

Prüfbericht-Nr.: <i>Test report No.:</i>	50246741 001	Auftrags-Nr.: <i>Order No.:</i>	238101669	Seite 1 von 36 <i>Page 1 of 36</i>	
Kunden-Referenz-Nr.: <i>Client reference No.:</i>	N/A	Auftragsdatum: <i>Order date.:</i>	10.03.2019		
Auftraggeber: <i>Client:</i>	Knectek Labs Inc. 9225 Leslie Street, Suite 201, Richmond Hill, Ontario, Canada				
Prüfgegenstand: <i>Test item:</i>	CubiTag Card				
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	CTAG0302				
Auftrags-Inhalt: <i>Order content:</i>	FCC and IC approval				
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 RSS-247 Issue 2 Feb 2017 CFR47 FCC Part 2: Subpart J Section 2.1093 KDB 447498 D01 v06 RSS-102 issue 5 Mar 2015				
Wareneingangsdatum: <i>Date of receipt:</i>	15.03.2019	Vertrauliche Informationen Confidential Information			
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000906284-001 to 002				
Prüfzeitraum: <i>Testing period:</i>	19.04.2019 - 30.04.2019				
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Guangdong) Ltd.				
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Guangdong) Ltd.				
Prüfergebnis*: <i>Test result*:</i>	Pass				
geprüft von / tested by:		kontrolliert von / reviewed by:			
<i>Amy Wang</i> 06.05.2019 Amy Wang / Project Manager		<i>Storm Shu</i> 13.05.2019 Storm Shu / Technical Certifier			
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>
Sonstiges / Other:					
FCC ID: 2AL4XCTAG0302 IC: 22723-CTAG0302					
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 auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines. <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>					

Test Summary

5.1.1 ANTENNA REQUIREMENT*RESULT: Pass***5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER***RESULT: Pass***5.1.3 CONDUCTED POWER SPECTRAL DENSITY***RESULT: Pass***5.1.4 6dB BANDWIDTH***RESULT: Pass***5.1.5 99% BANDWIDTH***RESULT: Pass***5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHz BANDWIDTH***RESULT: Pass***5.1.7 RADIATED SPURIOUS EMISSION***RESULT: Pass***6.1.1 ELECTROMAGNETIC FIELDS***RESULT: Pass*

Contents

1	GENERAL REMARKS	4
1.1	COMPLEMENTARY MATERIALS	4
2	TEST SITES	4
2.1	TEST FACILITIES	4
2.2	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	5
2.3	TRACEABILITY	6
2.4	CALIBRATION	6
2.5	MEASUREMENT UNCERTAINTY.....	6
2.6	LOCATION OF ORIGINAL DATA.....	6
2.7	STATUS OF FACILITY USED FOR TESTING.....	6
3	GENERAL PRODUCT INFORMATION	7
3.1	PRODUCT FUNCTION AND INTENDED USE.....	7
3.2	RATINGS AND SYSTEM DETAILS	7
3.3	INDEPENDENT OPERATION MODES	9
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	9
3.5	SUBMITTED DOCUMENTS.....	9
4	TEST SET-UP AND OPERATION MODES	10
4.1	PRINCIPLE OF CONFIGURATION SELECTION	10
4.2	TEST OPERATION AND TEST SOFTWARE	10
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	10
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE	10
4.5	TEST SETUP DIAGRAM	11
5	TEST RESULTS	13
5.1	TRANSMITTER REQUIREMENT & TEST SUITES	13
5.1.1	<i>Antenna Requirement</i>	<i>13</i>
5.1.2	<i>Maximum Peak Conducted Output Power</i>	<i>14</i>
5.1.3	<i>Conducted Power Spectral Density</i>	<i>18</i>
5.1.4	<i>6dB Bandwidth</i>	<i>22</i>
5.1.5	<i>99% Bandwidth</i>	<i>26</i>
5.1.6	<i>Conducted Spurious Emissions Measured in 100 kHz Bandwidth</i>	<i>28</i>
5.1.7	<i>Radiated Spurious Emission</i>	<i>34</i>
6	SAFETY HUMAN EXPOSURE	35
6.1	RADIO FREQUENCY EXPOSURE COMPLIANCE	35
6.1.1	<i>Electromagnetic Fields</i>	<i>35</i>
7	PHOTOGRAPHS OF THE TEST SET-UP	36
8	LIST OF TABLES.....	36

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results of General 2.4GHz wireless

Appendix P: Photo Documentation internal view

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Guangdong) Ltd.
No.102, 1F of Southwest and No.205, 2F No.767 Tianyuan Road, Tianhe District, Guangzhou 510663,
Guangdong Province P.R. China

FCC Registration No.: CN1207

Test site Industry Canada No.: 2932C

The tests at the test sites have been conducted under the supervision of a TÜV engineer.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

For the measurement Equipment list, refer to the appendix B.

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table

Item		Extended Uncertainty
Conducted Emission		± 2.68 dB
Radiated Emission (30-1000MHz)	Field strength (dBμV/m)	± 5.16 dB
Radiated Emission (above 1000MHz)	Field strength (dBμV/m)	± 2.22 dB
Radio Spectrum		± 4.51 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B & P of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The **FORMTEXT |TÜV Rheinland (Guangdong)** Ltd. Test facility located at No.102, 1F of Southwest and No.205, 2F No.767 Tianyuan Road, Tianhe District, Guangzhou 510663, Guangdong Province P.R. China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is a "CubiTag Card" with Bluetooth 4.0 single mode, It contains a Bluetooth compatible module enabling the user to communicate data through a Wireless interface.

Refer to User Manual and Circuit Diagram for further details.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

Technical Specification	Value
Kind of Equipment	CubiTag Card
Type Designation	CTAG-0302
FCC ID	2AL4XCTAG0302
IC	22723-CTAG0302
Operating Frequency	2402-2480 MHz
Operating Temperature Range	-20 °C ~ +60 °C
Operating Voltage	DC 3V
Type of Modulation	GFSK for Low Energy mode
Channel Number	40 channels for Low Energy mode
Channel Separation	2MHz for Low Energy mode
Antenna Type	PCB Antenna
Antenna Gain	3.3 dBi

Table 3: RF Channel and Frequency of Bluetooth Low Energy

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
00	2402.00	10	2422.00	20	2442.00	30	2462.00
01	2404.00	11	2424.00	21	2444.00	31	2464.00
02	2406.00	12	2426.00	22	2446.00	32	2466.00
03	2408.00	13	2428.00	23	2448.00	33	2468.00
04	2410.00	14	2430.00	24	2450.00	34	2470.00
05	2412.00	15	2432.00	25	2452.00	35	2472.00
06	2414.00	16	2434.00	26	2454.00	36	2474.00
07	2416.00	17	2436.00	27	2456.00	37	2476.00
08	2418.00	18	2438.00	28	2458.00	38	2478.00
09	2420.00	19	2440.00	29	2460.00	39	2480.00

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Bluetooth transmitting mode (Low Energy mode)
 - 1. Transmitting
 - a. Low Channel
 - b. Middle Channel
 - c. High Channel
 - 2. Receiving
- B. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- | | |
|-----------------------------|-------------------------|
| - Application Form | - Bill of Material |
| - Block Diagram | - Circuit Diagram |
| - FCC/IC Label and Location | - Operation Description |
| - Photo Document | - User Manual |

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

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

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013 and ANSI C63.4: 2014

It can transmit RF signal on the allowed maximum output power at low, mid and high channel through pressing button provided by manufacturer.

4.3 Special Accessories and Auxiliary Equipment

Table 4: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N	Rating
Notebook	Lenovo	ThinkPad X250	SL10H14859JS	N/A

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

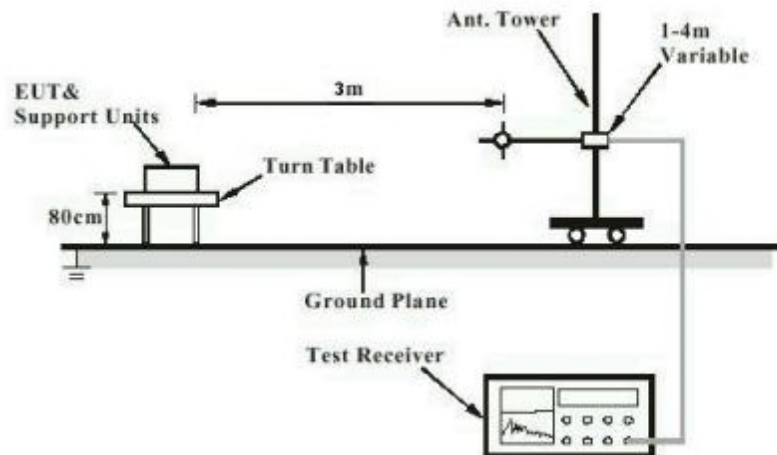


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

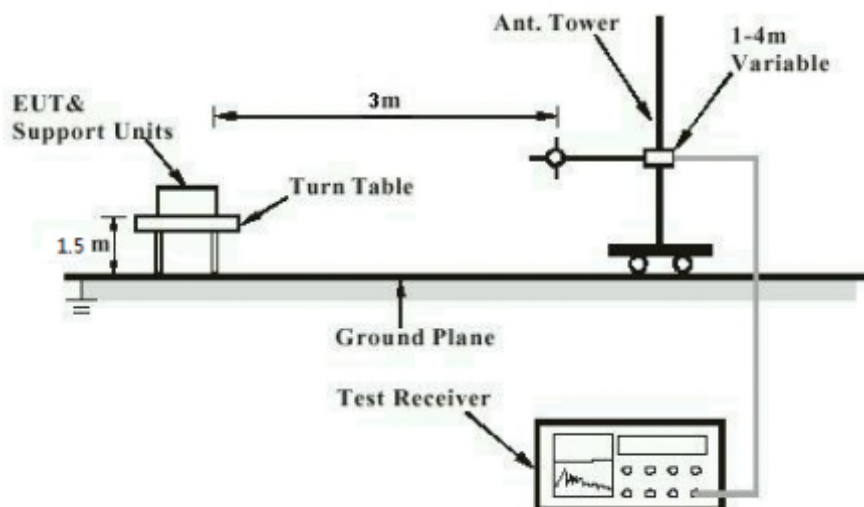


Diagram of Measurement Configuration for Mains Conduction Measurement

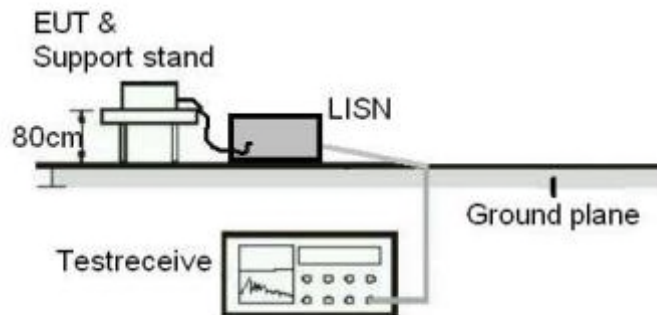
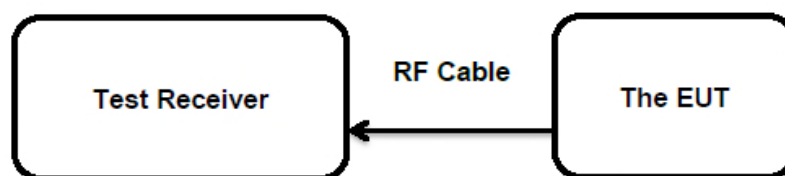


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(b)(4) and Part 15.203 RSS-Gen Clause 6.7
Limits	: the use of antennas with directional gains that do not exceed 6dBi

According to the manufacturer declared, the EUT has an internal antenna, the directional gain of antenna is 3.3 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

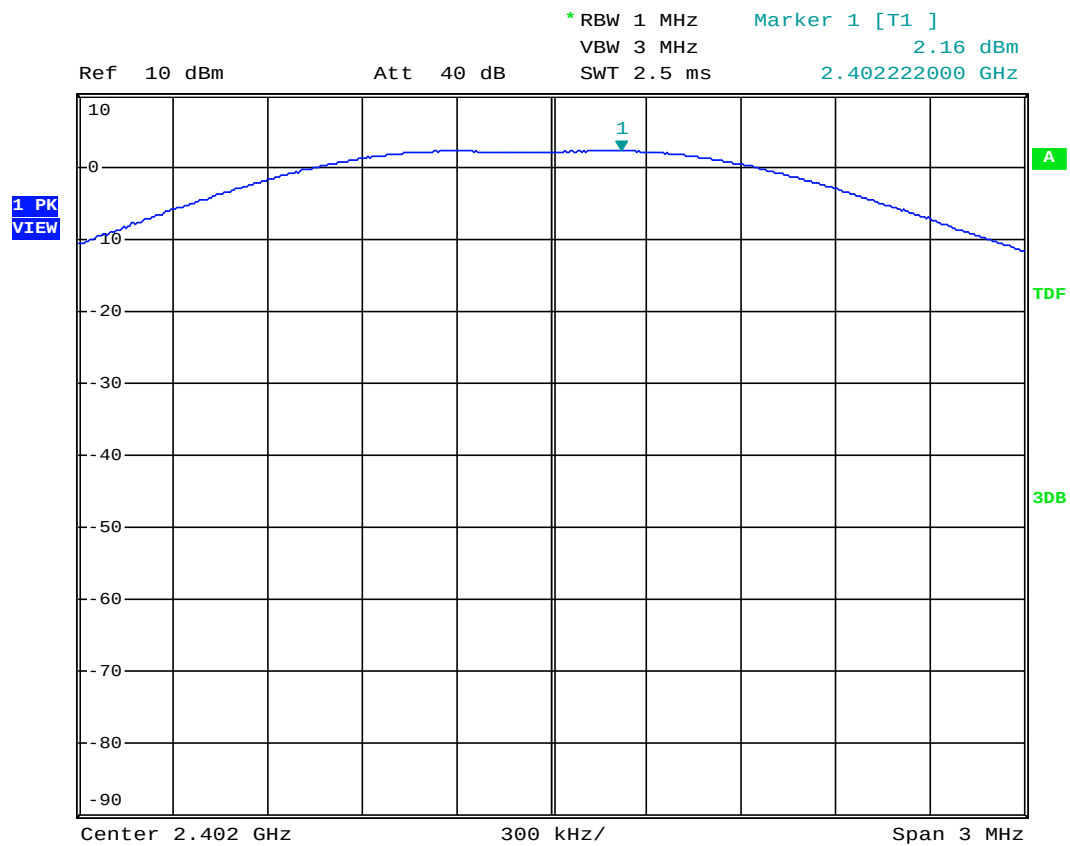
Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

For the measurement records, refer to following test plot:

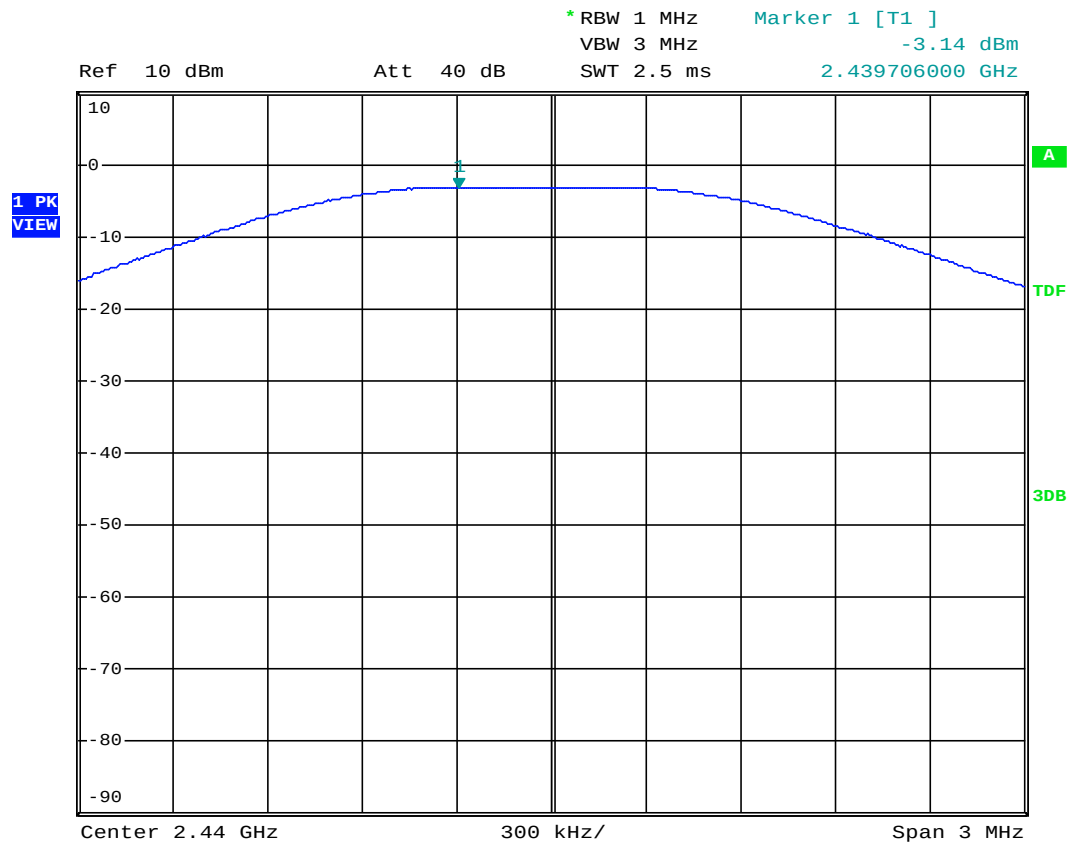
Test Plot of Maximum Peak Conducted Output Power, Low Energy mode

Low channel:



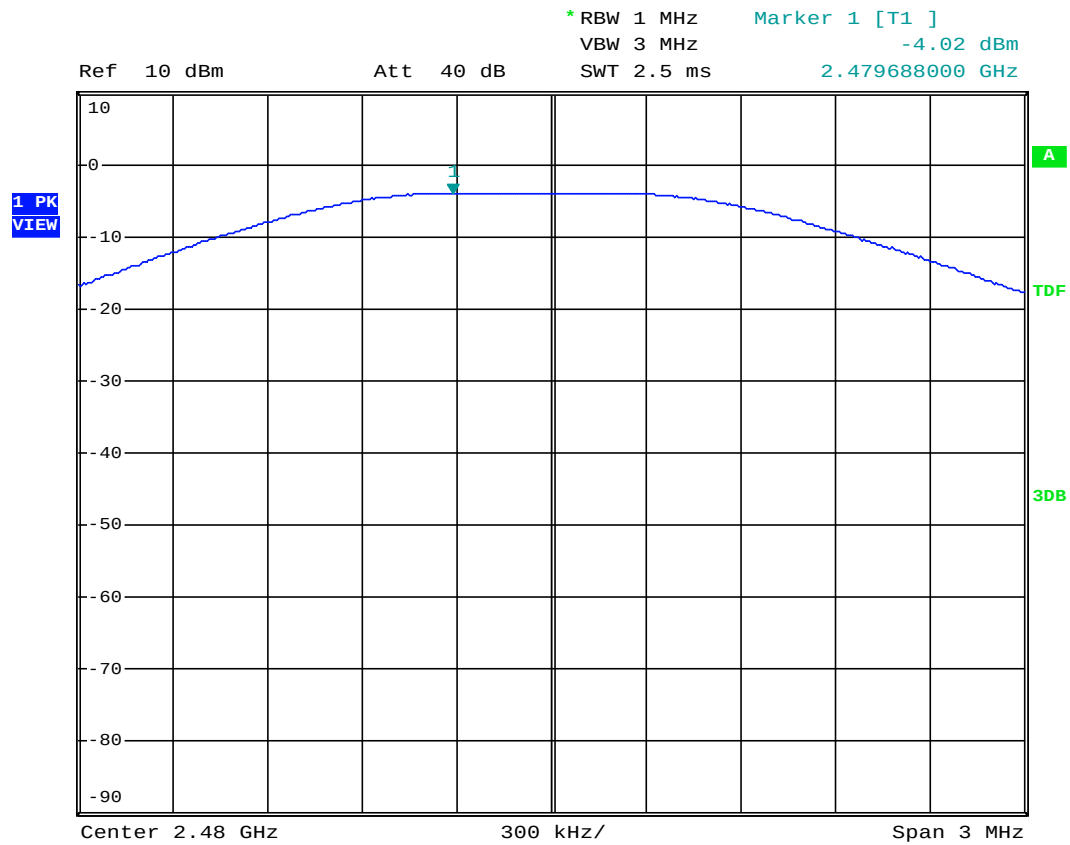
Date: 29.APR.2019 15:16:30

Middle channel:



Date: 29.APR.2019 15:17:27

High channel:



Date: 29.APR.2019 15:18:16

5.1.3 Conducted Power Spectral Density

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(e) RSS-247 Clause 5.2(2)
Basic standard	: ANSI C63.10: 2013
Limits	: < 8 dBm / 3kHz
Kind of test site	: Shielded Room

Test Setup

Date of testing	:	30.04.2019
Input voltage	:	DC 3V
Operation mode	:	A.1
Test channel	:	Low / Middle / High
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103kPa

Table 6: Test Result of Power Spectral Density

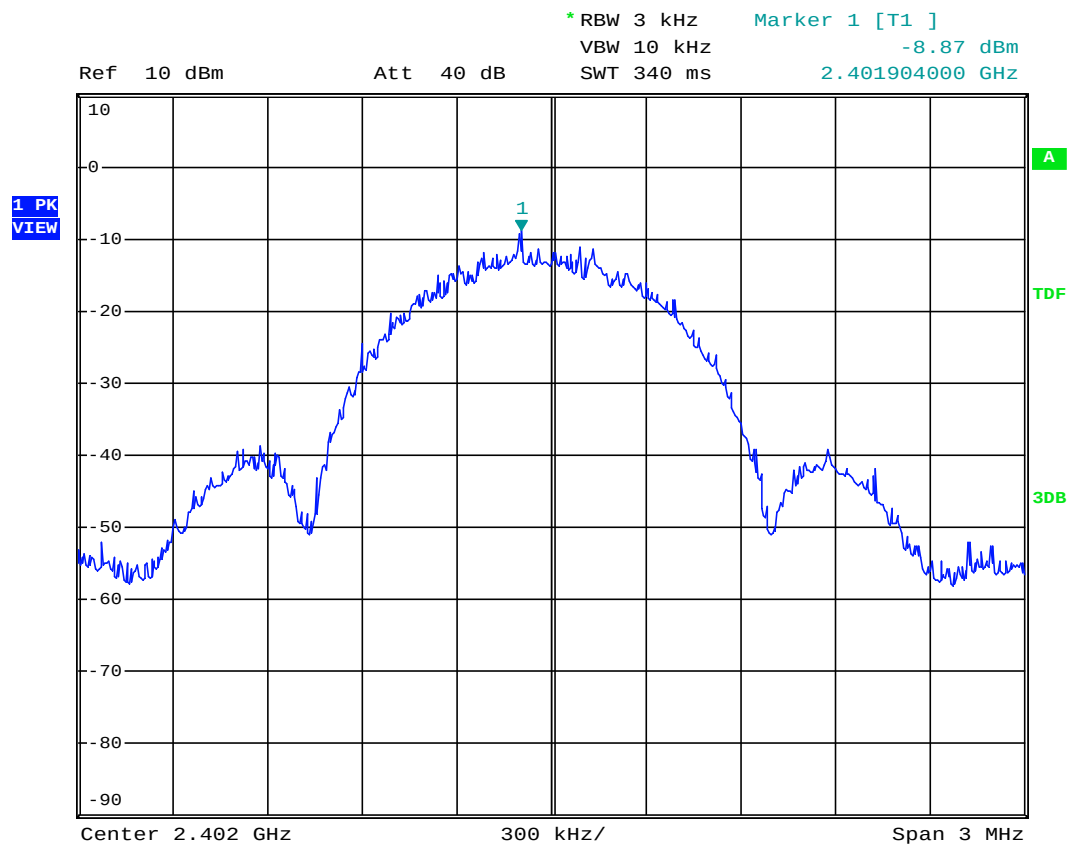
Test Mode	Channel Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
Low Energy	2402	-8.87	< 8.0
	2440	-15.66	
	2480	-13.50	
Maximum Measured Value		-8.87	

Note: The cable loss is taken into account in results.

For the measurement records, refer to following test plot:

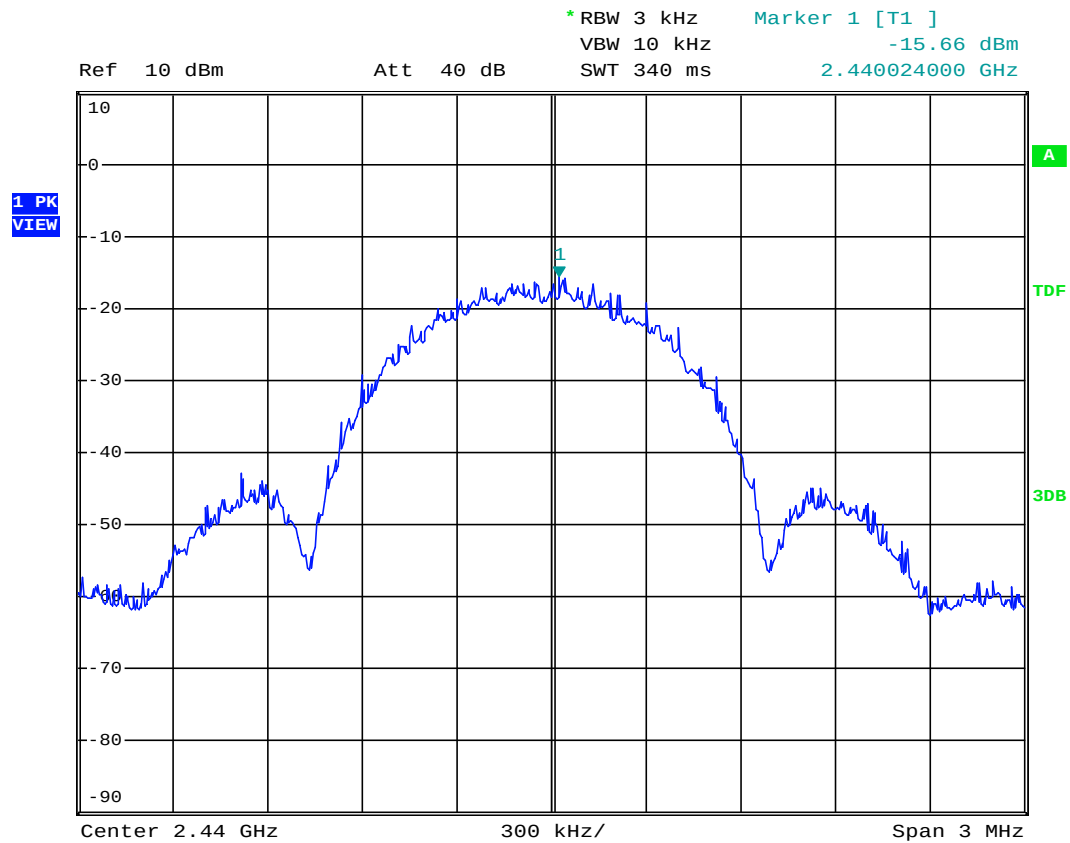
Test Plot of Power Spectral Density, Low Energy mode

Low channel:



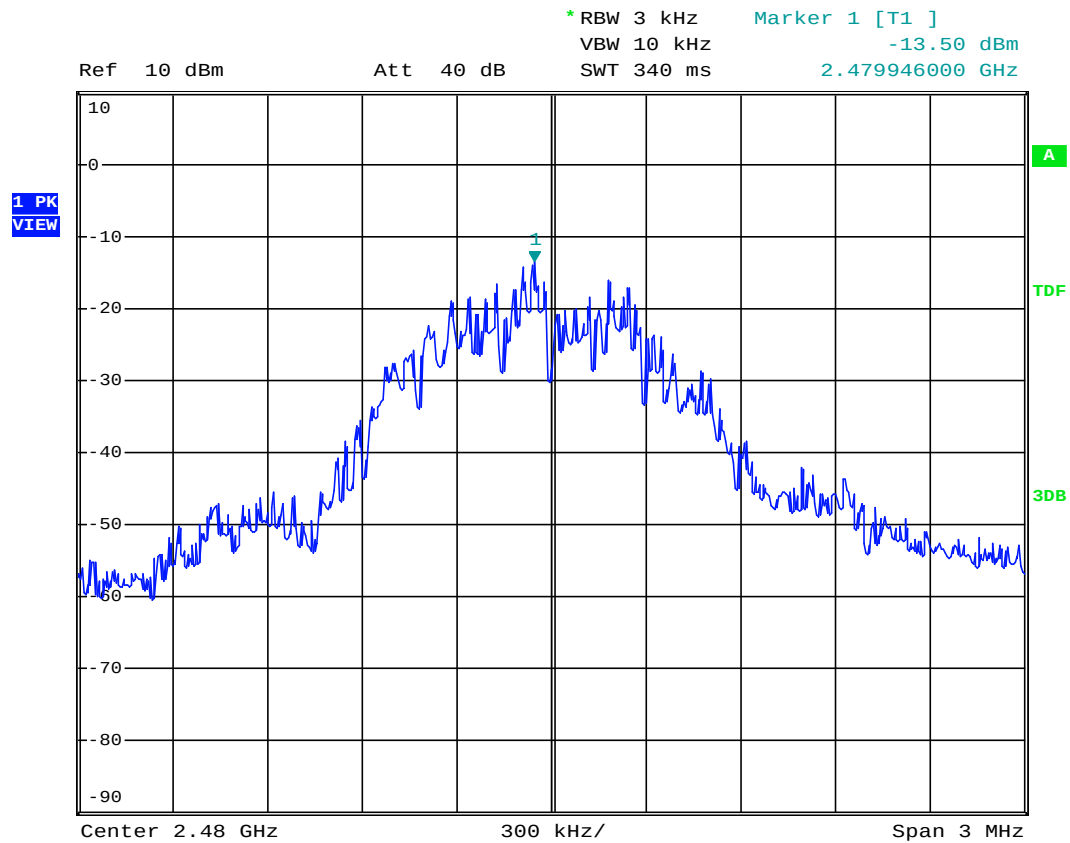
Date: 29.APR.2019 16:18:26

Middle channel:



Date: 29.APR.2019 16:19:14

High channel:



Date: 29.APR.2019 16:17:18

5.1.4 6dB Bandwidth

RESULT:
Pass
Test Specification

Test standard : FCC Part 15.247(a)(2)
 RSS-247 Clause 5.2(1)

Basic standard : ANSI C63.10: 2013

Limits : > 500 KHz

Kind of test site : Shielded Room

Test Setup

Date of testing : 30.04.2019

Input voltage : DC 3V

Operation mode : A.1

Test channel : Low / Middle / High

Ambient temperature : 20-24°C

Relative humidity : 50-65%

Atmospheric pressure : 100-103kPa

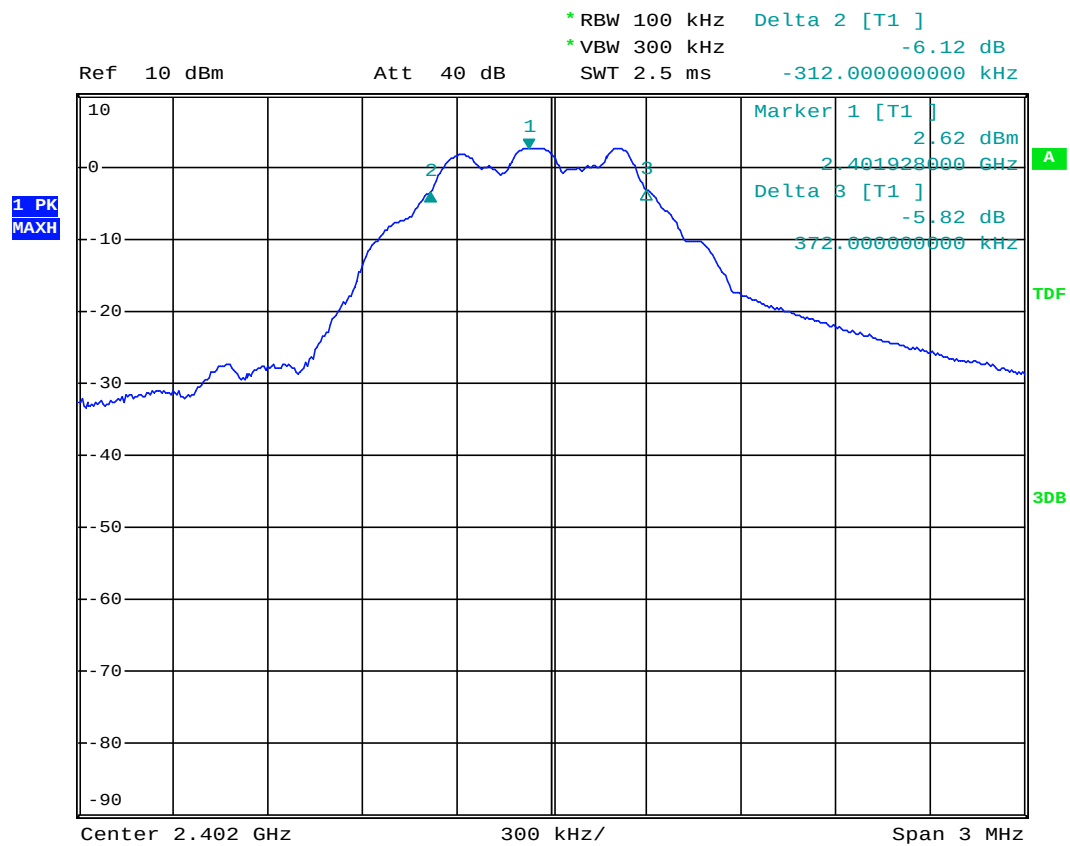
Table 7: Test Result of 6dB Bandwidth

Test Mode	Channel Frequency (MHz)	-6dB Bandwidth (kHz)	Limit (kHz)
Low Energy	2402	684.00	> 500
	2440	684.00	
	2480	696.00	
Minimum Measured Value		696.00	

For the measurement records, refer to following test plot:

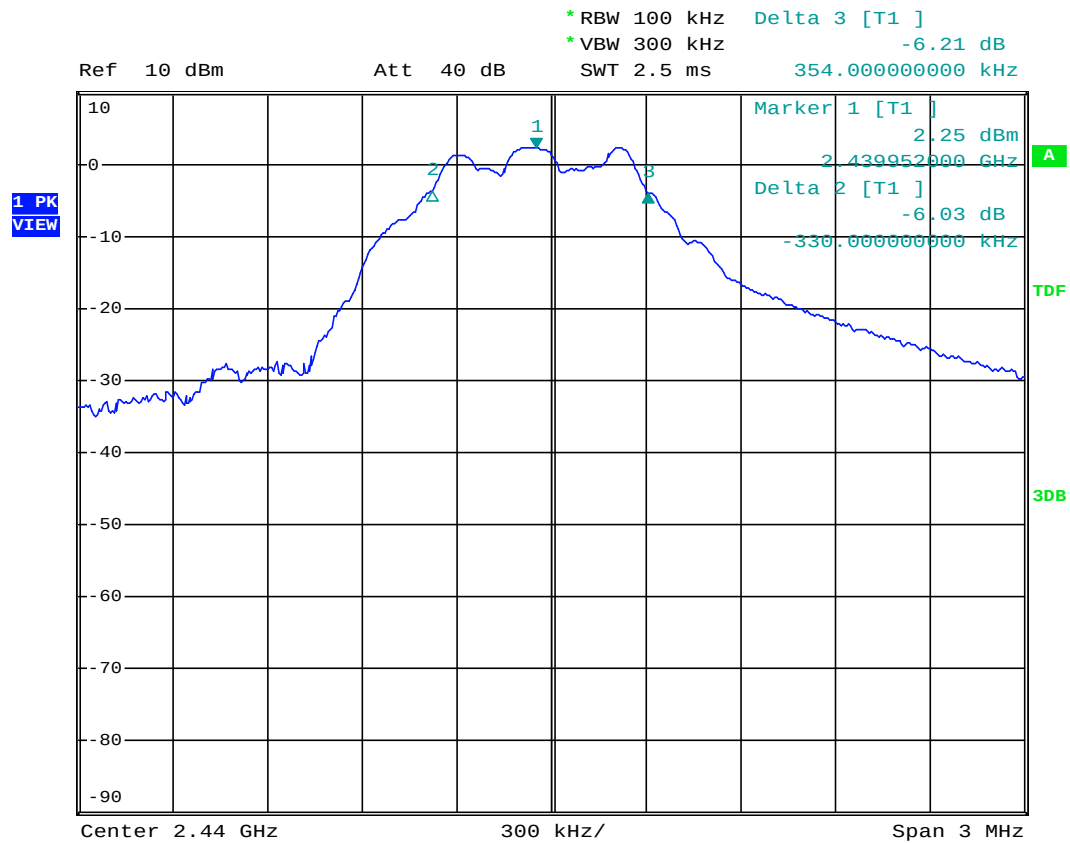
Test Plot of 6dB Bandwidth, Low Energy mode

Low channel:



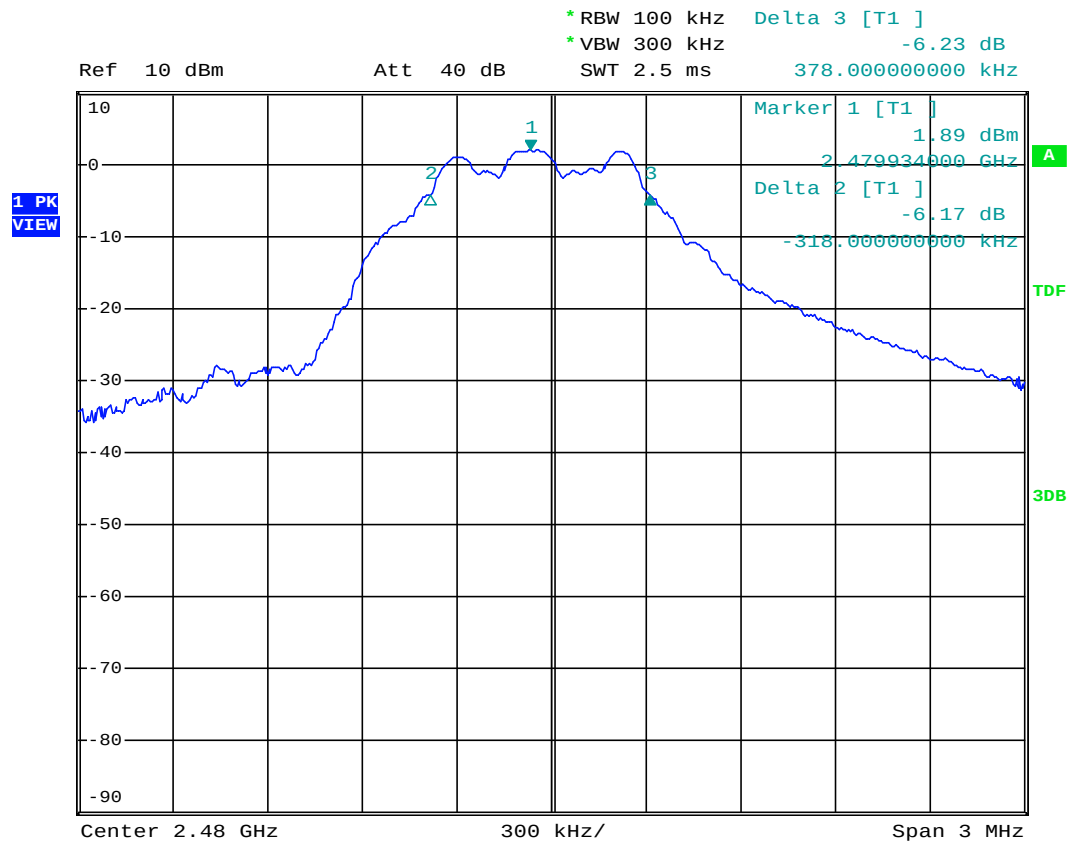
Date: 29.APR.2019 16:09:10

Middle channel:



Date: 29.APR.2019 16:12:17

High channel:



Date: 29.APR.2019 16:13:20

5.1.5 99% Bandwidth

RESULT:**Pass****Test Specification**

Test standard : RSS-Gen Clause 6.6
Basic standard : ANSI C63.10: 2013
Kind of test site : Shielded Room

Test Setup

Date of testing : 30.04.2019
Input voltage : DC 3V
Operation mode : A.1
Test channel : Low / Middle / High
Ambient temperature : 20-24°C
Relative humidity : 50-65%
Atmospheric pressure : 100-103kPa

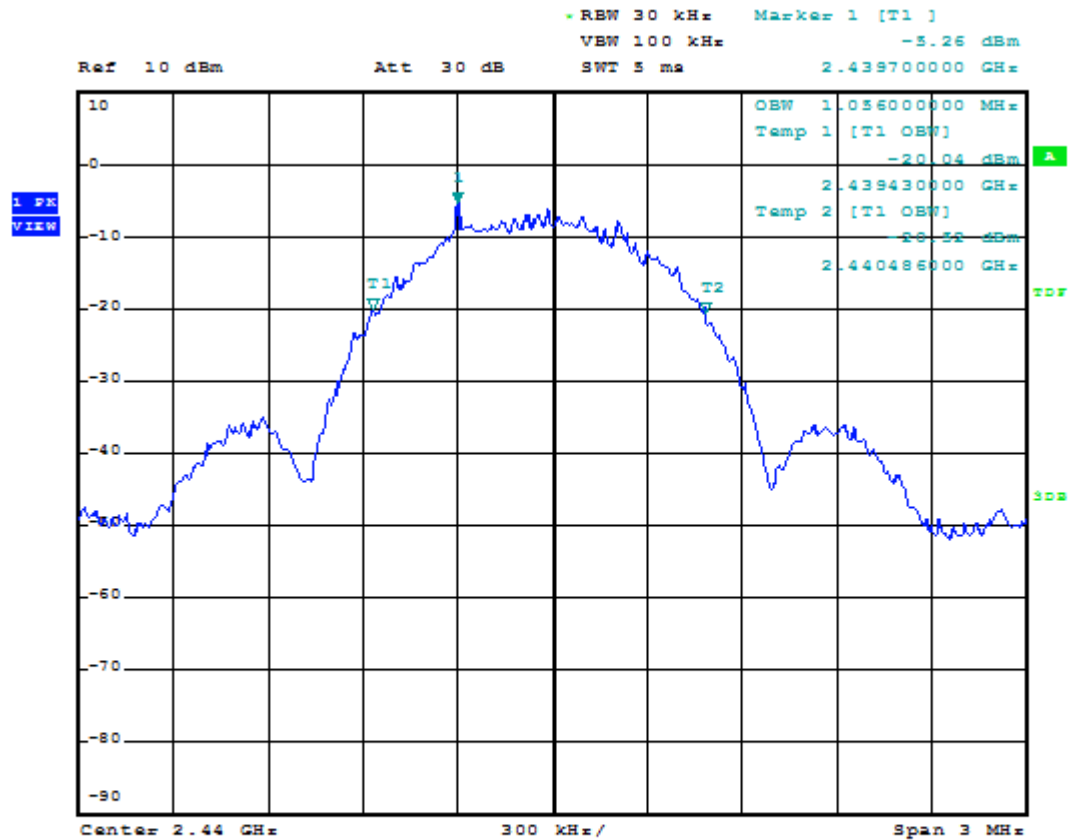
Table 8: Test Result of 99% Bandwidth

Test Mode	Channel Frequency (MHz)	99% Bandwidth (kHz)	Limit (kHz)
Low Energy	2440	1056.00	/
Maximum Measured Value		1056.00	/

For the measurement records, refer to following test plot:

Test Plot of 99% Bandwidth, Low Energy mode

Middle channel:



Date: 29.APR.2019 16:55:42

5.1.6 Conducted Spurious Emissions Measured in 100 kHz Bandwidth**RESULT:****Pass****Test Specification**

Test standard	: FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

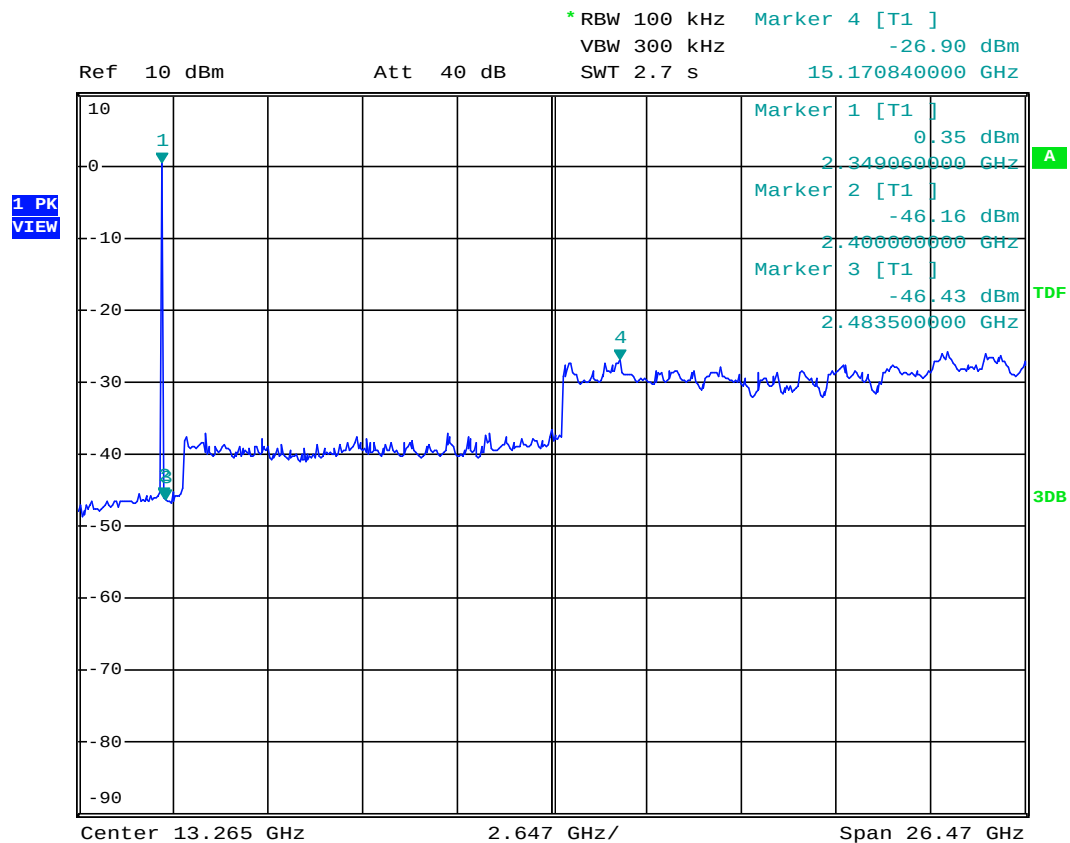
Date of testing	: 30.04.2019
Input voltage	: DC 3V
Operation mode	: A.1
Test channel	: Low / Middle / High
Ambient temperature	: 20-24°C
Relative humidity	: 50-65%
Atmospheric pressure	: 100-103kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to following test plot, and compliance is achieved as well.

For the measurement records, refer to following test plot:

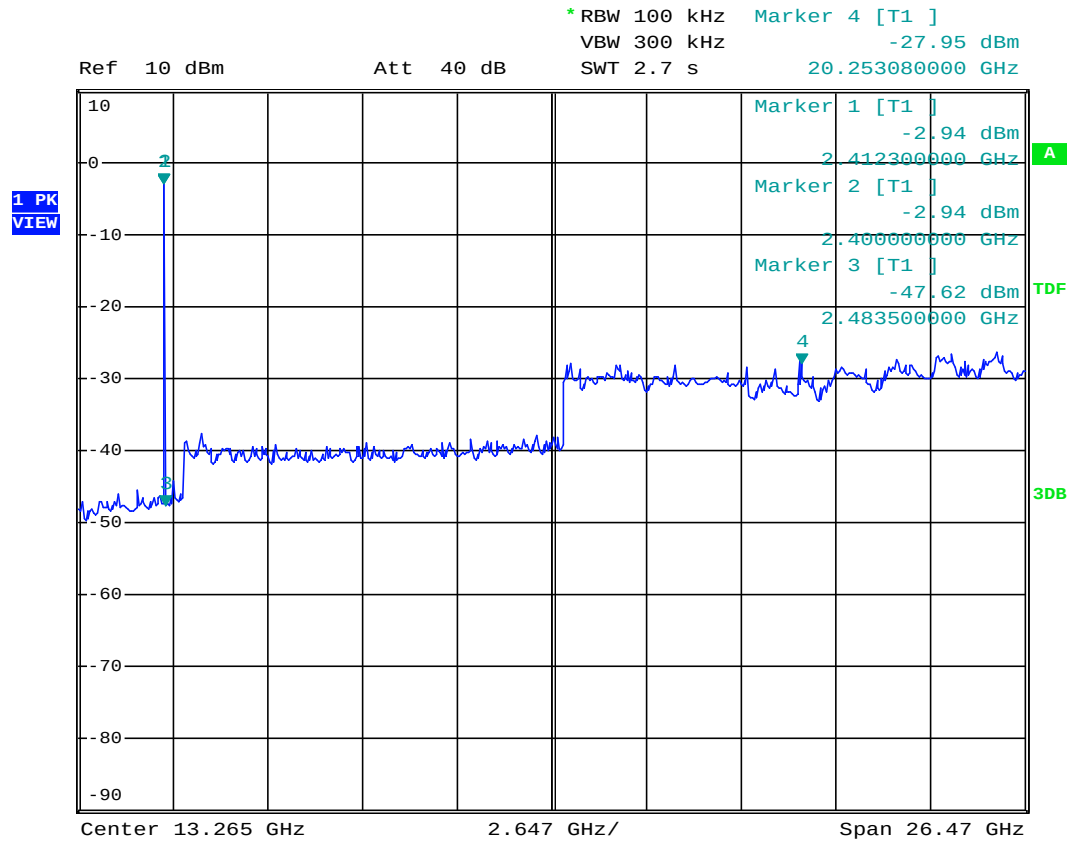
Test Plot of Conducted Spurious Emissions Measured in 100kHz Bandwidth, Low Energy mode

Low channel:



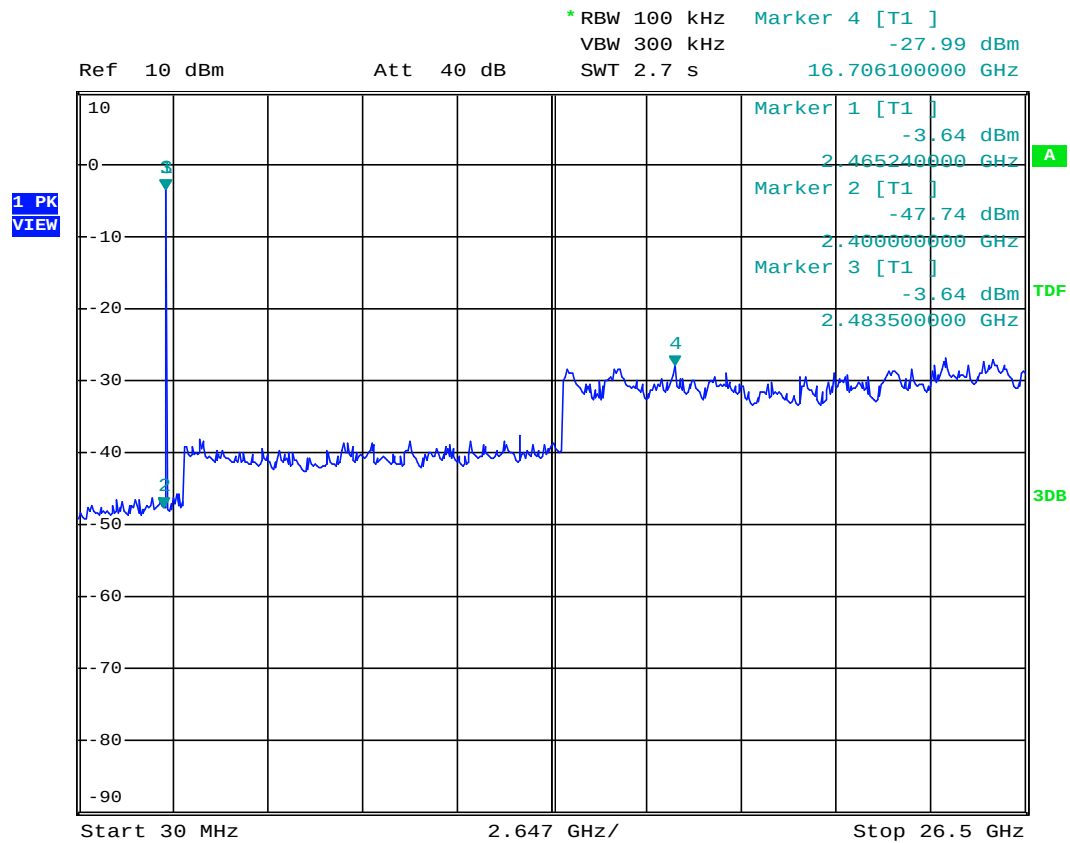
Date: 29.APR.2019 16:53:11

Middle channel:



Date: 29.APR.2019 16:47:47

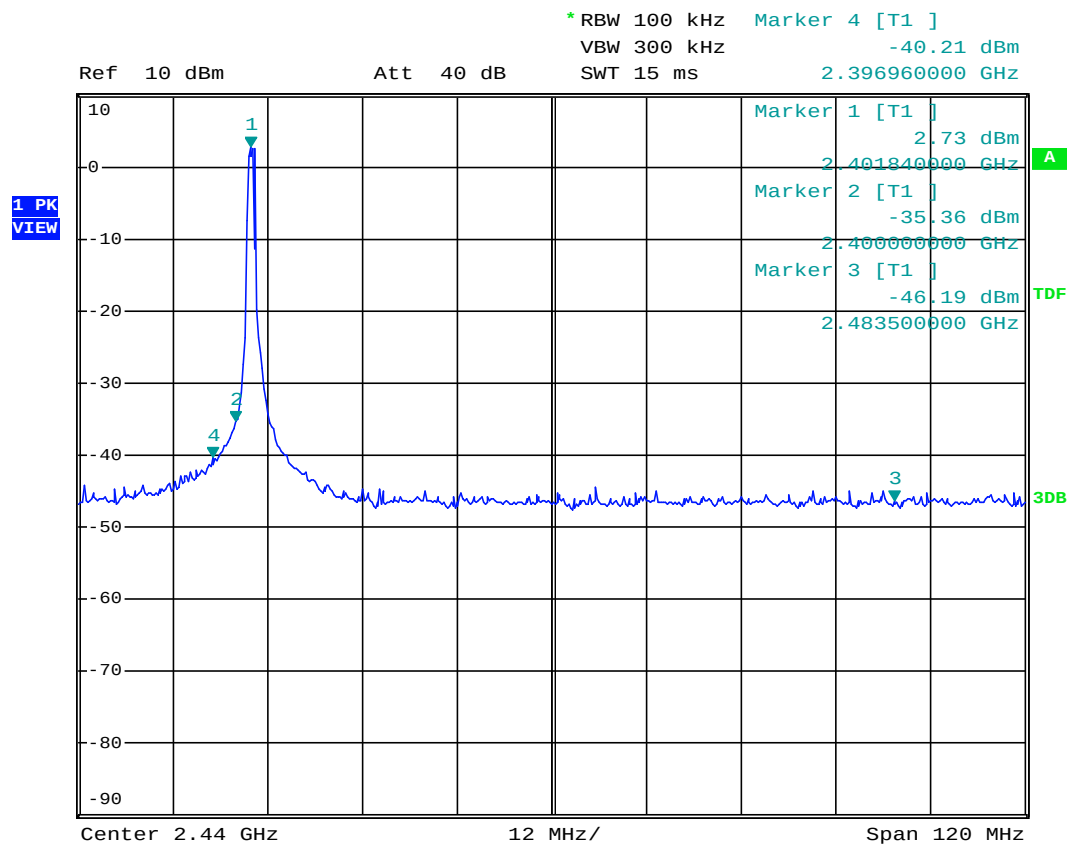
High channel:



Date: 29.APR.2019 16:39:25

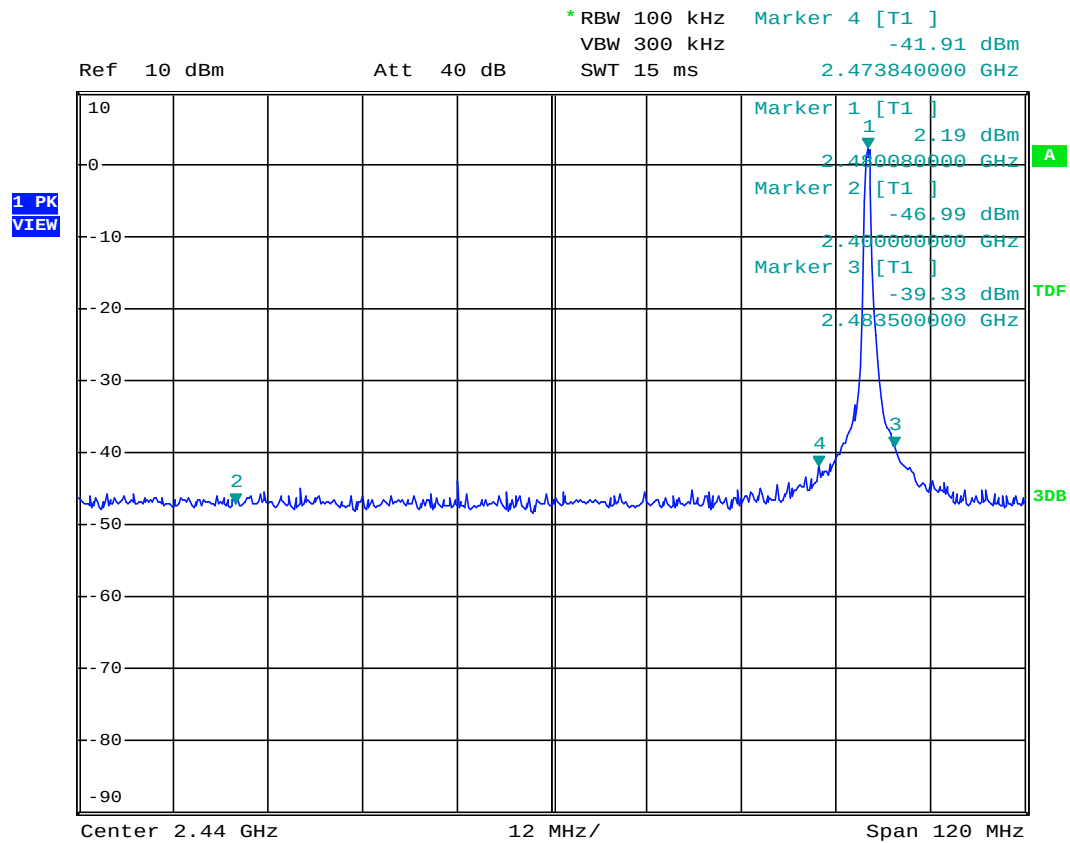
Test Plot of 100 kHz Bandwidth of Frequency Band Edge

Low channel:



Date: 29.APR.2019 16:28:30

High channel:



Date: 29.APR.2019 16:30:23

5.1.7 Radiated Spurious Emission

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d) RSS-Gen Table 4 & Table 5
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: Refer to Appendix B
Input voltage	: DC 3V
Operation mode	: A.1, A.2
Test channel	: Low / Middle / High
Ambient temperature	: Refer to Appendix B
Relative humidity	: Refer to Appendix B
Atmospheric pressure	: Refer to Appendix B

Remark:

During the pretest the EUT was rotated through three orthogonal axes to determine the attitude that maximizes the emissions. After that the EUT was manually handled to find the orientation that has the maximum emission, which is the orientation shown in the test set-up photos, refer to the appendix A.

Pre-test the EUT in continuous transmitting mode at the low (2402 MHz), middle (2440 MHz) and high (2480 MHz) channel with different data packet.

Testing was carried out within frequency range 9kHz to the tenth harmonics.

For the measurement records, refer to the appendix B.

6 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Pass****Test Specification**

Test standard : FCC KDB 447498 D01 v06
RSS-102 Issue 5 March 2015

Measurement Record:FCC:

The minimum distance for the EUT is less than 5mm.

Since maximum peak output power of the transmitter is 0.00164 mW < 10 mW.

Hence the EUT is excluded from SAR evaluation according to FCC KDB Publication 447498 D01 General RF Exposure Guidance v06

Canada:

Maximum conducted peak power: 0.00164 mW

Antenna Gain: 3.3 db -> x 2.1380

Maximum EIRP available 0.00351 mW

=====
Maximum Power available: 0.00351 mW
(higher of EIRP or conducted)

Since maximum output power of the transmitter is 0.00351mW < 4mW at 5mm, hence the EUT is excluded from SAR evaluation according to Table 1 in RSS-102

7 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix A.

8 List of Tables

Table 1: List of Test and Measurement Equipment.....	5
Table 2: Technical Specification of EUT	7
Table 3: RF Channel and Frequency of Bluetooth Low Energy	8
Table 4: List of Accessories and Auxiliary Equipment.....	10
Table 5: Test Result of Maximum Peak Conducted Output Power.....	14
Table 6: Test Result of Power Spectral Density.....	18
Table 7: Test Result of 6dB Bandwidth.....	22
Table 8: Test Result of 99% Bandwidth.....	26