

FCC - TEST REPORT

Report Number : **68.920.18.0061.02** Date of Issue: March 28, 2019

Model : Lagoon ANC

Product Type : BLUETOOTH HEADPHONES

Applicant : Beyerdynamic

Address : 56 Central Ave, Farmingdale, New York United States

Manufacturer : Beyerdynamic

Address : 56 Central Ave, Farmingdale, New York United States

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including
Appendices : **30**

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint
Road 2, Nanshan District
Shenzhen 518052
P.R. China

Telephone: 86 755 8828 6998
Fax: 86 755 828 5299

FCC Registration 514049
No.:
IC Registration 10320A
No.:

3 Description of the Equipment Under Test

Product:	BLUETOOTH HEADPHONES
Model no.:	Lagoon ANC
FCC ID:	OSDLAGOONANC
Options and accessories:	USB Cable
Rating:	3.7VDC, 1100mAh (Supplied by Built Li-ion Polymer battery) 5V 1.0A Charging by USB port
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	Integrated antenna
Antenna Gain:	2.59dBi
Description of the EUT:	The Equipment Under Test (EUT) is BLUETOOTH HEADPHONES operated at 2.4GHz

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2017 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB558074 D01 v04 DTS Measurement Guidance and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	--	--	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247 (b) (1)	Conducted peak output power	10	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(1)	20dB bandwidth	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)	Carrier frequency separation	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Dwell Time	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	13	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(e)	Power spectral density	16	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Spurious RF conducted emissions	20	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Band edge	24	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	26	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203	Antenna requirement	See note 2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a Integrated antenna, which gain is 2.59dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This report was based on the report 68.920.18.0061.01 for changing the hardware of power supply, so the RF output power and radiate emission have been retested, other test data were referred from original test report 68.920.18.0061.01, and the test data are still effective and they are representative of the compliance of the modification.

Lagoon ANC is a BLUETOOTH HEADPHONES with Bluetooth 5.0, which supports 1Mbps only for Bluetooth Low Energy. The TX and RX range is 2402MHz-2480MHz.

Note: The report is BLE only

SUMMARY:

All tests according to the regulations cited on page 6 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

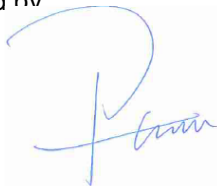
Sample Received Date: October 20, 2018

Testing Start Date: October 20, 2018

Testing End Date: March 20, 2019

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:



Phoebe Hu
EMC Section Manager

Prepared by:



Vincent Zheng
EMC Project Engineer

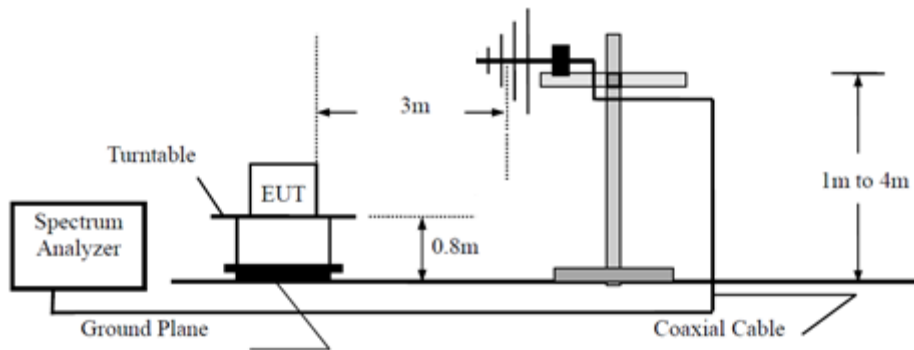
Tested by:



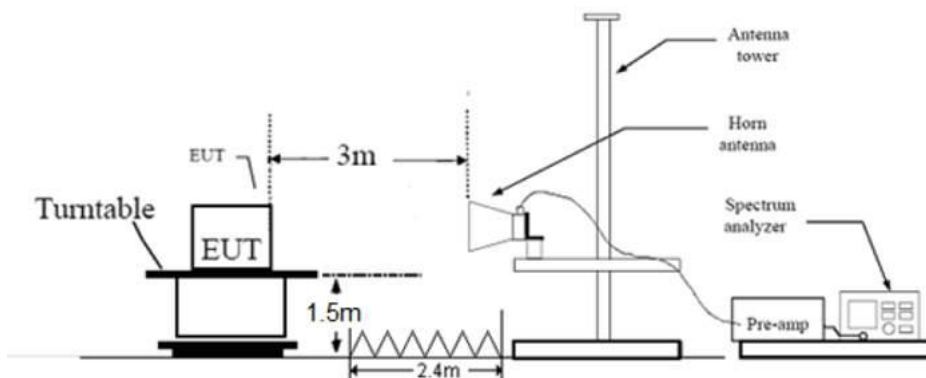
Tree Zhan
EMC Test Engineer

7 Test Setups

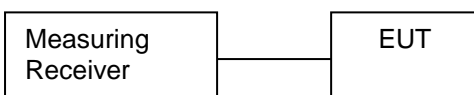
Below 1GHz



Above 1GHz



Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenovo	X220	---
Adapter	---	---	---

Test software: CSR tool, which used to control the EUT in continues transmitting mode.

The system was configured to channel 0, 19, and 39 for the test.

9 Technical Requirement

9.1 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
RBW > the 6dB bandwidth of the emission being measured, VBW \geq 3RBW, Span \geq 3RBW
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

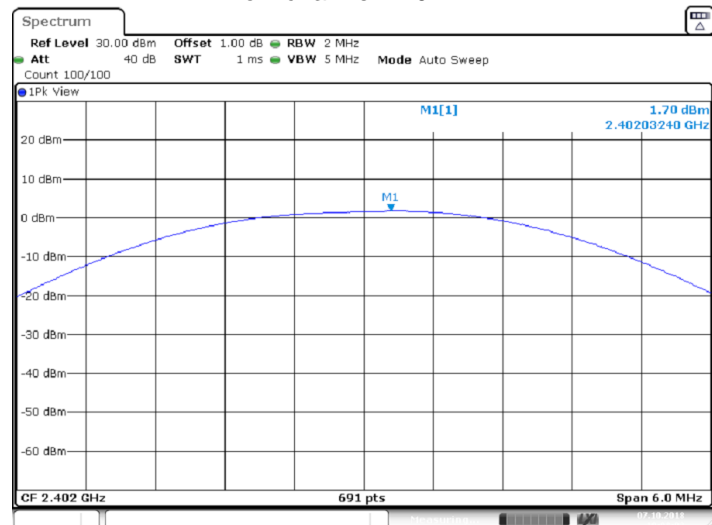
According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 1	≤ 30

Test result as below table

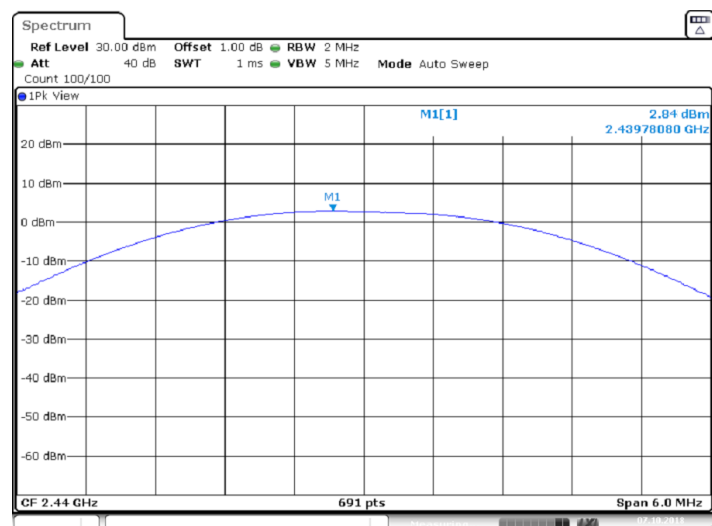
Frequency MHz	Conducted Peak Output Power dBm	Result
Bottom channel 2402MHz	1.70	Pass
Middle channel 2440MHz	2.84	Pass
Top channel 2480MHz	3.16	Pass

Low channel 2402MHz



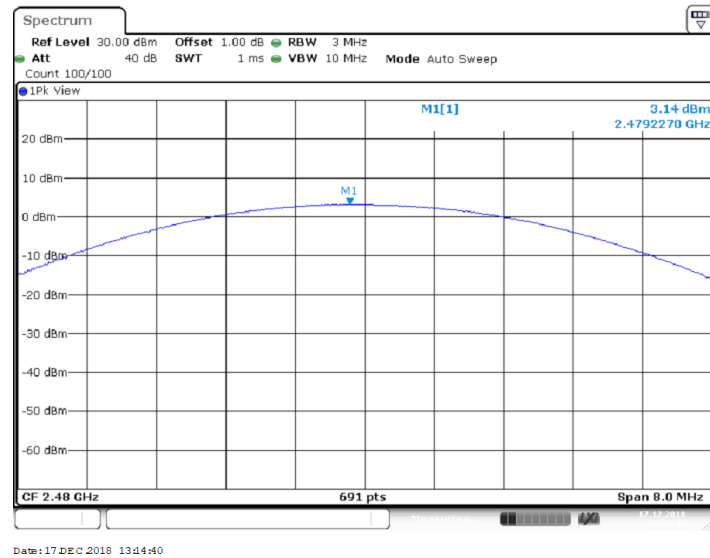
Date: 7 OCT 2018 10:08:04

Middle channel 2440MHz



Date: 7 OCT 2018 10:09:59

High channel 2480MHz



9.2 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW \geq 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

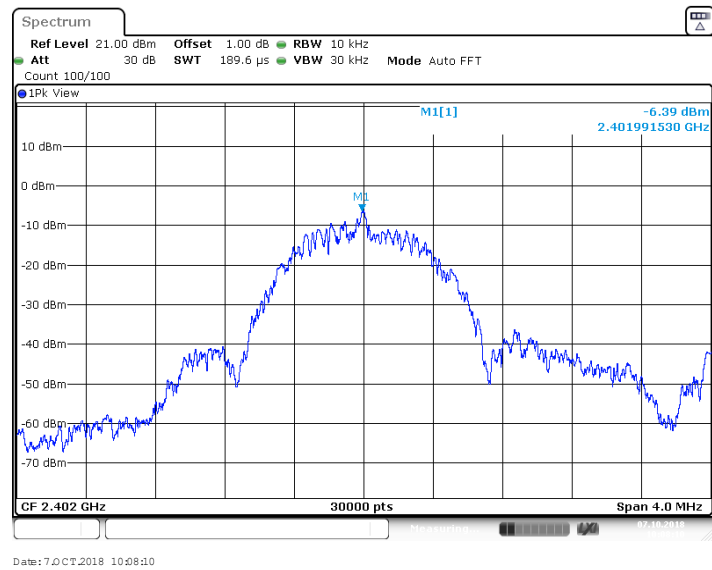
Limit [dBm]

≤ 8

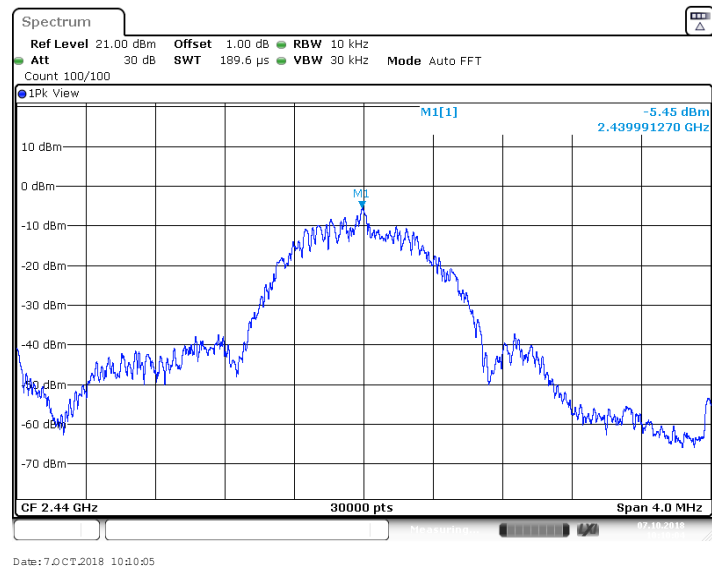
Test result

Frequency MHz	Power spectral density dBm	Result
Top channel 2402MHz	-6.39	Pass
Middle channel 2440MHz	-5.45	Pass
Bottom channel 2480MHz	-4.46	Pass

Low channel 2402MHz

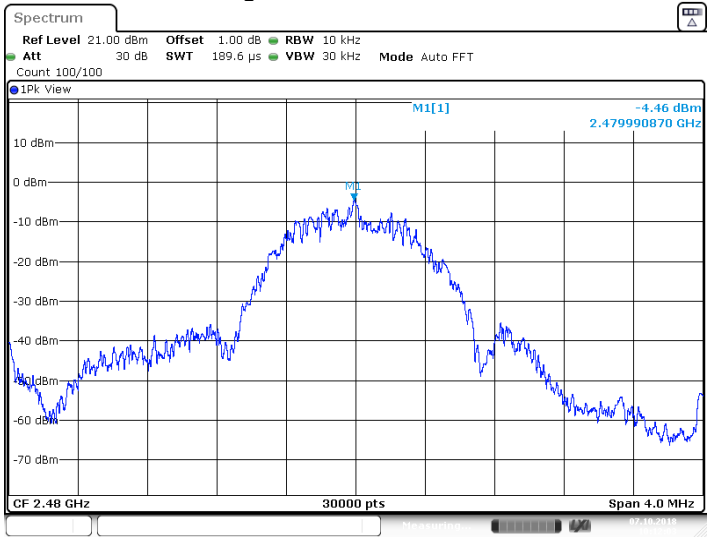


Middle channel 2440MHz





High channel 2480MHz



Date: 7 OCT 2018 10:12:03

9.3 6 dB Bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
RBW=100K, VBW \geq 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be \geq 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

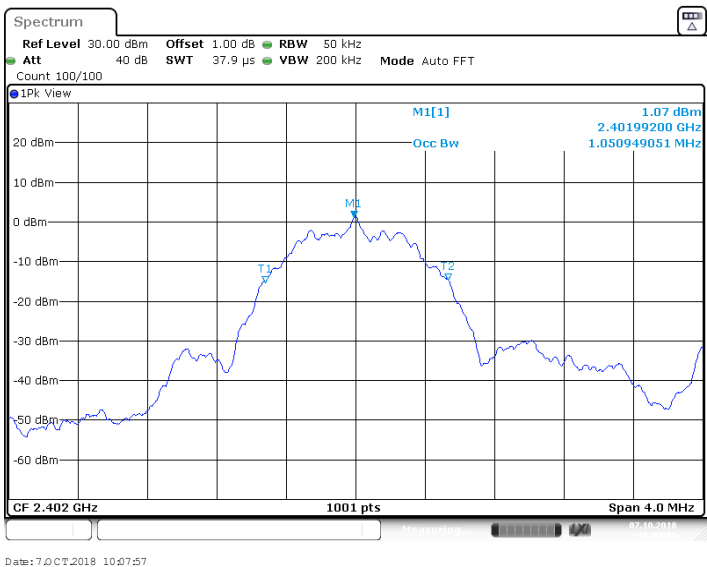
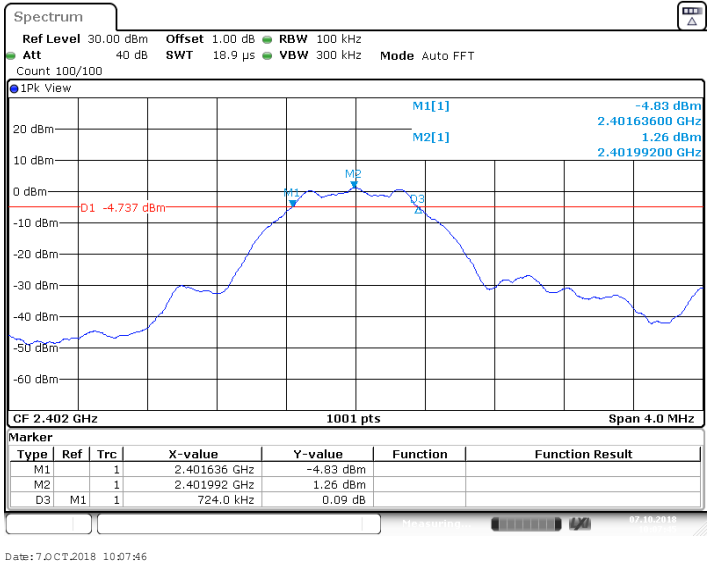
≥ 500

Test result

Frequency MHz	6dB bandwidth kHz	99 bandwidth kHz	Result
Bottom channel 2402MHz	724	1055.0	Pass
Middle channel 2440MHz	720	1059.3	Pass
Top channel 2480MHz	724	1055.0	Pass

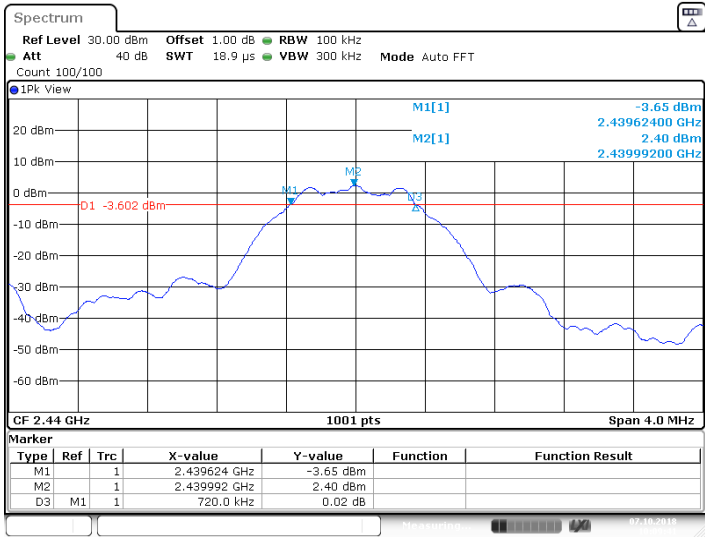
6 dB Bandwidth

Low channel 2402MHz

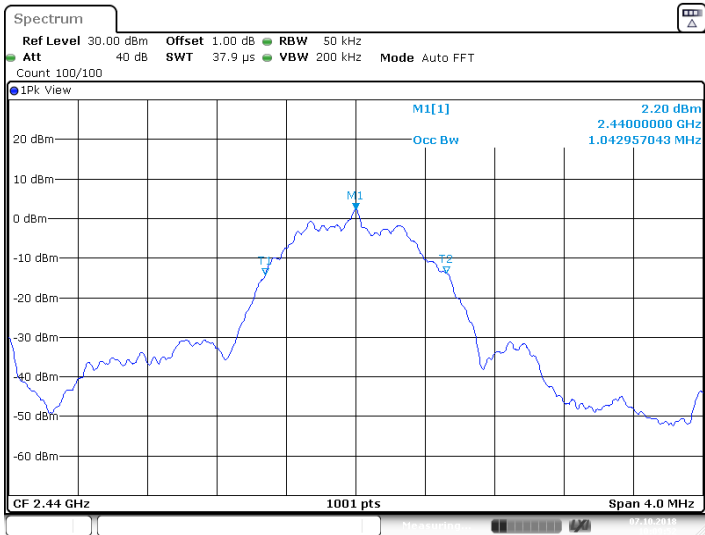




Middle channel 2440MHz



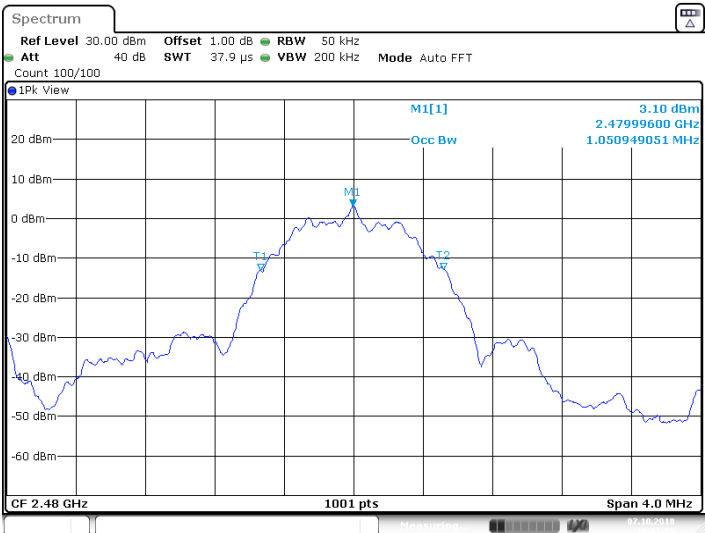
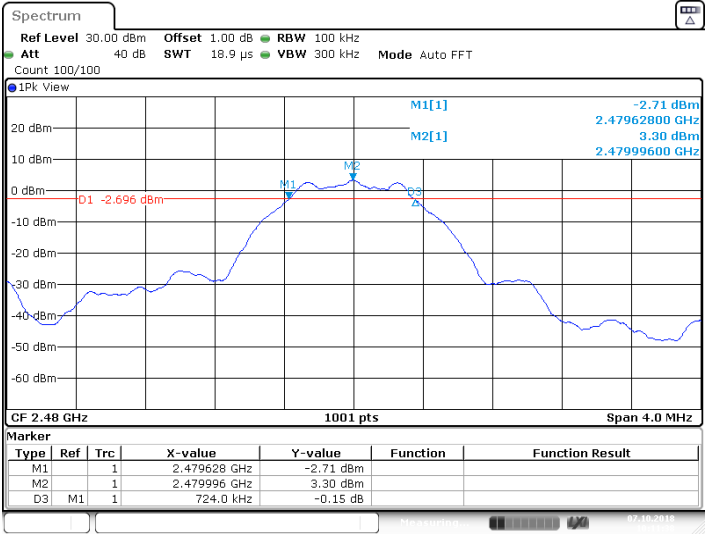
Date: 7 OCT 2018 10:09:41



Date: 7 OCT 2018 10:09:52



High channel 2480MHz



9.4 Spurious RF conducted emissions

Test Method

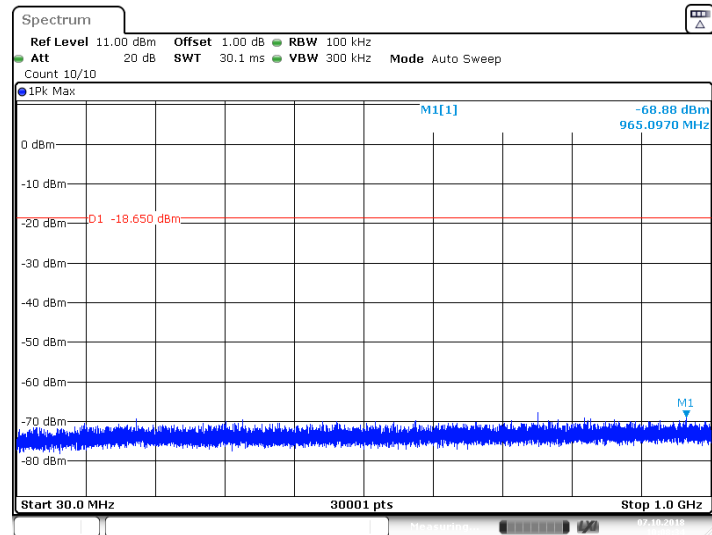
1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW \geq 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
 - a. Set the center frequency and span to encompass frequency range to be measured.
 - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

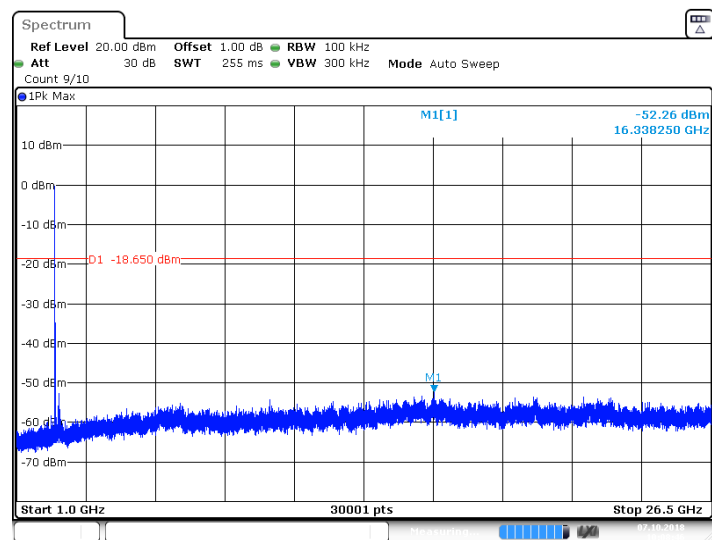
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

2402MHz

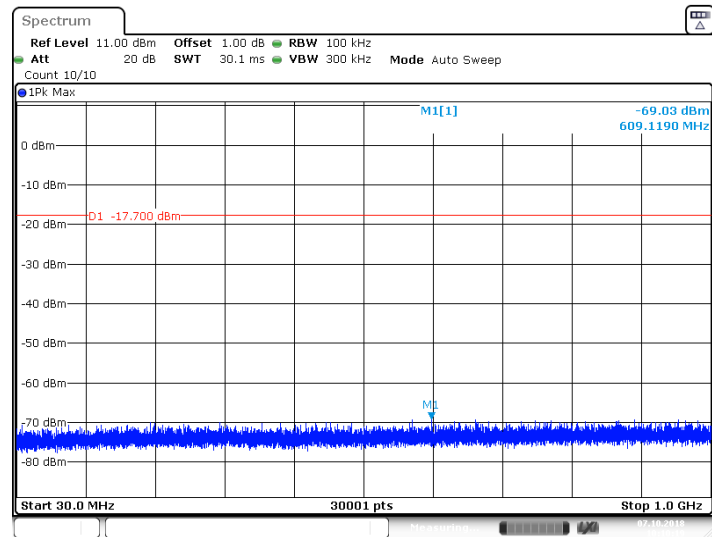


Date: 7 OCT 2018 10:08:34

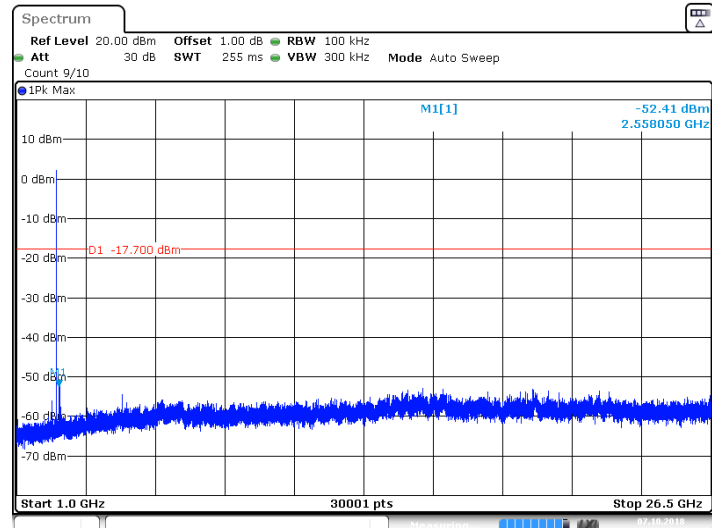


Date: 7 OCT 2018 10:08:46

2440MHz



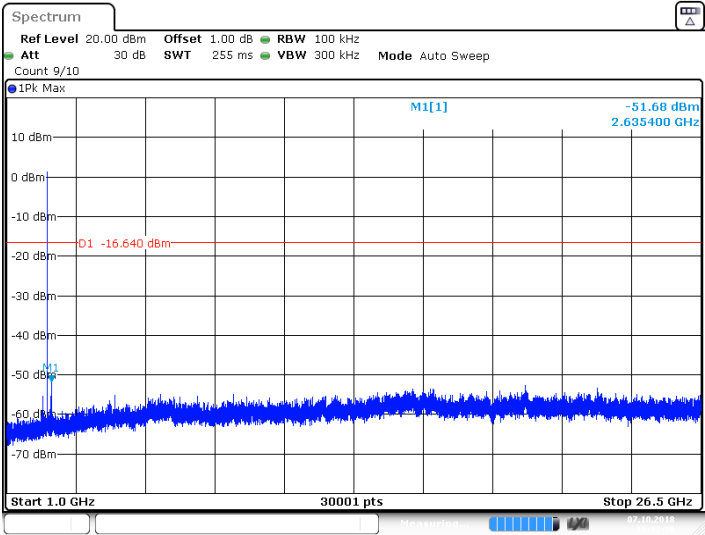
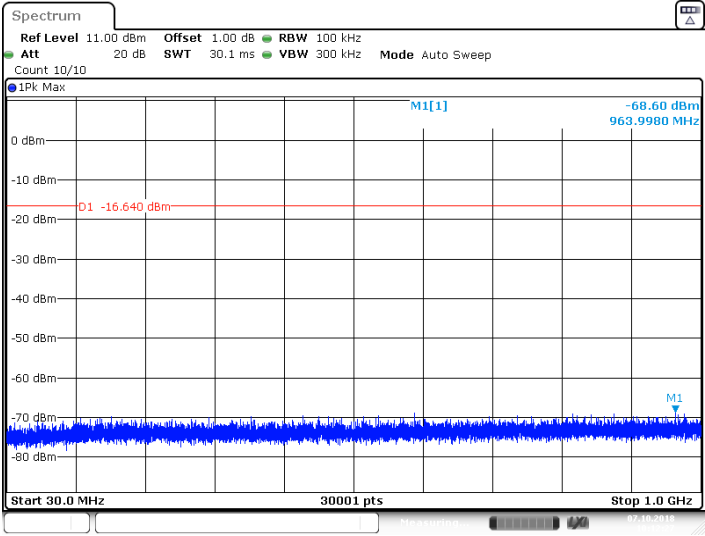
Date: 7 OCT 2018 10:10:19



Date: 7 OCT 2018 10:10:31



2480MHz



9.5 Band edge

Test Method

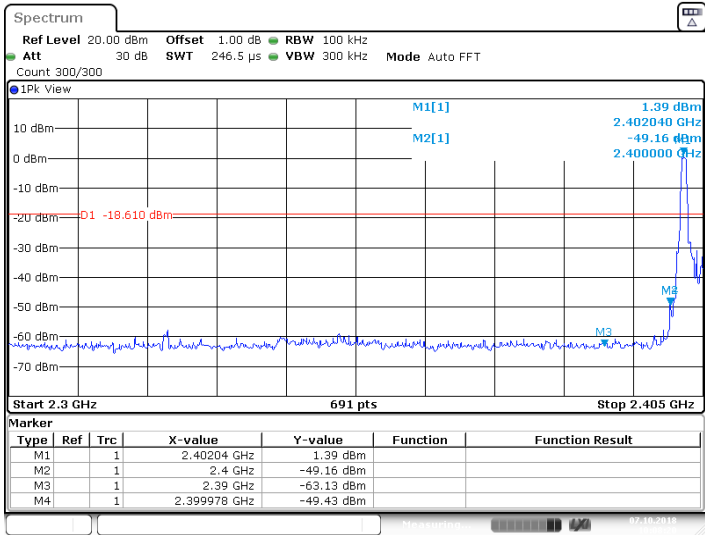
- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

Limit

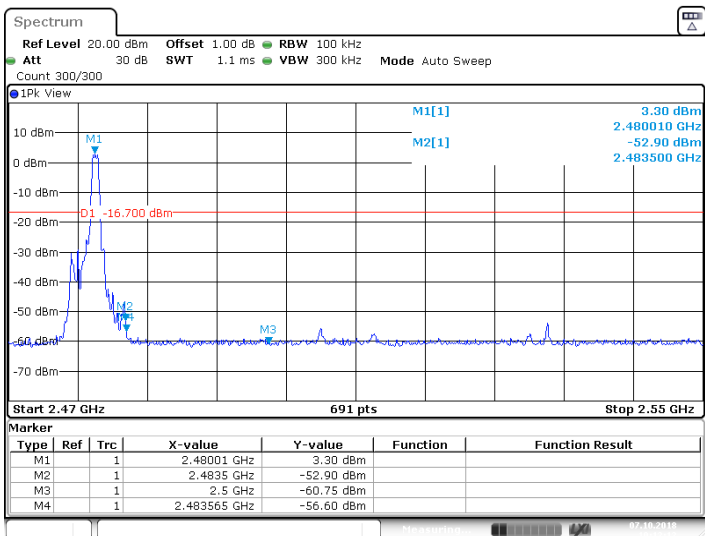
Frequency Range MHz	Limit (dBc)
30-25000	-20

Band edge testing

2402MHz



2480MHz



9.6 Spurious radiated emissions for transmitter

Test Method

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
 RBW = 100 KHz to 120KHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
 RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1 MHz.
- b) VBW \ [3 × RBW].
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq \text{RBW} / 2$.
 Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty

cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section 15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBμV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

Transmitting spurious emission test result as below:

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Low channel 2402MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	625.84	30.16	H	46	QP	15.84	-19.3	Pass
	775.94	28.79	V	46	QP	17.21	-18.7	Pass
1000-25000MHz	4804.12*	44.86	H	74	PK	29.14	4.3	Pass
	7204.45*	45.91	H	74	PK	28.09	8.2	Pass
	4804.11*	41.02	V	74	PK	32.98	4.3	Pass
	7205.81*	42.53	V	74	PK	31.47	8.2	Pass

Middle channel 2440MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	H	46	QP	--	--	Pass
1000-25000MHz	4879.26*	H	74	PK	31.38	4.3	42.62	Pass
	7320.61*	H	74	PK	29.82	8.2	44.18	Pass
	4881.29*	V	74	PK	30.28	4.3	43.72	Pass
	7321.56*	V	74	PK	29.71	8.2	44.29	Pass

High channel 2480MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	H	46	QP	--	--	Pass
1000-25000MHz	4959.66*	44.16	H	74	PK	29.84	4.3	Pass
	7441.26*	45.27	H	74	PK	28.73	8.2	Pass
	4959.35*	43.28	V	74	PK	30.72	4.3	Pass
	7441.03*	44.19	V	74	PK	29.81	8.2	Pass

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss.
(The Reading Level is recorded by software which is not shown in the sheet)

10 Test Equipment List

List of Test Instruments

Radiated Spurious Emission Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-003	101031	2020-6-28
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	68-4-80-14-003	708	2020-7-5
Horn Antenna	Rohde & Schwarz	HF907	68-4-80-14-004	102295	2020-7-5
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	2020-7-5
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	2020-7-7
Pre-amplifier	Rohde & Schwarz	SCU 18	68-4-29-14-001	102230	2020-6-28
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	2020-7-16
Fully Anechoic Chamber	TDK	8X4X4	68-4-90-14-002	--	2020-7-7
Test software	Rohde & Schwarz	EMC32	68-4-90-14-002-A10	Version 9.15.00	N/A

RF Test System

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	2020-6-28

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.91dB; Vertical: 4.89dB;
Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz	Horizontal: 4.80dB; Vertical: 4.79dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	Power level test involved: 1.16dB Frequency test involved: 0.6×10 ⁻⁷