFTWARE	5
DUTY CYCLE	6
SUPPORT EQUIPMENT LIST AND DETAILS	6
EXTERNAL I/O CABLE.....	6
BLOCK DIAGRAM OF TEST SETUP	7
SUMMARY OF TEST RESULTS	8
TEST EQUIPMENT LIST	9
FCC§15.247 (i), §1.1307 (b) (1) & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)	10
APPLICABLE STANDARD	10
FCC §15.203 - ANTENNA REQUIREMENT	11
APPLICABLE STANDARD	11
ANTENNA CONNECTOR CONSTRUCTION	11
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS	12
APPLICABLE STANDARD	12
EUT SETUP	12
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	13
TEST PROCEDURE	13
CORRECTED AMPLITUDE & MARGIN CALCULATION	13
TEST RESULTS SUMMARY	14
TEST DATA	14
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH	22
APPLICABLE STANDARD	22
TEST PROCEDURE	22
TEST DATA	22
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER	25
APPLICABLE STANDARD	25
TEST PROCEDURE	25
TEST DATA	25
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE	26
APPLICABLE STANDARD	26
TEST PROCEDURE	26
TEST DATA	26
FCC §15.247(e) - POWER SPECTRAL DENSITY	28
APPLICABLE STANDARD	28
TEST PROCEDURE	28
TEST DATA	28

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	CAN2BT Adapter
Tested Model	NI337
Multiple Model	NI336
Frequency Range	Bluetooth LE: 2402~2480MHz
Max Peak Output Power	Bluetooth LE: 2.01 dBm
Modulation Technique	Bluetooth LE: GFSK
Antenna Specification	2.5 dBi
Voltage Range	DC 12V
Date of Test	2019/08/13~2019/09/04
Sample serial number	190702006 (Assigned by BACL, Shenzhen)
Received date	2019/07/02
Sample/EUT Status	Good condition

Notes: This series products model: NI336 and NI337 are electrically identical, model NI337 was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.

Objective

This report is prepared on behalf of *Amazonen Werke H.Dreyer GmbH & Co. KG* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter	Uncertainty	
Occupied Channel Bandwidth	±5%	
RF Output Power with Power meter	±0.73dB	
RF conducted test with spectrum	±1.6dB	
AC Power Lines Conducted Emissions	±1.95dB	
Emissions, Radiated	Below 1GHz Above 1GHz	±4.75dB ±4.88dB
Temperature	±1°C	
Humidity	±6%	
Supply voltages	±0.4%	

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

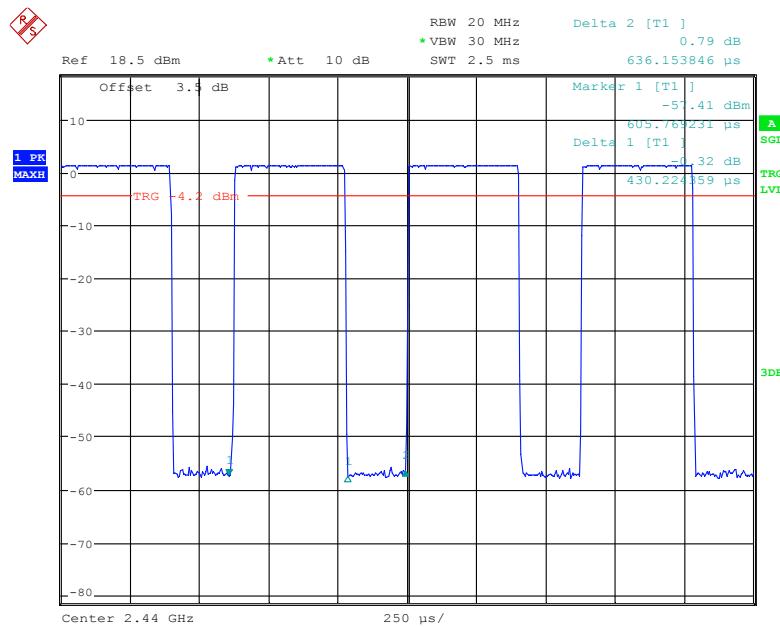
No modification was made to the EUT tested.

EUT Exercise Software

“uEnergyTestApp.exe” software was used, and the power level was set as 5.

Duty cycle

BLE Mode



Date: 22.AUG.2019 20:29:45

Mode	Duty Cycle (%)	T(us)	1/T(kHz)	VBW Setting	10log(1/ Duty Cycle)
BLE	67.61	430	2.326	3kHz	1.70

Support Equipment List and Details

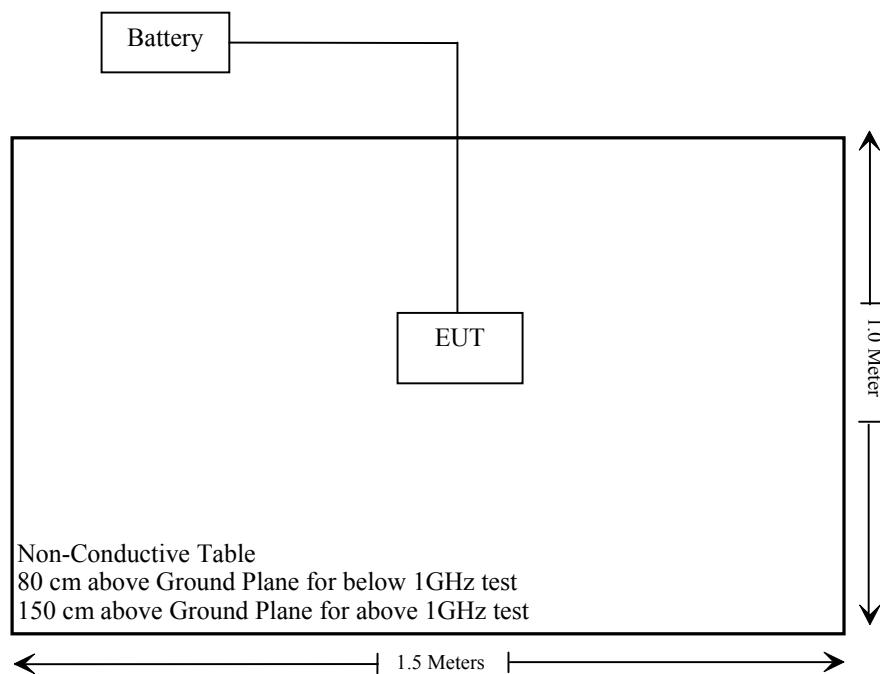
Manufacturer	Description	Model	Serial Number
Panasonic Storage Battery(Shenyang) Co.,Ltd.	Valve Regulated Lead-Acid Battery	LC-P1224ST	Unknown

External I/O Cable

Cable Description	Length (m)	From Port	To
Unshielded Detachable DC Cable	2.0	Battery	EUT

Block Diagram of Test Setup

For radiated emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1) & §2.1091	Maximum Permissible exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Note:

Not Applicable: The device is only powered by 12V DC power supply.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019-07-22	2020-07-21
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-12	2019-11-12
Sonoma Instrument	Amplifier	310N	186238	2018-11-12	2019-11-12
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2019-07-09	2020-07-08
Ducommun technologies	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	104PEA	218124002	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	RG-214	1	2018-11-12	2019-11-12
Ducommun technologies	RF Cable	RG-214	2	2018-11-12	2019-11-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Heatsink Required	Amplifier	QLW-18405536-J0	15964001002	2018-11-12	2019-11-12
Sinoscite	Notch Filter	BSF2402-2480MN-0898-001	99632	2018-11-12	2019-11-12
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
RF Conducted Test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2019-07-10	2020-07-09
WEINSCHEL	3dB Attenuator	6231	666	Each Time	
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2019-03-02	2020-03-01
Ducommun technologies	RF Cable	RG-214	3	Each Time	

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC§15.247 (i), §1.1307 (b) (1) & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

MPE Calculated :

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Results

Tune-Up Power Including Tolerance:

Frequency (MHz)	Antenna Gain		Max Tune-up Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
	(dBi)	(numeric)	(dBm)	(mW)			
2402-2480	2.5	1.78	2.5	1.78	20	0.0006	1.0

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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. 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi 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

The EUT has an internal antenna arrangement, which was permanently attached and the antenna gain is 2.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

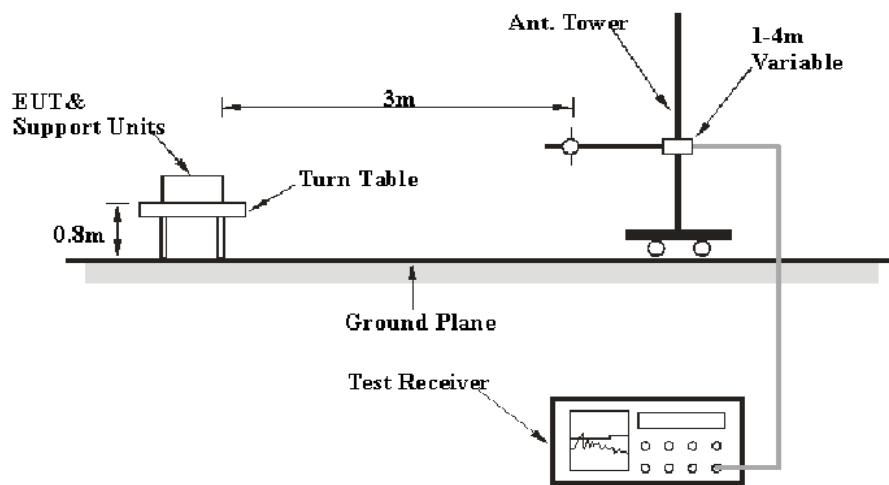
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

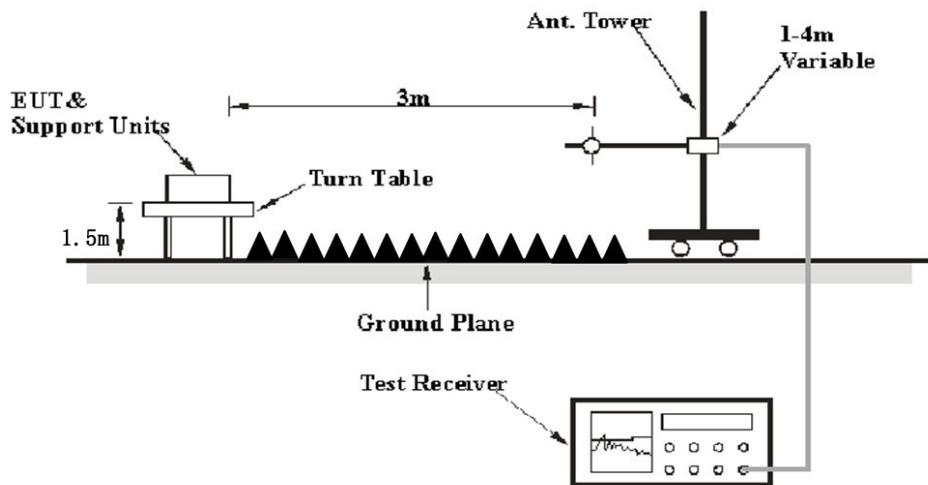
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz ^{Note 1}	/	Average
	1MHz	>1/T ^{Note 2}	/	Average

Note 1: when duty cycle is no less than 98%

Note 2: when duty cycle is less than 98%

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

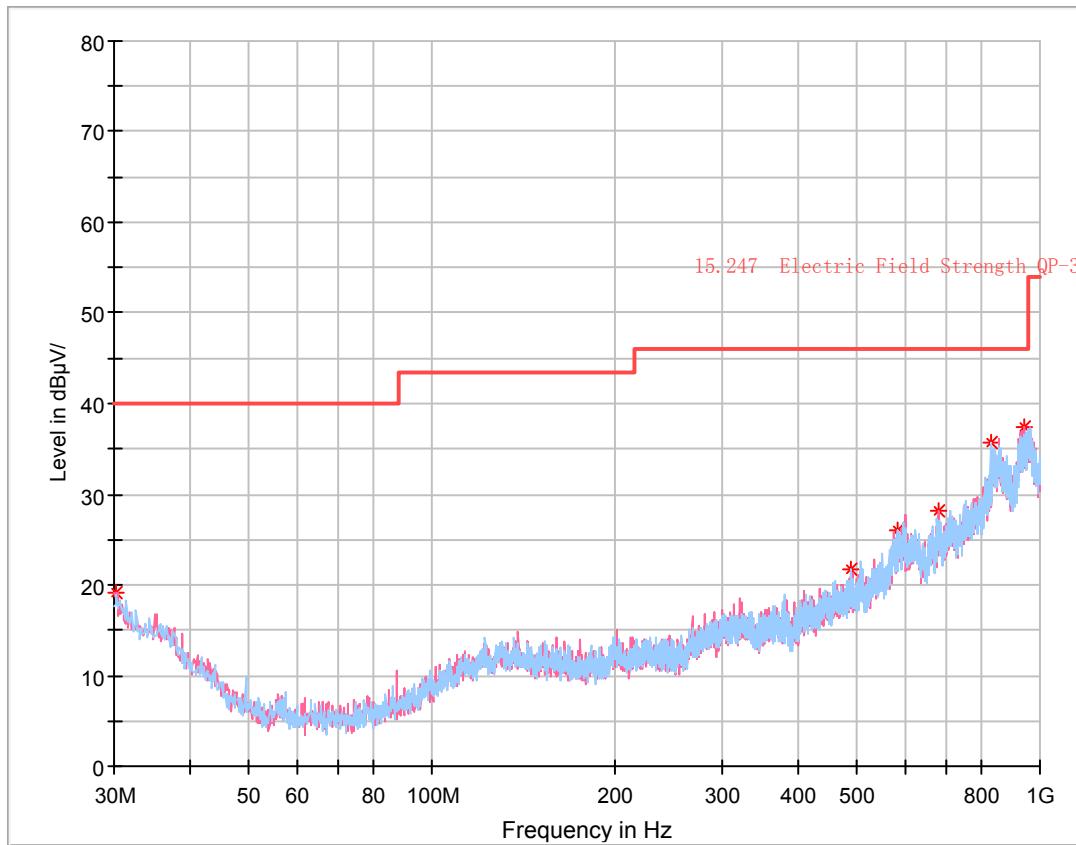
Environmental Conditions

Temperature:	25~26 °C
Relative Humidity:	52~53 %
ATM Pressure:	101.0 kPa

The testing was performed by Zero Yan on 2019-09-04 and by Curry Xiang on 2019-08-13.

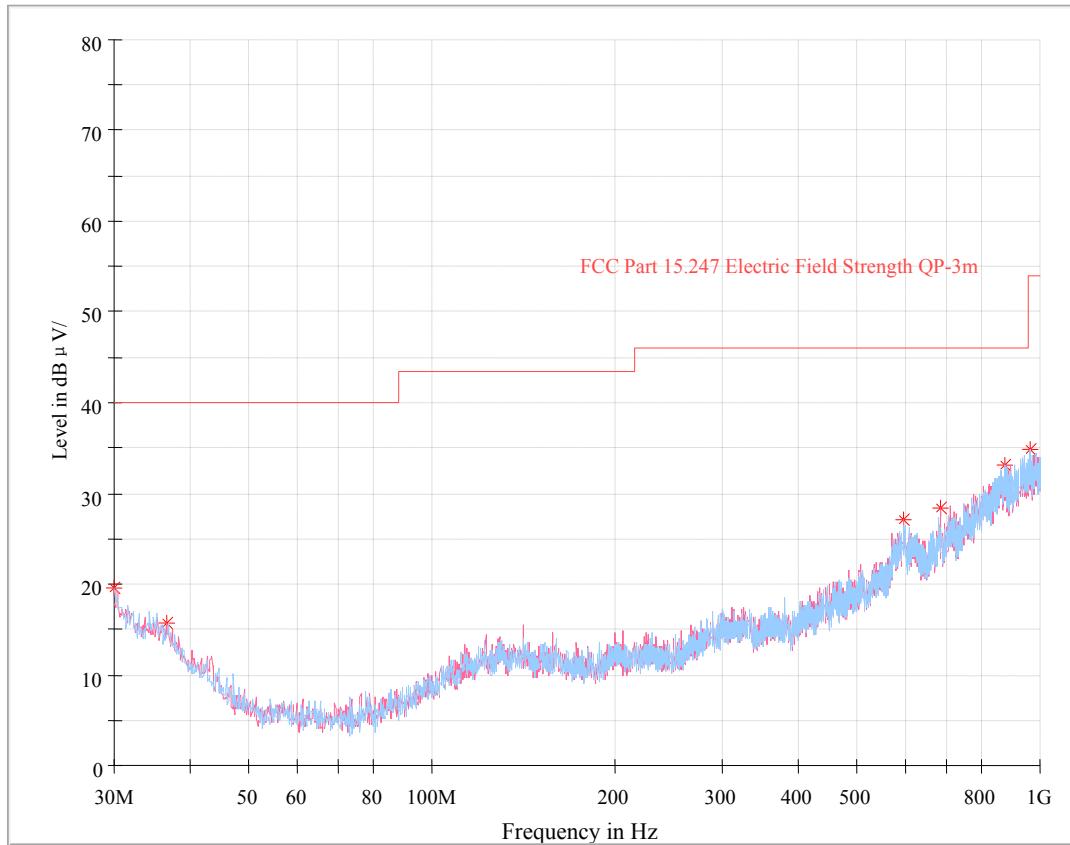
EUT operation mode: Transmitting

30 MHz~1 GHz: (Worst case, High channel) (Model NI337)



Frequency (MHz)	Corrected Amplitude (dB μ V/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
487.718750	21.71	202.0	H	0.0	-7.4	46.00	24.29
828.431250	35.72	300.0	H	111.0	4.8	46.00	10.28
584.233750	26.08	300.0	H	239.0	-2.8	46.00	19.92
30.242500	19.24	102.0	V	15.0	-7.8	40.00	20.76
683.658750	28.11	102.0	V	60.0	-2.0	46.00	17.89
940.951250	37.39	102.0	V	119.0	8.9	46.00	8.61

30 MHz~1 GHz: (Worst case, High channel) (Model NI336)



Frequency (MHz)	Corrected Amplitude (dB μ V/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)
30.000000	19.59	300.0	H	13.0	-7.6	40.00	20.41
36.547500	15.76	102.0	V	112.0	-11.5	40.00	24.24
597.450000	27.00	102.0	V	218.0	-1.8	46.00	19.00
684.992500	28.35	202.0	V	92.0	-1.9	46.00	17.65
877.416250	33.17	300.0	H	93.0	5.4	46.00	12.83
961.563750	34.74	202.0	H	285.0	9.1	53.90	19.16

1 GHz-25 GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Reading (dB μ V)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2402 MHz)									
2361.60	28.10	PK	113	2.3	H	31.87	59.97	74	14.03
2361.60	15.07	Ave.	113	2.3	H	31.87	46.94	54	7.06
2495.11	28.46	PK	166	2.4	H	32.13	60.59	74	13.41
2495.11	15.14	Ave.	166	2.4	H	32.13	47.27	54	6.73
4804.00	43.29	PK	292	1.0	H	6.28	49.57	74	24.43
4804.00	29.87	Ave.	292	1.0	H	6.28	36.15	54	17.85
Middle Channel (2440 MHz)									
4880.00	44.05	PK	286	2.0	H	6.76	50.81	74	23.19
4880.00	33.32	Ave.	48	1.5	H	6.76	40.08	54	13.92
High Channel (2480 MHz)									
2380.91	28.01	PK	158	1.3	H	31.87	59.88	74	14.12
2380.91	15.22	Ave.	158	1.3	H	31.87	47.09	54	6.91
2498.00	27.62	PK	108	1.6	H	32.13	59.75	74	14.25
2498.00	14.60	Ave.	108	1.6	H	32.13	46.73	54	7.27
4960.00	47.03	PK	17	1.2	H	6.80	53.83	74	20.17
4960.00	40.24	Ave.	17	1.2	H	6.80	47.04	54	6.96

Note:

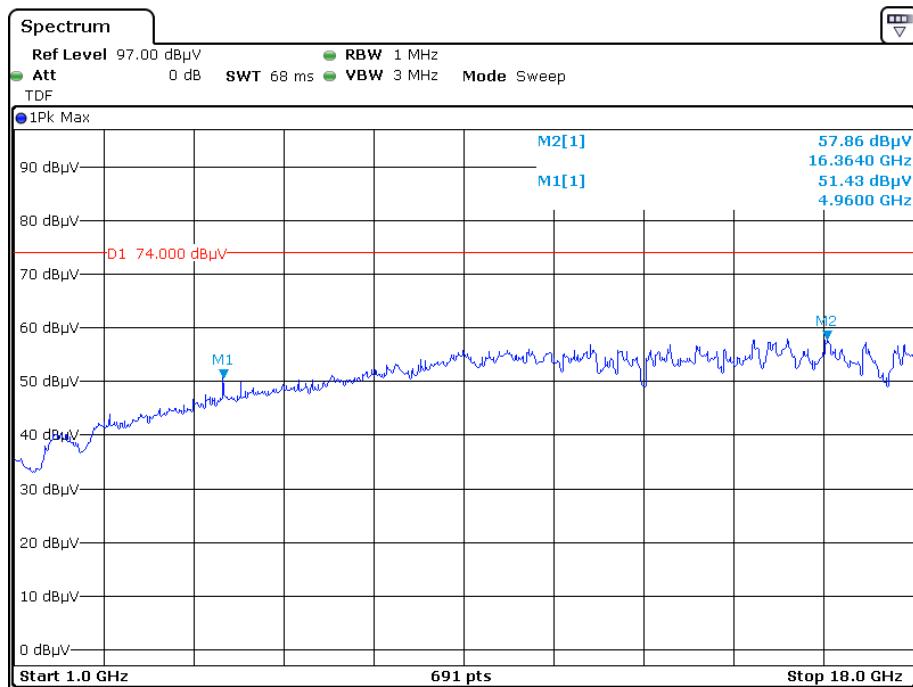
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

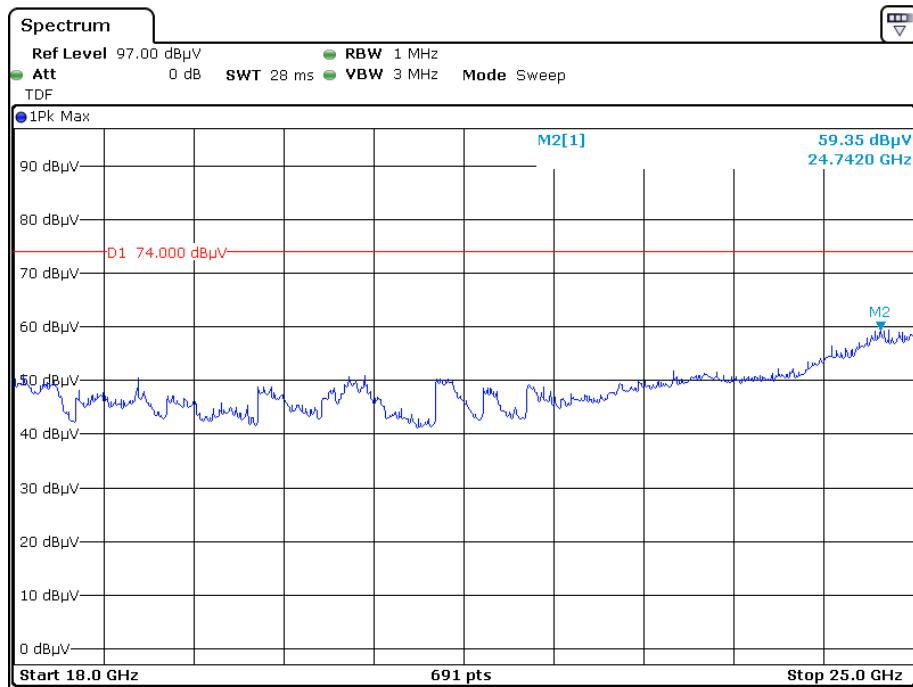
Margin = Limit - Corrected. Amplitude

The other spurious emission which is 20dB to the limit was not recorded.

And for the pre-scan is performed with the 2400-2483.5MHz band filter.

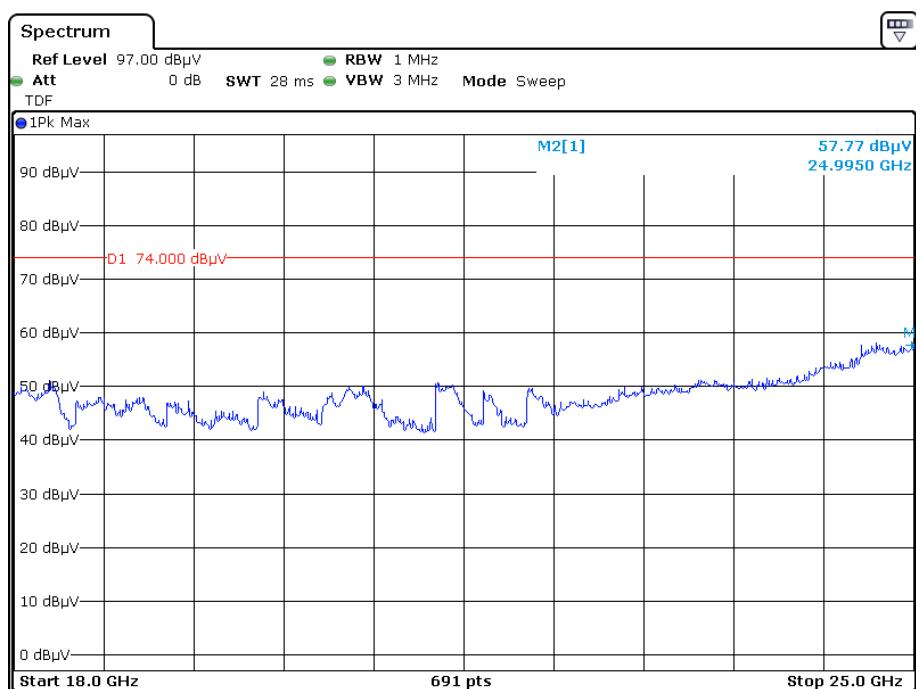
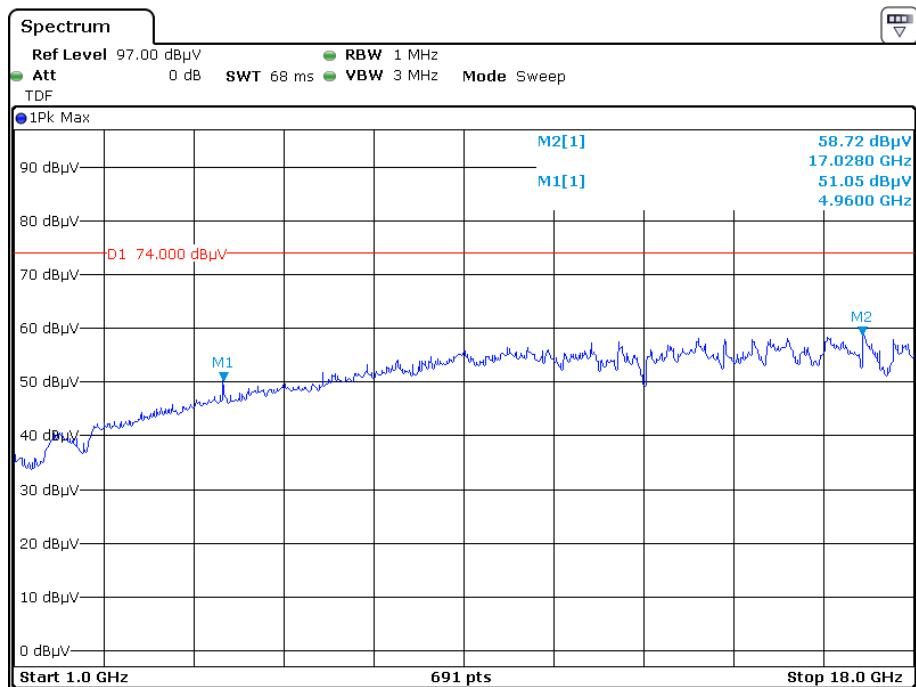
**Pre-scan with High channel
Horizontal**

Date: 13.AUG.2019 18:07:49

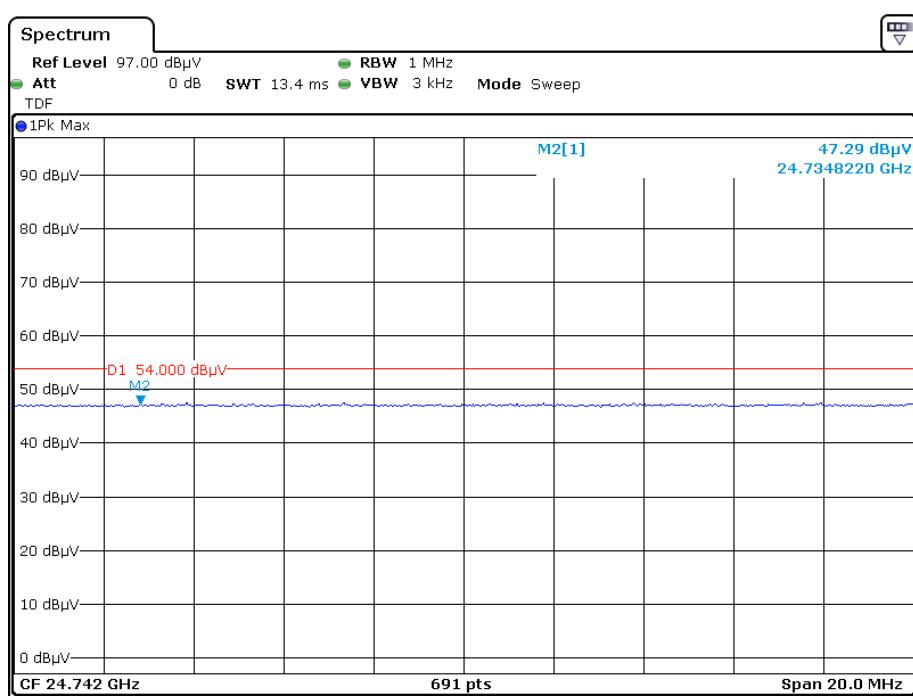
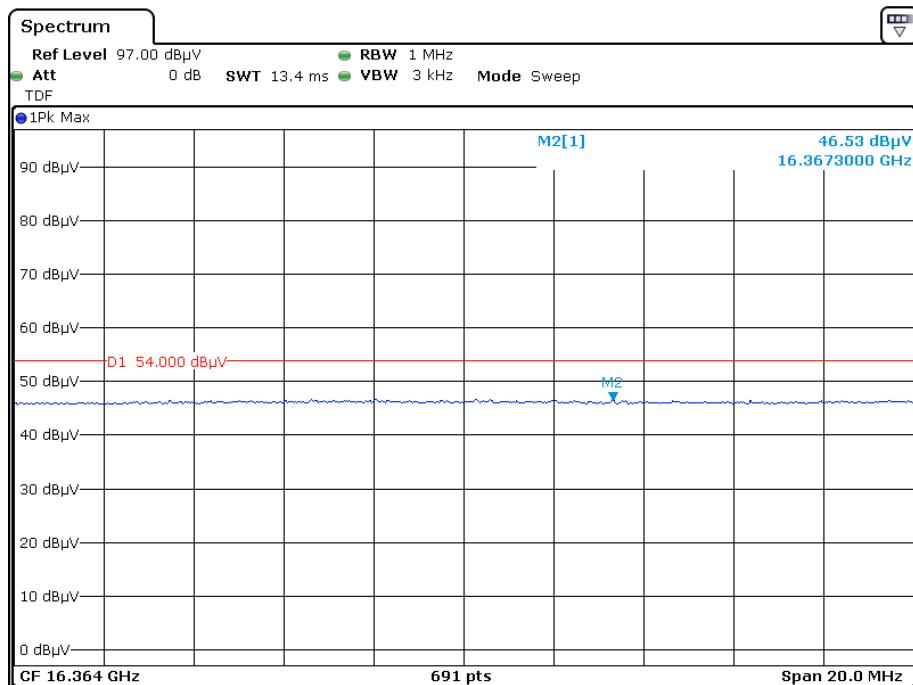


Date: 13.AUG.2019 18:47:21

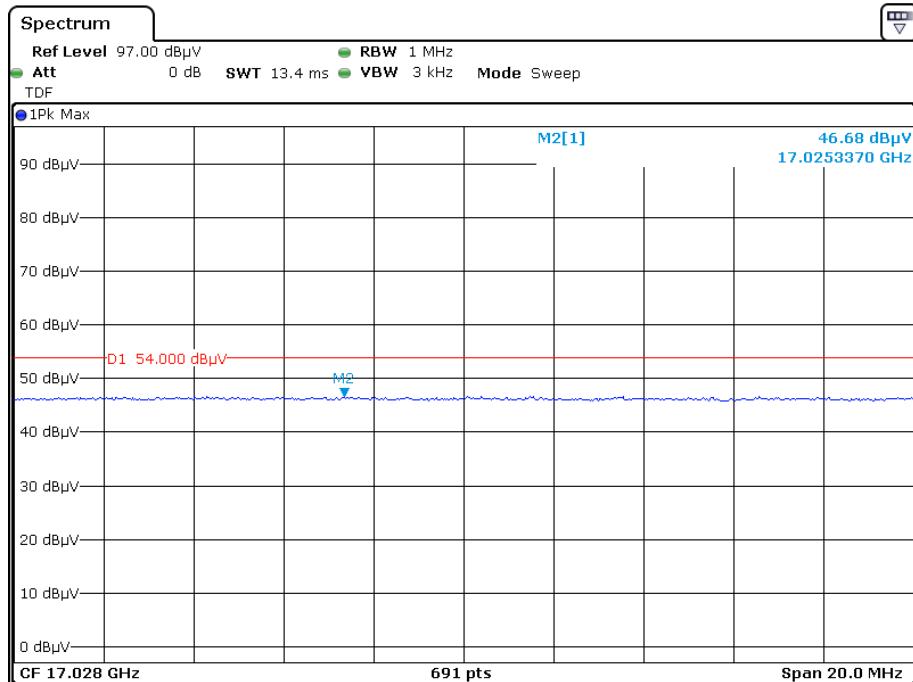
Vertical



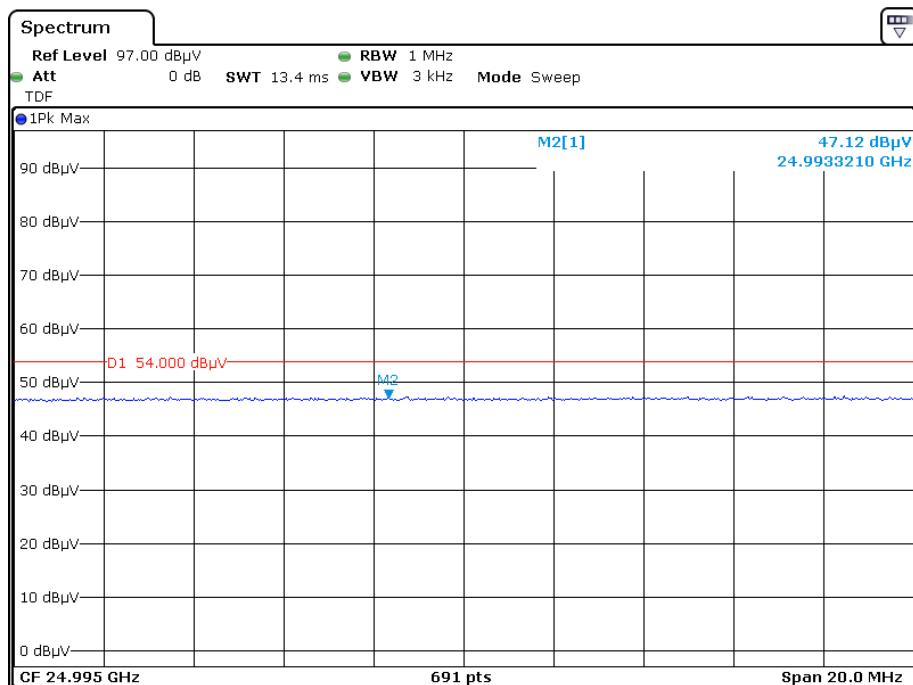
Pre-scan for Average Horizontal



Vertical



Date: 13.AUG.2019 18:04:01



Date: 13.AUG.2019 18:58:05

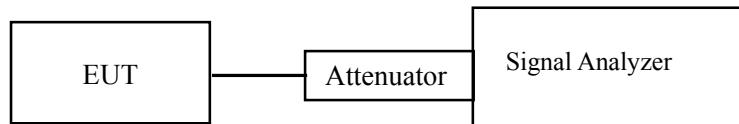
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Leo Huang on 2019-08-17.

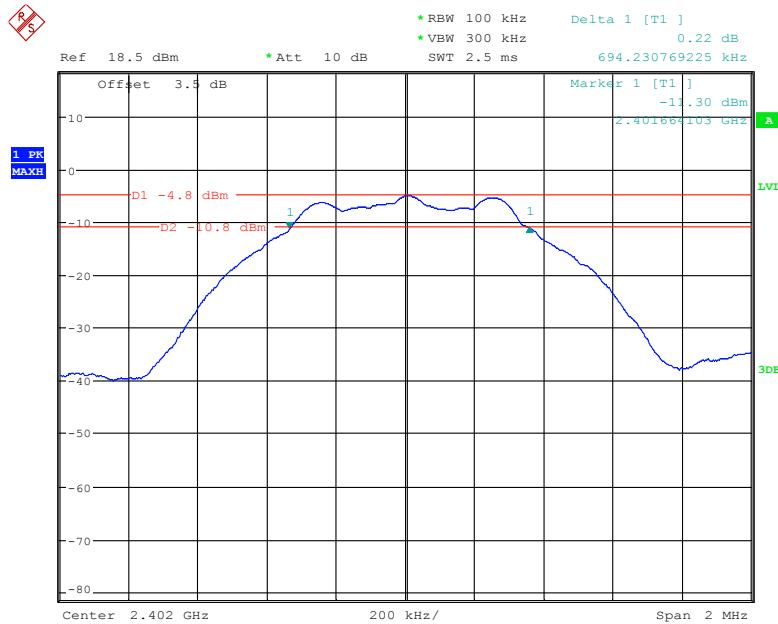
Test Result: Pass.

Please refer to the following table and plots.

EUT operation mode: Transmitting

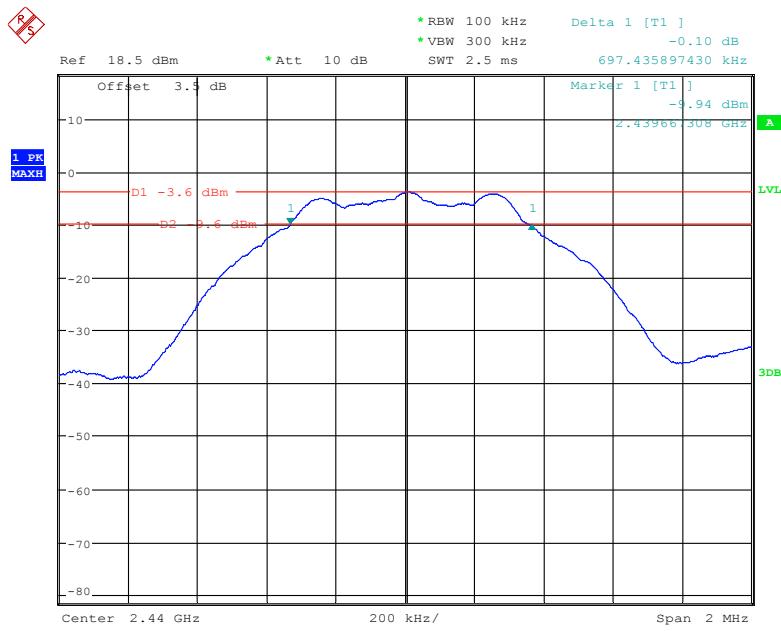
Channel	Frequency (MHz)	6 dB Emission Bandwidth(MHz)	Limit (kHz)
BLE mode			
Low	2402	0.694	≥500
Middle	2440	0.697	≥500
High	2480	0.697	≥500

BLE Low Channel



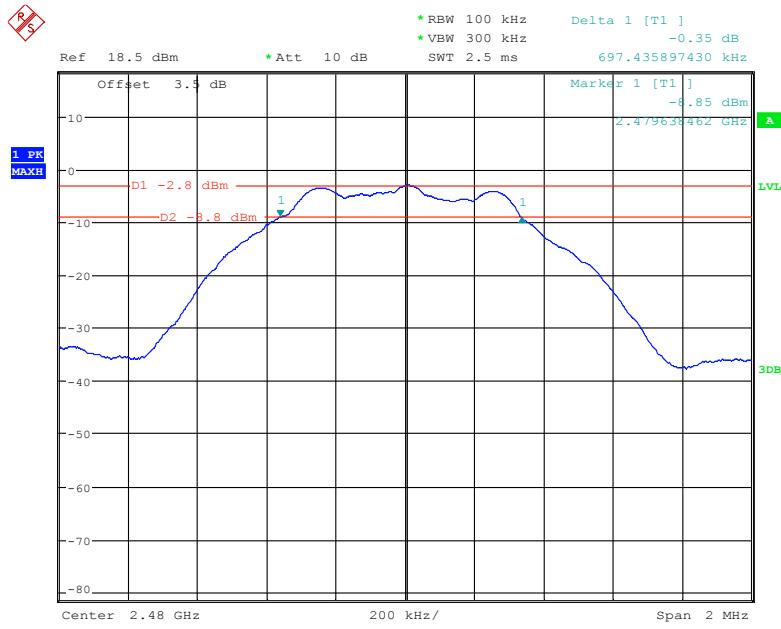
Date: 17.AUG.2019 16:14:26

BLE Middle Channel



Date: 17.AUG.2019 16:12:43

BLE High Channel



Date: 17.AUG.2019 16:11:09

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

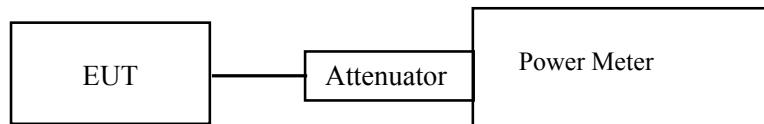
Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 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.

Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Leo Huang on 2019-08-17.

EUT operation mode: Transmitting

BLE mode

Channel	Frequency (MHz)	Max Peak Output Power (dBm)	Limit (dBm)	Result
Low	2402	-0.31	30	Pass
Middle	2440	1.04	30	Pass
High	2480	2.01	30	Pass

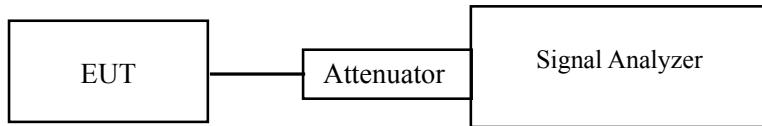
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

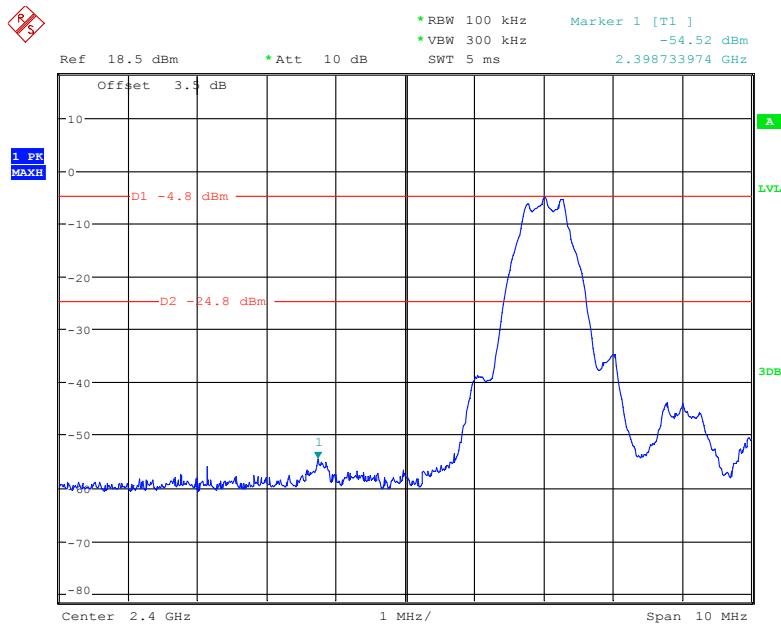
Temperature:	23 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Leo Huang on 2019-08-17.

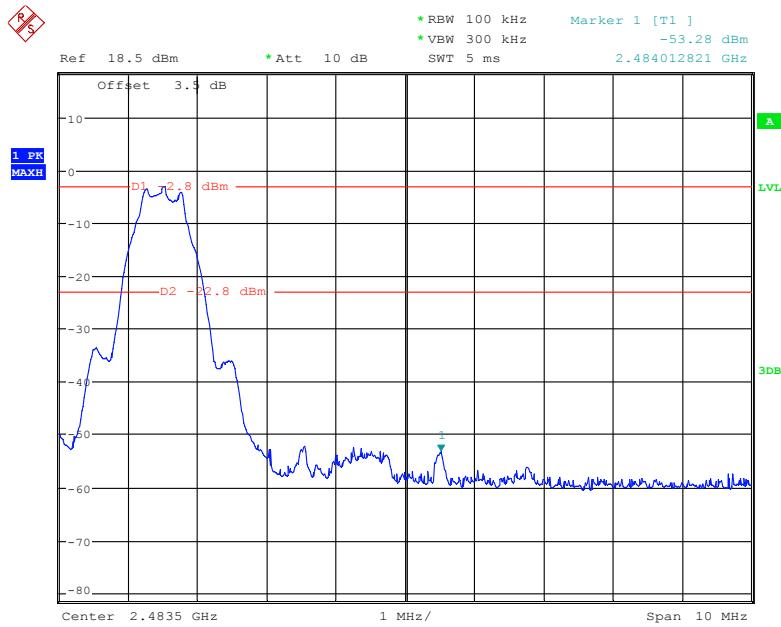
EUT operation mode: Transmitting

Test Result: Compliance

Please refer to the following plots.

BLE: Band Edge, Left Side

Date: 17.AUG.2019 16:15:42

BLE: Band Edge, Right Side

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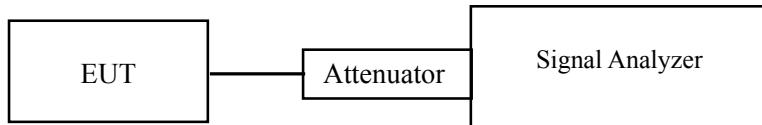
FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: $3\text{kHz} \leq \text{RBW} \leq 100\text{ kHz}$.
3. Set the VBW $\geq 3 \times \text{RBW}$.
4. Set the span to 1.5 times the DTS bandwidth.
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.



Test Data

Environmental Conditions

Temperature:	23 °C
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

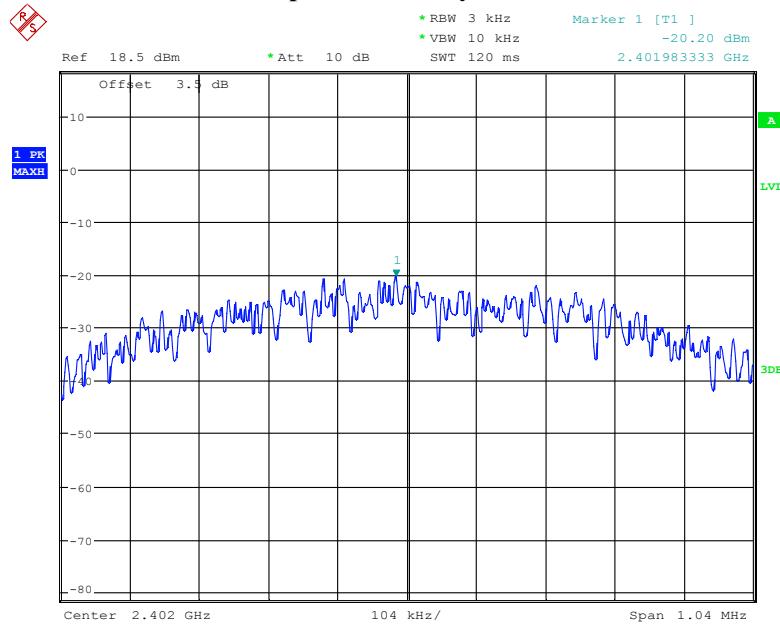
The testing was performed by Leo Huang on 2019-08-17.

EUT operation mode: Transmitting

Test Result: Pass

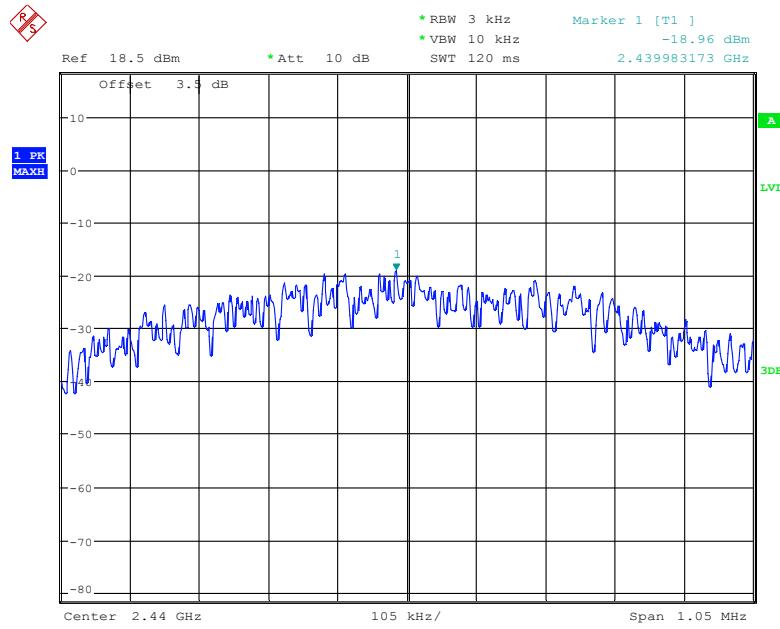
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
BLE mode			
Low	2402	-20.20	≤8
Middle	2440	-18.96	≤8
High	2480	-18.16	≤8

Power Spectral Density, BLE Low Channel

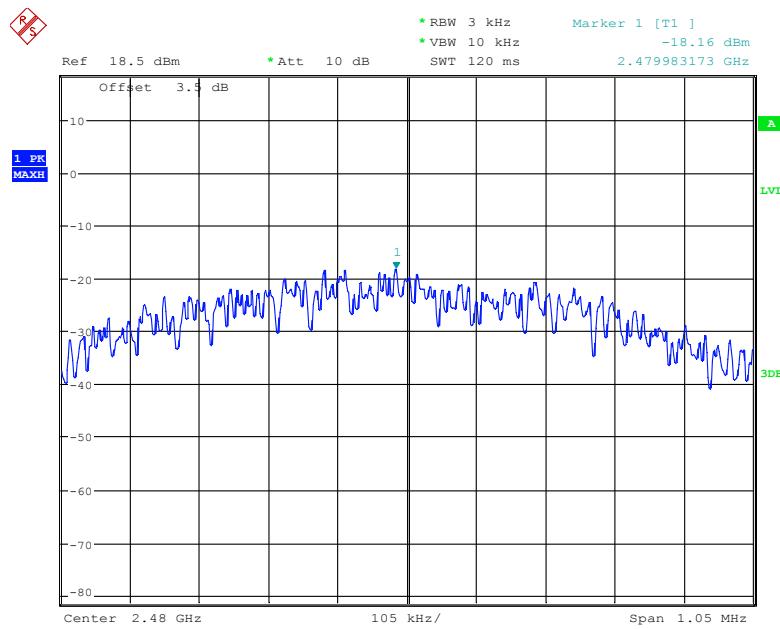


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Power Spectral Density, BLE Middle Channel



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Power Spectral Density, BLE High Channel

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******* END OF REPORT *******