

FCC and ISED Test Report

Apple Inc
Model: A2330

In accordance with FCC 47 CFR Part 15C,
ISED RSS-247 and ISED RSS-GEN

(Bluetooth FHSS)

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

FCC ID: BCGA2330 IC: 579C-A2330

COMMERCIAL-IN-CONFIDENCE

Document 75948763-09 Issue 01



Add value.
Inspire trust.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	09 June 2020

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, ISED RSS-247 and ISED 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	09 June 2020	
Testing	Malik Mohammad	09 June 2020	
Testing	Faisal Malyar	09 June 2020	
Testing	Ahmad Javid	09 June 2020	
Testing	Jaiyanth Balendrarajah	09 June 2020	
Testing	Ainsley Jenkins	09 June 2020	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED 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: 2019, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019) for the tests detailed in section 1.3.



DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2020 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

TÜV SÜD
is a trading name of TÜV SÜD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom



Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Product Information	5
1.5	Deviations from the Standard.....	5
1.6	EUT Modification Record	5
1.7	Test Location	6
2	Test Details	7
2.1	Maximum Conducted Output Power	7
2.2	Frequency Hopping Systems - Average Time of Occupancy	19
2.3	Frequency Hopping Systems - Channel Separation.....	27
2.4	Frequency Hopping Systems - Number of Hopping Channels	33
2.5	Frequency Hopping Systems - 20 dB Bandwidth	36
2.6	Authorised Band Edges	48
2.7	Restricted Band Edges.....	57
2.8	Spurious Radiated Emissions	66
3	Measurement Uncertainty	95



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	09 June 2020

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2330
Serial Number(s)	C07CG081PW8X, C07CF029PW92, C07CF06DPW91, C07CG05BPW8V and C07CG05KPW8V
Hardware Version(s)	REV1.0
Software Version(s)	20A2236b
Number of Samples Tested	5
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number	0540201015
Date	07-April-2020
Date of Receipt of EUT	08-April-2020 and 28-April-2020
Start of Test	11-April-2020
Finish of Test	06-June-2020
Name of Engineer(s)	Mehadi Choudhury, Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian
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, ISSED RSS-247 and ISSED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth - BR/EDR (Core 0)						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.5	15.247 (a)(1)	5.1	6.7	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.6	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.7	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.8	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz Bluetooth - BR/EDR (Core 1)						
2.8	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)



Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.5	15.247 (a)(1)	5.1	6.7	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.6	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.7	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.8	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)

Table 2



1.4 Product Information

1.4.1 Technical Description

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

1.4.2 Additional Information

Bluetooth is supported across all cores, however simultaneous transmission on multiple cores at the same time is not supported. Bluetooth operation on Core 2 is independent to operation on Core 0 or 1, therefore tests have been performed on Core 2 and repeated for the Core with the highest antenna gain out of Core 0 and Core 1.

For Radiated Spurious Emissions, tests were performed with the device operating independently on Core-0, Core-1 and Core 2.

BT Core	Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
0	2400 - 2480	5.00	0.7
1	2400 - 2480	0.25	0.7
2	2400 - 2480	0	0.7

Table 3 – Antenna Gains

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: A2330, Serial Number: C07CG081PW8X			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2330, Serial Number: C07CF029PW92			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2330, Serial Number: C07CF06DPW91			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2330, Serial Number: C07CG05BPW8V			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2330, Serial Number: C07CG05KPW8V			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4



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: 2.4 GHz Bluetooth - BR/EDR (Core 0)		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Channel Separation	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Mehadi Choudhury	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Restricted Band Edges	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - BR/EDR (Core 1)		
Spurious Radiated Emissions	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Channel Separation	Mehadi Choudhury	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Mehadi Choudhury	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Restricted Band Edges	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Spurious Radiated Emissions	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS

Table 5

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)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause 6.12

2.1.2 Equipment Under Test and Modification State

A2330, S/N: C07CG05BPW8V - Modification State 1

2.1.3 Date of Test

15-May-2020 to 19-May-2020

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 7.8.5.

Additionally, power measurements were performed using an average power method, to confirm the DUT's output power setting.

2.1.5 Environmental Conditions

Ambient Temperature	23.0 - 25.1 °C
Relative Humidity	21.6 - 31.5 %

2.1.6 Test Results

2.4 GHz Bluetooth - BR/EDR (Core 0)

Frequency (MHz)	Modulation Scheme	Maximum Output Power - Peak		Maximum Output Power - Average	
		dBm	mW	dBm	mW
2402	GFSK	12.58	18.11	12.37	17.30
2402	$\pi/4$ DQPSK	10.00	10.00	8.15	6.53
2402	8-DPSK	10.27	10.64	8.12	6.49
2441	GFSK	12.63	18.32	12.41	17.42
2441	$\pi/4$ DQPSK	9.91	9.79	8.05	6.38
2441	8-DPSK	10.16	10.38	8.29	6.75
2480	GFSK	12.36	17.22	12.32	17.06
2480	$\pi/4$ DQPSK	9.75	9.44	8.02	6.34
2480	8-DPSK	10.00	10.00	8.26	6.70

Table 6 - Maximum Conducted Output Power Results

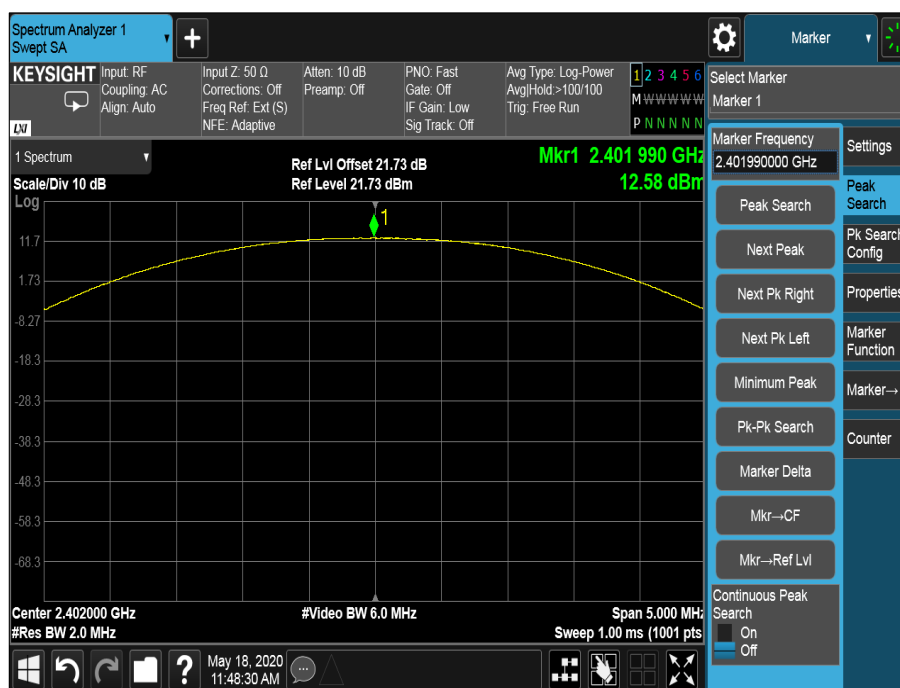


Figure 1 - 2402 MHz - Maximum Output Power, GFSK

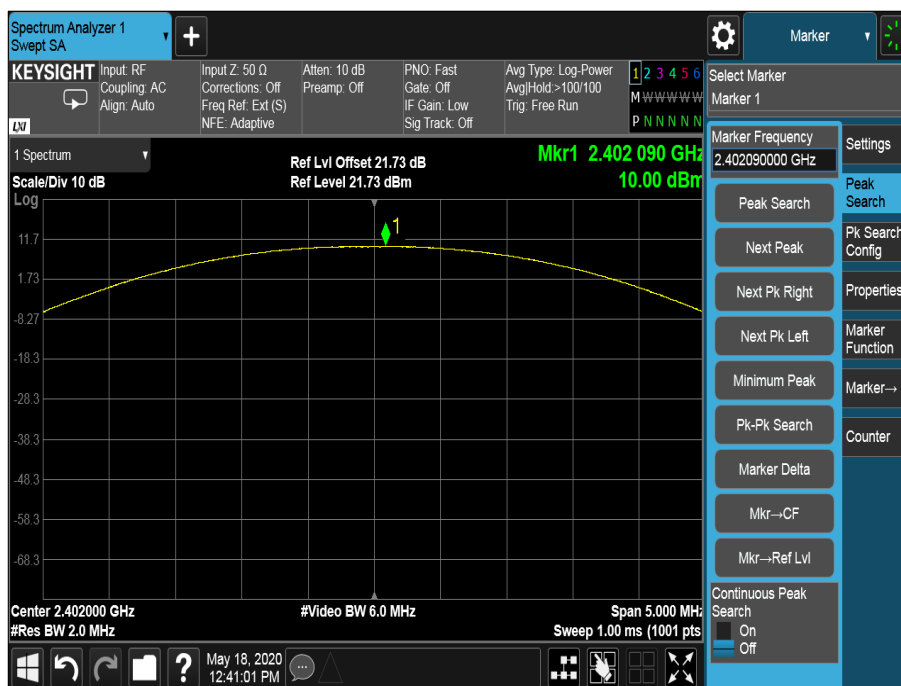


Figure 2 - 2402 MHz - Maximum Output Power, $\pi/4$ DQPSK



Figure 3 - 2402 MHz - Maximum Output Power, 8-DPSK

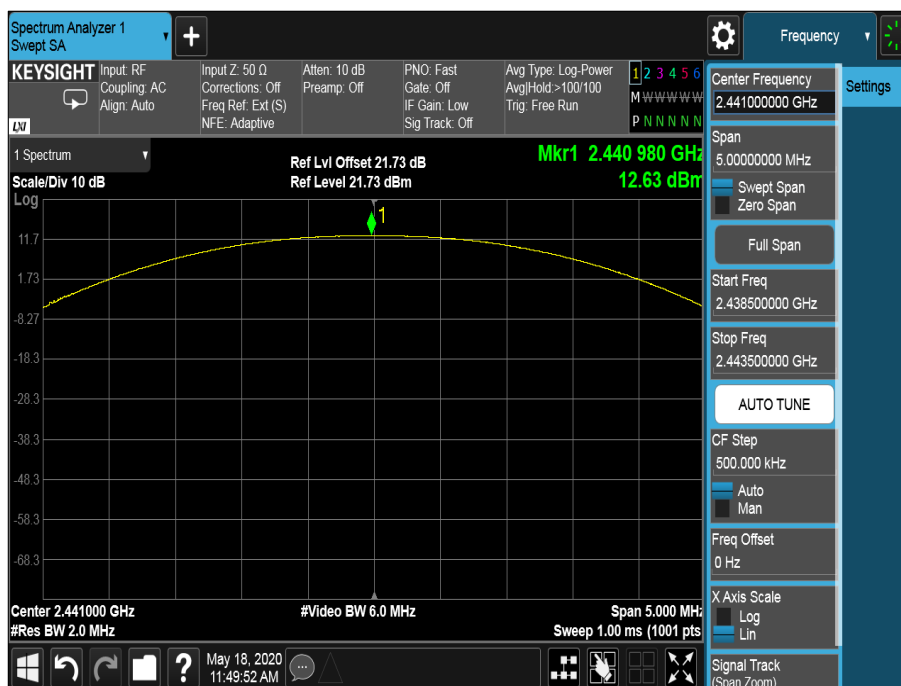


Figure 4 - 2441 MHz - Maximum Output Power, GFSK

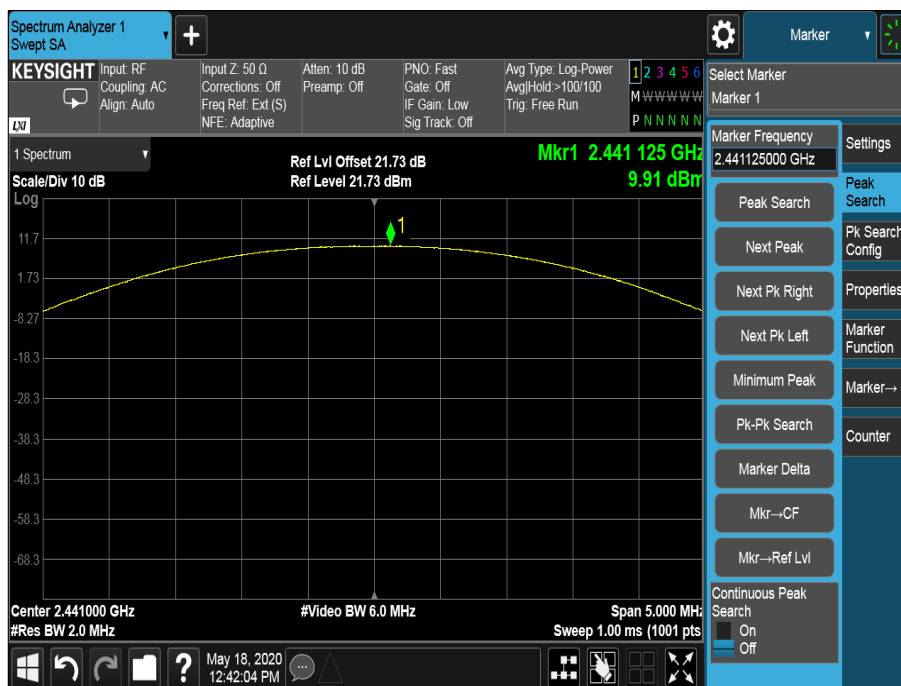


Figure 5 - 2441 MHz - Maximum Output Power, $\pi/4$ DQPSK

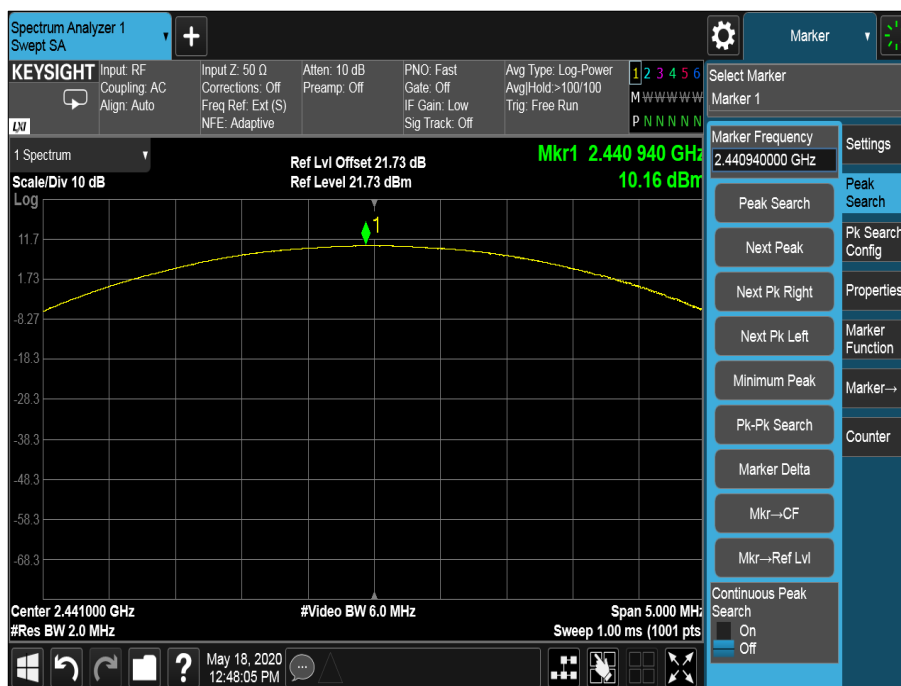


Figure 6 - 2441 MHz - Maximum Output Power, 8-DPSK

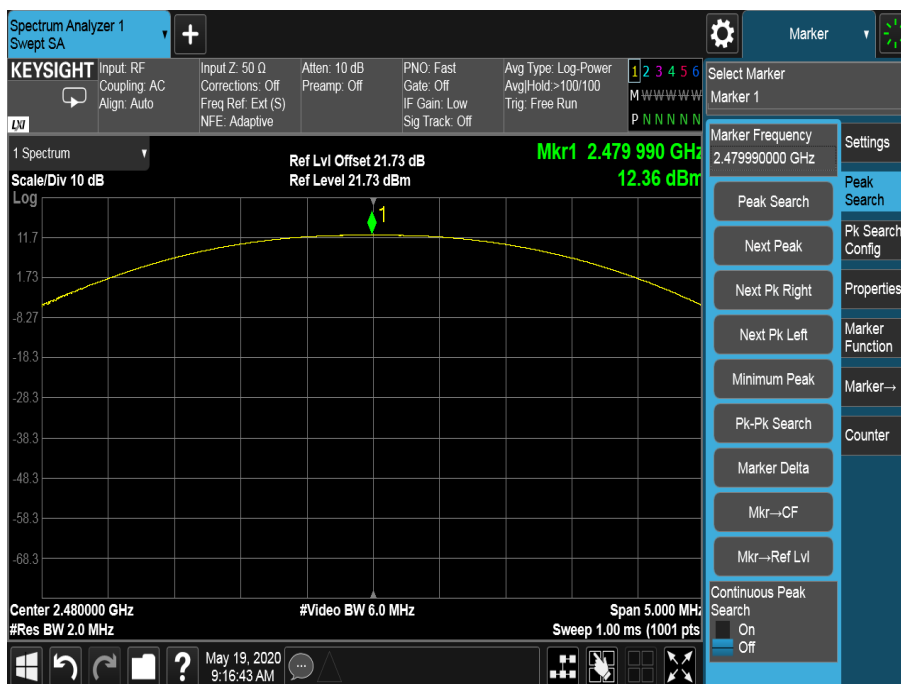


Figure 7 - 2480 MHz - Maximum Output Power, GFSK

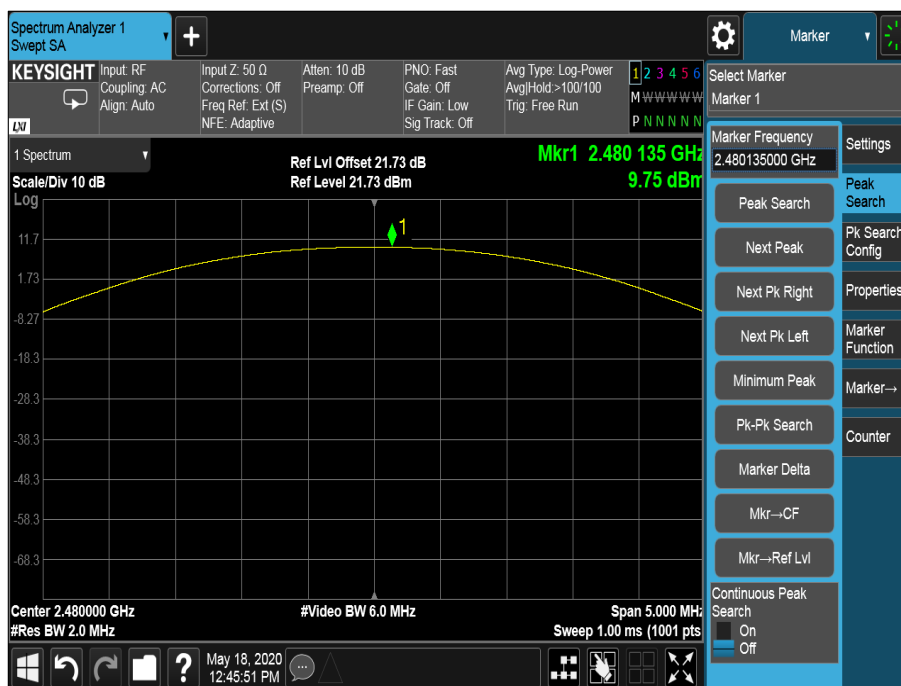


Figure 8 - 2480 MHz - Maximum Output Power, $\pi/4$ DQPSK



Figure 9 - 2480 MHz - Maximum Output Power, 8-DPSK

2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)

Frequency (MHz)	Modulation Scheme	Maximum Output Power - Peak		Maximum Output Power - Average	
		dBm	mW	dBm	mW
2402	GFSK	11.85	15.31	11.27	13.40
2402	$\pi/4$ DQPSK	10.14	10.33	8.25	6.68
2402	8-DPSK	10.43	11.04	8.25	6.68
2441	GFSK	12.20	16.60	11.57	14.35
2441	$\pi/4$ DQPSK	10.40	10.96	8.50	7.08
2441	8-DPSK	10.73	11.83	8.50	7.08
2480	GFSK	12.72	18.71	12.30	16.98
2480	$\pi/4$ DQPSK	10.85	12.16	8.50	7.08
2480	8-DPSK	10.60	11.48	8.50	7.08

Table 7 - Maximum Conducted Output Power Results

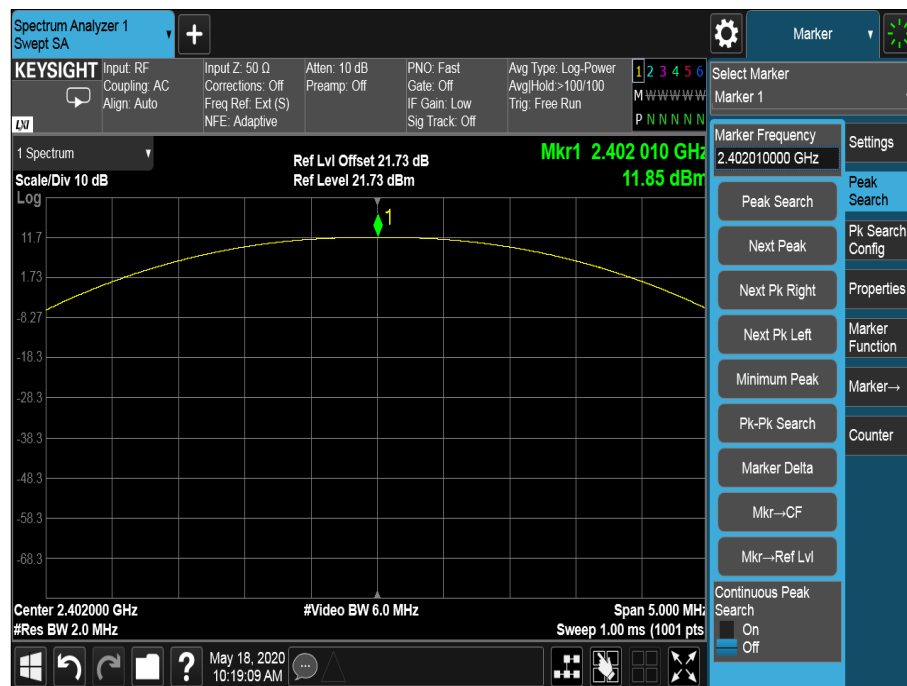


Figure 10 - 2402 MHz - Maximum Output Power, GFSK

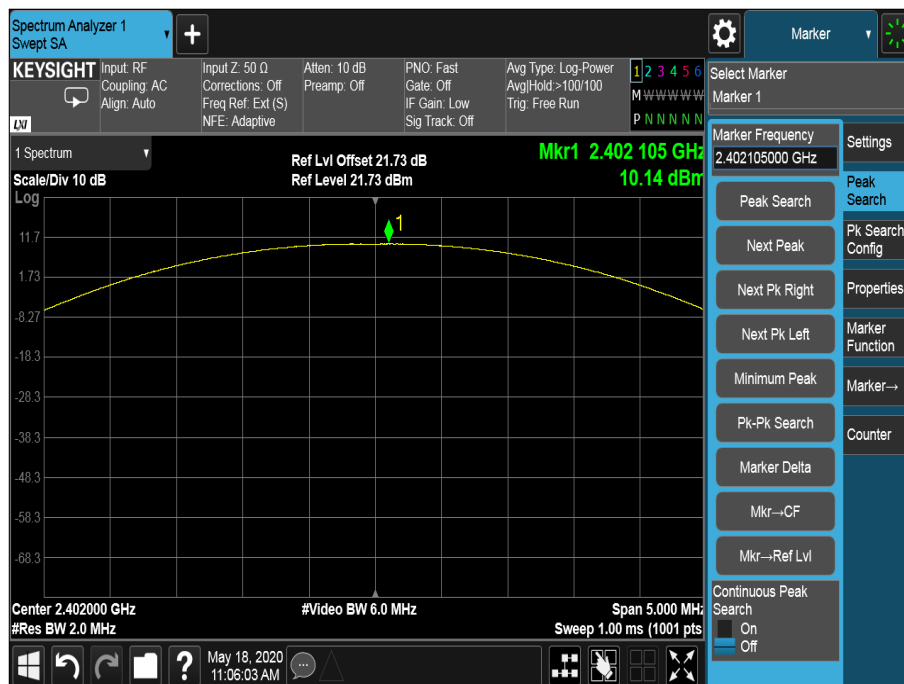


Figure 11 - 2402 MHz - Maximum Output Power, $\pi/4$ DQPSK



Figure 12 - 2402 MHz - Maximum Output Power, 8-DPSK

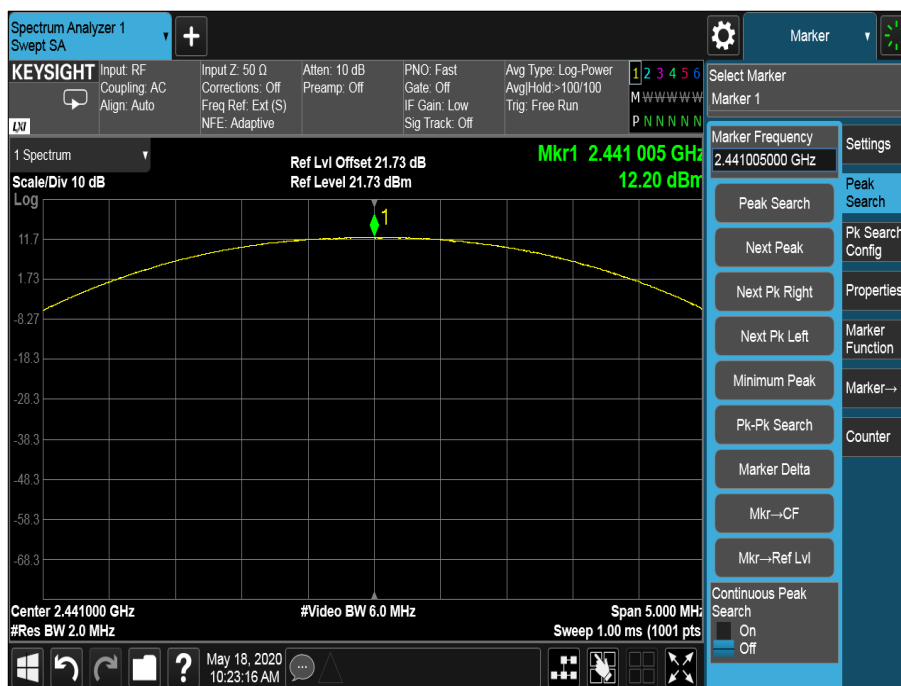


Figure 13 - 2441 MHz - Maximum Output Power, GFSK

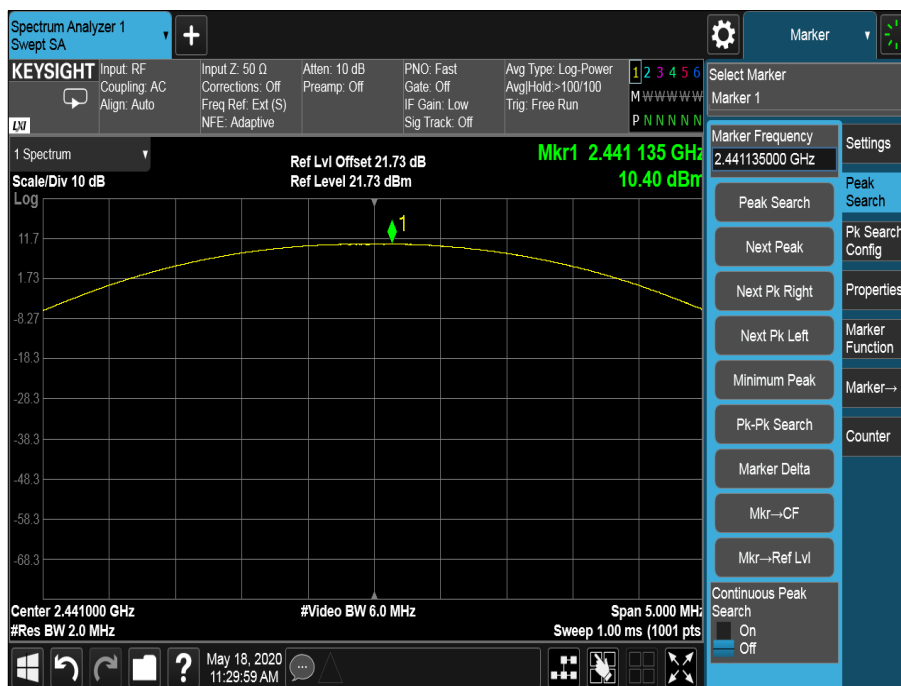


Figure 14 - 2441 MHz - Maximum Output Power, $\pi/4$ DQPSK

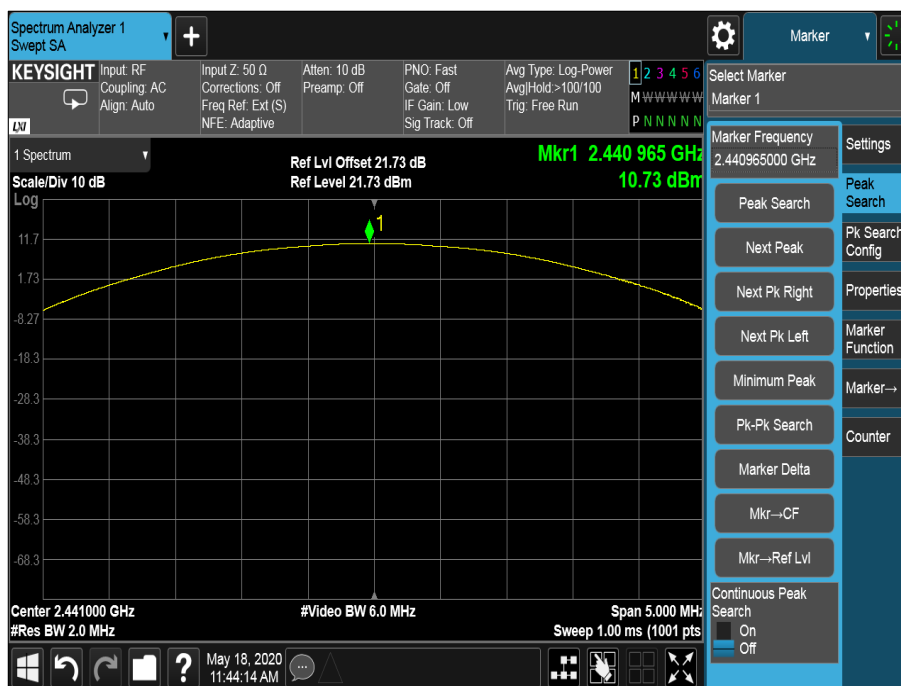


Figure 15 - 2441 MHz - Maximum Output Power, 8-DPSK

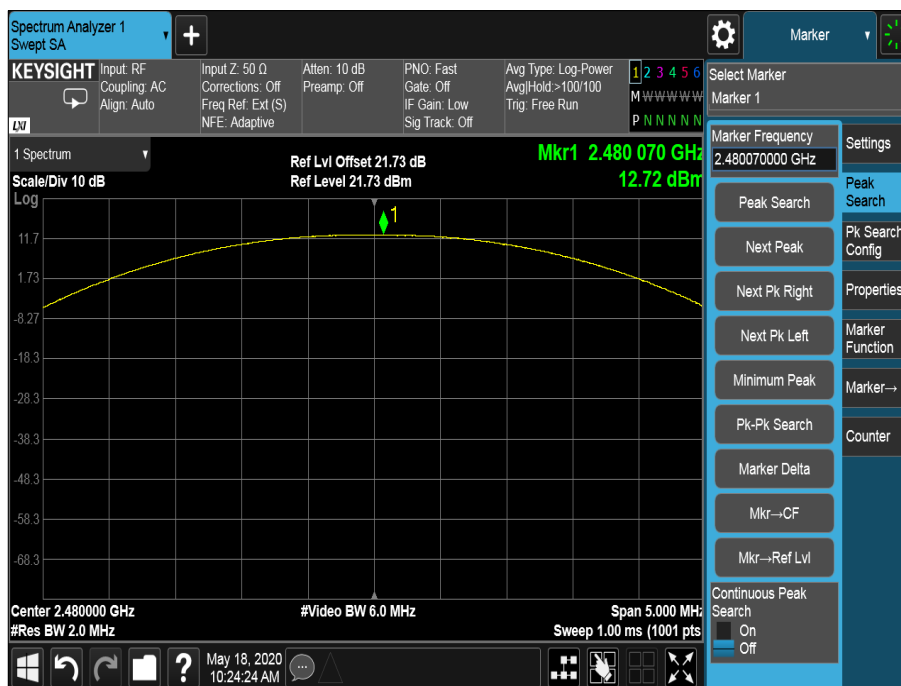


Figure 16 - 2480 MHz - Maximum Output Power, GFSK

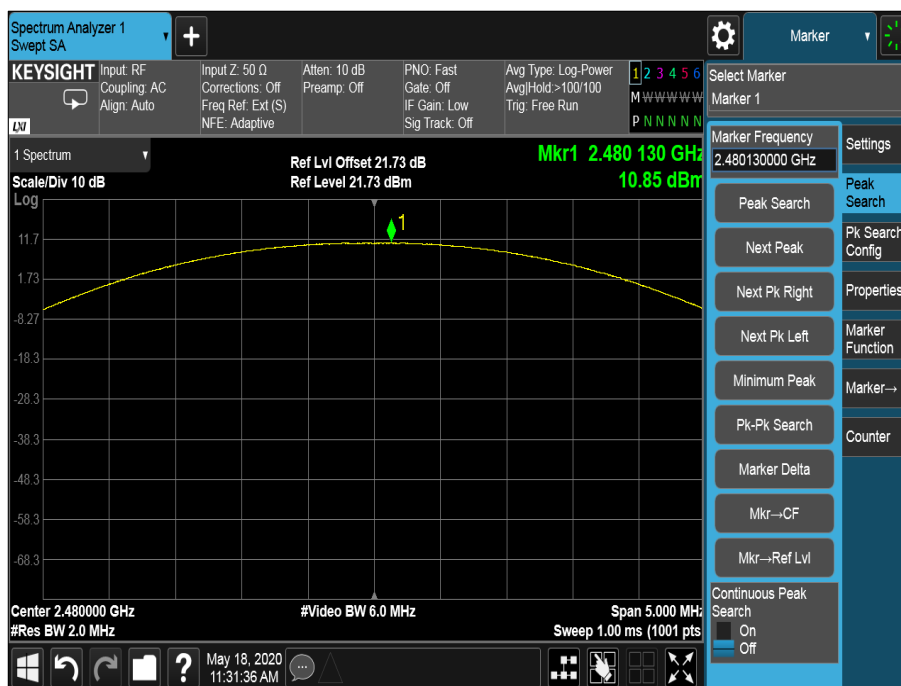


Figure 17 - 2480 MHz - Maximum Output Power, $\pi/4$ DQPSK



Figure 18 - 2480 MHz - Maximum Output Power, 8-DPSK



FCC 47 CFR Part 15, Limit Clause 15.247 (b)(1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

ISED RSS-247, Limit Clause 5.4 (b)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channel; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channel. 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	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
EXA	Keysight Technologies	N9010B	4969	24	03-Feb-2022
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	6	13-Jun-2020
20 dB Attenuator	Sealectro	60-674 102089	N/S	-	O/P Mon

Table 8

O/P Mon – Output Monitored using calibrated equipment

2.2 Frequency Hopping Systems - Average Time of Occupancy

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

A2330, S/N: C07CG081PW8X - Modification State 0

2.2.3 Date of Test

21-April-2020 to 23-April-2020

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.2.5 Environmental Conditions

Ambient Temperature 23.0 - 24.8 °C
Relative Humidity 27.7 - 32.0 %

2.2.6 Test Results

2.4 GHz Bluetooth - BR/EDR (Core 0)

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
DH5	2.90	110	319.00
2DH5	2.88	103	296.64
3DH5	2.88	117	336.96

Table 9

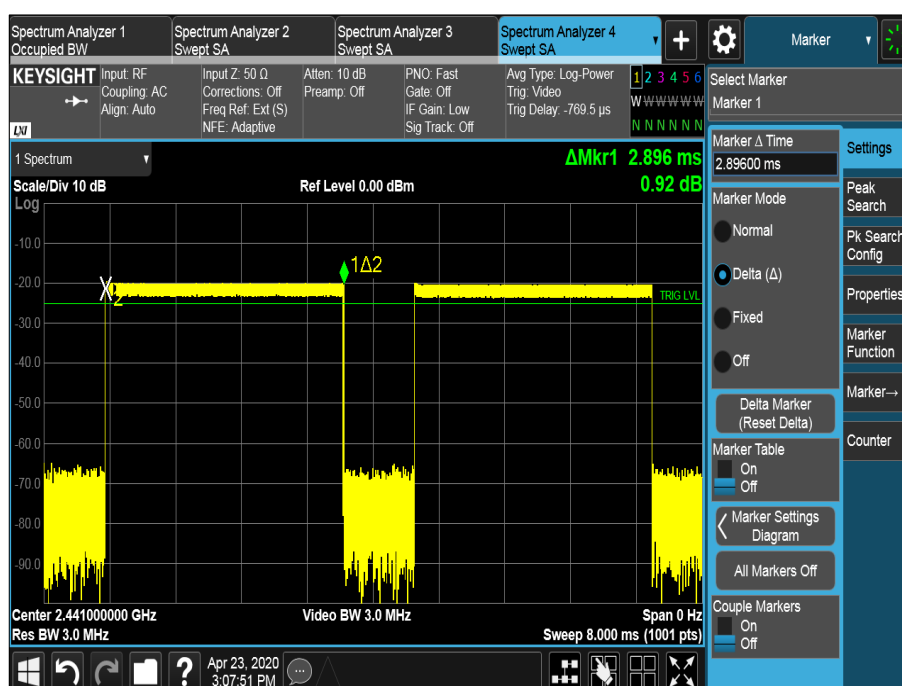


Figure 19 - DH5, Dwell Time

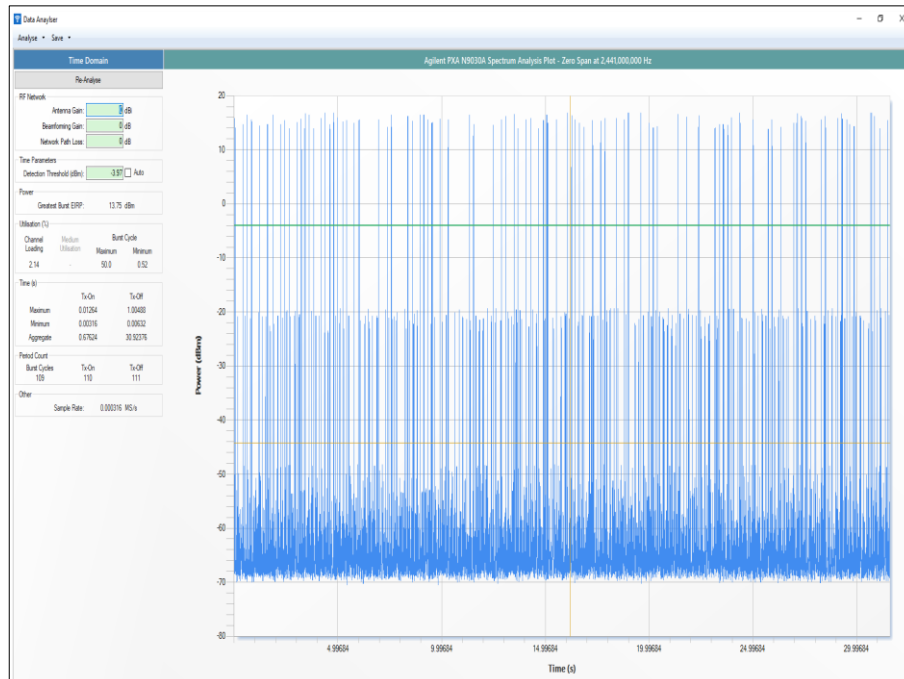


Figure 20 - DH5, Total Average Time of Occupancy

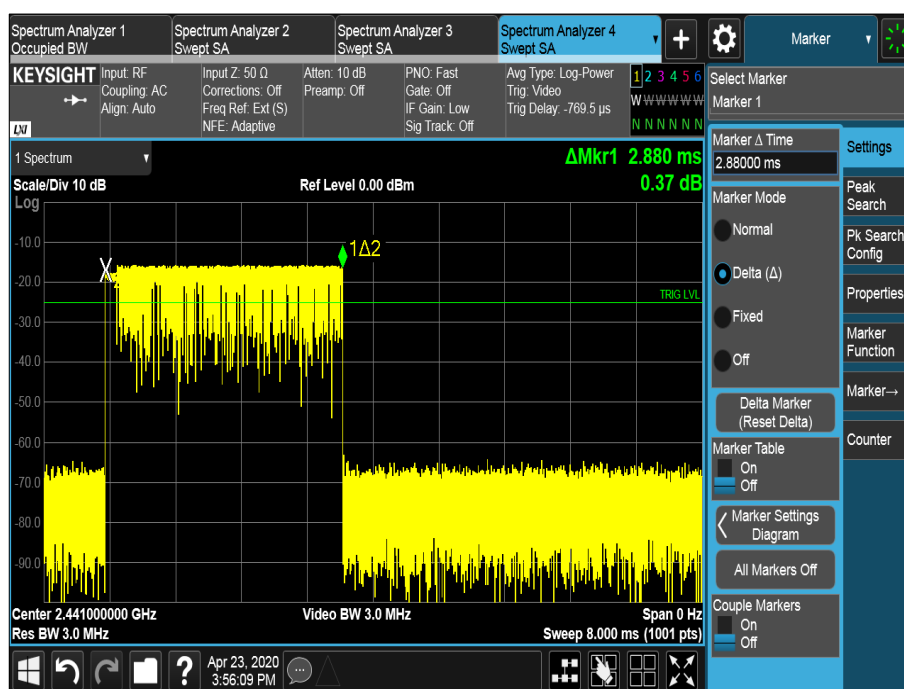


Figure 21 - 2DH5, Dwell Time

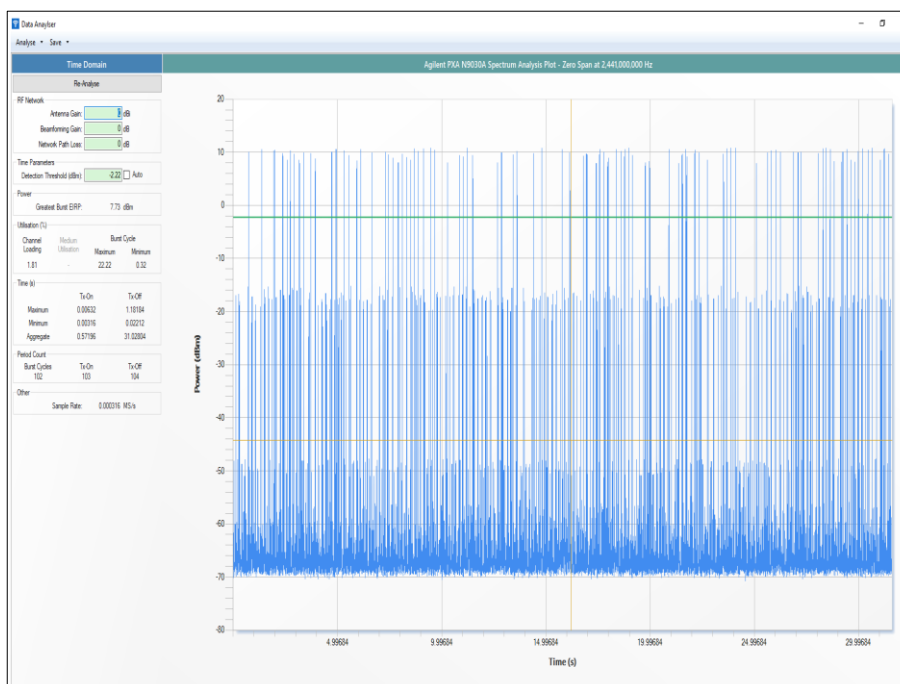


Figure 22 - 2DH5, Total Average Time of Occupancy

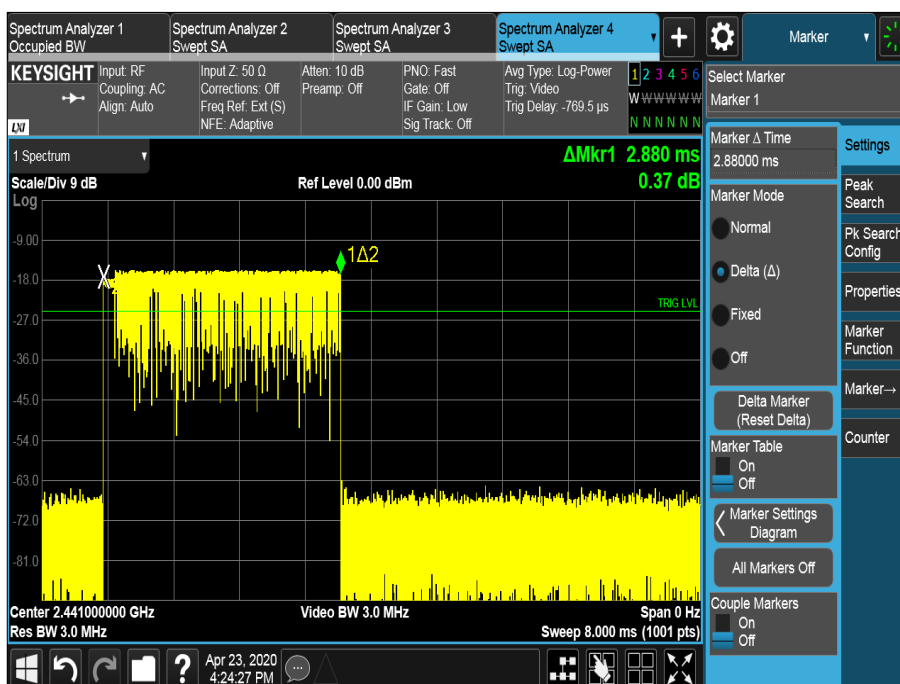


Figure 23 - 3DH5, Dwell Time

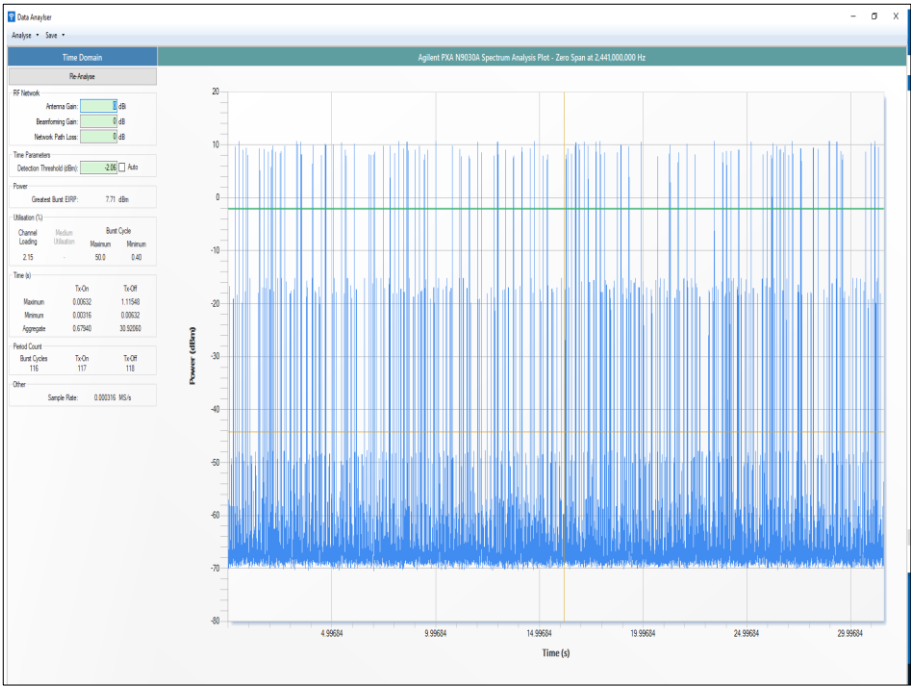


Figure 24 - 3DH5, Total Average Time of Occupancy

2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
DH5	2.88	110	316.80
2DH5	2.88	99	285.12
3DH5	2.88	107	308.16

Table 10

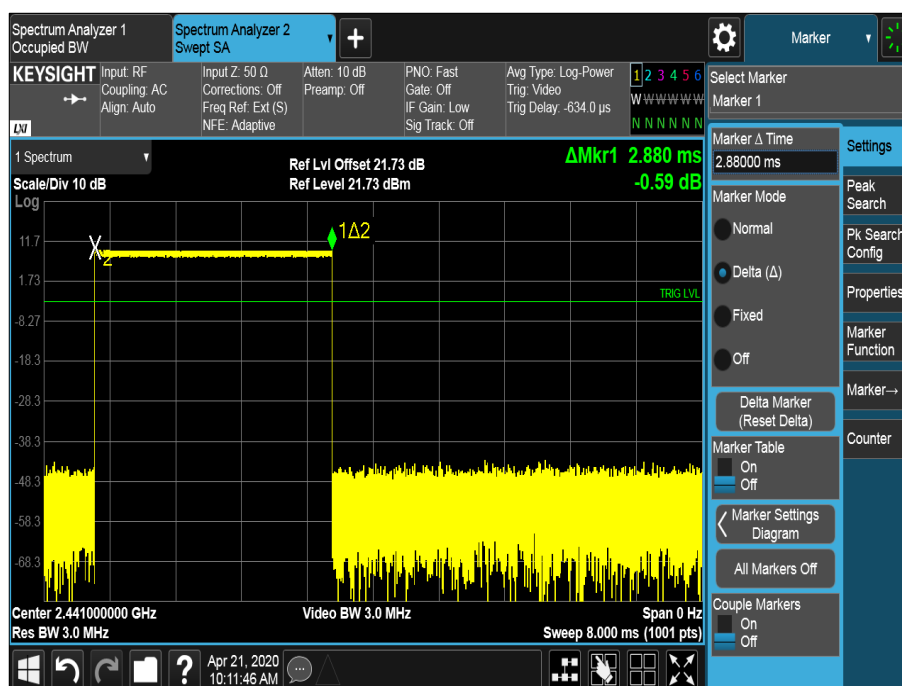


Figure 25 - DH5, Dwell Time

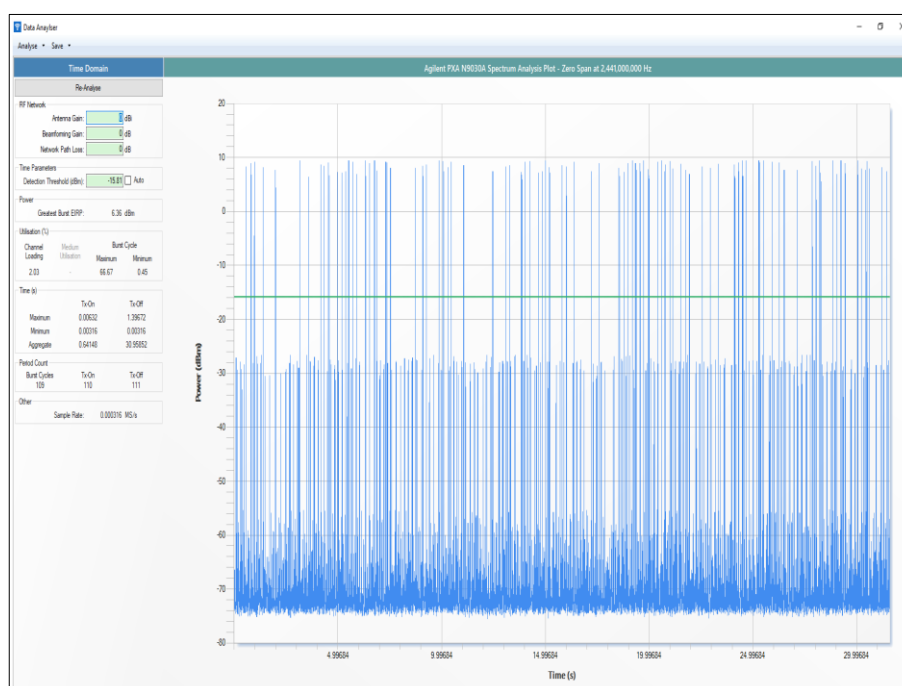


Figure 26 - DH5, Total Average Time of Occupancy

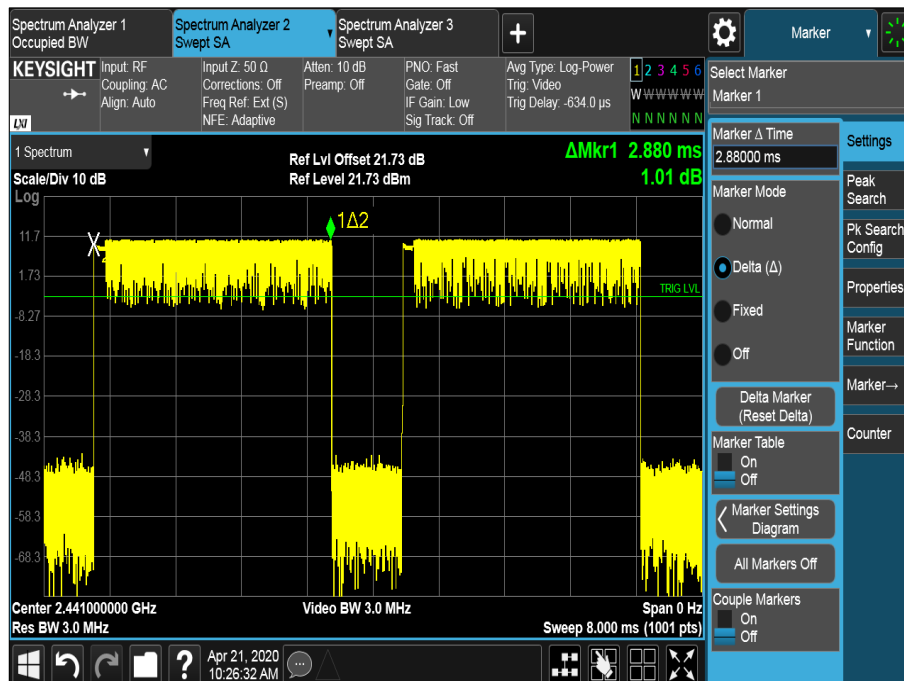


Figure 27 - 2DH5, Dwell Time

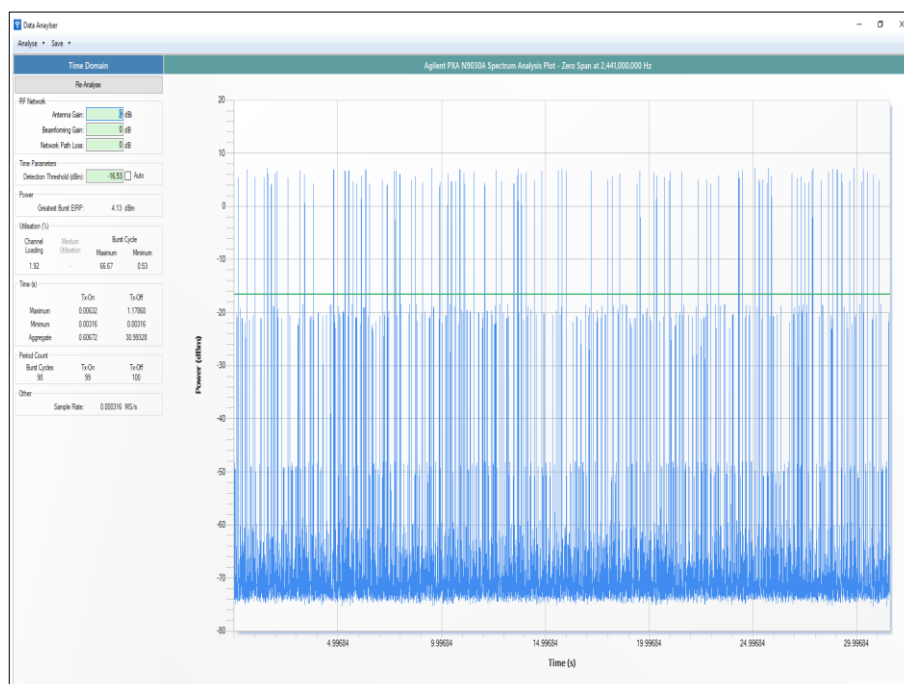


Figure 28 - 2DH5, Total Average Time of Occupancy

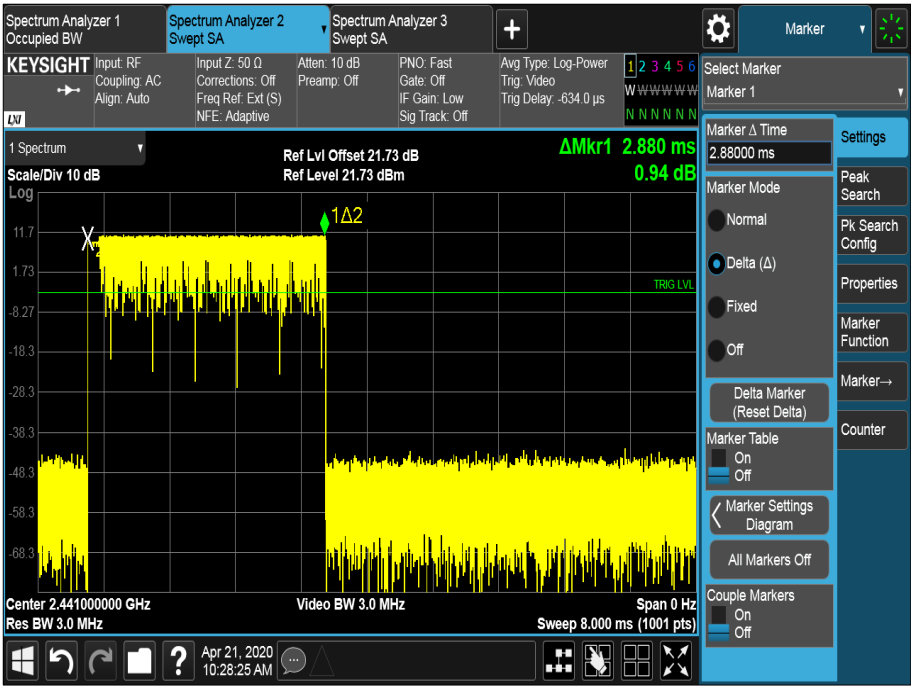


Figure 29 - 3DH5, Dwell Time

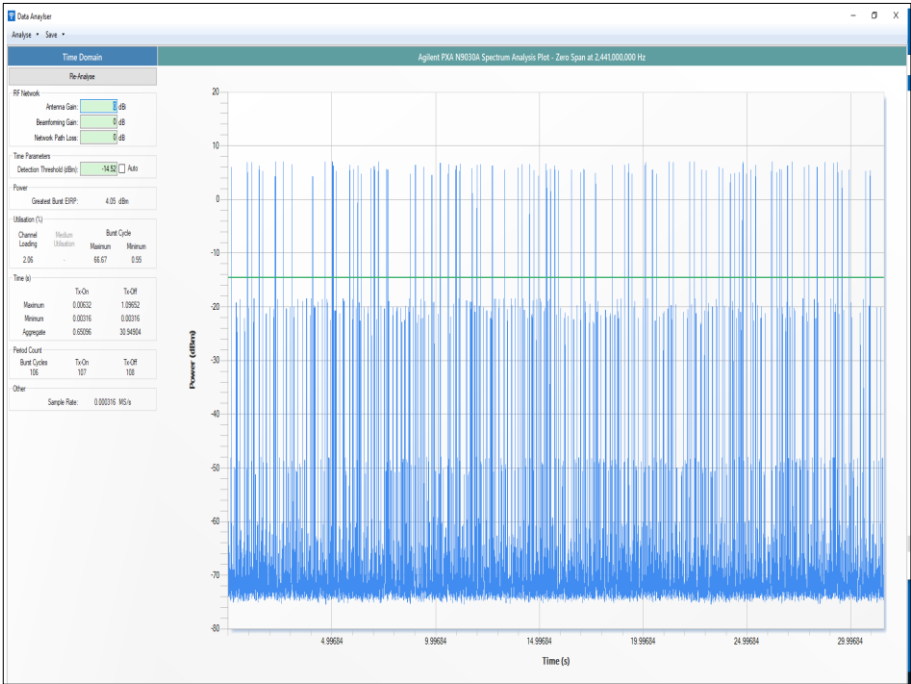


Figure 30 - 3DH5, Total Average Time of Occupancy



FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

ISED RSS-247, Limit Clause 5.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

2.2.7 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	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	05-May-2020
EXA	Keysight Technologies	N9010B	4969	24	03-Feb-2022
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	6	13-Jun-2020
20 dB Attenuator	Sealectro	60-674 102089	N/S	-	O/P Mon

Table 11

O/P Mon – Output Monitored using calibrated equipment



2.3 Frequency Hopping Systems - Channel Separation

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1

2.3.2 Equipment Under Test and Modification State

A2330, S/N: C07CG081PW8X - Modification State 0
A2330, S/N: C07CF06DPW91 - Modification State 0
A2330, S/N: C07CG05BPW8V - Modification State 1

2.3.3 Date of Test

20-April-2020 to 23-April-2020

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.3.5 Environmental Conditions

Ambient Temperature 23.3 - 24.8 °C
Relative Humidity 28.4 - 32.0 %

2.3.6 Test Results

2.4 GHz Bluetooth - BR/EDR (Core 0)

Modulation	Channel Separation (MHz)
GFSK	0.999
$\pi/4$ DQPSK	1.002
8-DPSK	0.999

Table 12



Figure 31 - GFSK



Figure 32 - $\pi/4$ DQPSK



Figure 33 - 8-DPSK



2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)

Modulation	Channel Separation (MHz)
GFSK	0.999
$\pi/4$ DQPSK	1.002
8-DPSK	1.002

Table 13



Figure 34 - GFSK

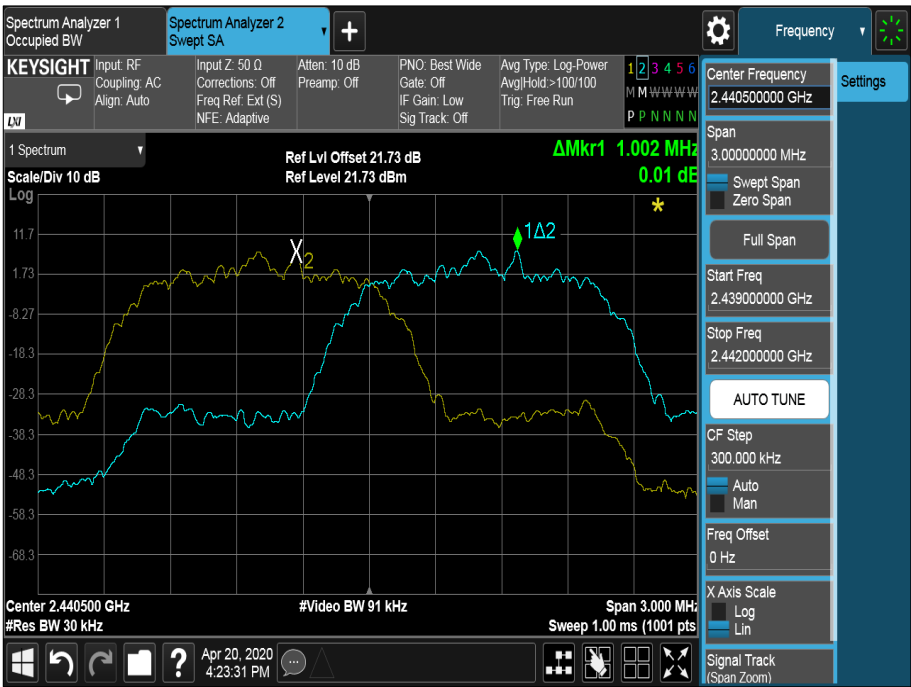


Figure 35 - $\pi/4$ DQPSK



Figure 36 - 8-DPSK

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

ISED RSS-247, Limit Clause 5.1 (b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.



2.3.7 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	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	05-May-2020
EXA	Keysight Technologies	N9010B	4969	24	03-Feb-2022
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	6	13-Jun-2020
20 dB Attenuator	Sealectro	60-674 102089	N/S	-	O/P Mon

Table 14

O/P Mon – Output Monitored using calibrated equipment

2.4 Frequency Hopping Systems - Number of Hopping Channels

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1

2.4.2 Equipment Under Test and Modification State

A2330, S/N: C07CG081PW8X - Modification State 0

2.4.3 Date of Test

21-April-2020 to 23-April-2020

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.4.5 Environmental Conditions

Ambient Temperature 23.0 - 24.8 °C
Relative Humidity 27.7 - 32.0 %

2.4.6 Test Results

2.4 GHz Bluetooth - BR/EDR (Core 0)

Number of Hopping Channels: 79

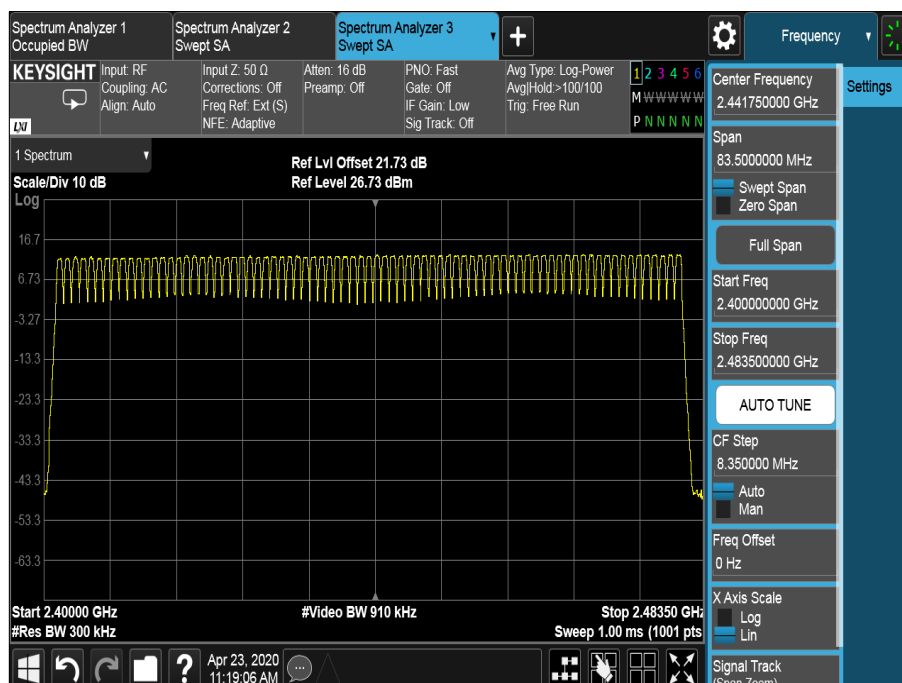


Figure 37 - Measurement Frequency Range: 2400 MHz to 2483.5 MHz

2.4 GHz Bluetooth - BR/EDR (Dedicated Core 2)

Number of Hopping Channels: 79

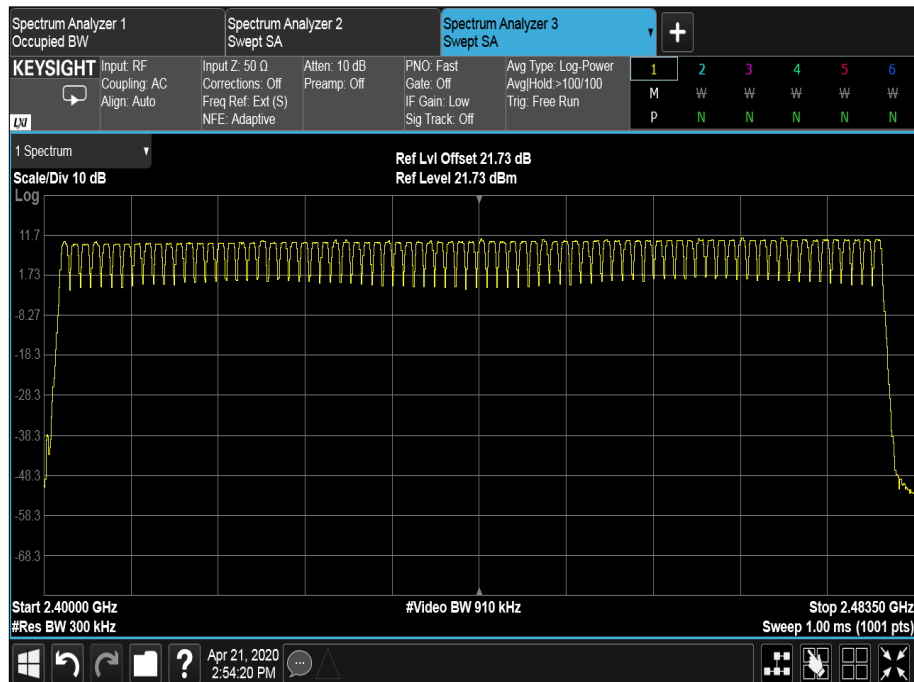


Figure 38 - Measurement Frequency Range: 2400 MHz to 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)

≥ 15 channels

ISED RSS-247, Limit Clause 5.1 (d)

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.



2.4.7 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	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	05-May-2020
EXA	Keysight Technologies	N9010B	4969	24	03-Feb-2022
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5424	6	13-Jun-2020
20 dB Attenuator	Sealectro	60-674 102089	N/S	-	O/P Mon

Table 15

O/P Mon – Output Monitored using calibrated equipment



2.5 Frequency Hopping Systems - 20 dB Bandwidth

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1
ISED RSS-GEN, Clause 6.7

2.5.2 Equipment Under Test and Modification State

A2330, S/N: C07CG081PW8X - Modification State 0

2.5.3 Date of Test

20-April-2020 to 23-April-2020

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

2.5.5 Environmental Conditions

Ambient Temperature 23.3 - 24.8 °C
Relative Humidity 28.4 - 32.0 %

2.5.6 Test Results

2.4 GHz Bluetooth - BR/EDR (Core 0)

Frequency (MHz)	20 dB Bandwidth (kHz)		
	GFSK	$\pi/4$ DQPSK	8-DPSK
2402	934.9	1347	1302
2441	933.3	1349	1303
2480	932.9	1347	1304

Table 16



Figure 39 - 2402 MHz - GFSK

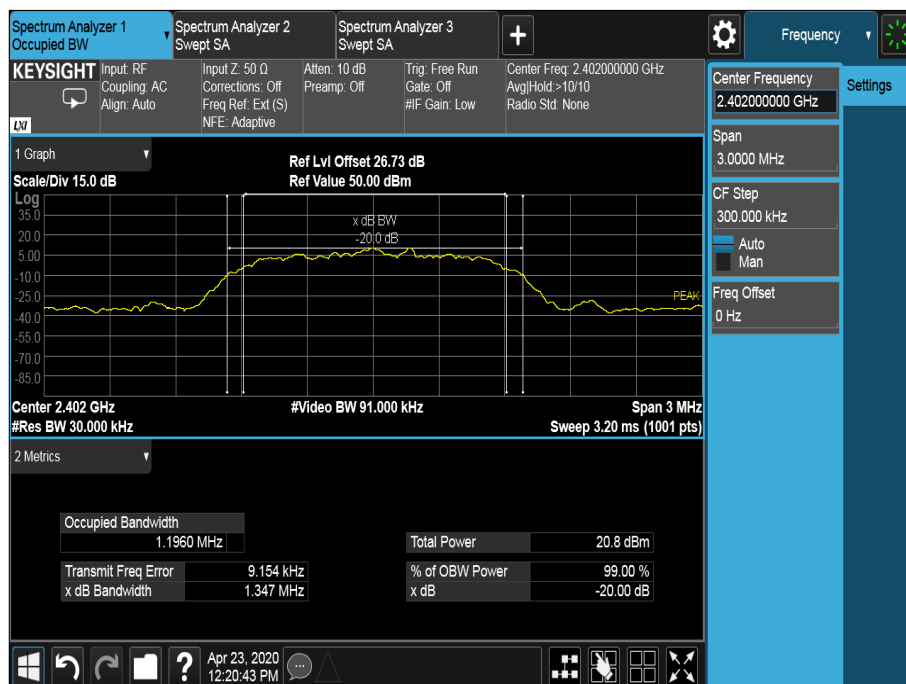


Figure 40 - 2402 MHz - $\pi/4$ DQPSK

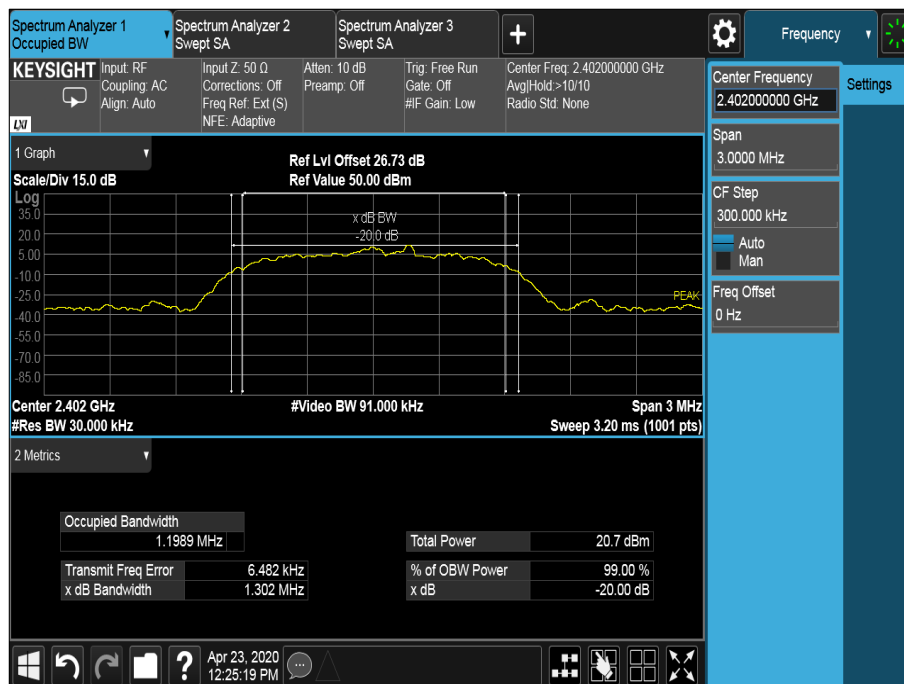


Figure 41 - 2402 MHz - 8-DPSK



Figure 42 - 2441 MHz - GFSK



Figure 43 - 2441 MHz - $\pi/4$ DQPSK

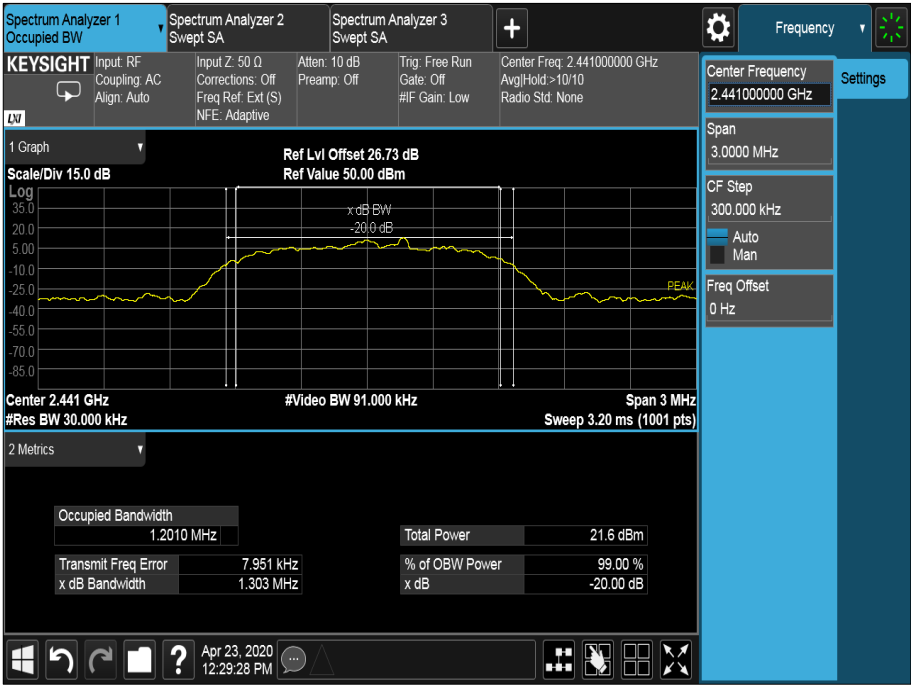


Figure 44 - 2441 MHz - 8-DPSK

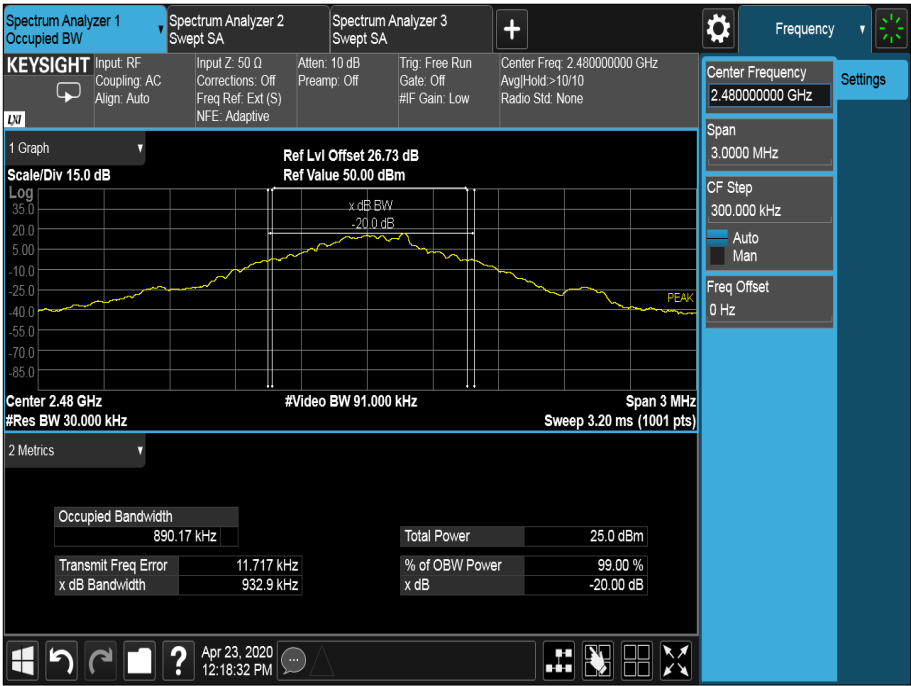


Figure 45 - 2480 MHz - GFSK

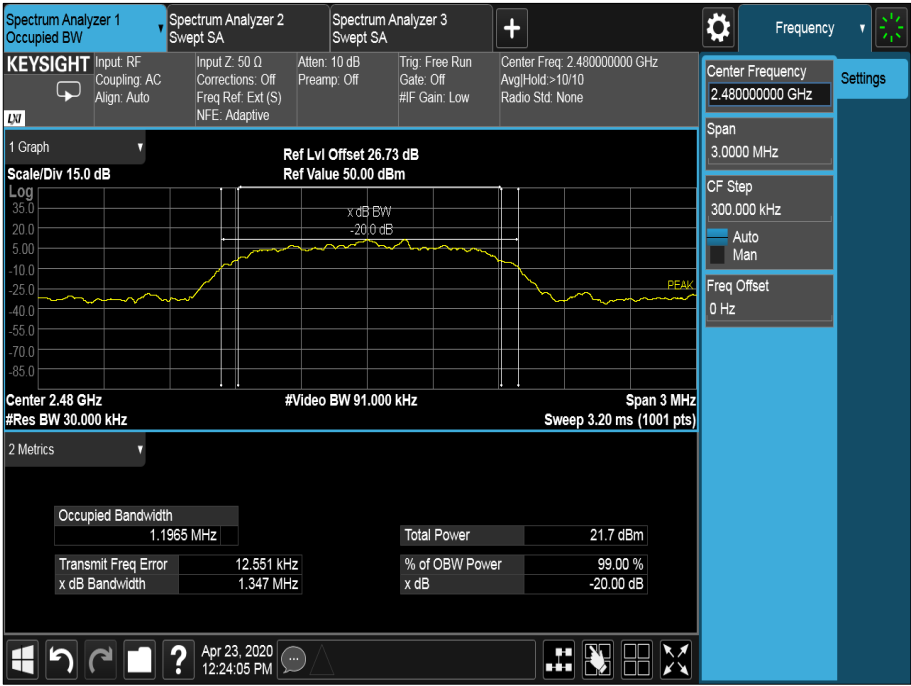


Figure 46 - 2480 MHz - $\pi/4$ DQPSK



Figure 47 - 2480 MHz - 8-DPSK