Prüfbericht-Nr.: *Test Report No.:*	**50254142 001**	**Auftrags-Nr.:** *Order No.:*	238105139	Seite 1 von 41 *Page 1 of 41*
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order date:*	08-May-2019	
Auftraggeber: *Client:*	SMK Corporation 5-5 Togoshi 6-chome Shinagawa-kuTokyo142-8511Japan			
Prüfgegenstand: *Test item:*	Bluetooth low energy Module			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	BTS05			
Auftrags-Inhalt: *Order content:*	FCC Part 15C / IC RSS-247 Test report (BLE)			
Prüfgrundlage: *Test specification:*	FCC 47CFR Part 15: Subpart C Section 15.247(DTS) RSS-247 (02-2017)			

Wareneingangsdatum: *Date of receipt:*	14-May-2019
Prüfmuster-Nr.: *Test sample No.:*	A000922090-001 to 002
Prüfzeitraum: *Testing period:*	15-May-2019 – 20-May-2019
Ort der Prüfung: *Place of testing:*	EMC/RF Laboratory Taipei
Prüflaboratorium: *Testing laboratory:*	TUV Rheinland Taiwan Ltd.
Prüfergebnis*: *Test result*:*	Pass

Report date / *tested by:*			**kontrolliert von** / *reviewed by:*		
11-Jul-2019	Jack Chang/Project Manager		11-Jul-2019	Arvin Ho/Vice General Manager	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other:*

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:* — Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*

* 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*

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

5.1.4 POWER DENSITY
RESULT: Passed

5.1.5 CONDUCTED SPURIOUS EMISSIONS AND FREQUENCY BAND EDGE MEASURED IN 100KHZ BANDWIDTH
RESULT: Passed

5.1.6 SPURIOUS EMISSION
RESULT: Passed

5.2.1 MAINS CONDUCTED EMISSIONS
RESULT: Passed

6.1.1 ELECTROMAGNETIC FIELDS
RESULT: Passed

Contents

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: 50254142 001 APPENDIXP)

Appendix D: Test Result of Radiated Emissions
(File Name: 50254142 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, April 2018
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 RegistrationNo.: 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
Test Software	Farad	EZ_EMC	Ver. TUV3A1	N/A	N/A
EMI Test Receiver	R&S	ESR 7	101062	2018/10/01	2019/10/01
Spectrum Analyzer	R&S	FSV 40	101514	2019/02/07	2020/02/07
EXA Signal Analyzer	KEYSIGHT	N9010A	MY52221334	2019/02/15	2020/02/15
Preamplifier (30MHz -1GHz)	HP	8447F	2805A03335	2018/08/22	2019/08/22
Pre-Amplifier (1GHz~18GHz)	EM Electronics	EM01G18G	060558	2018/11/30	2019/11/30
Bilog Antenna	TESEQ	CBL 6111D	29802	2018/08/22	2019/08/22
Horn Antenna	ETS-Lindgren	3117	00138160	2018/06/01	2019/06/01
Horn Antenna (18GHz~40GHz)	COM-POWER	AH-840	101029	2018/12/22	2019/12/22
Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2018/06/21	2019/06/21
LISN (1 phase)	R&S	ENV216	101243	2018/06/18	2019/06/18
LISN	R&S	ENV216	101262	2018/06/22	2019/06/22

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	± 1 x 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 ºC
Humidity	± 5 %

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a Bluetooth low energy Module. It contains a Bluetooth compatible 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	Bluetooth low energy Module
Type Designation	BTS05
FCC ID	GT3SCI01
IC	3683A-SCI01
HVIN	BTS05

Table 5: Technical Specification of EUT

Technical Specification	Value
Operating Frequencies	2402~2480MHz
Channel number	40
Operation Voltage	1.7Vdc to 3.6Vdc (Tested with 3.3Vdc)
Modulation	LE 1M: GFSK LE 2M: GFSK
Antenna gain	-1.36dBi

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 equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Setup for testing: The module is mounted on an Evaluation Board provided by the manufacturer. The EVB is provided with an USB interface which makes it possible to control the module through the test software installed on a notebook computer.

This software 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 sample: A000922090-001
Radiation sample: A000922090-002

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

BLE mode:

Channel Low (2402MHz), Channel Mid (2440MHz) and Channel High (2480MHz) were chosen for full testing.

4.3 Special Accessories and Auxiliary Equipment

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

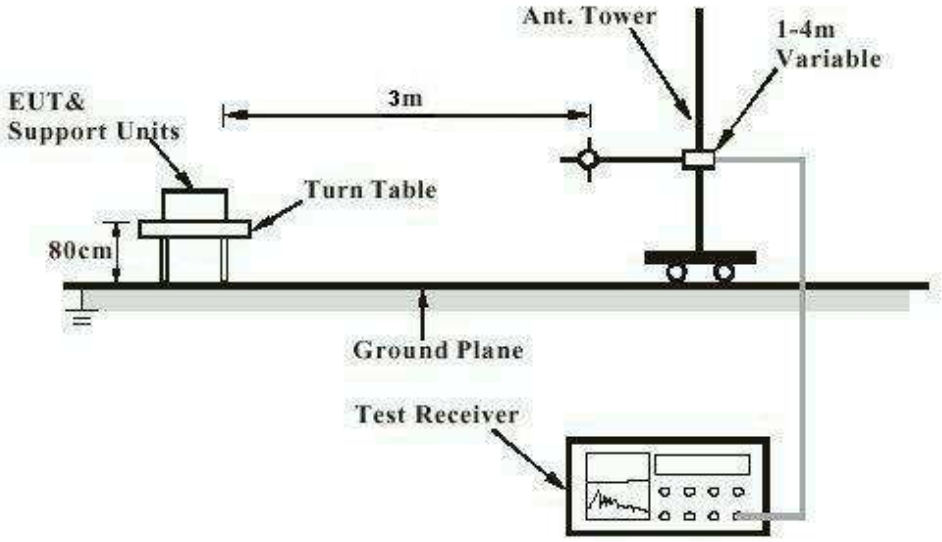
Description	Manufacturer	Model No.	Serial No.
Notebook(EMC-06)	Lenovo	TP00048A	PB-0F8B2
Test tool	Microchip	DTM Tool for BTS05 (DLE)	v0.2.0

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 Mains Conduction Measurement (if applicable)

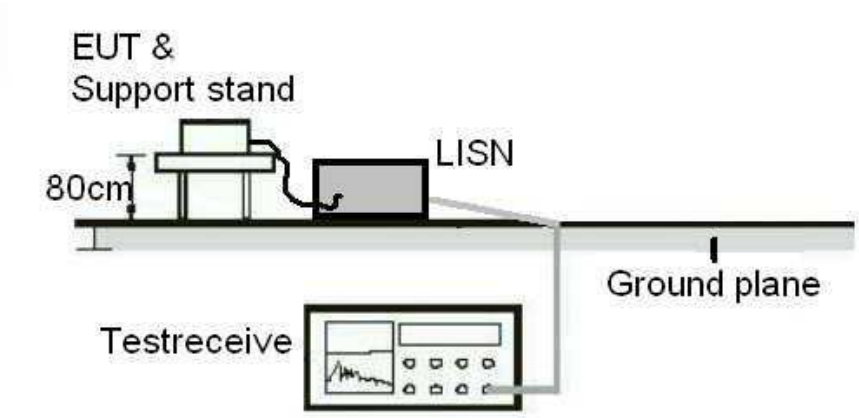
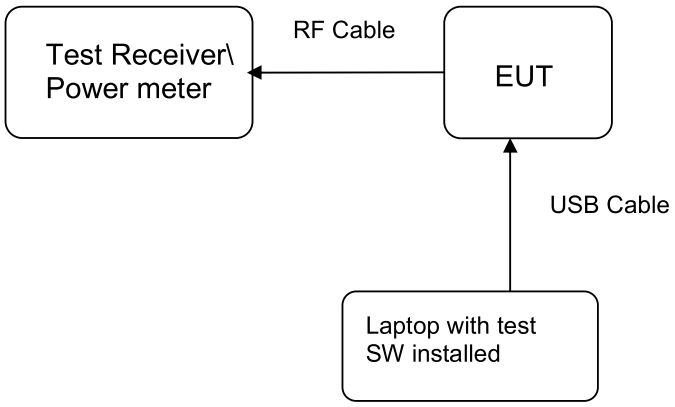


Diagram of Measurement Equipment Configuration for Conducted Transmitter Measurement



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 Max directional gain of -1.36dBi. 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 6: Test result of Maximum conducted Peak output power, LE 1M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	4.02	0.00252	1
Middle Channel	2440	4.26	0.00267	1
High Channel	2480	4.00	0.00251	1

Pmax: 4.26dBm, 2.67mW

Table 7: Test result of Maximum conducted Peak output power, LE 2M

Channel	Channel Frequency (MHz)	Output Power		Limit
		(dBm)	(W)	(W)
Low Channel	2402	4.13	0.00259	1
Middle Channel	2440	4.34	0.00272	1
High Channel	2480	4.12	0.00258	1

Pmax: 4.34dBm, 2.72mW

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 (Issue 5) 6.7
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 8: Test result of 6dB Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	713.9	>500	Pass
Mid Channel	2440	716.3	>500	Pass
High Channel	2480	711.9	>500	Pass

Table 9: Test result of 99% Bandwidth, LE 1M

Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	1.0630

Table 10: Test result of 6dB Bandwidth, LE 2M

Channel	Channel Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Result
Low Channel	2402	1.168	>500	Pass
Mid Channel	2440	1.148	>500	Pass
High Channel	2480	1.168	>500	Pass

Table 11: Test result of 99% Bandwidth, LE 2M

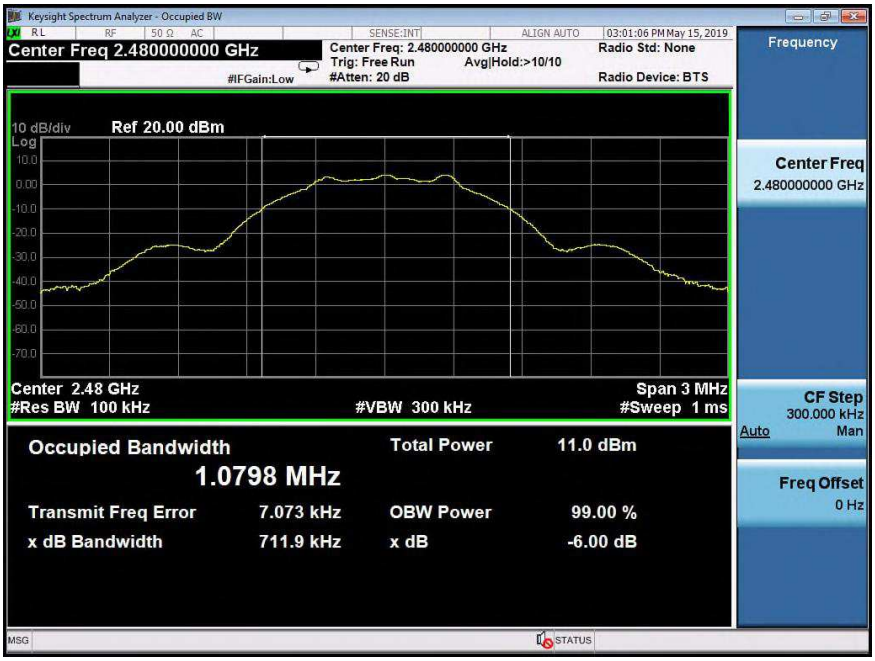
Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
Mid Channel	2440	2.0915

Test Plot of 6dB Bandwidth, LE 1M

Low Channel

Middle Channel

High Channel



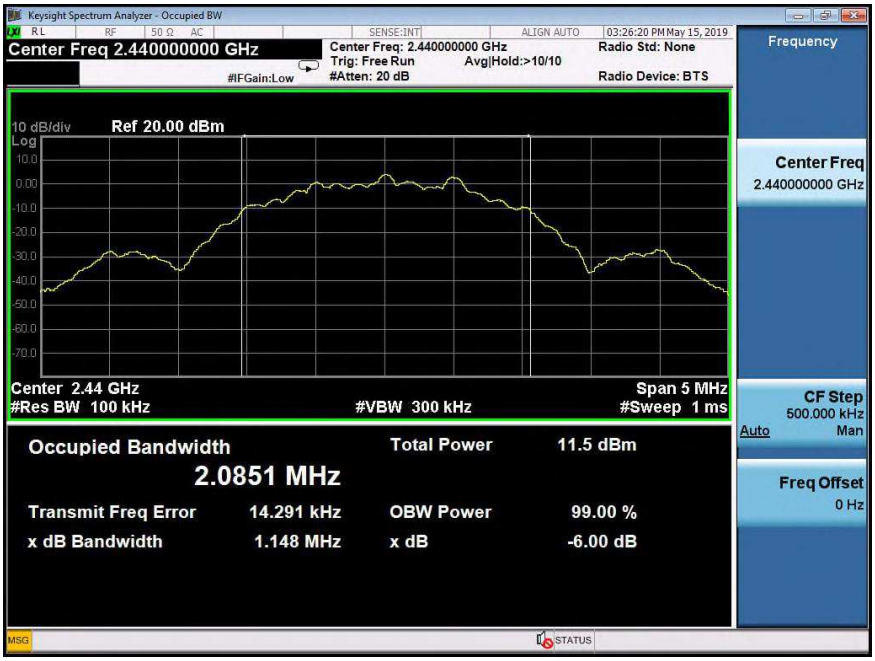
Test Plot of 99% Bandwidth, LE 1M

Middle Channel

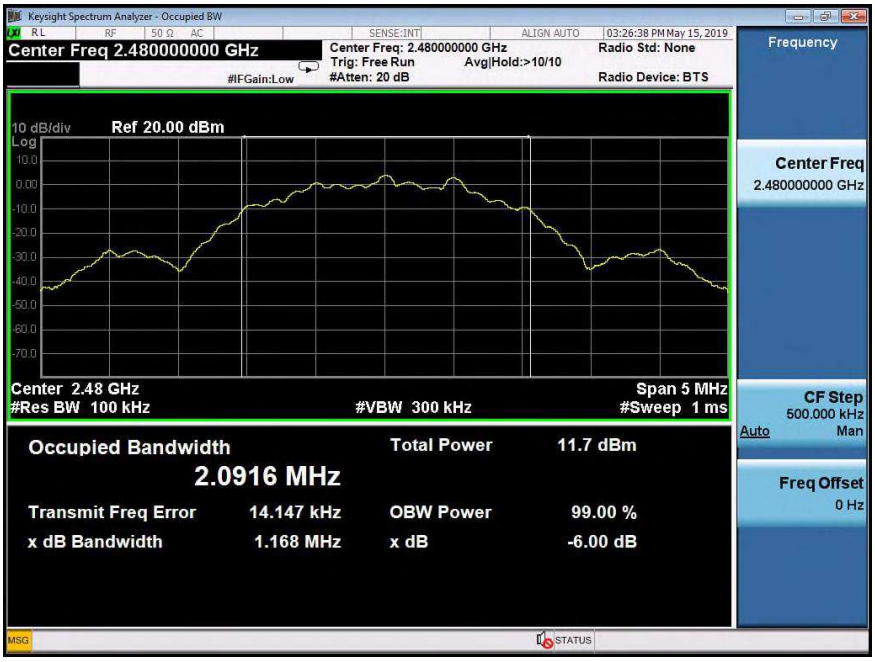
Test Plot of 6dB Bandwidth, LE 2M

Low Channel

Middle Channel



High Channel



Test Plot of 99% Bandwidth, LE 2M

Middle Channel

5.1.4 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 12: Test result of Power Density, LE 1M

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2402	-12.14	8
Middle Channel	2440	-11.73	8
High Channel	2480	-12.30	8

Table 13: Test result of Power Density, LE 2M

Channel	Channel Frequency (MHz)	Power Density	Limit
		(dBm)	(dBm)
Low Channel	2402	-13.97	8
Middle Channel	2440	-13.79	8
High Channel	2480	-14.02	8

Test Plot of Power Density, LE 1M

Low Channel

Middle Channel

High Channel

Test Plot of Power Density, LE 2M

Low Channel

Middle Channel

High Channel

5.1.5 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

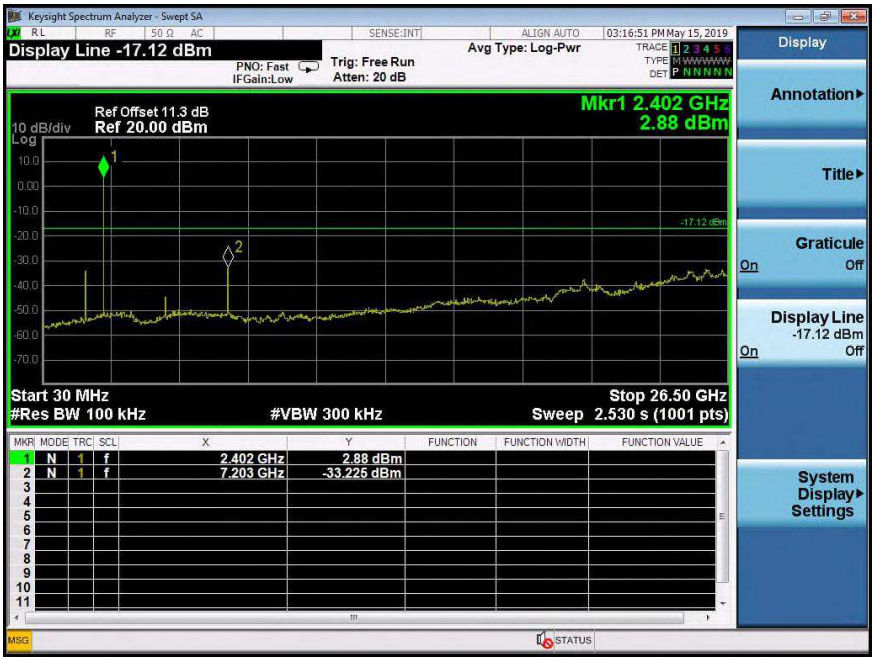
Test setup

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

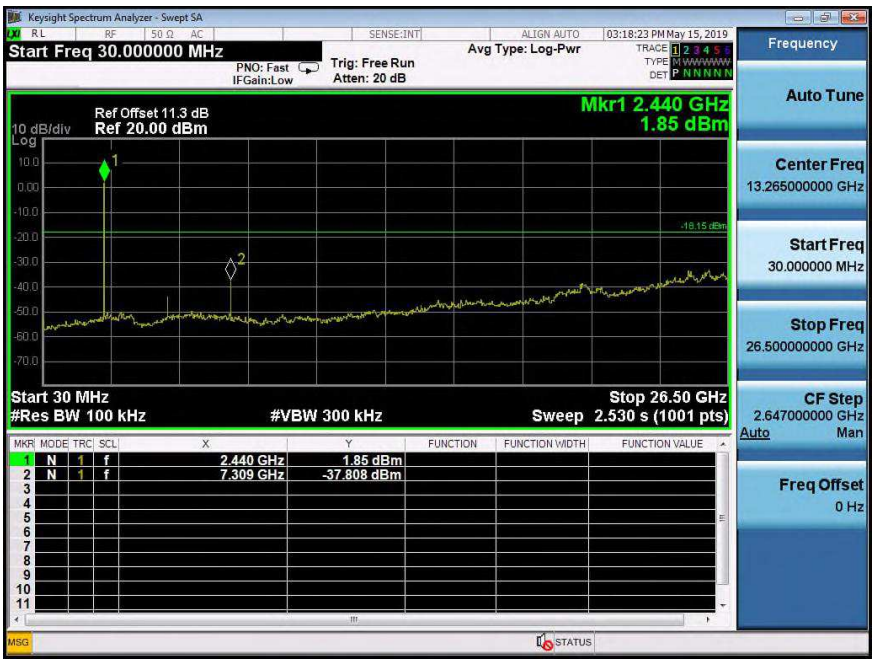
All emissions are more than 20dB below fundamental, details refer to following test plot, and compliance is achieved as well.
Due to the small size of the product and that there are no inductive components of significant size, 9kHz to 30MHz frequency range is not tested based on technical judgment.

Test Plot 100kHz Conducted Emissions, LE 1M

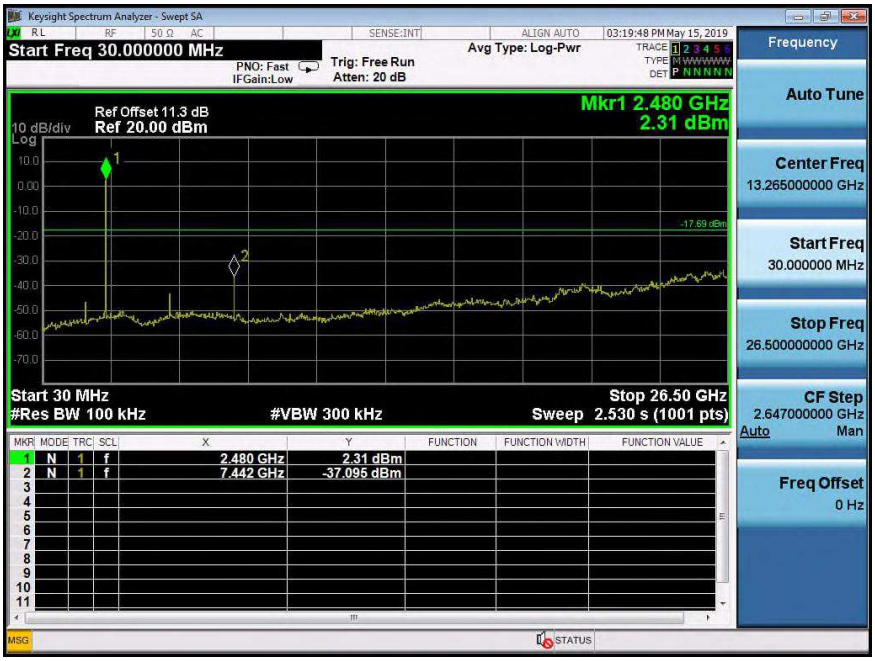
Low Channel



Middle Channel

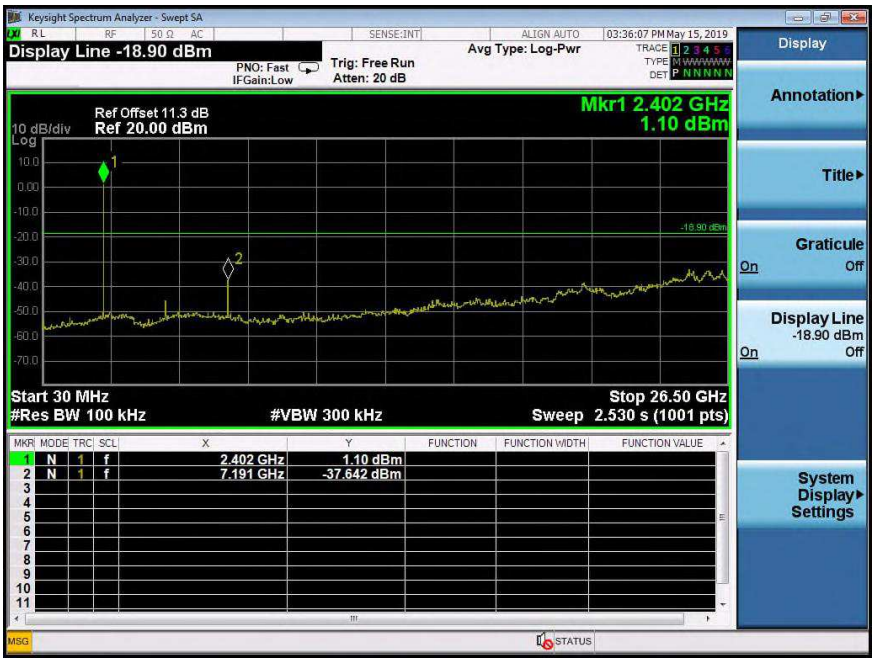


High Channel

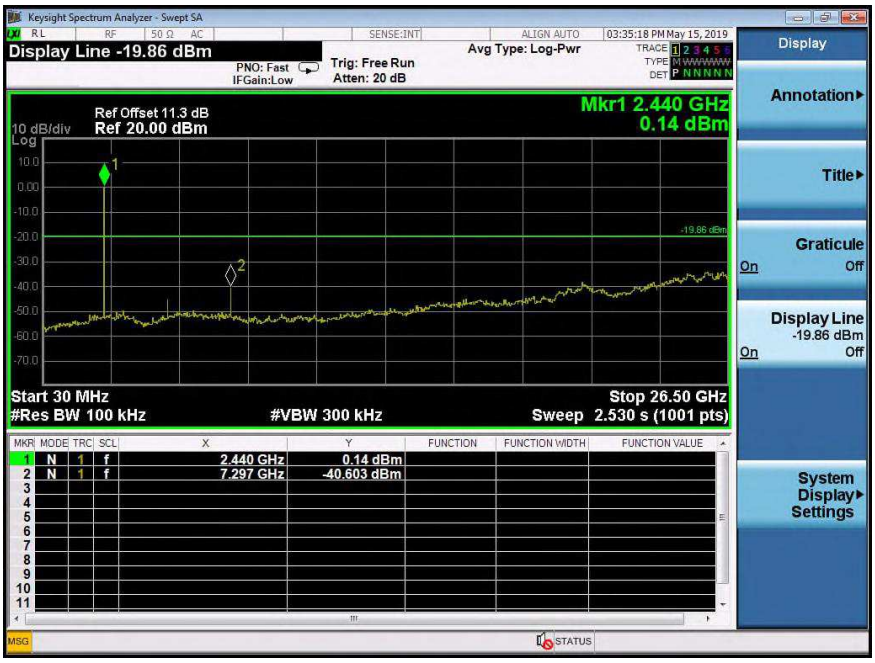


Test Plot 100kHz Conducted Emissions, LE 2M

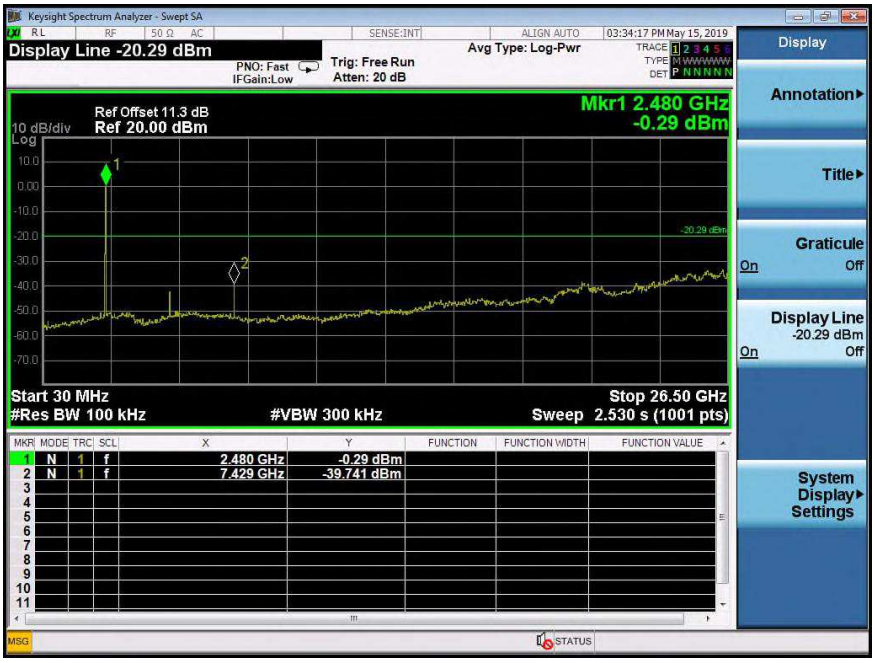
Low Channel



Middle Channel

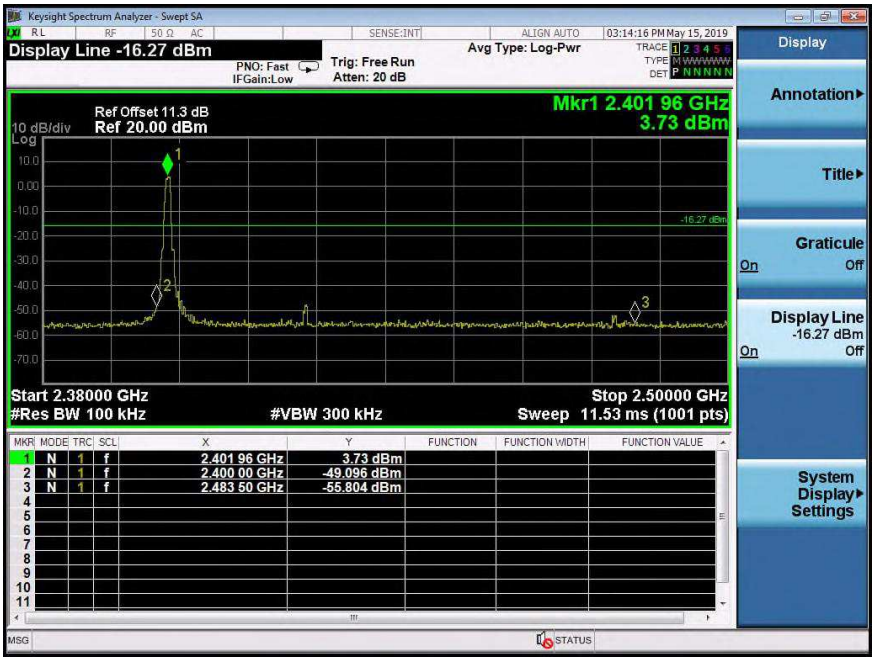


High Channel

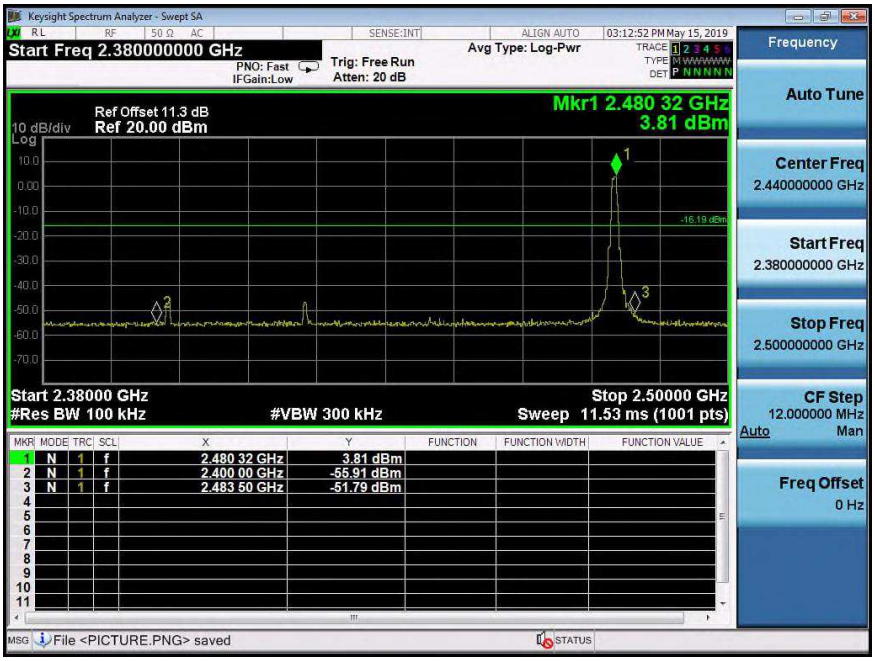


Test Plot 100kHz RBW of Band Edge, LE 1M

Low Channel

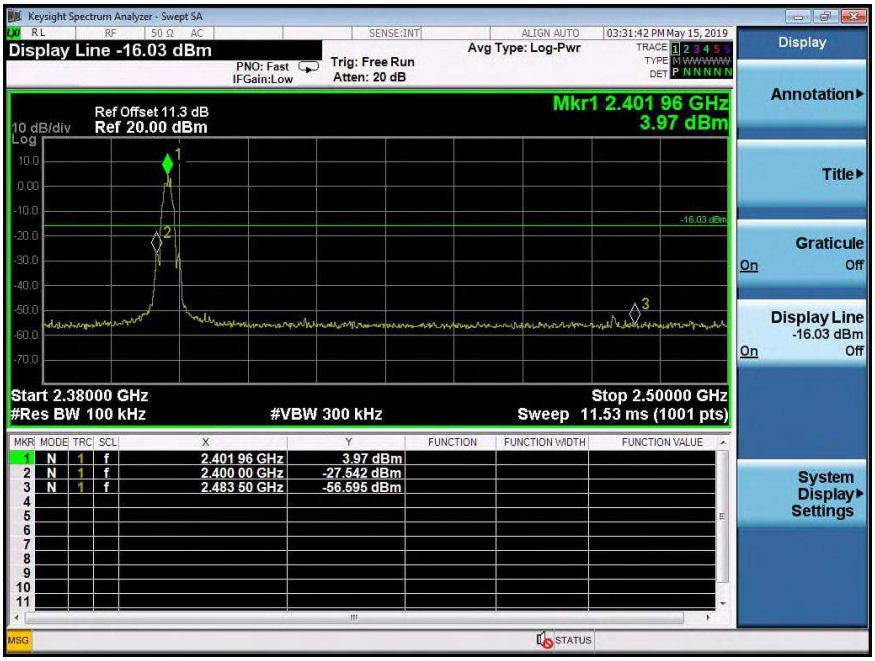


High Channel

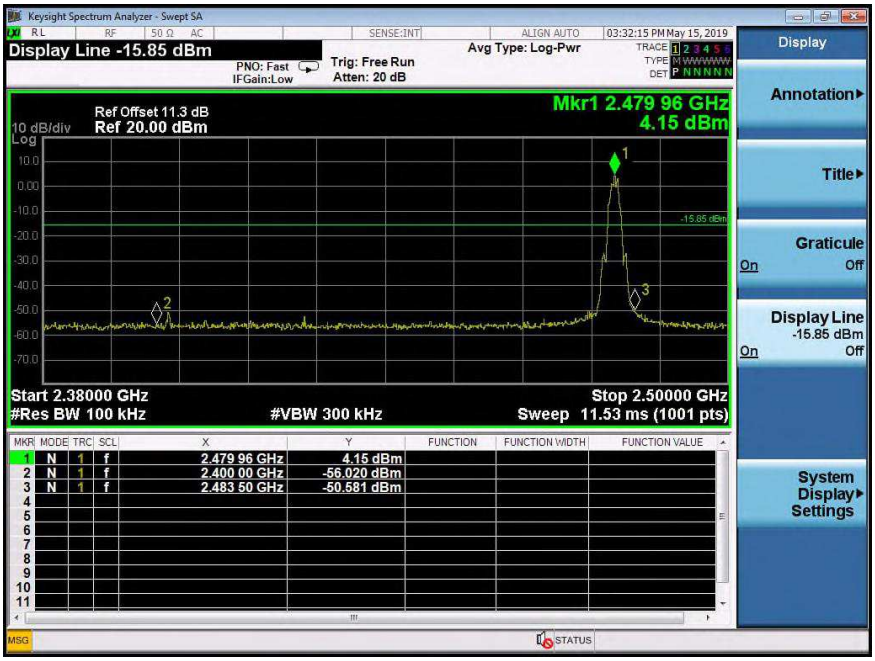


Test Plot 100kHz RBW of Band Edge, LE 2M

Low Channel



High Channel



5.1.6 Spurious Emission

RESULT: **Passed**

Test standard	:	FCC part 15.247(d), FCC 15.205, FCC 15.209, RSS-247 5.5 and RSS-Gen issue 5 LP0002(2018): 3.10.1, (5)
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 specified frequency bands must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen i5, 8.9 (Table 5 and 6).
Kind of test site	:	3m Semi-Anechoic Chamber

Test setup

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

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.

Factor (dB/m)=Antenna Factor(dB/m)+Cable loss (dB)
Level(dBuV/m)=Reading(dBuV)+ Factor(dB/m)

5.2 Mains Emissions

5.2.1 Mains Conducted Emissions

RESULT: **Passed**

Test standard	:	FCC Part 15.207 FCC Part 15.107 RSS-Gen i5 8.8
Limits	:	Mains Conducted emissions as defined in above test standards must comply with the mains conducted emission limits specified
Kind of test site	:	Shielded Room

Test setup

Test Channel	:	Middle
Operation mode	:	A

Remark: For details refer to Appendix D.

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
47CFR 1.1310
47CFR 2.1091
RSS-102 issue 5

FCC:
LE 1M:
Therefore the maximum output power of the transmitter is 2.67mW < 10mW(Distance: 5 mm), hence the EUT is excluded from SAR evaluation according to FCC KDB publication 447498 D01: Mobile Portable RF Exposure.

LE 2M:
Therefore the maximum output power of the transmitter is 2.72mW < 10mW(Distance: 5 mm), hence the EUT is excluded from SAR evaluation according to FCC KDB publication 447498 D01: Mobile Portable RF Exposure.

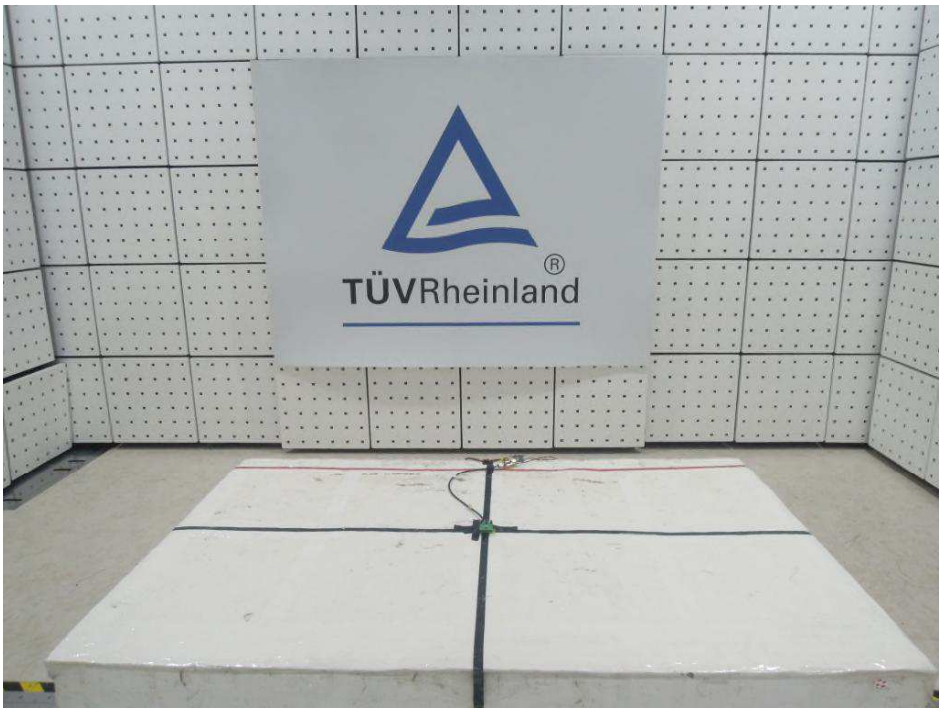
Canada:
LE 1M:
Maximum conducted peak power: 2.67 mW
Antenna Gain: -1.36 dbi
Maximum EIRP available 1.95 mW
Since maximum output power of the transmitter is 1.95mW <4mW (distance ≤5 mm), hence the EUT is excluded from SAR evaluation according to Table 1 in RSS-102, For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 of RSS-102 are multiplied by a factor of 2.5.

LE 2M:
Maximum conducted peak power: 2.72 mW
Antenna Gain: -1.36 dbi
Maximum EIRP available 1.99 mW
Since maximum output power of the transmitter is 1.99mW <4mW (distance ≤5 mm), hence the EUT is excluded from SAR evaluation according to Table 1 in RSS-102, For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 of RSS-102 are multiplied by a factor of 2.5.

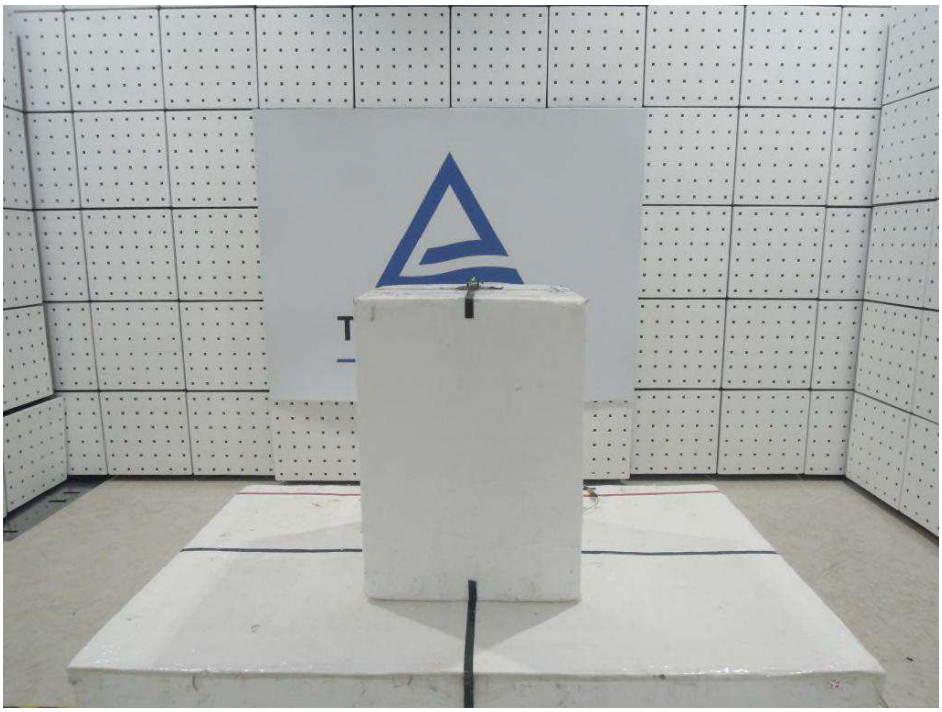
---End---

7. Photographs of the Test Set-Up

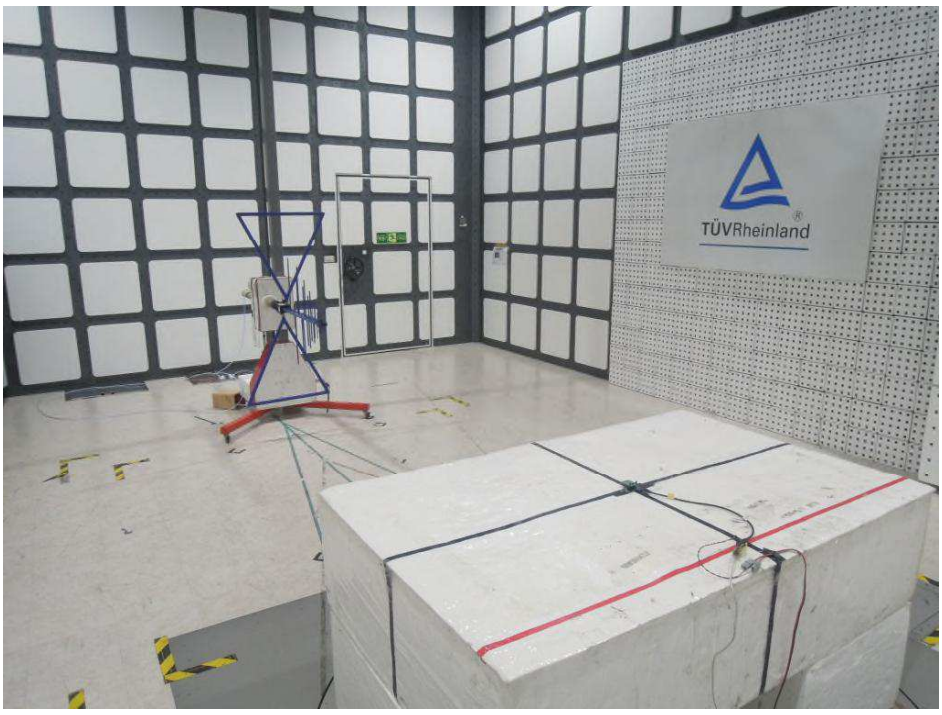
Photograph 1: Set-up for Spurious Emissions (Front View 1)



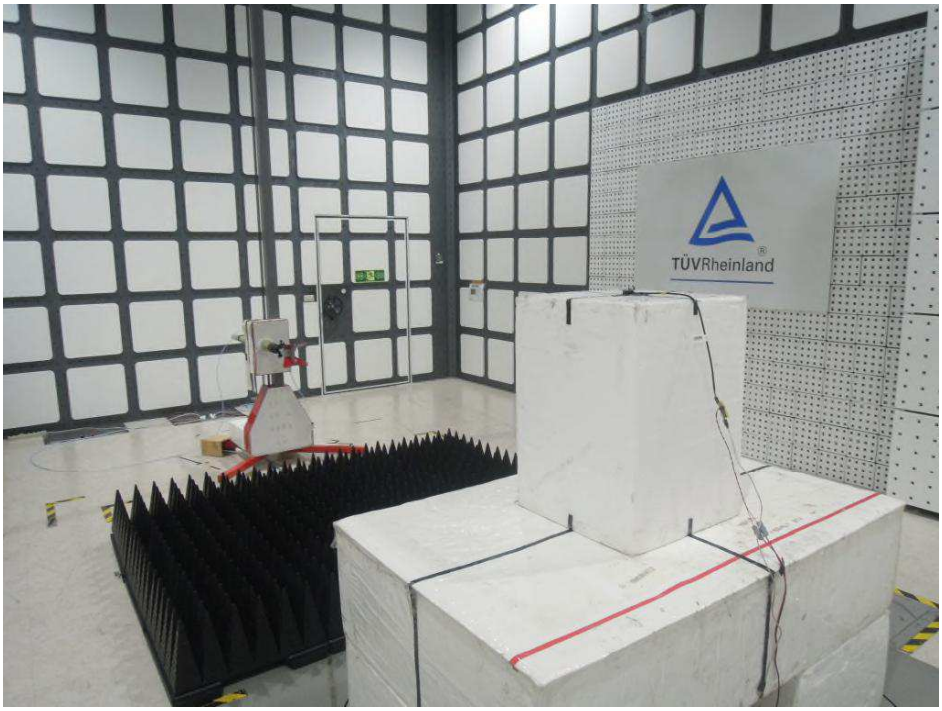
Photograph 2: Set-up for Spurious Emissions (Front View 2)



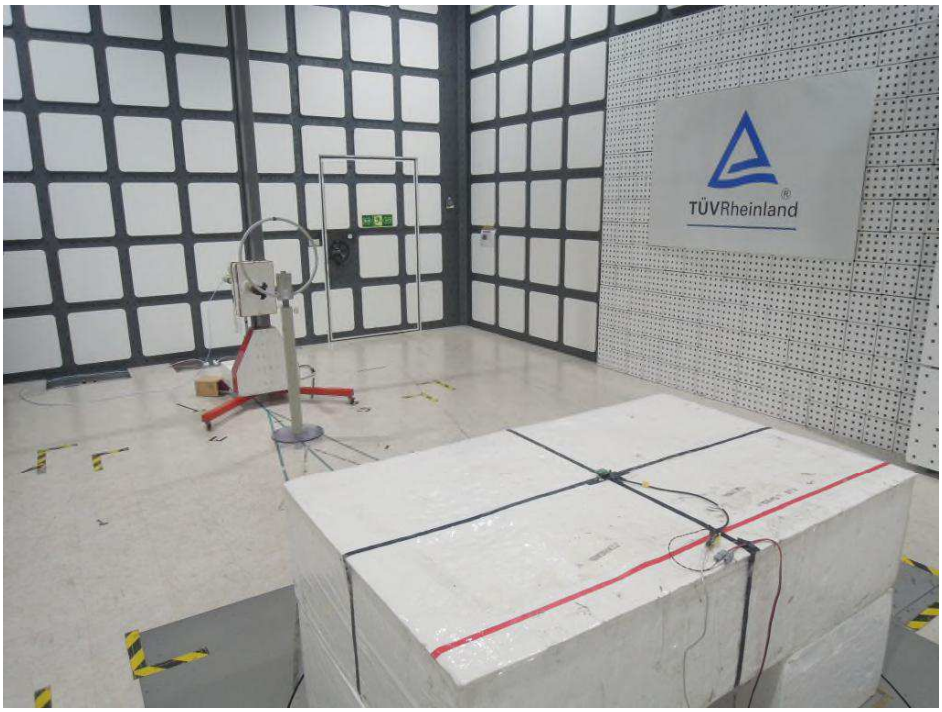
Photograph 3: Set-up for Spurious Emissions (Back View 1)



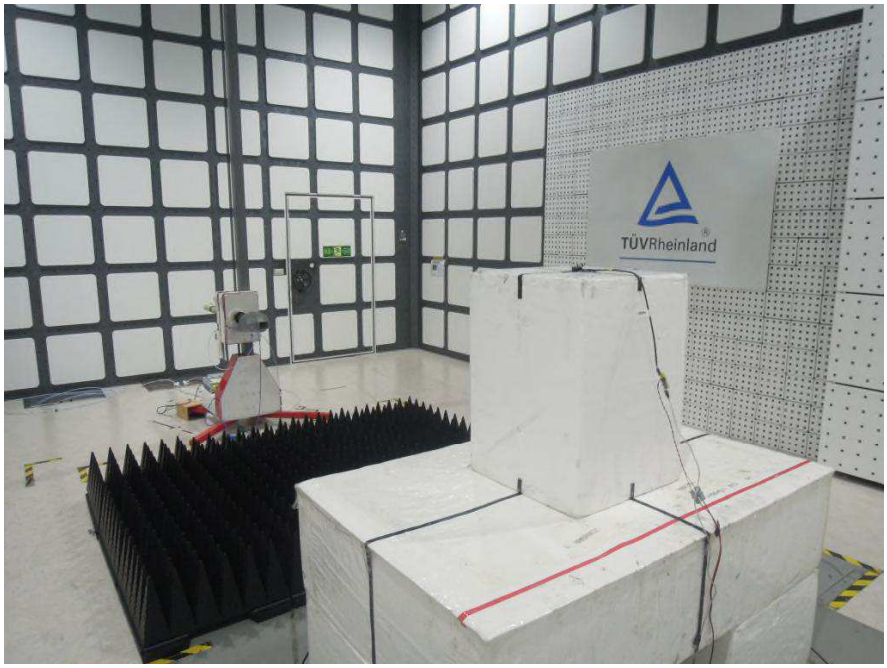
Photograph 4: Set-up for Spurious Emissions (Back View 2)



Photograph 5: Set-up for Spurious Emissions (Back View 3)

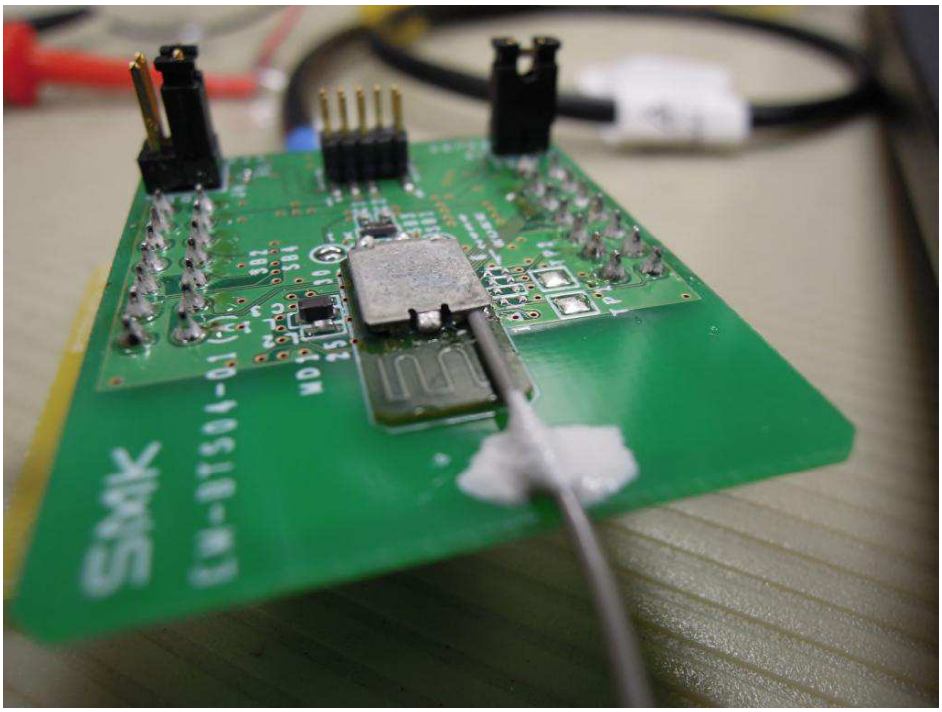


Photograph 6: Set-up for Spurious Emissions (Back View 4)

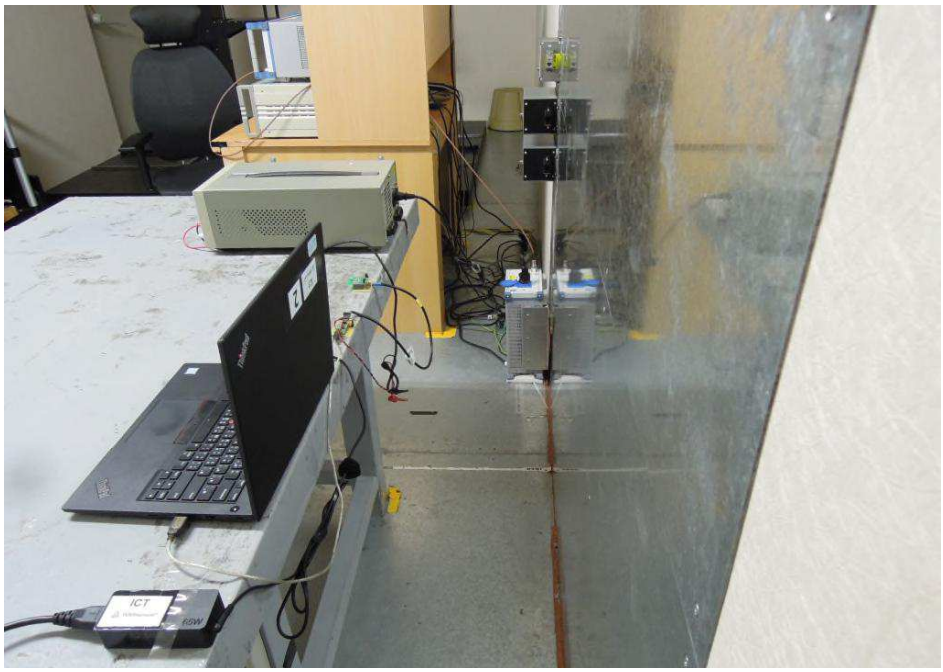


Photograph 7: Set-up for Conducted testing

Photograph 8: Set-up for Conducted testing



Photograph 9: Set-up for Mains Conducted testing (Back View)



Photograph 10: Set-up for Mains Conducted testing (Front View)

8. List of Tables

9. List of Photographs