

Prüfbericht-Nr.: <i>Test Report No.:</i>	50289620 001	Auftrags-Nr.: <i>Order No.:</i>	238109330	Seite 1 von 37 Page 1 of 37	
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	02-Jul-2019		
Auftraggeber: <i>Client:</i>	Pass & Seymour, Inc. d/b/a Legrand 301 Fulling Mill Road, Suite G, Middletown, PA 17057				
Prüfgegenstand: <i>Test item:</i>	Motion Sensor				
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	HKMS2				
Auftrags-Inhalt: <i>Order content:</i>	FCC Part 15C / IC RSS-247 Test report				
Prüfgrundlage: <i>Test specification:</i>	FCC 47CFR Part 15: Subpart C Section 15.247 FCC 47CFR Part 2: Subpart J Section 2.1091 RSS-247 Issue 2, Feb 2017 RSS-102 Issue 5, March 2015				
Wareneingangsdatum: <i>Date of receipt:</i>	29-Aug-2019				
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000982201-001 A000982201-002				
Prüfzeitraum: <i>Testing period:</i>	29-Aug-2019 ~ 24-Sep-2019				
Ort der Prüfung: <i>Place of testing:</i>	EMC/RF Laboratory Taipei				
Prüflaboratorium: <i>Testing laboratory:</i>	TUV Rheinland Taiwan Ltd.				
Prüfergebnis*: <i>Test result*:</i>	Pass				
Report date / tested by:			kontrolliert von / reviewed by:		
01-Oct-2019 Mars Y.J. Lin/ Project Engineer			01-Oct-2019 Arvin Ho/Vice General Manager		
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:					
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 specification(s) F(ail) = failed a.m. test specification(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>					

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENT

RESULT: Passed

5.1.2 MAXIMUM CONDUCTED PEAK OUTPUT POWER

RESULT: Passed

5.1.3 6dB BANDWIDTH AND 99% BANDWIDTH

RESULT: Passed

POWER DENSITY

RESULT: Passed

5.1.4 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100kHz BANDWIDTH

RESULT: Passed

5.1.5 SPURIOUS EMISSION

RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS

RESULT: Passed

Contents

1.	GENERAL REMARKS	5
1.1	COMPLEMENTARY MATERIALS.....	5
1.2	DECISION RULE OF CONFORMITY.....	5
2.	TEST SITES	6
2.1	TEST LABORATORY	6
2.2	TEST FACILITY.....	6
2.3	LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	7
2.4	TRACEABILITY	8
2.5	CALIBRATION	8
2.6	MEASUREMENT UNCERTAINTY	8
3.	GENERAL PRODUCT INFORMATION.....	9
3.1	PRODUCT FUNCTION AND INTENDED USE	9
3.2	SYSTEM DETAILS AND RATINGS.....	9
3.3	INDEPENDENT OPERATION MODES.....	10
3.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS	10
3.5	SUBMITTED DOCUMENTS.....	10
4.	TEST SET-UP AND OPERATION MODES.....	11
4.1	PRINCIPLE OF CONFIGURATION SELECTION	11
4.2	TEST OPERATION AND TEST SOFTWARE.....	11
4.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	12
4.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	12
4.5	TEST SETUP DIAGRAM	12
5.	TEST RESULTS	14
5.1	TRANSMITTER REQUIREMENT & TEST SUITES	14
5.1.1	<i>Antenna Requirement</i>	<i>14</i>
5.1.2	<i>Maximum conducted Peak output power.....</i>	<i>15</i>
5.1.3	<i>6dB Bandwidth and 99% Bandwidth.....</i>	<i>16</i>
	<i>Power Density</i>	<i>22</i>
5.1.4	<i>Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth.....</i>	<i>26</i>
5.1.5	<i>Spurious Emission</i>	<i>32</i>
6.	SAFETY HUMAN EXPOSURE	33
6.1	RADIO FREQUENCY EXPOSURE COMPLIANCE	33
6.1.1	<i>Electromagnetic Fields.....</i>	<i>33</i>

Prüfbericht - Nr.: 50289620 001

Test Report No.

Seite 4 von 37

Page 4 of 37

7.	PHOTOGRAPHS OF THE TEST SET-UP.....	34
8.	LIST OF TABLES	37
9.	LIST OF PHOTOGRAPHS.....	37

1. General Remarks

1.1 Complementary Materials

The following attachments are integral parts of this test report:

Appendix P: Photo Documentation internal view
(File Name: 50289620 001 APPENDIXP)

Appendix D: Test Result of Radiated Emissions
(File Name: 50289620 001 APPENDIXD)

Test Specifications

The following standards were applied.

Table 1: Applied Standard and Test Levels

Radio
FCC 47CFR Part 15: Subpart C Section 15.247 FCC 47CFR Part 2: Subpart J Section 2.1091 RSS-247 Issue 2, Feb 2017 RSS-102 Issue 5, March 2015 RSS-Gen, Issue 5, March 2019 ANSI C63.10:2013 KDB558074 D01 DTS Meas Guidance v05r02 KDB447498 D01 General RF Exposure Guidance v06

1.2 Decision Rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

2. Test Sites

2.1 Test Laboratory

TUV Rheinland Taiwan Ltd.
Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

TUV Rheinland Taiwan Ltd.

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

FCC Registration No.: 180491
IC Canada Registration No.: 9465A
TAF Accredited NCC Test Lab. No.:3567
TAF ISO17025 Certification effective period: 6th-May-2019 to 05th-May-2022



Testing Laboratory
3567

2.3 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manu-facturer	Type	S/N	Last Calibration	Next Calibration
EMI Test Receiver	Rohde & Schwarz	ESR 7	101062	2018/10/01	2019/10/01
Spectrum Analyzer	Rohde & Schwarz	FSV-40	100921	2019/04/30	2020/04/30
Pre-Amplifier	Hewlett Packard	8447D	2944A06641	2019/01/08	2020/01/08
Pre-Amplifier	EM Electronics	EM01G18G	060558	2018/11/30	2019/11/30
Pre-Amplifier	EMC Instruments	EMC184045SE	980408	2019/06/12	2020/06/14
Bilog Antenna	TESEQ	CBL 6111D	29804	2019/07/12	2020/07/12
Horn Antenna	ETS-Lindgren	3117	00138160	2019/06/24	2020/06/24
Horn Antenna	Com-Power	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2019/07/11	2020/07/11
Test Software	Audix	e3	Ver. 9	N/A	N/A
Spectrum Analyzer	Agilent	N9010A	MY53470241	2019/06/17	2020/06/17
Power Meter	Anritu	ML2495A	1901008	2019/04/29	2020/04/29

2.4 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.5 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular schedule using in house standards or comparisons.

2.6 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements .

Table 3: Emission Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	± 1.5 dB
RF power density, conducted	± 3 dB
spurious emissions, conducted	± 3 dB
all emissions, radiated	± 6 dB
Temperature	± 1 °C
Humidity	± 5 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Motion Sensor. It contains a bluetooth compatible wireless module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Table 4: Basic Information of EUT

Item	EUT information
Kind of Equipment/Test Item	Motion Sensor
Type Designation	HKMS2
FCC ID	YV8-SA7161
IC	9922A-SA7161
HVIN	HKMS2

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2402~2480MHz
Channel number	40
Operation Voltage	3.6Vdc
Modulation	LE 1M: GFSK LE 2M: GFSK
Antenna gain	1.04dBi

3.3 Independent Operation Modes

Basic operation modes are:

- A. Transmitting
 - 1. Low channel
 - 2. Middle channel
 - 3. High channel
- B. Receiving
- C. Standby
- D. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.5 Submitted Documents

- Circuit Diagram
- Blocking Diagram
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Table 6: Table for Parameters of Test Software Setting

Mode	Channel Frequency		
	2402 MHz	2440 MHz	2480 MHz
LE 1M	4	4	4
LE 2M	4	4	4

4.2 Test Operation and Test Software

Setup for testing: Test samples are provided with USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software nRF_DTM was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed in section 3.3 as appropriate.

The samples were used as follows:
Conducted: A000982201-001
Radiation: A000982201-002

Full test was applied on all test modes, but only worst case was shown.

4.3 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

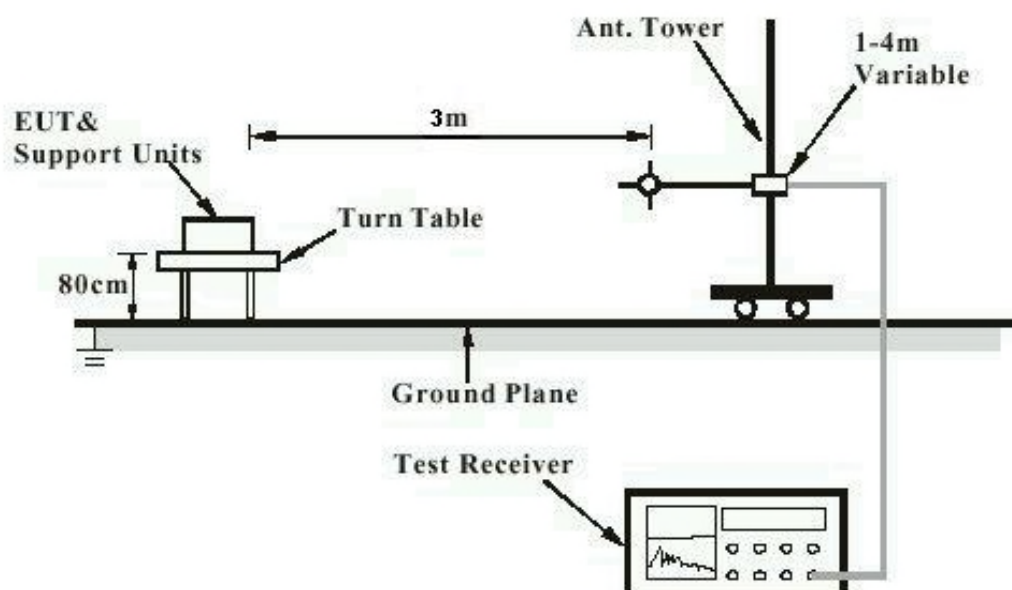
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2

4.4 Countermeasures to achieve EMC Compliance

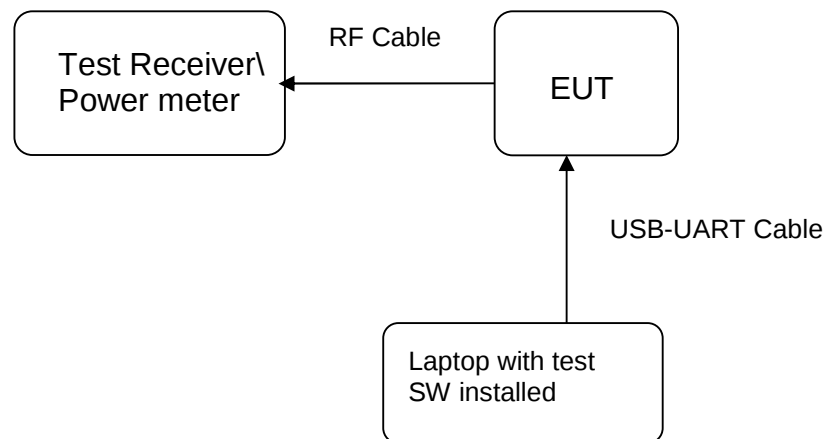
The test sample which has been tested contained the noise suppression parts as described in the Constructional Data Form or the Technical Construction File. No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m

Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement

5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Passed**

Test standard : FCC Part 15.247(b)(4), Part 15.203 and RSS-Gen 6.8

Requirement : use of approved antennas only with directional gains that do not exceed 6 dBi

According to the manufacturer declaration, the EUT has an antenna with directional gain of 1.04 dBi. The antenna is a printed PCB trace with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

Refer to EUT photo for details.

5.1.2 Maximum conducted Peak output power

RESULT:

Passed

Test standard : FCC Part 15.247(b)(3), RSS-247 5.4(b)
 Basic standard : ANSI C63.10:2013, KDB558074
 Limit : 1 Watt
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

Ambient temperature : 20-24 °C
 Relative humidity : 50-65 %
 Atmospheric pressure : 100-103 kPa

Table 7: Test result of Maximum conducted Peak output power, LE 1M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	2.44	0.00175	1
Middle Channel	2440	2.39	0.00173	1
High Channel	2480	2.27	0.00169	1

Table 8: Test result of Maximum conducted Peak output power, LE 2M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	2.46	0.00176	1
Middle Channel	2440	2.41	0.00174	1
High Channel	2480	2.27	0.00169	1

5.1.3 6dB Bandwidth and 99% Bandwidth

RESULT:
Passed

Test standard : FCC Part 15.247(a)(2), RSS-247 5.2(a)
 RSS-Gen
 Basic standard : ANSI C63.10:2013, KDB558074
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A

Ambient temperature : 20-24°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103 kPa

Table 9: Test result of 6dB Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	701.9	>500	Pass
Mid Channel	2440	694.8	>500	Pass
High Channel	2480	697.1	>500	Pass

Table 10: Test result of 99% Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	1.0548

Table 11: Test result of 6dB Bandwidth, LE 2M

Channel	Channel Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low Channel	2402	1.152	>500	Pass
Mid Channel	2440	1.163	>500	Pass
High Channel	2480	1.156	>500	Pass

Table 12: Test result of 99% Bandwidth, LE 2M

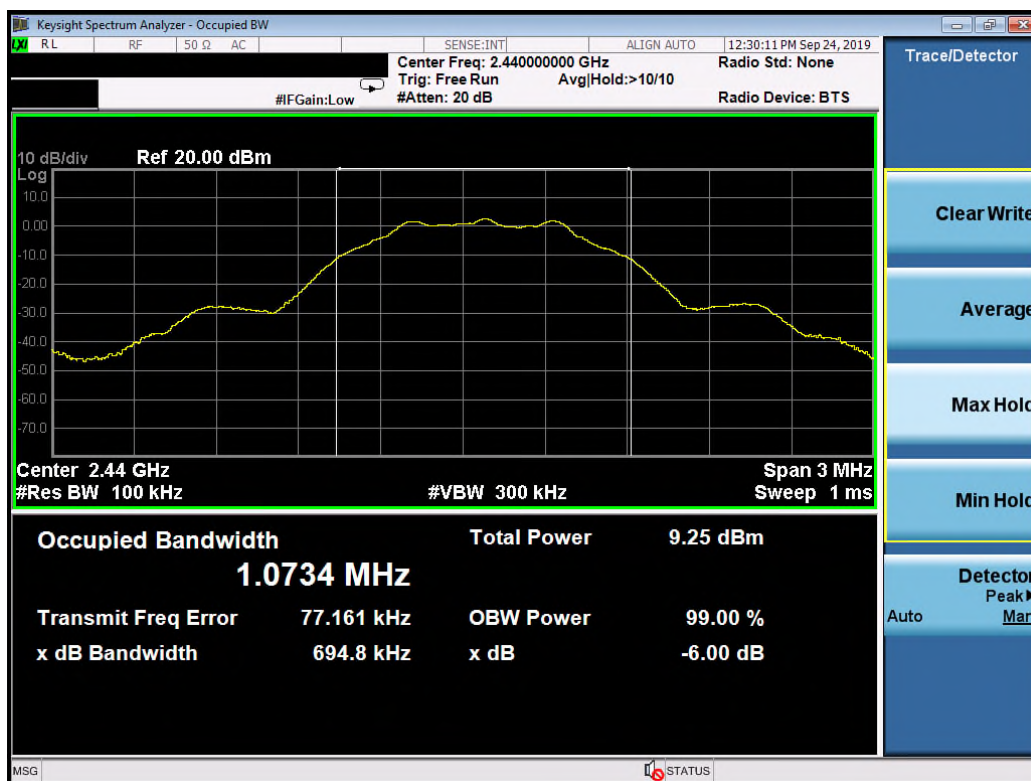
Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	2.0672

Test Plot of 6dB Bandwidth, LE 1M

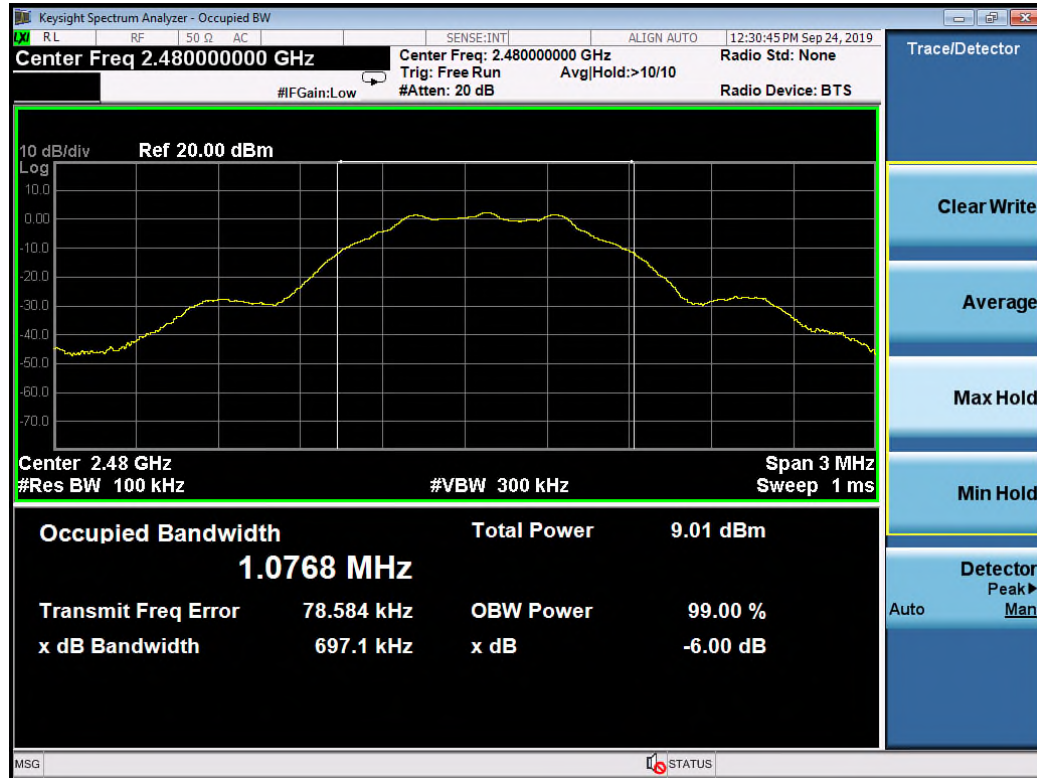
Low Channel



Middle Channel



High Channel



LE 2M

Low Channel



Middle Channel

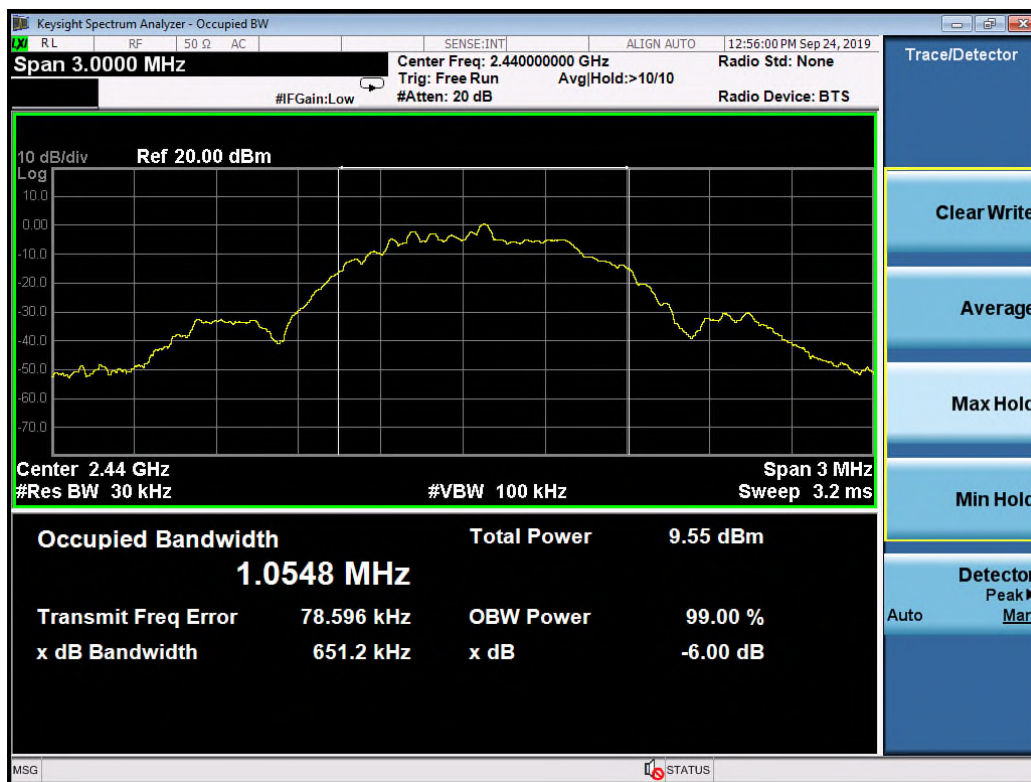


High Channel



LE 1M

Middle Channel



LE 2M

Middle Channel



Power Density

RESULT:
Passed

Test standard : FCC Part 15.247(e) , RSS-247 5.2(b)
 Basic standard : ANSI C63.10:2013, KDB558074
 Kind of test site : Shielded room

Test setup

Test Channel : Low/ Middle/ High
 Operation Mode : A
 Ambient temperature : 20-24°C
 Relative humidity : 50-65%
 Atmospheric pressure : 100-103 kPa

Table 13: Test result of Power Density, LE 1M

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2402	-12.90	8
Middle Channel	2440	-13.02	8
High Channel	2480	-13.18	8

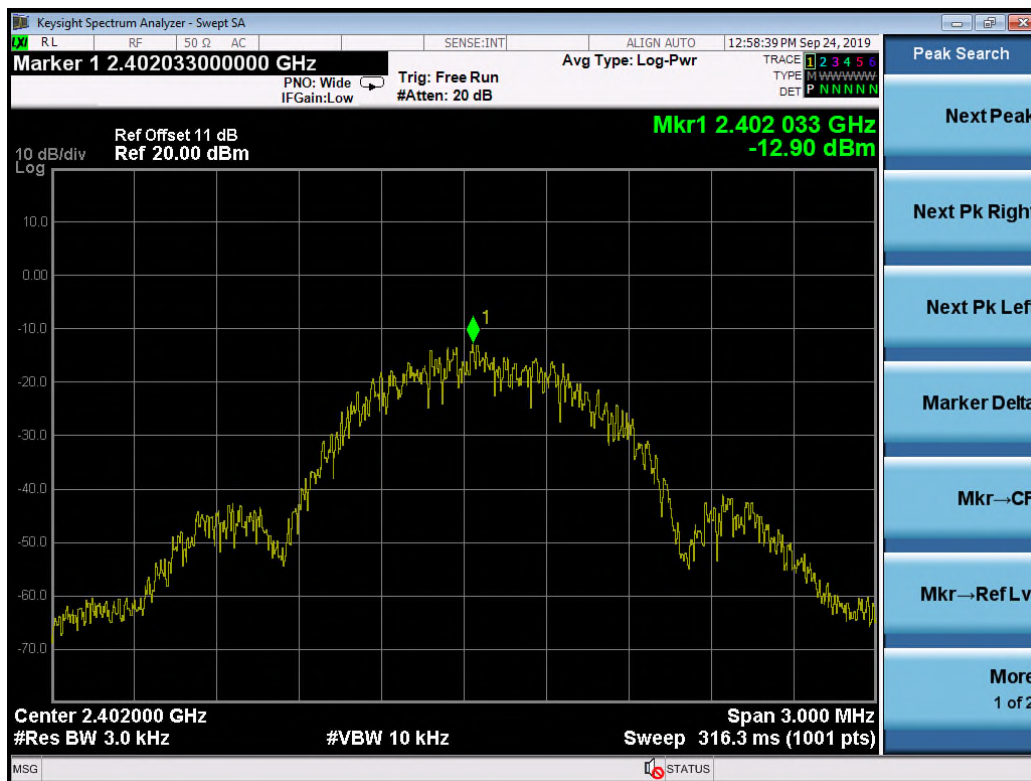
Table 14: Test result of Power Density, LE 2M

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2402	-15.52	8
Middle Channel	2440	-15.54	8
High Channel	2480	-15.67	8

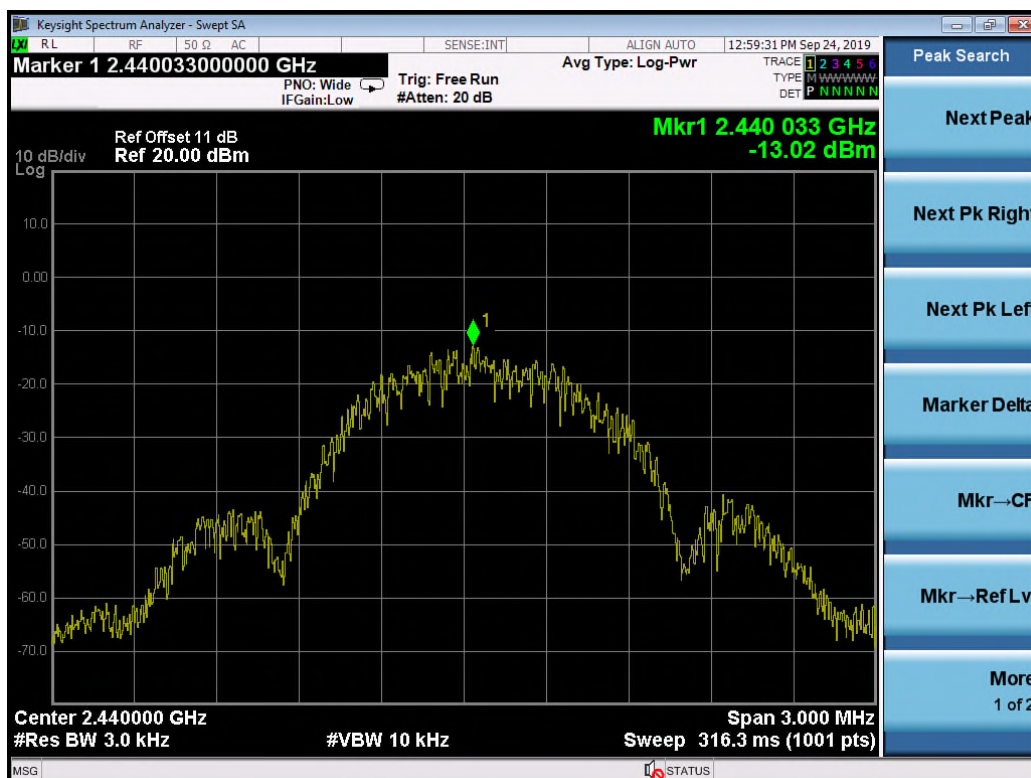
Test Plot of Power Density

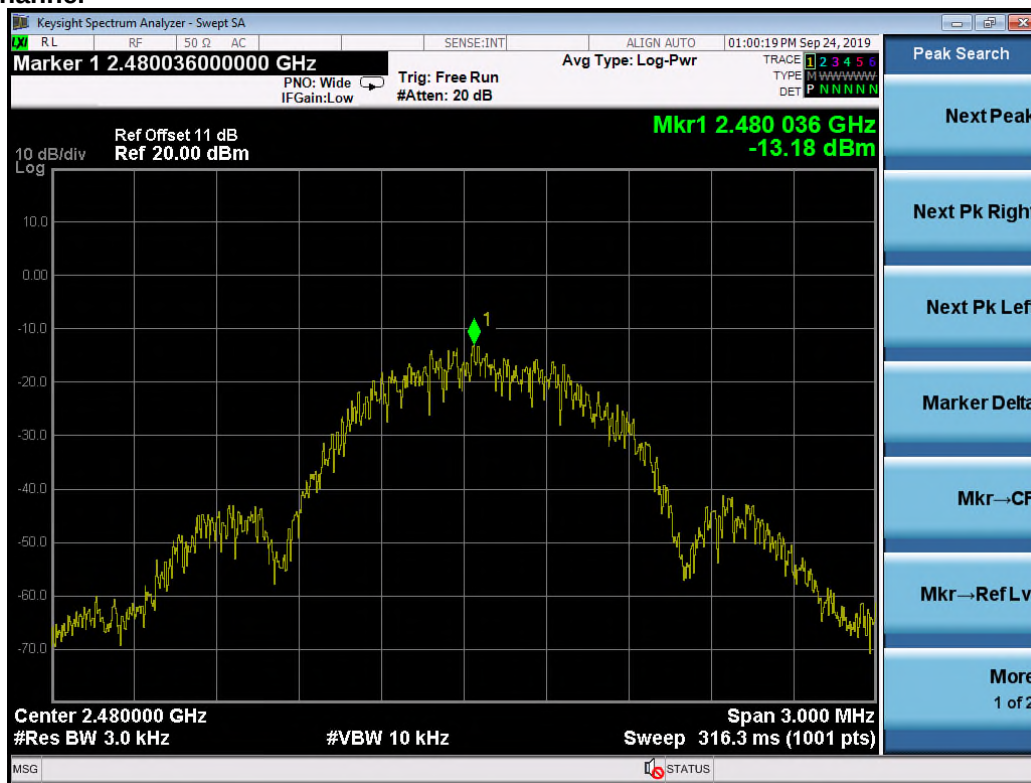
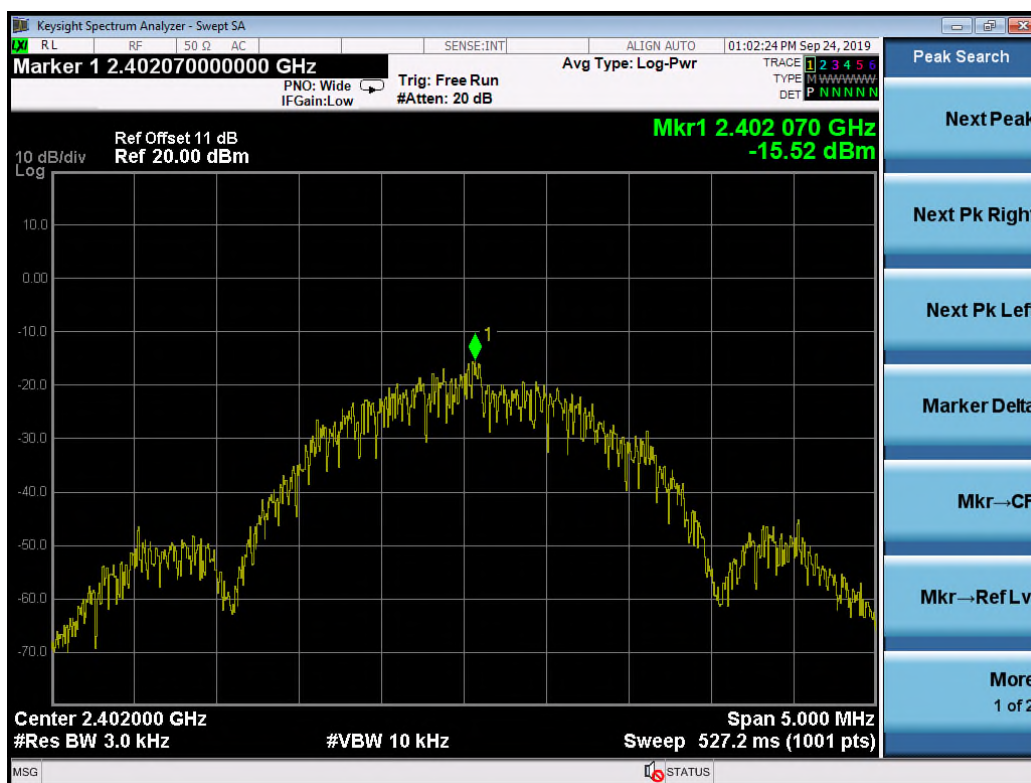
LE 1M

Low Channel

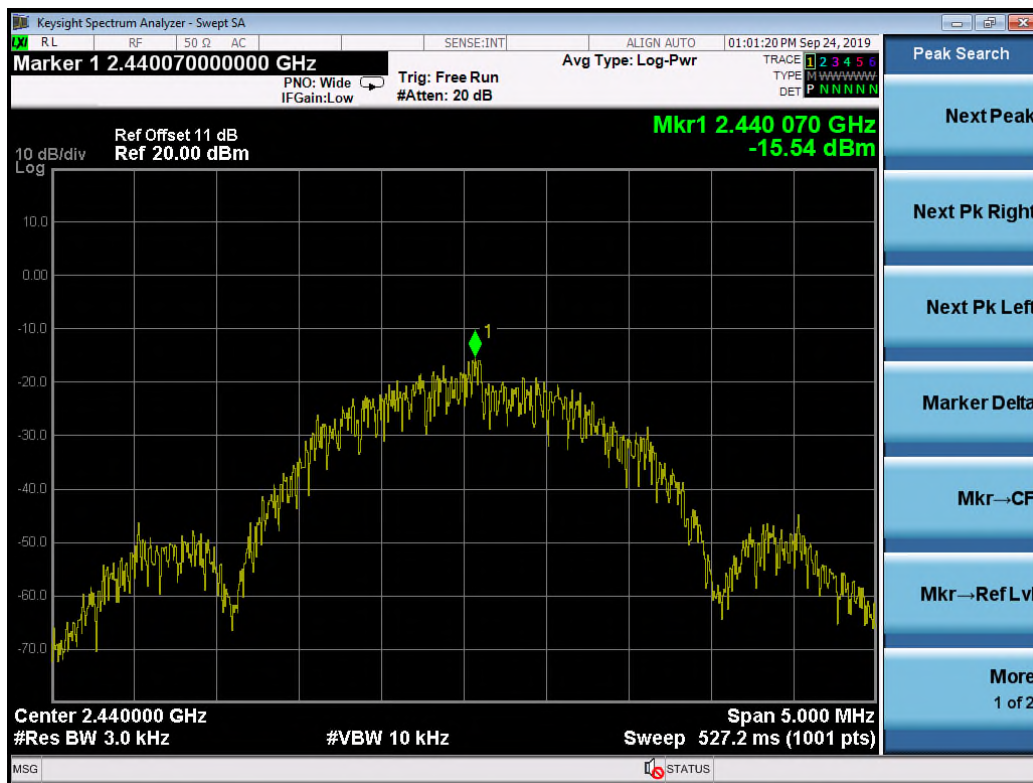


Middle Channel

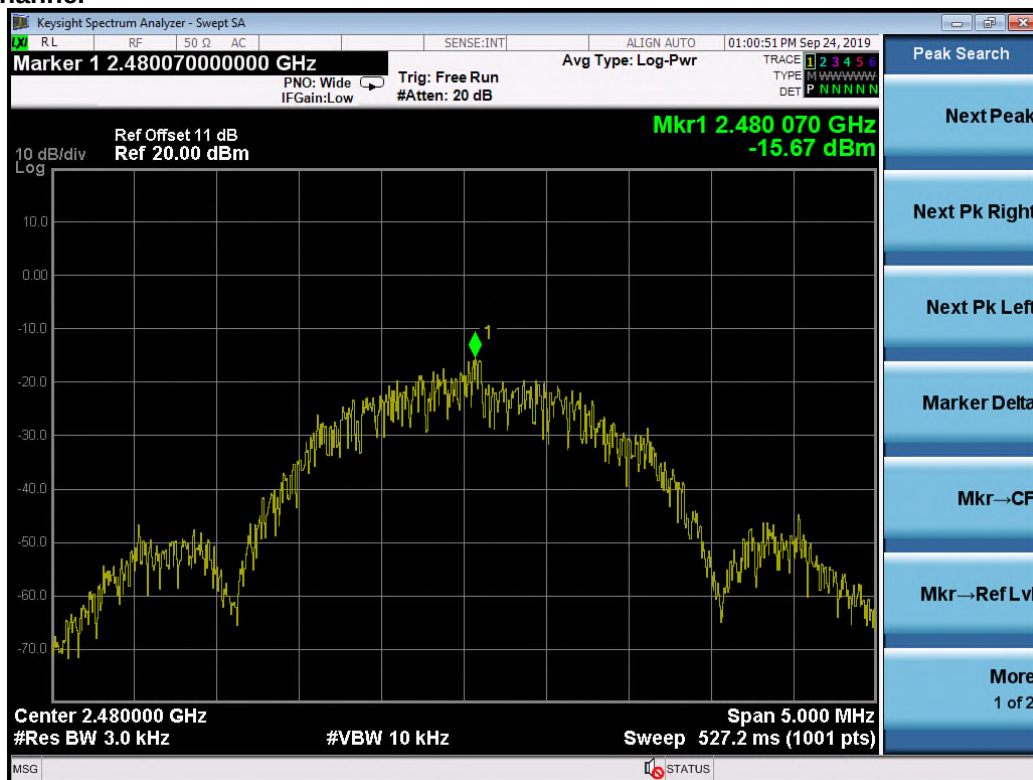


High Channel

LE 2M
Low Channel


Middle Channel



High Channel



5.1.4 Conducted spurious emissions and Frequency Band Edge measured in 100kHz Bandwidth

RESULT:**Passed**

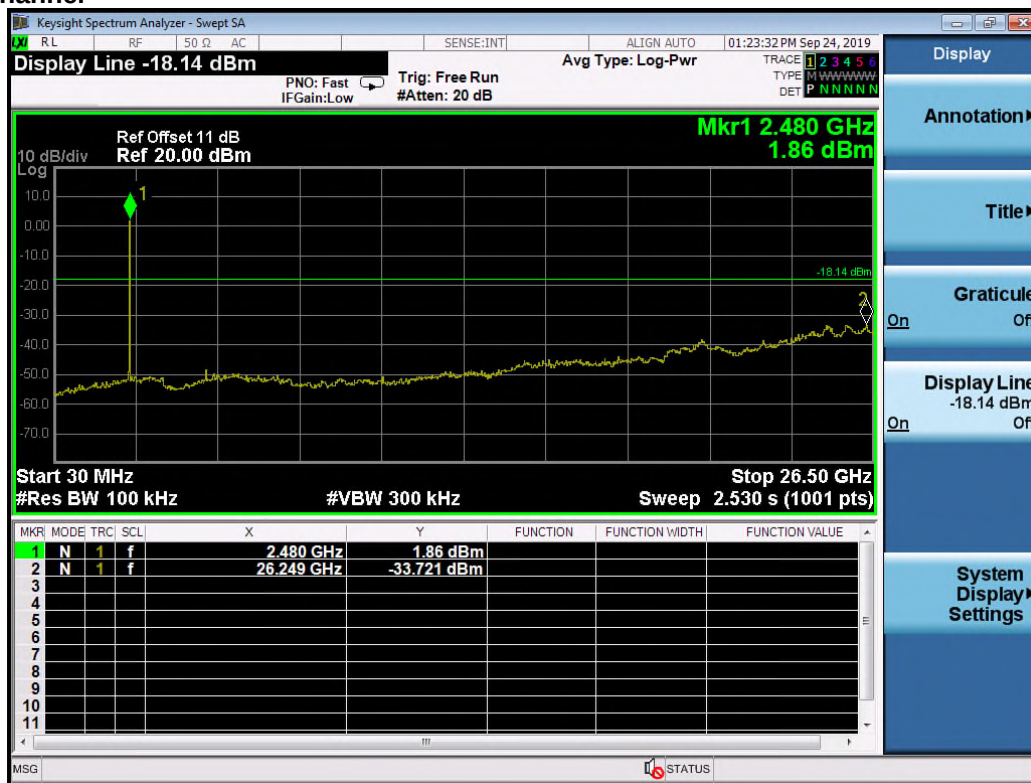
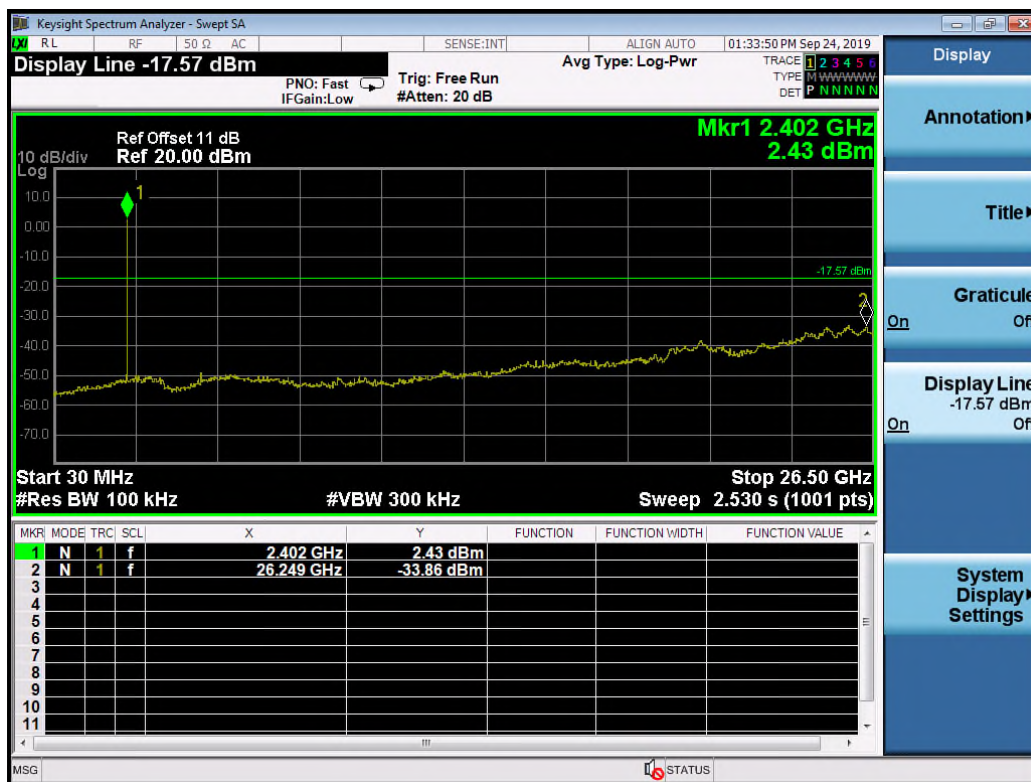
Test standard	:	FCC part 15.247(d), RSS-247 5.5
Basic standard	:	ANSI C63.10:2013, KDB558074
Limit	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power)
Kind of test site	:	Shielded room

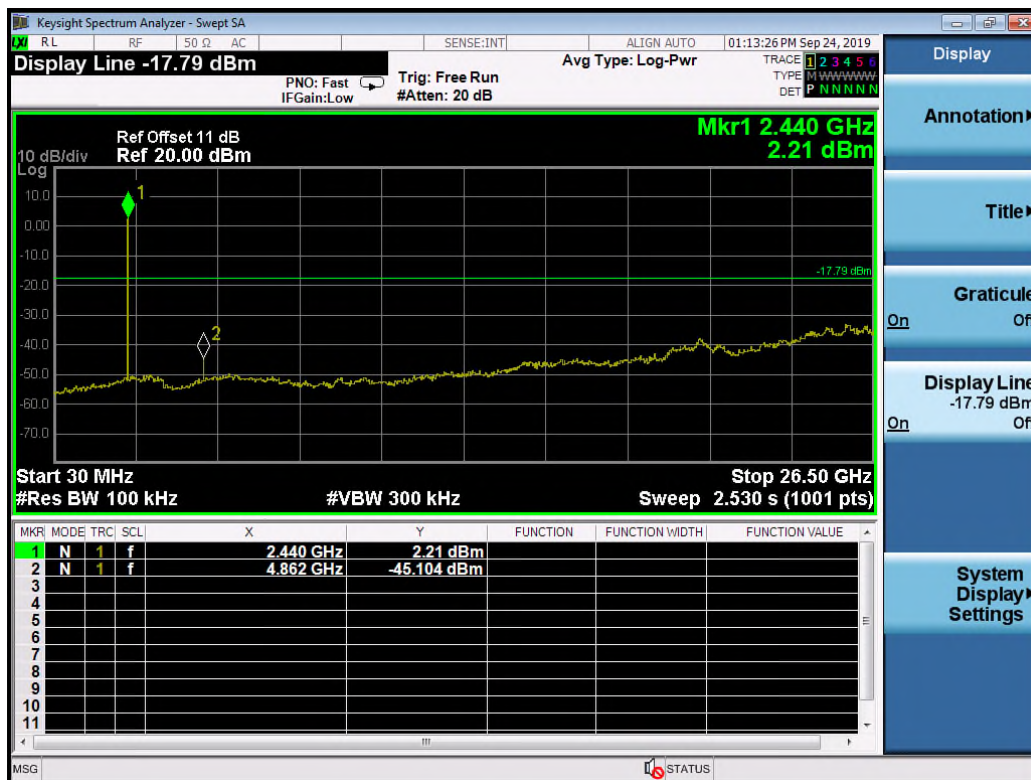
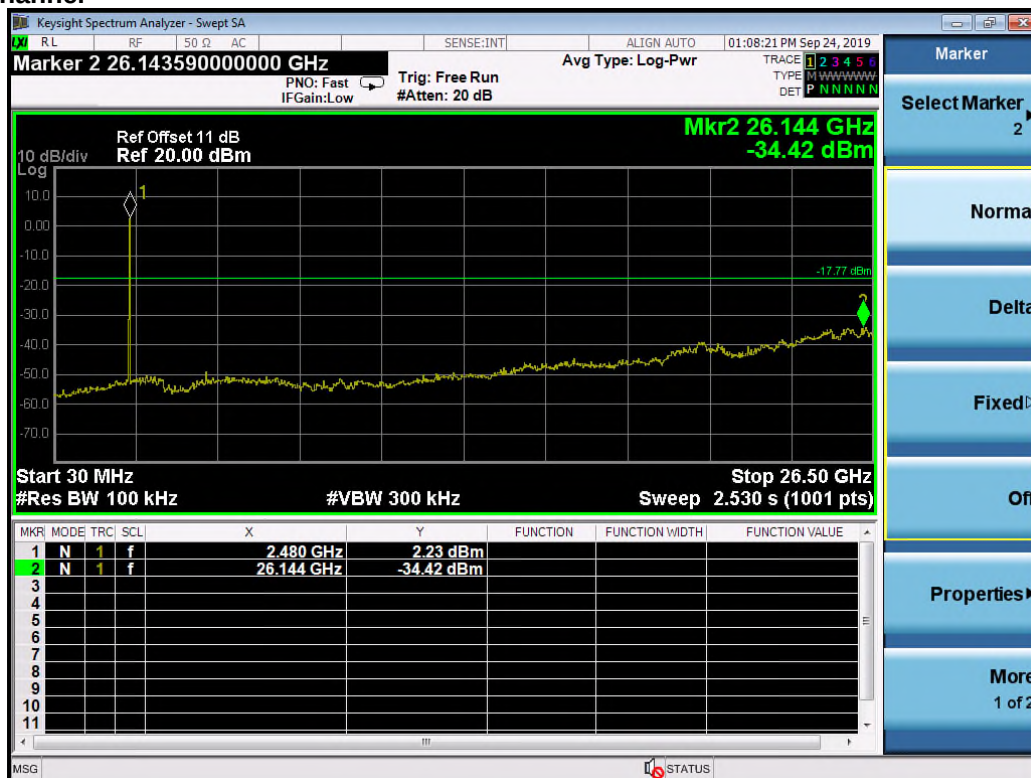
Test setup

Test Channel	:	Low/ Mid/ High for spurious, Low/ High for Band Edge
Operation mode	:	A
Ambient temperature	:	20-24°C
Relative humidity	:	50-65%
Atmospheric pressure	:	100-103 kPa

All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.

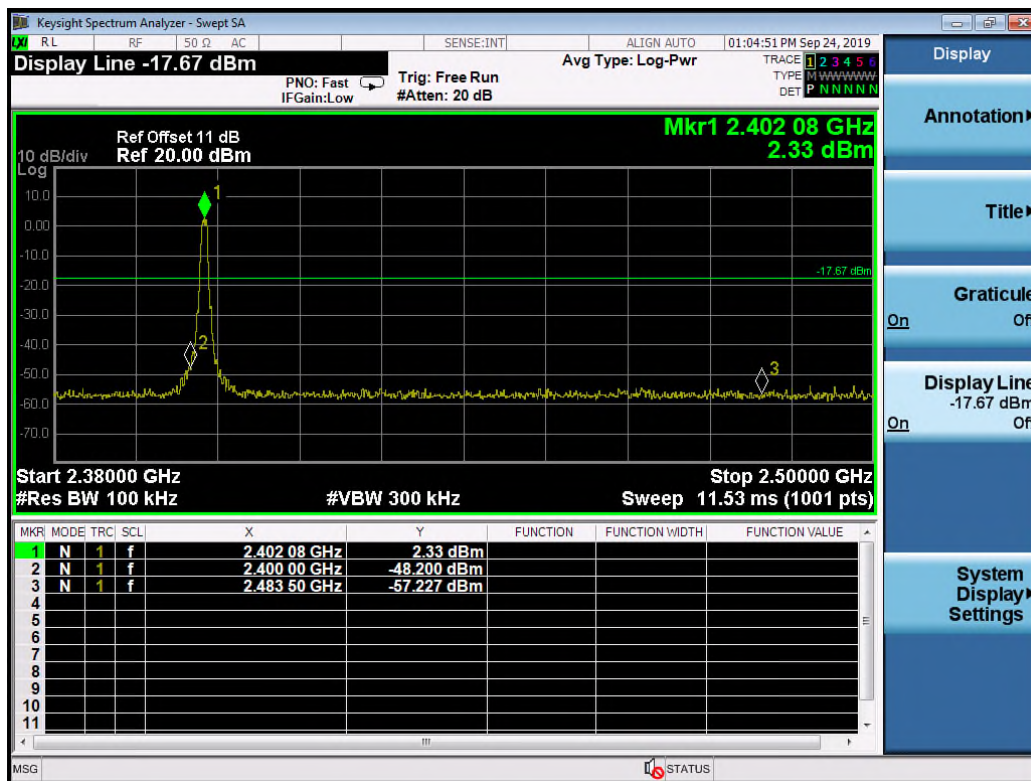
Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

High Channel

LE 2M
Low Channel


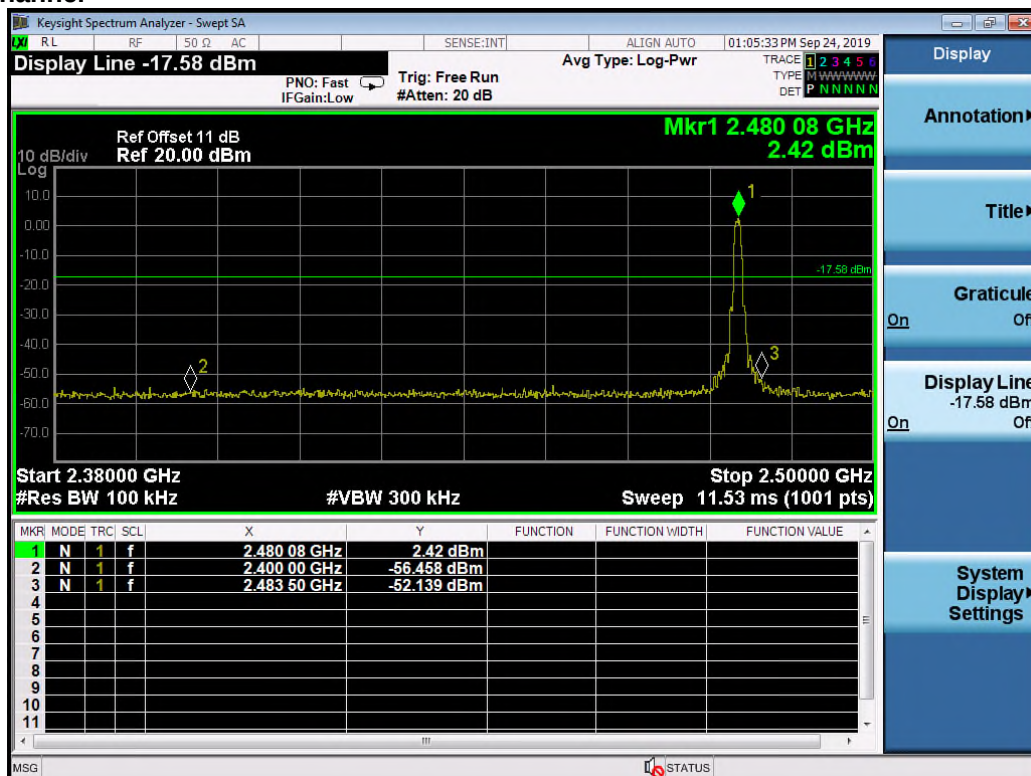
Middle Channel

High Channel


Test Plot 100kHz RBW of Band Edge LE 1M

Low Channel

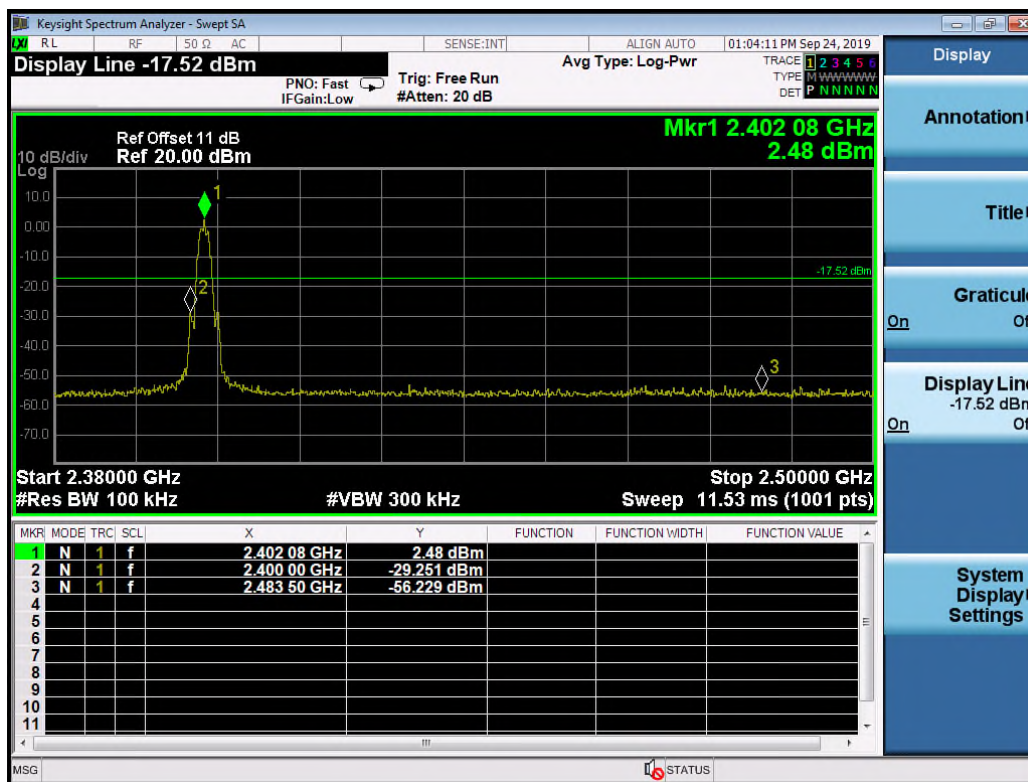


High Channel

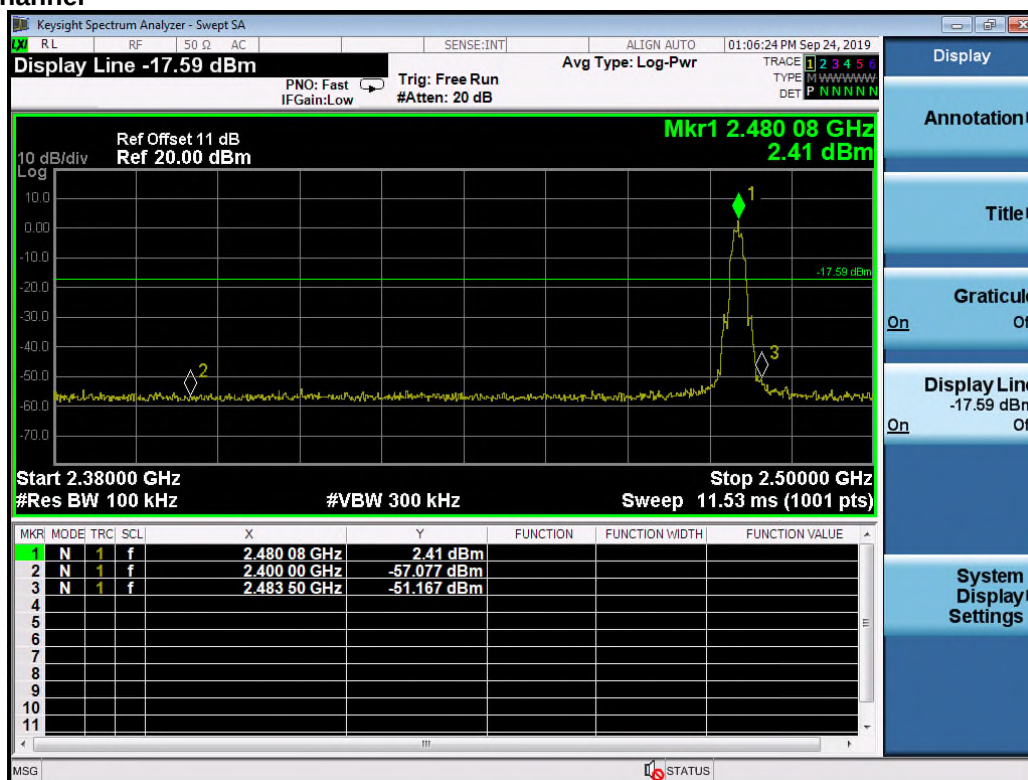


LE 2M

Low Channel



High Channel



5.1.5 Spurious Emission

RESULT:**Passed**

Test standard : FCC part 15.247(d), FCC 15.205, FCC 15.209
RSS-Gen 8.9 and RSS-Gen 8.10
Basic standard : ANSI C63.10: 2013
Limits : Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-Gen i5, 8.10 (Table 7), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen i5, 8.9 (Table 5 and 6).

Emission radiated outside the restricted and authorized frequency bands must either comply with the radiated emission limits specified for the restricted bands or in FCC15.247(d) and RSS-247 i2, 5.5

Kind of test site : 3m Semi-Anechoic Chamber

Test setup

Test Channel : Low/ Middle/ High
Operation mode : A

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)

Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

Testing was carried out within frequency range 9kHz to the tenth harmonic. For details refer to Appendix D. The Radiated Emissions testing was performed in the X, Y and Z axis orientation. The worst-case Axis orientation is recorded in this test report.

6. Safety Human exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT:**Passed**

Test standard : FCC KDB Publication 447498 D01 v06
RSS-102

Separation distance is more than 20 cm, thus mobile device exposure limits can be applied.

Maximum Exposure:

Power to Antenna (mW)	1.76 mW
Power to Antenna (dBm)	2.5 dBm
Antenna Gain	1.04 dBi
Power+Ant Gain	2.2 mW
Distance	20 cm
S=	0.000 mW/cm ²

Limit FCC:

0.3-1.34 MHz (100) mW/cm²
1.34-30 MHz (180/f²) mW/cm²
30-300 MHz 0.2 mW/cm²
300-1500 MHz f/1500 mW/cm²
1500-100,000 MHz 1.0 mW/cm²

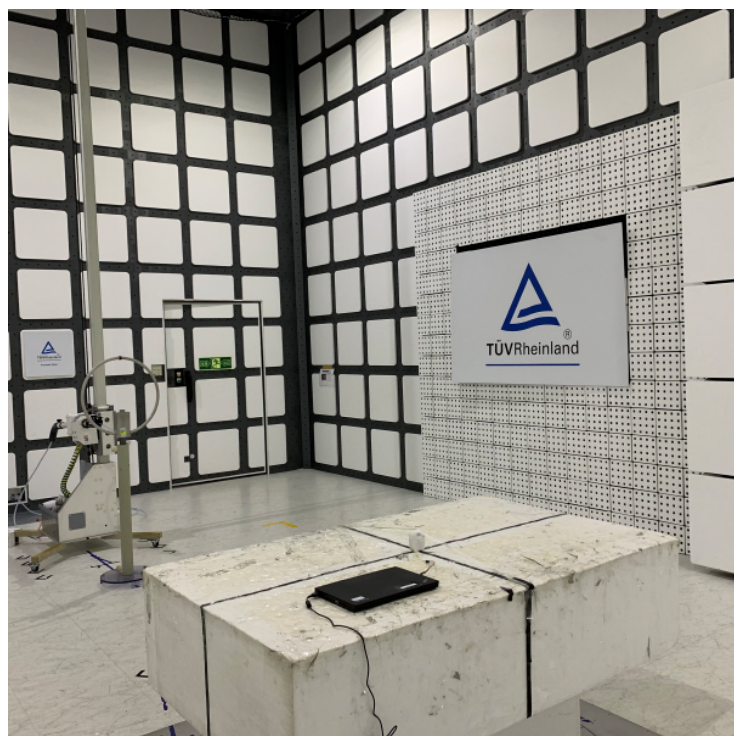
Limit Canada: $0.02619f^{0.6834}$

7. Photographs of the Test Set-Up

Photograph 1: Set-up for Spurious Emissions (Front View 1)



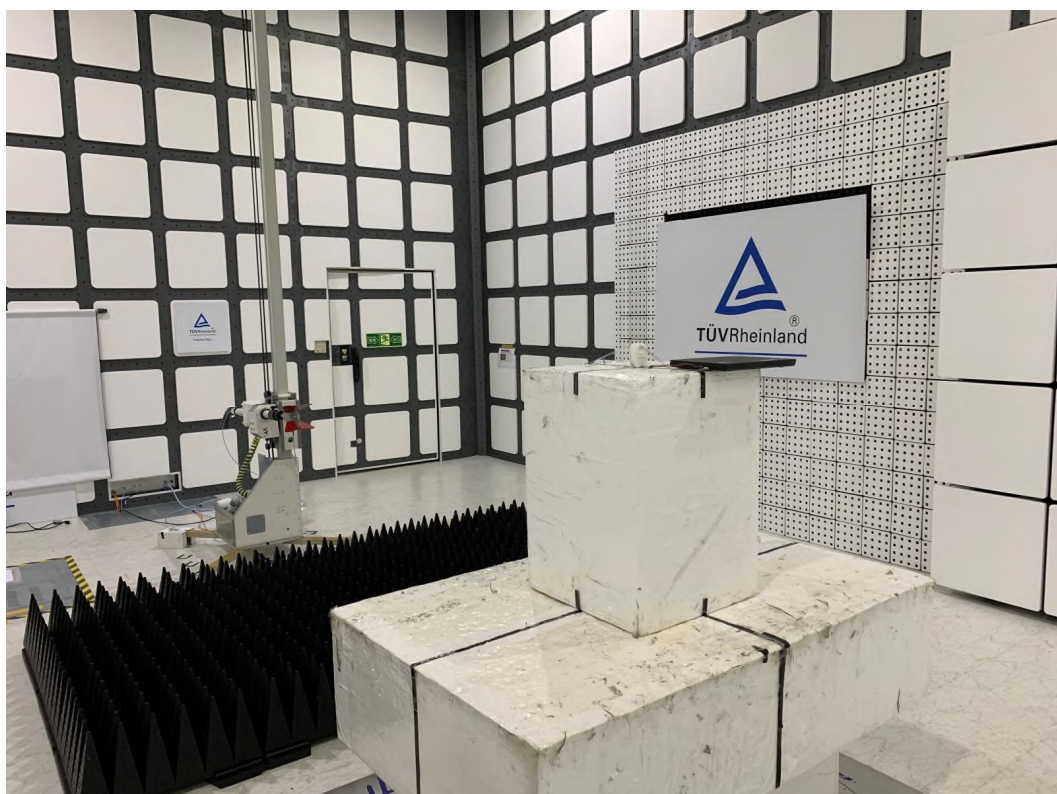
Photograph 2: Set-up for Spurious Emissions (Back View 1)



Photograph 3: Set-up for Spurious Emissions (Front View 2)



Photograph 4: Set-up for Spurious Emissions (Back View 2)



Photograph 5: Set-up for Conducted testing



Photograph 6: Set-up for Conducted testing



8. List of Tables

Table 1: Applied Standard and Test Levels	5
Table 2: List of Test and Measurement Equipment	7
Table 3: Emission Measurement Uncertainty.....	8
Table 4: Basic Information of EUT	9
Table 5: Technical Specification of EUT	9
Table 6: Table for Parameters of Test Software Setting	11
Table 7: Test result of Maximum conducted Peak output power, LE 1M.....	15
Table 8: Test result of Maximum conducted Peak output power, LE 2M.....	15
Table 9: Test result of 6dB Bandwidth, LE 1M	16
Table 10: Test result of 99% Bandwidth, LE 1M	16
Table 11: Test result of 6dB Bandwidth, LE 2M	17
Table 12: Test result of 99% Bandwidth, LE 2M	17
Table 13: Test result of Power Density, LE 1M	22
Table 14: Test result of Power Density, LE 2M	22

9. List of Photographs

Photograph 1: Set-up for Spurious Emissions (Front View 1).....	34
Photograph 2: Set-up for Spurious Emissions (Back View 1)	34
Photograph 3: Set-up for Spurious Emissions (Front View 2).....	35
Photograph 4: Set-up for Spurious Emissions (Back View 2)	35
Photograph 5: Set-up for Conducted testing	36
Photograph 6: Set-up for Conducted testing	36