FCC and ISEDC Test Report
Apple Inc, Model: A2304
In accordance with FCC 47 CFR Part 15C, ISEDC RSS-247 and ISEDC RSS-GEN

Prepared for: Apple Inc.
One Apple Park Way
Cupertino, California 95014
USA

FCC ID: BCGA2304 IC: 579C-A2304

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Document 75945250-11 Issue 01

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NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Matthew Russell	RF Team Leader	Authorised Signatory	22 November 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, ISEDC RSS-247 and ISEDC RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Mehadi Choudhury	22 November 2019	
Testing	Cristian Onaca	22 November 2019	
Testing	George Porter	22 November 2019	
Testing	Malik Mohammad	22 November 2019	
Testing	Jay Balendrarajah	22 November 2019	
Testing	Ahmad Javid	22 November 2019	
Testing	Faisal Malyar	22 November 2019	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISEDC Accreditation
12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2018, ISEDC RSS-247: Issue 2 (2017-02) and ISEDC RSS-GEN: Issue 5 A1 (2019-03) for the tests detailed in section 1.3.

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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	22 November 2019

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A2304
Serial Number(s)	C02Z1001N5VL and C02Z1006N5VL
Hardware Version(s)	REV 1.0
Software Version(s)	19A556 & 19A507
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2018 ISEDC RSS-247: Issue 2 (2017-02) ISEDC RSS-GEN: Issue 5 A1 (2019-03)
Order Number Date	0540176069 25-February-2019
Date of Receipt of EUT	21-October-2019
Start of Test	21-October-2019
Finish of Test	24-October-2019
Name of Engineer(s)	Mehadi Choudhury, Cristian Onaca, George Porter Malik Mohammad, Jay Balendrarajah, Ahmad Javid and Faisal Malyar
Related Document(s)	ANSI C63.10 (2013)

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISEDC RSS-247 and ISEDC RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
Configuration and Mode: Bluetooth Low Energy - LE1M						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.3	15.205 N/A and 8.10	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.4	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.5	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.6	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
Configuration and Mode: Bluetooth Low Energy - LE2M						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.3	15.205 N/A and 8.10	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.5	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.6	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)

Table 2

1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a rack mounted computer, with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5 GHz bands.

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: A2304: Serial Number: C02Z1001N5VL			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2304: Serial Number: C02Z1006N5VL			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.7 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Bluetooth Low Energy - LE1M		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Authorised Band Edges	Cristian Onaca and George Porter	UKAS
Restricted Band Edges	Cristian Onaca and George Porter	UKAS
Spurious Radiated Emissions	Cristian Onaca, Malik Mohammad, Jay Balendrarajah, Ahmad Javid and Faisal Malyar	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Configuration and Mode: Bluetooth Low Energy - LE2M		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Authorised Band Edges	Cristian Onaca and George Porter	UKAS
Restricted Band Edges	Cristian Onaca and George Porter	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISEDC RSS-247, Clause 5.4
ISEDC RSS-GEN, Clause 6.12

2.1.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1001N5VL - Modification State 0

2.1.3 Date of Test

24-October-2019

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

2.1.5 Environmental Conditions

Ambient Temperature	23.2 °C
Relative Humidity	49.2 %

2.1.6 Test Results

Bluetooth Low Energy - LE1M

GFSK

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	4.27	2.67
2440	4.39	2.75
2480	4.17	2.61

Table 5 - Maximum Conducted Output Power Results

Bluetooth Low Energy - LE2M

GFSK

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	4.50	2.82
2440	4.35	2.72
2480	4.45	2.79

Table 6 - Maximum Conducted Output Power Results

FCC 47 CFR Part 15, Limit Clause 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.

ISEDC RSS-247, Limit Clause 5.4 (d)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	75 Mk3	455	12	11-Oct-2020
Attenuator (20 dB, 2 W)	Pasternack	PE7004-20	489	12	24-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (40 GHz)	Rosenberger	LU1-001-2000	5024	-	O/P Mon
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon

Table 7

O/P Mon – Output Monitored using calibrated equipment

2.2 Authorised Band Edges

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
ISEDC RSS-247, Clause 5.5

2.2.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1006N5VL - Modification State 0

2.2.3 Date of Test

12-August-2019 to 06-November-2019

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.2.5 Environmental Conditions

Ambient Temperature	15.8 - 27.0 °C
Relative Humidity	35.0 - 40.3 %

2.2.6 Test Results

Bluetooth Low Energy - LE1M

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	DH1	2402	2400.0	-49.90

Table 8

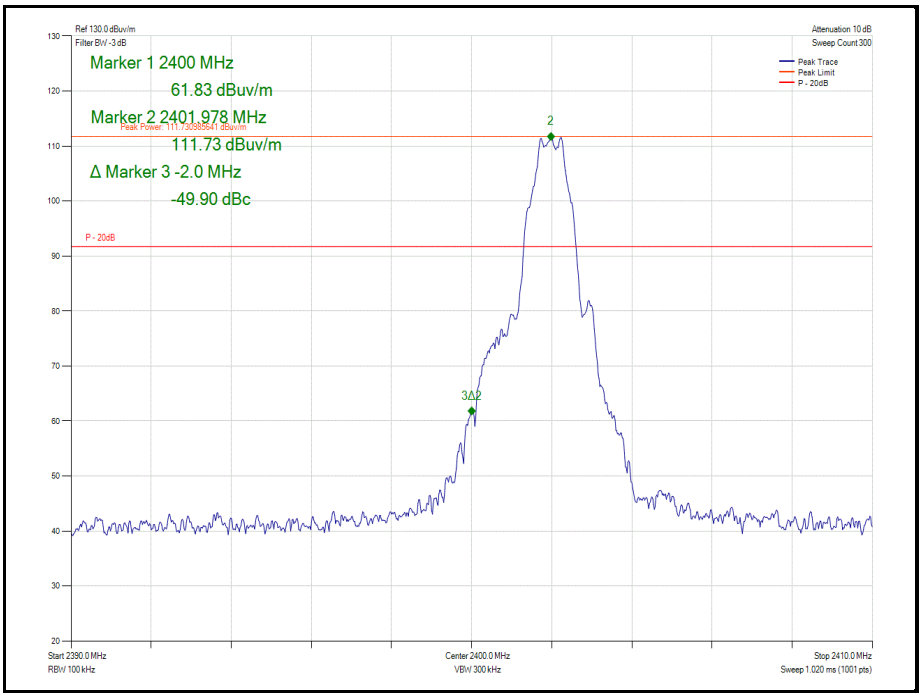


Figure 1 - GFSK- 2402 MHz – Band Edge Frequency 2400.0 MHz

Bluetooth Low Energy – LE2M

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	DH1	2402	2400.0	-35.08

Table 9

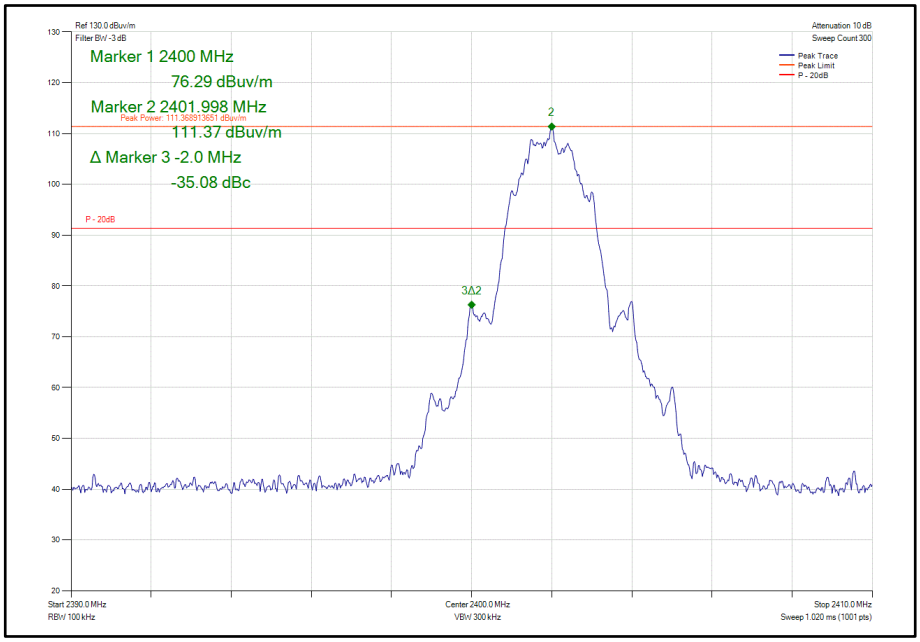


Figure 2 - GFSK - 2402 MHz - Band Edge Frequency 2400.0 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.2.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5 and RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	15-Nov-2019
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	11-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	05-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	N/A - Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020

Table 10

O/P Mon – Output Monitored using calibrated equipment
TU – Traceability Unscheduled

2.3 Restricted Band Edges

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
ISEDC RSS-GEN, Clause 8.10

2.3.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1006N5VL - Modification State 0

2.3.3 Date of Test

12-August-2019 to 06-November-2019

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.5. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.3.5 Environmental Conditions

Ambient Temperature	15.8 - 27.0 °C
Relative Humidity	35.0 - 40.3 %

2.3.6 Test Results

Bluetooth Low Energy - LE1M

Modulation	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
GFSK	2402	2390	53.98	40.92
GFSK	2480	2483.5	61.70	43.02

Table 11

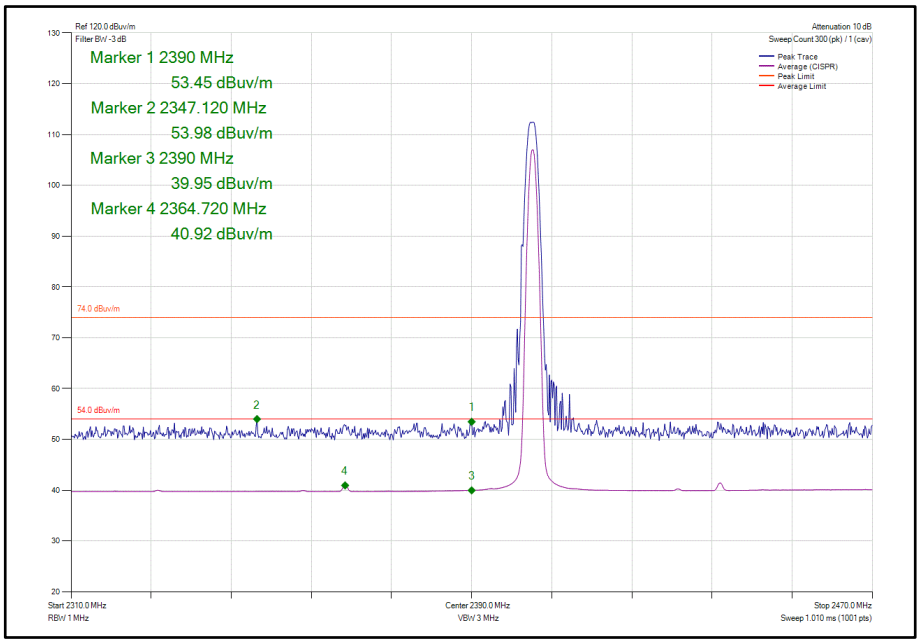


Figure 3 – GFSK - 2402 MHz - Band Edge Frequency 2390.0 MHz

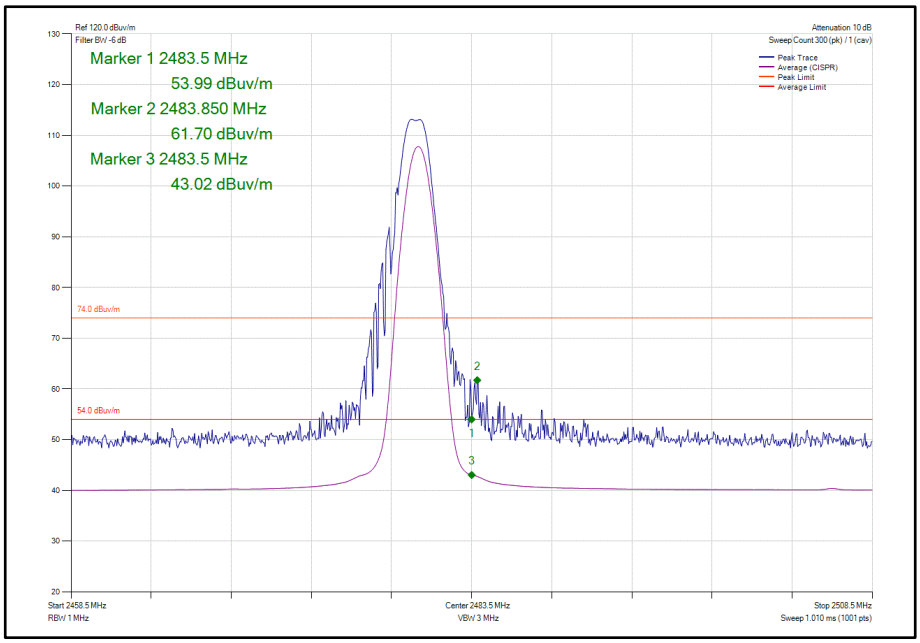


Figure 4 – GFSK - 2480 MHz - Band Edge Frequency 2483.5 MHz

Bluetooth Low Energy – LE2M

Modulation	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
GFSK	2402	2390	54.63	40.20
GFSK	2480	2483.5	60.19	47.25

Table 12 - Restricted Band Edge Results

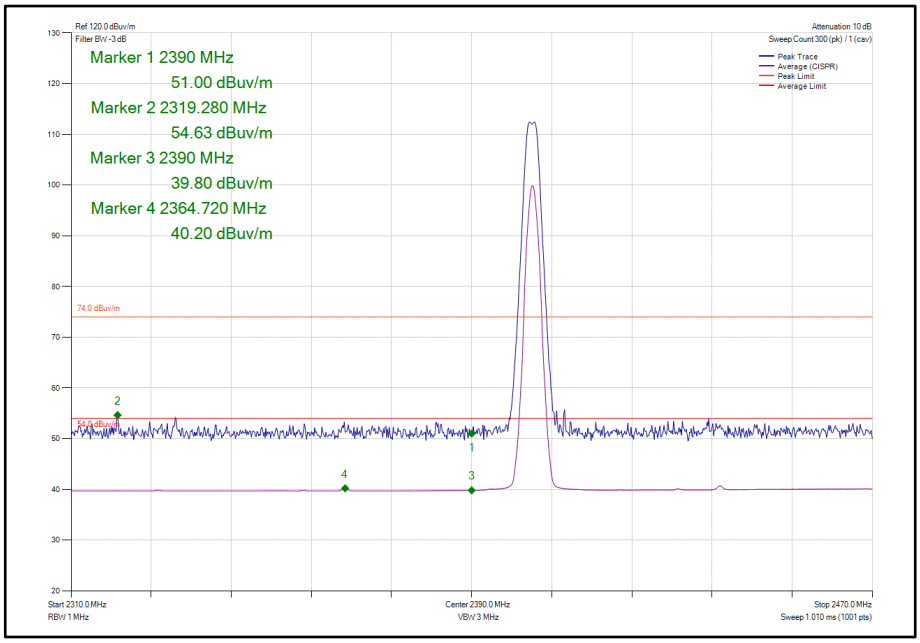


Figure 5 – GFSK - 2402 MHz - Band Edge Frequency 2390.0 MHz

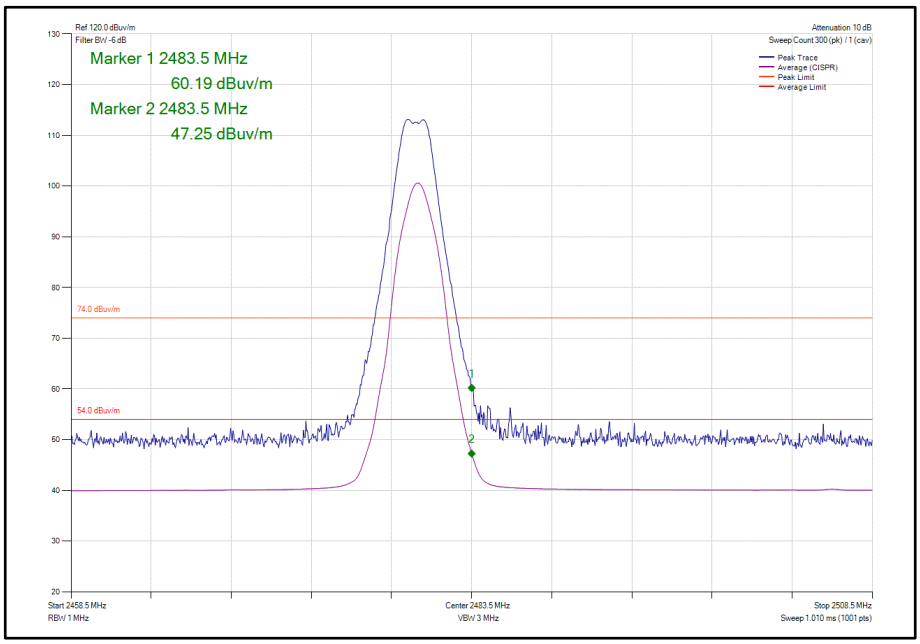


Figure 6 – GFSK - 2480 MHz - Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 13

ISEDC RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (µV/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 14

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.3.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5 and RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	15-Nov-2019
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	11-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	05-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020

Table 15

O/P Mon – Output Monitored using calibrated equipment
TU – Traceability Unscheduled

2.4 Spurious Radiated Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
ISEDC RSS-247, Clause 5.5
ISEDC RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1006N5VL - Modification State 0

2.4.3 Date of Test

18-October-2019 to 29-October-2019

2.4.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

The EUT was placed on the non-conducting platform in a manner typical of a normal installation.

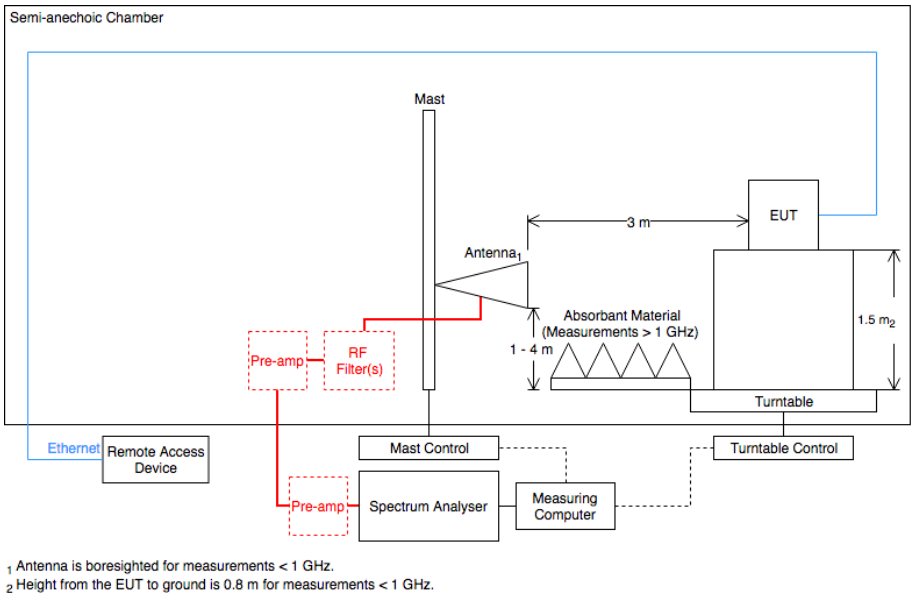
Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4. Multiple connectors of the same type and additional interconnecting cables were connected and pre-scans performed to determine whether the level of the emissions were increased by >2 dB.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

Measurements from 30 MHz to 1 GHz were only made on the middle channel.



1 Antenna is boresighted for measurements < 1 GHz.
2 Height from the EUT to ground is 0.8 m for measurements < 1 GHz.

Figure 7 - Radiated Emissions Test Setup Diagram

2.4.5 Environmental Conditions

Ambient Temperature	15.8 - 27.0 °C
Relative Humidity	35.0 - 40.3 %

2.4.6 Test Results

Bluetooth Low Energy - LE1M

Frequency (MHz)	QP Level (dBµV/m)	QP Limit (dBµV/m)	QP Margin (dB)	Angle (Deg)	Height(cm)	Polarisation
37.6	31.9	40	8.1	218	190	Vertical
37.7	19.3	40	20.7	182	242	Horizontal
284.6	33.5	46	32.5	289	107	Horizontal

Table 16 – 2440 MHz, 30 MHz to 1 GHz Radiated Emissions Results

All other emissions that were detected are within the unrestricted bands and are therefore at least 20 dB from the applicable test limit.

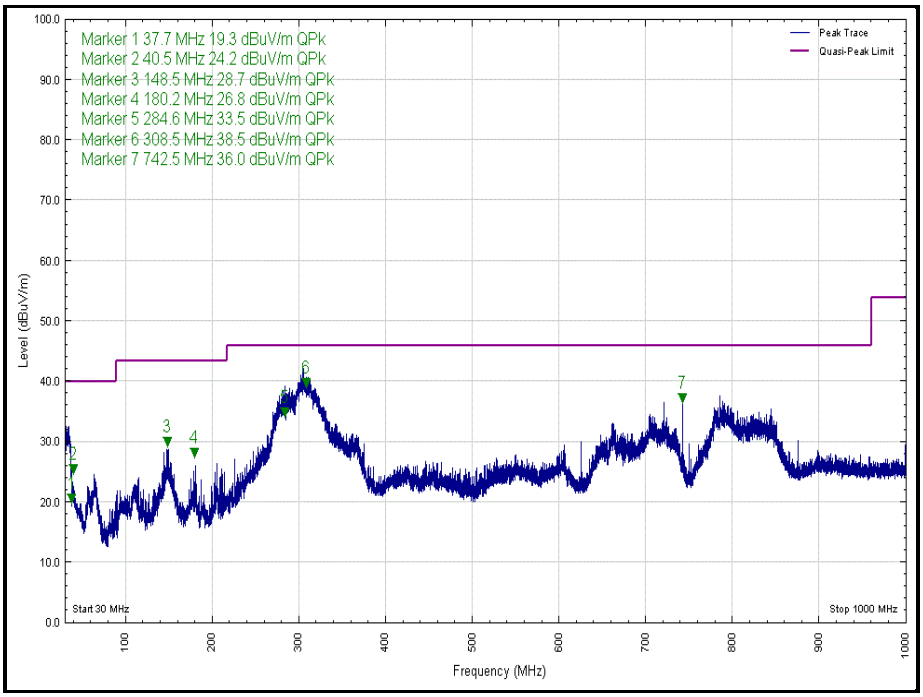


Figure 8 - 2440 MHz, 30 MHz to 1 GHz, Polarisation: Horizontal

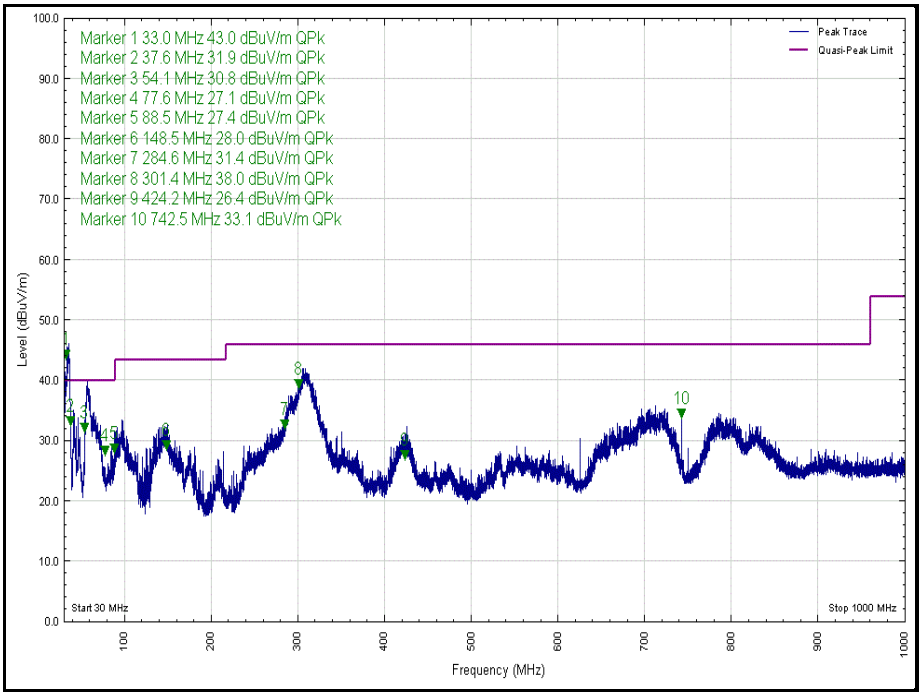


Figure 9 - 2440 MHz, 30 MHz to 1 GHz, Polarisation: Vertical

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
2.3271	-	34.8	74	54	-	-19.2
2.3646	-	40.2	74	54	-	-13.8
20.4159	55.2		84	64	-28.8	-
20.4895	55.8	-	84	64	-28.2	-
23.8303	61.0	-	84	64	-23.0	-
23.8937	62.8		84	64	-21.2	-
23.9622	-	40.1	84	64	-	-23.9
23.9699	-	41.6	84	64	-	-22.4

Table 17 - 2402 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

All other emissions that were detected are within the unrestricted bands and are therefore at least 20 dB from the applicable test limit.

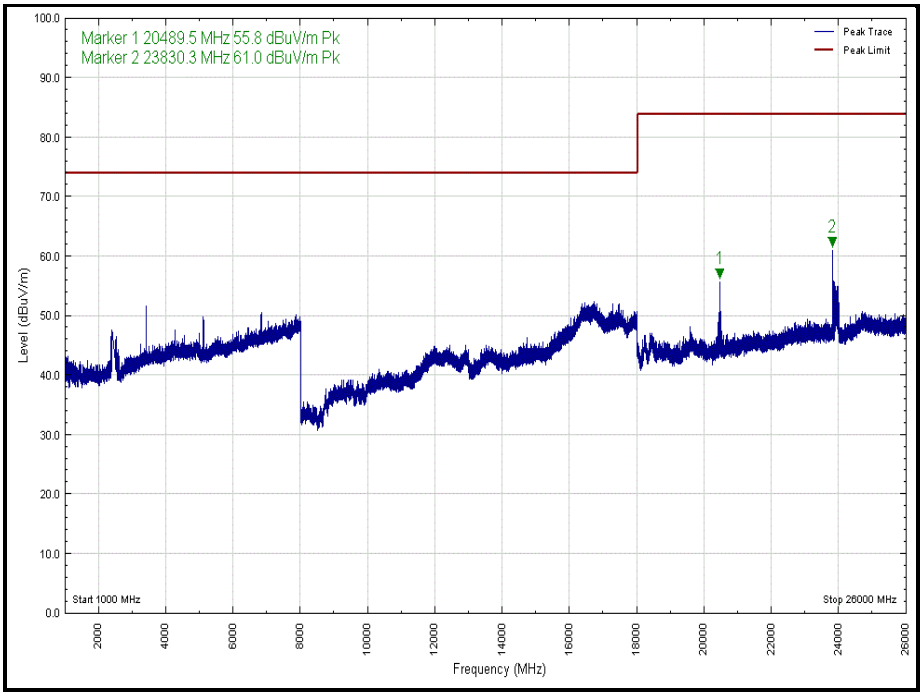


Figure 10 - 2402 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Peak)

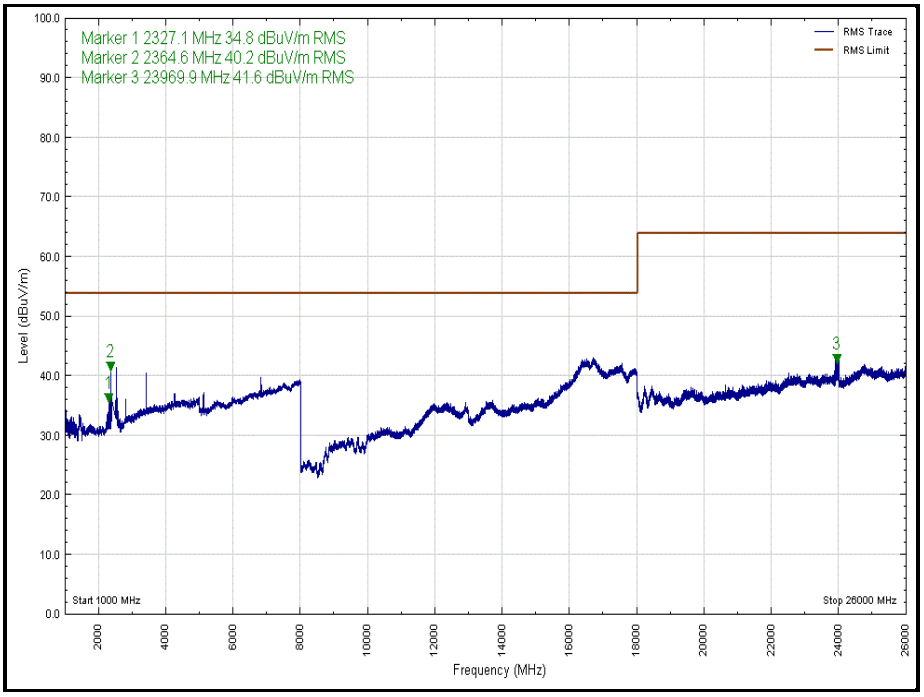


Figure 11 - 2402 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Average)

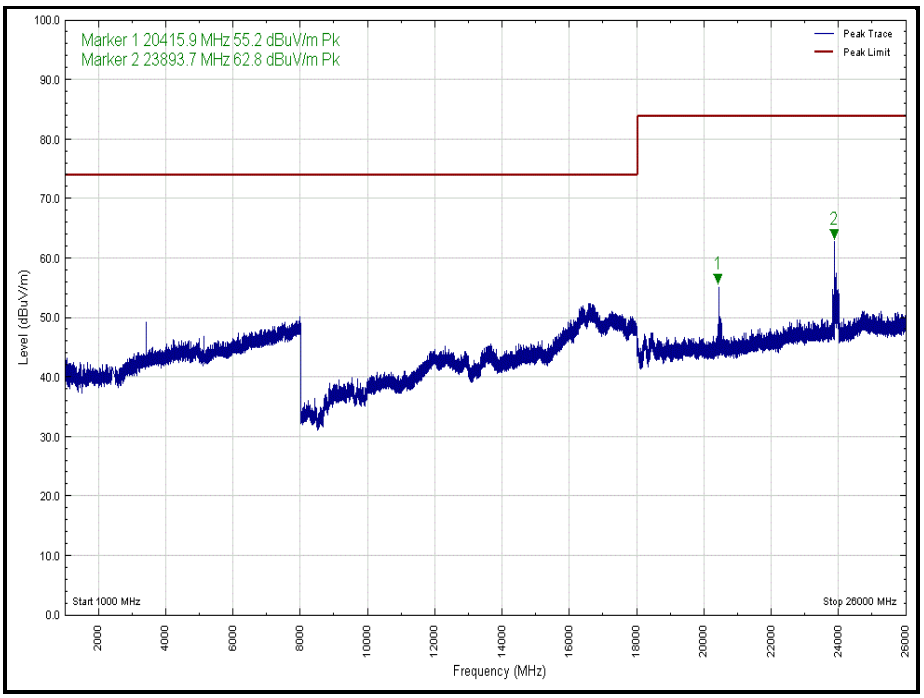


Figure 12 - 2402 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Peak)

Figure 13 - 2402 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Average)

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
2.3652	-	36.3	74	54	-	-17.7
3.4063	52.9	-	74	54	-21.1	-
7.3194	-	41.9	74	54	-	-12.1
20.4451	55.1	-	84	64	-28.9	-
20.5126	58.5	-	84	64	-25.5	-
23.8409	60.9	-	84	64	-23.1	-
23.8702	63.4	-	84	64	-20.6	-
23.8854	-	40.3	84	64	-	-23.7

Table 18 - 2440 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

All other emissions that were detected are within the unrestricted bands and are therefore at least 20 dB from the applicable test limit.

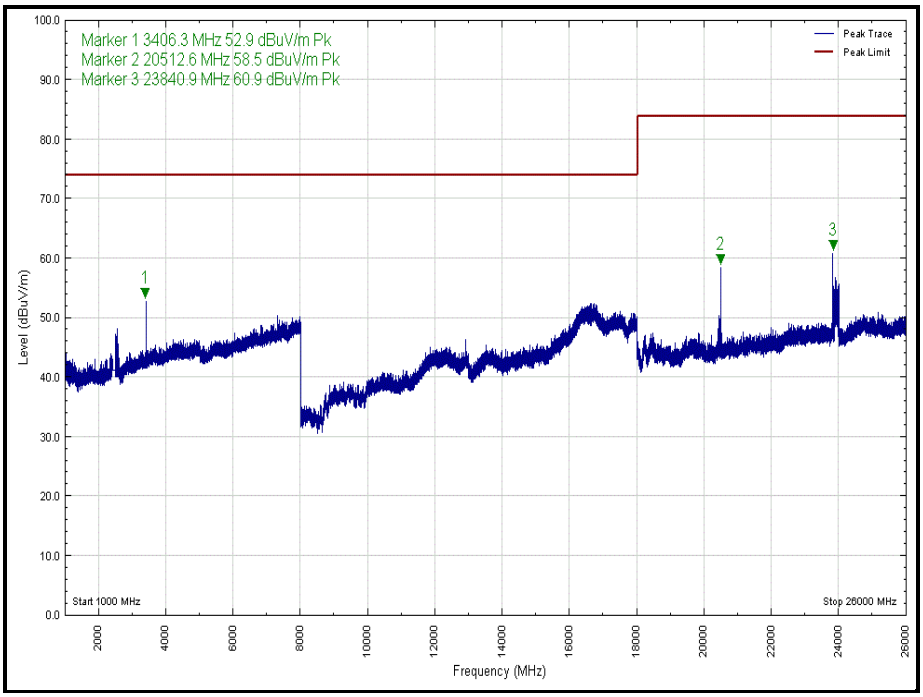


Figure 14 - 2440 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Peak)

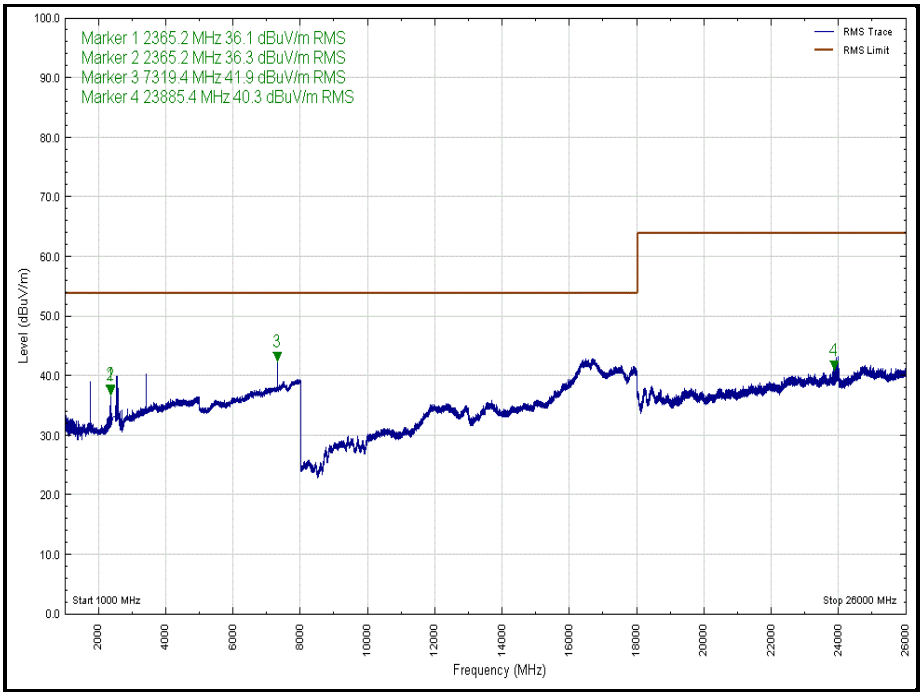


Figure 15 - 2440 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Average)

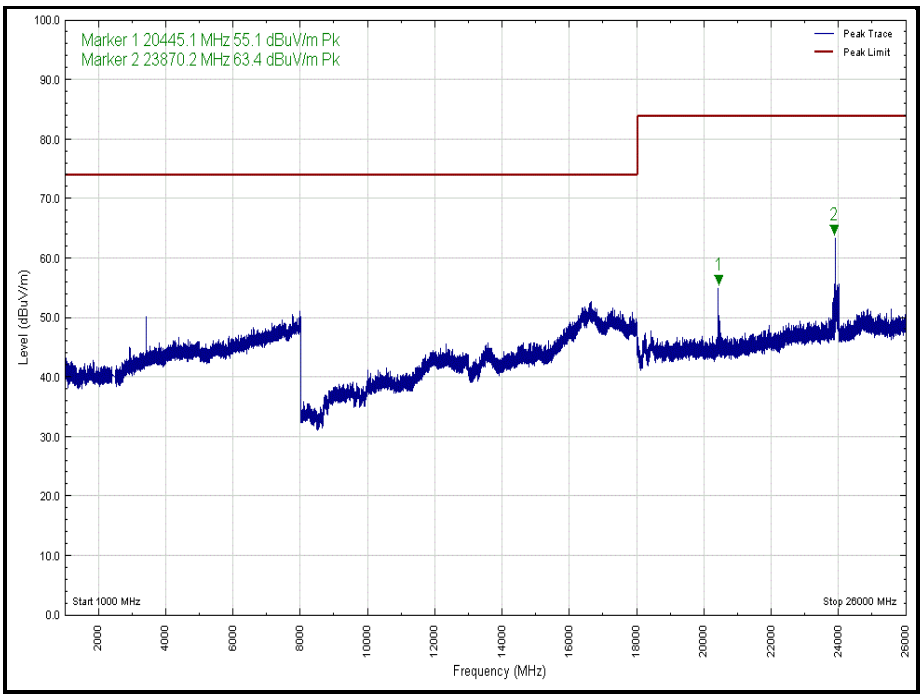


Figure 16 - 2440 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Peak)

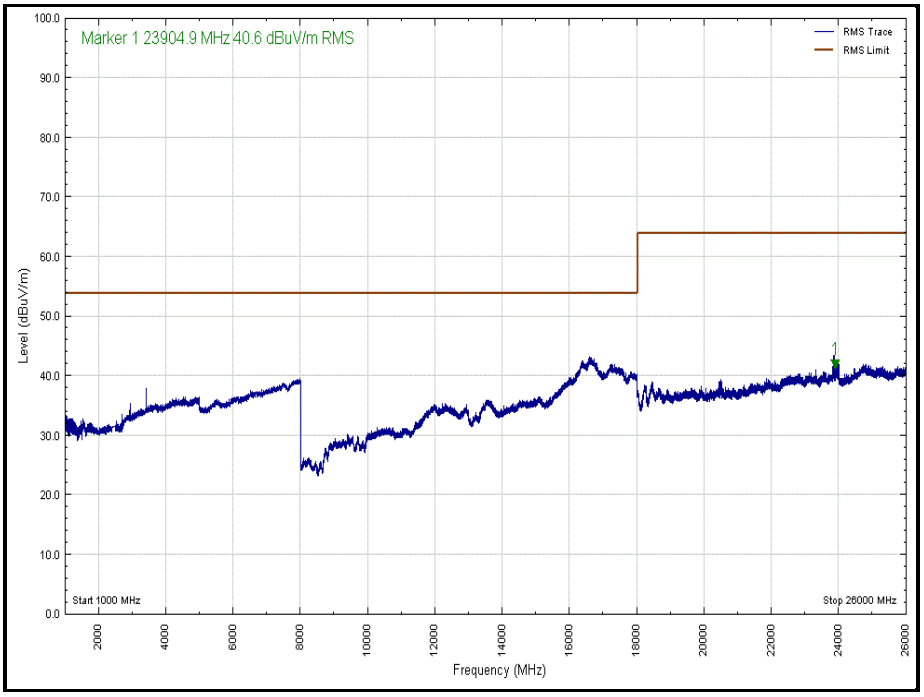


Figure 17 - 2440 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Average)

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
2.3651	-	36.9	74	54	-	-17.1
20.4889	55.4	-	84	64	-28.6	-
20.5020	54.6	-	84	64	-29.4	-
23.8744	62.7	-	84	64	-21.3	-
23.8884	-	39.7	84	64	-	-24.3
23.9299	71.1	-	84	64	-12.9	-
23.9625	-	40.3	84	64	-	-23.7

Table 19 - 2480 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

All other emissions that were detected are within the unrestricted bands and are therefore at least 20 dB from the applicable test limit.

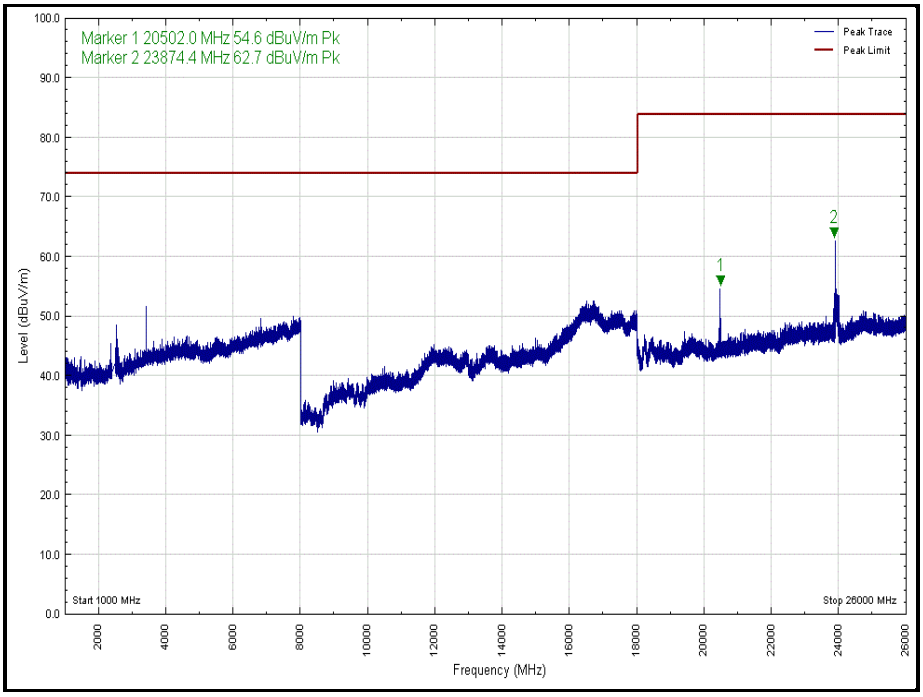


Figure 18 - 2480 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Peak)

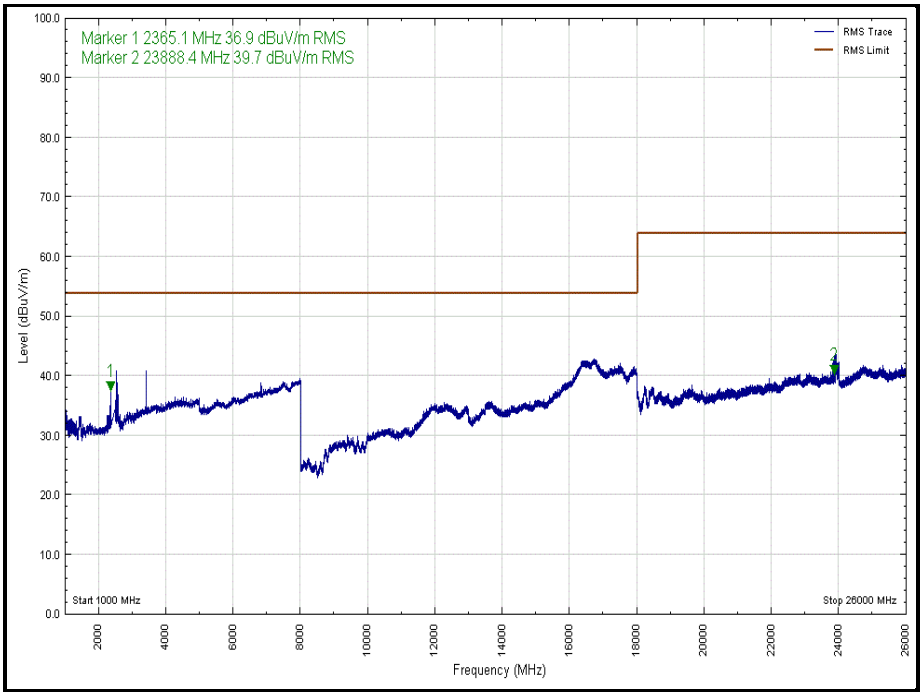


Figure 19 - 2480 MHz - 1 GHz to 26 GHz, Polarisation: Horizontal (Average)

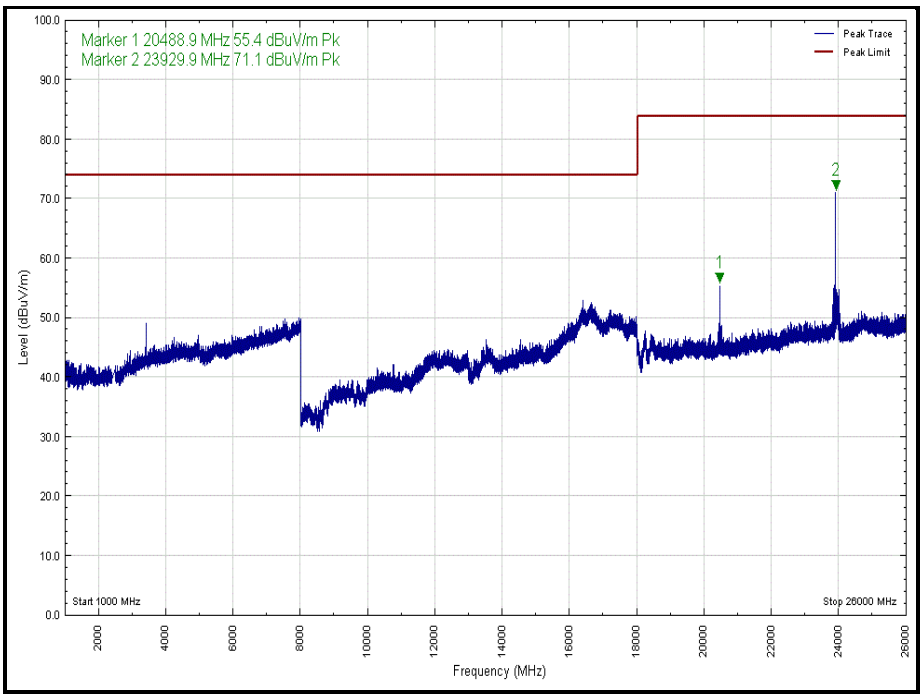


Figure 20 - 2480 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Peak)

Figure 21 - 2480 MHz - 1 GHz to 26 GHz, Polarisation: Vertical (Average)

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

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)

ISEDC RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

2.4.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5 and RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	15-Nov-2019
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
High Pass Filter (4GHz)	K&L Microwave	11SH10-4000/X18000-0/0	4599	12	05-Sep-2020
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	05-Mar-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
8 - 18 GHz pre amp	Wright Technologies	PS06-0061	4971	12	07-Dec-2019
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5066	12	01-Oct-2020
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5068	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	01-Oct-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	11-Nov-2019

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	06-Oct-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	05-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	11-Mar-2020
3 GHz High pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	5219	12	15-Feb-2020

Table 20

Tu – Traceability Unscheduled

2.5 Power Spectral Density

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
ISEDC RSS-247, Clause 5.2
ISEDC RSS-GEN, Clause 6.12

2.5.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1001N5VL - Modification State 0

2.5.3 Date of Test

23-October-2019

2.5.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.10.2.

2.5.5 Environmental Conditions

Ambient Temperature	25.0 °C
Relative Humidity	35.5 %

2.5.6 Test Results

Bluetooth Low Energy - LE1M

Frequency (MHz)	Power Spectral Density (dBm/RBW)	RBW (kHz)
2402	3.04	51
2440	3.40	51
2480	3.05	51

Table 21 - Power Spectral Density

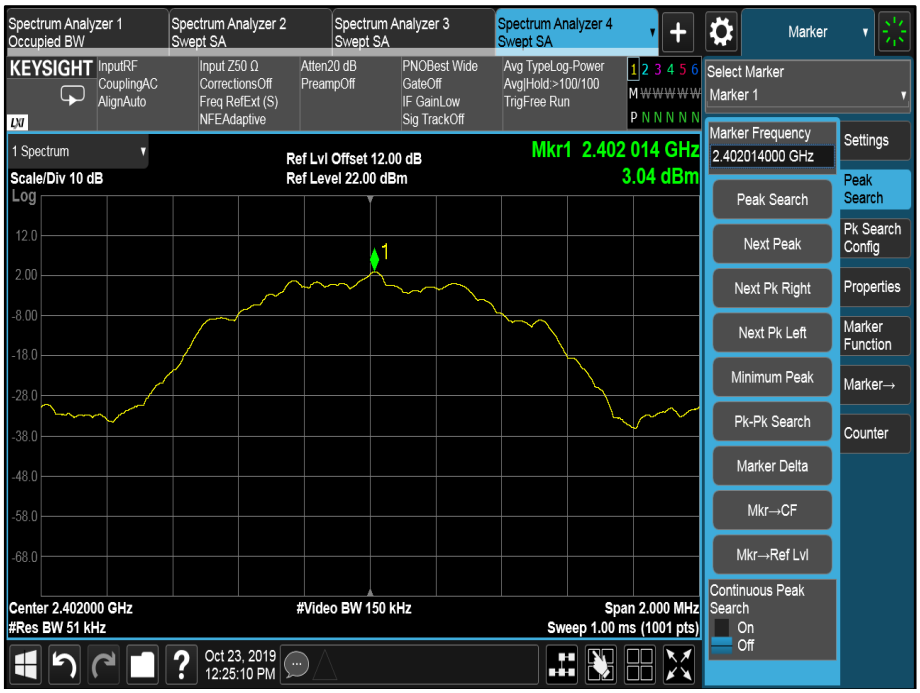


Figure 22 - 2402 MHz, Power Spectral Density

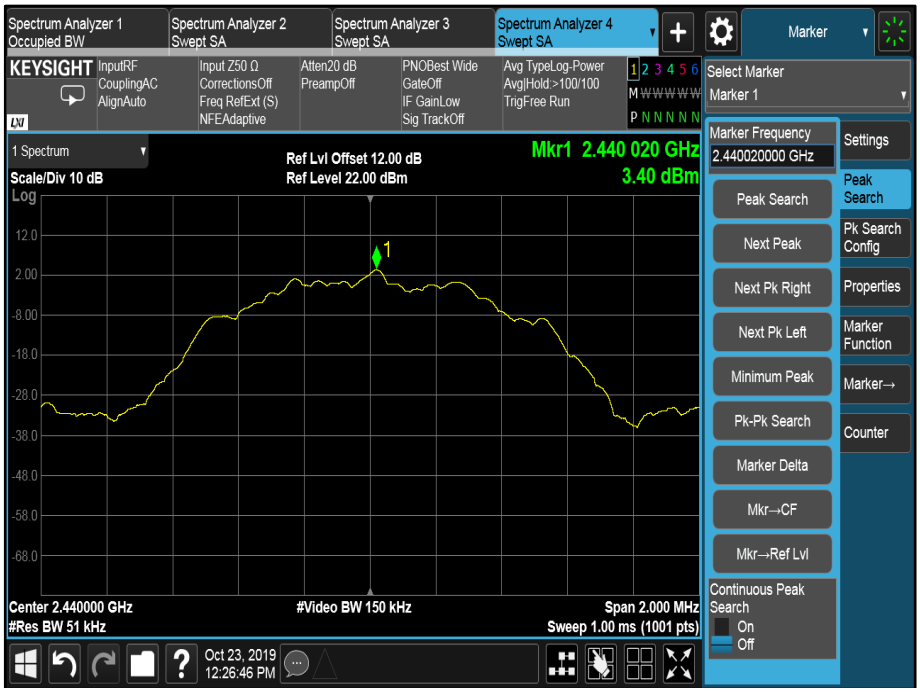


Figure 23 - 2440 MHz, Power Spectral Density

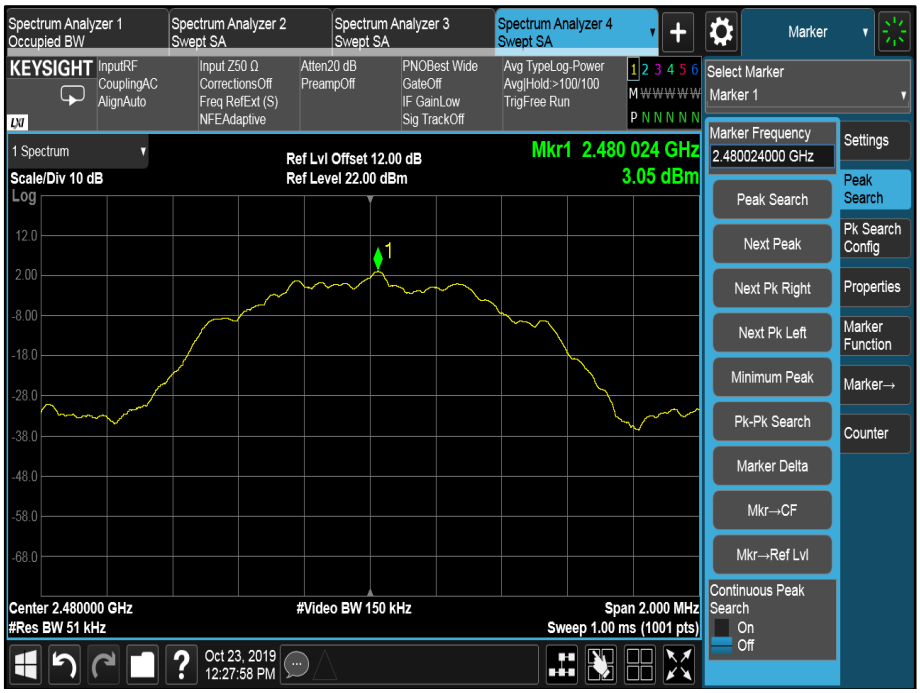


Figure 24 - 2480 MHz, Power Spectral Density

Bluetooth Low Energy - LE2M

Frequency (MHz)	Power Spectral Density (dBm/RBW)	RBW (kHz)
2402	1.17	51
2440	1.35	51
2480	1.01	51

Table 22 - Power Spectral Density

Figure 25 - 2402 MHz, Power Spectral Density

Figure 26 - 2440 MHz, Power Spectral Density

Figure 27 - 2480 MHz, Power Spectral Density

FCC 47 CFR Part 15, Limit Clause 15.247 (e)

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.

ISEDC RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	75 Mk3	455	12	11-Oct-2020
Attenuator (20 dB, 2 W)	Pasternack	PE7004-20	489	12	24-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (40 GHz)	Rosenberger	LU1-001-2000	5024	-	O/P Mon
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon

Table 23

O/P Mon – Output Monitored using calibrated equipment

2.6 Emission Bandwidth

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
ISEDC RSS-247, Clause 5.2
ISEDC RSS-GEN, Clause 6.7

2.6.2 Equipment Under Test and Modification State

A2304, S/N: C02Z1001N5VL - Modification State 0

2.6.3 Date of Test

23-October-2019

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2.

2.6.5 Environmental Conditions

Ambient Temperature	25.0 °C
Relative Humidity	35.5 %

2.6.6 Test Results

Bluetooth Low Energy - LE1M

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
2402	714.9	1079.8
2440	722.4	1060.9
2480	719.2	1083.6

Table 24

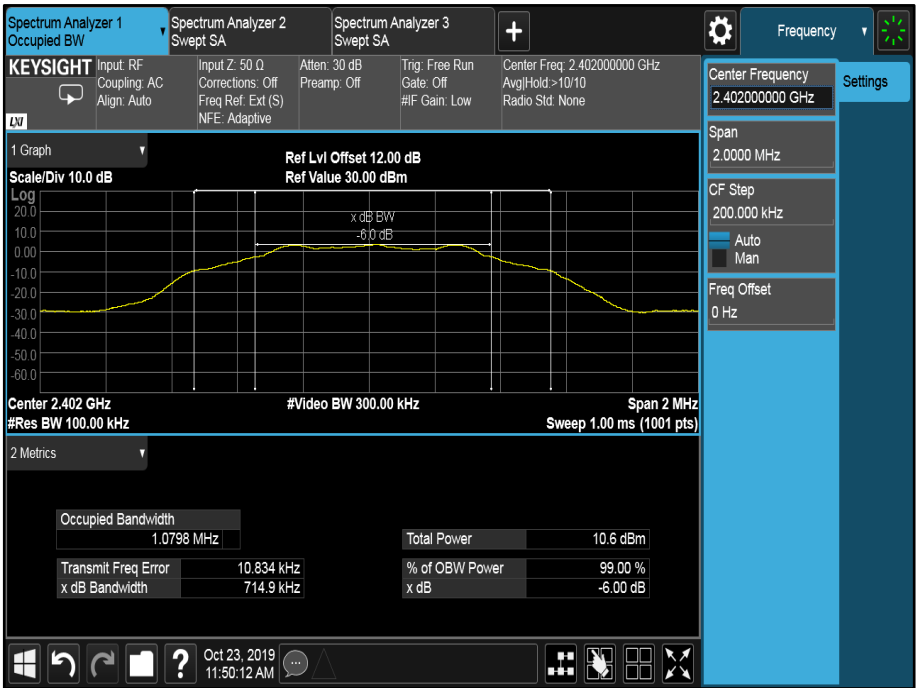


Figure 28 - 2402 MHz – Emission Bandwidth

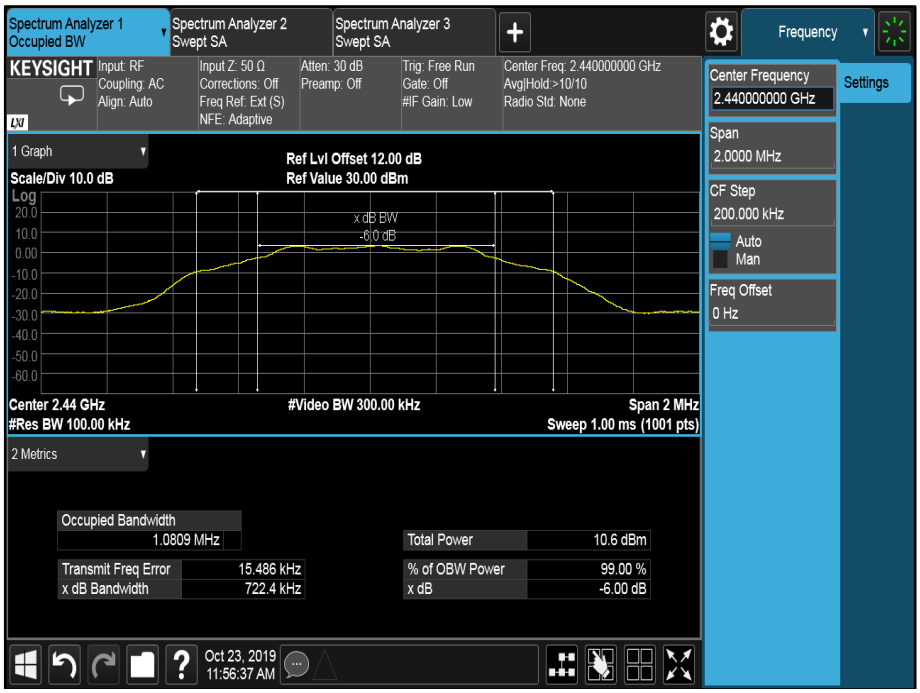


Figure 29 - 2440 MHz – Emission Bandwidth

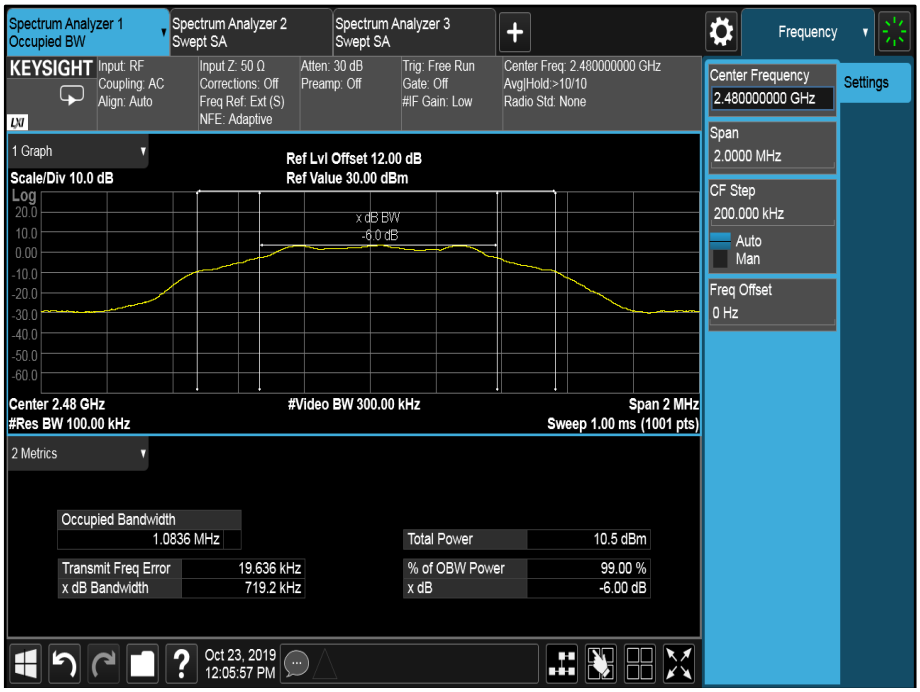


Figure 30 - 2480 MHz – Emission Bandwidth

Bluetooth Low Energy - LE2M

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
2402	1128	2051.7
2440	1124	2049.0
2480	1124	2048.0

Table 25

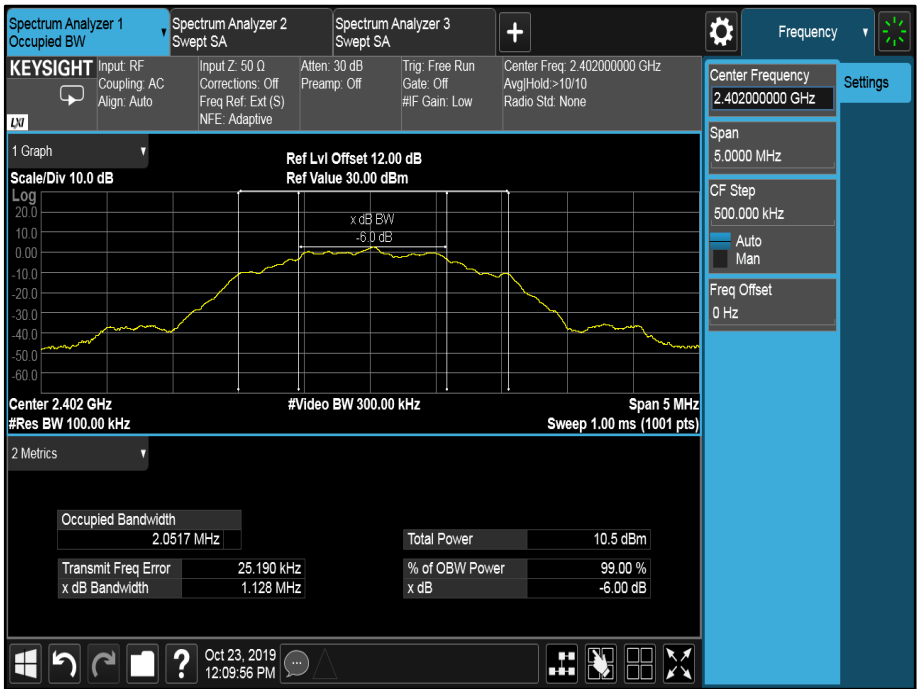


Figure 31 - 2402 MHz – Emission Bandwidth

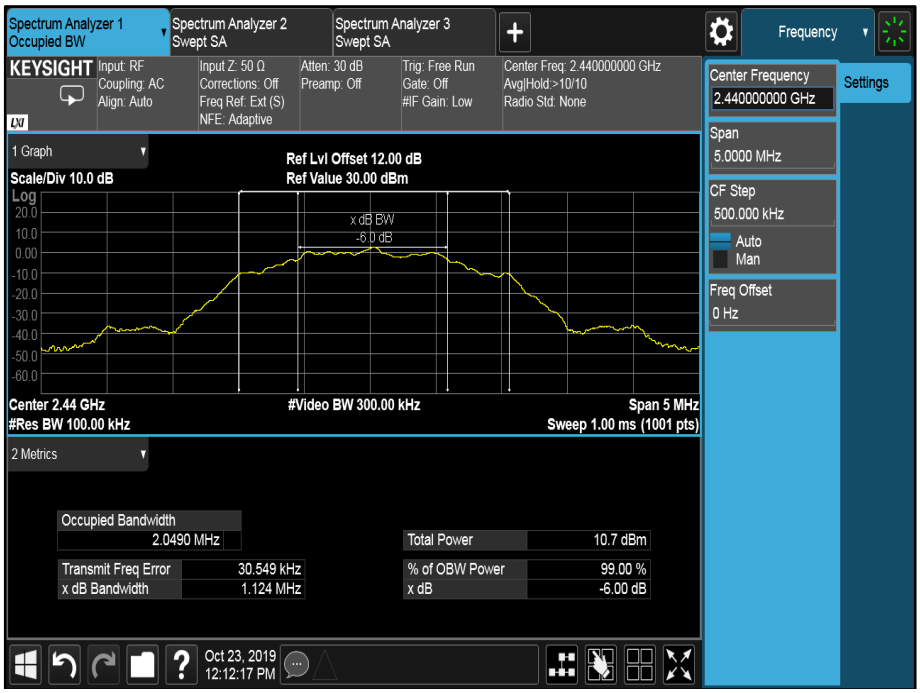


Figure 32 - 2440 MHz – Emission Bandwidth

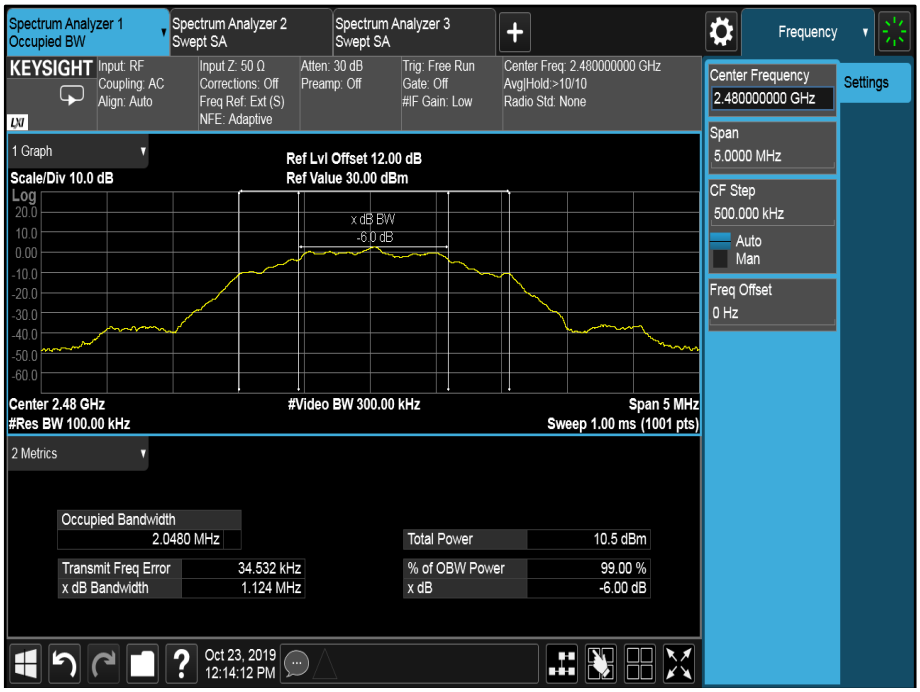


Figure 33 - 2480 MHz – Emission Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISEDC RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	75 Mk3	455	12	11-Oct-2020
Attenuator (20 dB, 2 W)	Pasternack	PE7004-20	489	12	24-Oct-2019
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Dec-2019
Network Analyser	Keysight Technologies	E5063A	5018	12	20-May-2020
Cable (40 GHz)	Rosenberger	LU1-001-2000	5024	-	O/P Mon
Electronic Calibration Module	Keysight Technologies	85093C	5188	12	21-May-2020
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon

Table 26

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Power Spectral Density	± 3.2 dB
Emission Bandwidth	± 58.64 kHz

Table 27

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the result of the compliance measurement and does not take into account measurement instrumentation uncertainty. Measurement system uncertainty is calculated, as indicated above, in accordance with the appropriate guidelines detailed within the specification of test.