Test Report Serial Number:	**45461583 R1.0**
Test Report Date:	**26 May 2020**
Project Number:	**1494**

EMC Test Report - New Certification

Applicant:

Garmin International Inc.
1200 East 151 St
Olathe, KS, 66062
USA

FCC ID:	IC Registration Number
IPH-03989	**1792A-03989**

Product Model Number / HVIN

A03989

In Accordance With:

CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B

Digital Transmission System (DTS)

RSS-Gen, RSS-247 Issue 2

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Approved By:

Ben Hewson, President
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada

Test Lab Certificate: 2470.01 **IC Registration 3874A-1** **FCC Registration: CA3874**

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1.0 DOCUMENT CONTROL

Revision History					
Samples Tested By:	Art Voss, P.Eng.		**Date(s) of Evaluation:**	17 March - 3 April, 2020	
Report Prepared By:	Art Voss, P.Eng.		**Report Reviewed By:**	Ben Hewson	
Report Revision	**Description of Revision**		**Revised Section**	**Revised By**	**Revision Date**
0.1	Initial Draft Release		n/a	Art Voss	8 May 2020
1.0	Initial Release		n/a	Art Voss	26 May 2020

2.0 CLIENT AND DUT INFORMATION

Client Information		
Applicant Name	**Garmin International Inc.**	
Applicant Address	1200 East 151 St	
	Olathe, KS, 66062	
	USA	
DUT Information		
Device Identifier(s):	**FCC ID:**	**IPH-03989**
	ISED ID:	**1792A-03989**
Device Model(s) / HVIN:	A03989	
Test Sample Serial No.:	3326988634 - Conducted, 3326988670 - OTA/SAR	
Device Type:	Extremity Worn Digital Transceiver	
FCC Equipment Class:	WiFi - Digital Transmission System (DTS)	
	BlueTooth - Spread Spectrum Transmitter (DSS)	
	BlueTooth LE/ANT - Low Power Communication Device Transmitter (DXX)	
	NFC - Low Power Communication Device Transmitter (DXX)	
ISED Equipment Class:	WiFi: Wi-Fi Device	
	BlueTooth: Spread Spectrum/Digital Device (2400-2483.5MHz)	
	BlueTooth LE/ANT - Low Power Device (2400-2483.5MHz)	
	NFC - RFID Device	
Transmit Frequency Range:	WiFi (DTS): 2412-2462MHz	
	BT/BLE/ANT: 2402-2480MHz	
	NFC: 13.56MHz	
Manuf. Max. Rated Output Power:	WiFi - Digital Transmission System (DTS): 17.84dBm	
	BlueTooth - Spread Spectrum Transmitter (DSS): 14.11dBm	
	BLE/ANT - Low Power Communication Device Transmitter (DXX): 4dBm	
	NFC - Low Power Communication Device Transmitter (DXX): -36dBm	
Antenna Type and Gain:	0.6dBi Max	
Modulation:	WiFi: DSSS, OFDM, CCK, MCS0-7	
Modulation:	BT BR: GFSK	
Modulation:	BT EDR: Pi/4-DQPSK	
Modulation:	BLE: GMSK	
Modulation:	ANT: GFSK	
Modulation:	NFC:	
DUT Power Source:	3VDC Rechargeable Li-Ion	
DUT Dimensions [LxWxH]	H x W x D: 50mm x 45mm x 18mm	
Deviation(s) from standard/procedure:	None	
Modification of DUT:	None	

3.0 SCOPE

Preface:

This Certification Report was prepared on behalf of:

Garmin International Inc.

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

Device:

The Garmin Model/HVIN: A03989 is an extremity worn digital transceiver device consisting of a WiFi, BlueTooth (BT), BlueTooth Low Energy (BLE), Adaptive Network Topology (ANT) and Near Field Communication (NFC) transceivers. The WiFi and BT/BLE/ANT transceivers share the same antenna and cannot simultaneously transmit.

Requirement:

The transceivers of this *equipment* are subject to emissions evaluation in accordance with FCC: 47 CFR 2, 15C, ISED: RSS-Gen, RSS-210 and RSS-247. As per FCC 47 CFR §2.1093 and Health Canada Safety Code 6, an RF Exposure (SAR) evaluation is required for this *Equipment* and the results of the RF Exposure (SAR) evaluation appear in a separate report.

Application:

This is an application for a New Certification.

Scope:

The scope of this investigation is limited to the evaluation and reporting of the wanted and spurious emissions in accordance with the rule parts cited in Normative References section of this report.

4.0 TEST SUMMARY

TEST SUMMARY						
Section	**Description of Test**	**Procedure Reference**	**Applicable Rule Part(s) FCC**	**Applicable Rule Part(s) ISED**	**Test Date**	**Result**
7.0	Occupied Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§2.1049	RSS-Gen (6.7)	17 Mar 2020	Pass
8.0	6dB Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(2)	RSS-Gen (6.7) RSS-247 (5.2)(a)	18 Mar 2020	Pass
9.0	20dB Bandwidth	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(a)(1)	RSS-Gen (6.7) RSS-247 (5.1)(c)	25 Mar 2020	Pass
10.0	Duty Cycle and Transmission Duration	ANSI C63.10-2013 KDB 558074 D01v05	n/a	n/a	20 Mar 2020	n/a
11.0	Conducted Power (Fundamental) (WiFi)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(3)	RSS-Gen (6.12) RSS-247 (5.4)(d)	20 Mar 2020	Pass
12.0	Conducted Power (Fundamental) (BlueTooth)	ANSI C63.10-2013 KDB 558074 D01v05	§2.1046 §15.247(b)(1)	RSS-Gen (6.12) RSS-247 (5.4)(b)	20 Mar 2020	Pass
13.0	Power Spectral Density	ANSI C63.10-2013 KDB 558074 D01v05	§15.247(e)	RSS-247 (5.2)(b)	24 Mar 2020	Pass
14.0	FHSS Hopping Channels	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	RSS-247 (5.1)(d)	25 Mar 2020	Pass
15.0	FHSS Channel Separation	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)	RSS-247 (5.1)(b)	25 Mar 2020	Pass
16.0	FHSS Time of Occupancy	ANSI C63.4-2014 KDB 558074 D01v05	§15.247(a)(1)(iii)	RSS-247 (5.1)(d)	25 Mar 2020	Pass
17.0	Conducted Tx Spurious Emissions	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	31 Mar 2020	Pass
18.0	Conducted Tx Spurious Emissions Band Edge	ANSI C63.10-2013 KDB 558074 D01v05	§2.1051 §15.247(d)	RSS-Gen (6.13) RSS-247 (5.5)	1 Apr 2020	Pass
19.0	Radiated Tx Spurious Emissions And Restricted Band	ANSI C63.4-2014 KDB 558074 D01v05	§15.109 §15.247(d)	RSS-Gen (6.13)	1 Apr 2020	Pass
20.0	Radiated Rx Spurious Emissions	ANSI C63.4-2014 KDB 558074 D01v05	§15.109	RSS-Gen (7.4) ICES-003(6.2)	1 Apr 2020	Pass

Test Station Day Log					
Date	Ambient Temp (°C)	Relative Humidity (%)	Barometric Pressure (kPa)	Test Station	Tests Performed Section(s)
17 Mar 2020	22.8	16	101.6	**EMC**	**7, 8, 9**
18 Mar 2020	24.5	17	101.5	**EMC**	**7, 8, 9**
19 Mar 2020	22.7	16	102.0	**EMC**	**11**
20 Mar 2020	23.1	16	102.7	**EMC**	**10, 12**
23 Mar 2020	23.7	16	100.4	**EMC**	**13**
24 Mar 2020	20.6	17	101.4	**EMC**	**13**
25 Mar 2020	21.5	18	101.6	**EMC**	**9,14,15,16**
26 Mar 2020	20.8	17	101.3	**SAC**	**20, 21**
26 Mar 2020	6.0	46	101.2	**OATS**	**20, 21**
27 Mar 2020	9.0	43	101.2	**OATS**	**20, 21**
31 Mar 2020	21.2	17	101.3	**EMC**	**17, 18**
1 Apr 2020	4.0	33	102.1	**OATS**	**19, 20**

EMC - EMC Test Bench
SAC - Semi-Anechoic Chamber
OATS - Open Area Test Site
TC - Temperature Chamber
LISN - LISN Test Area
ESD - ESD Test Bench
IMM - Immunity Test Area
RI - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.

Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

1 May 2020
Date

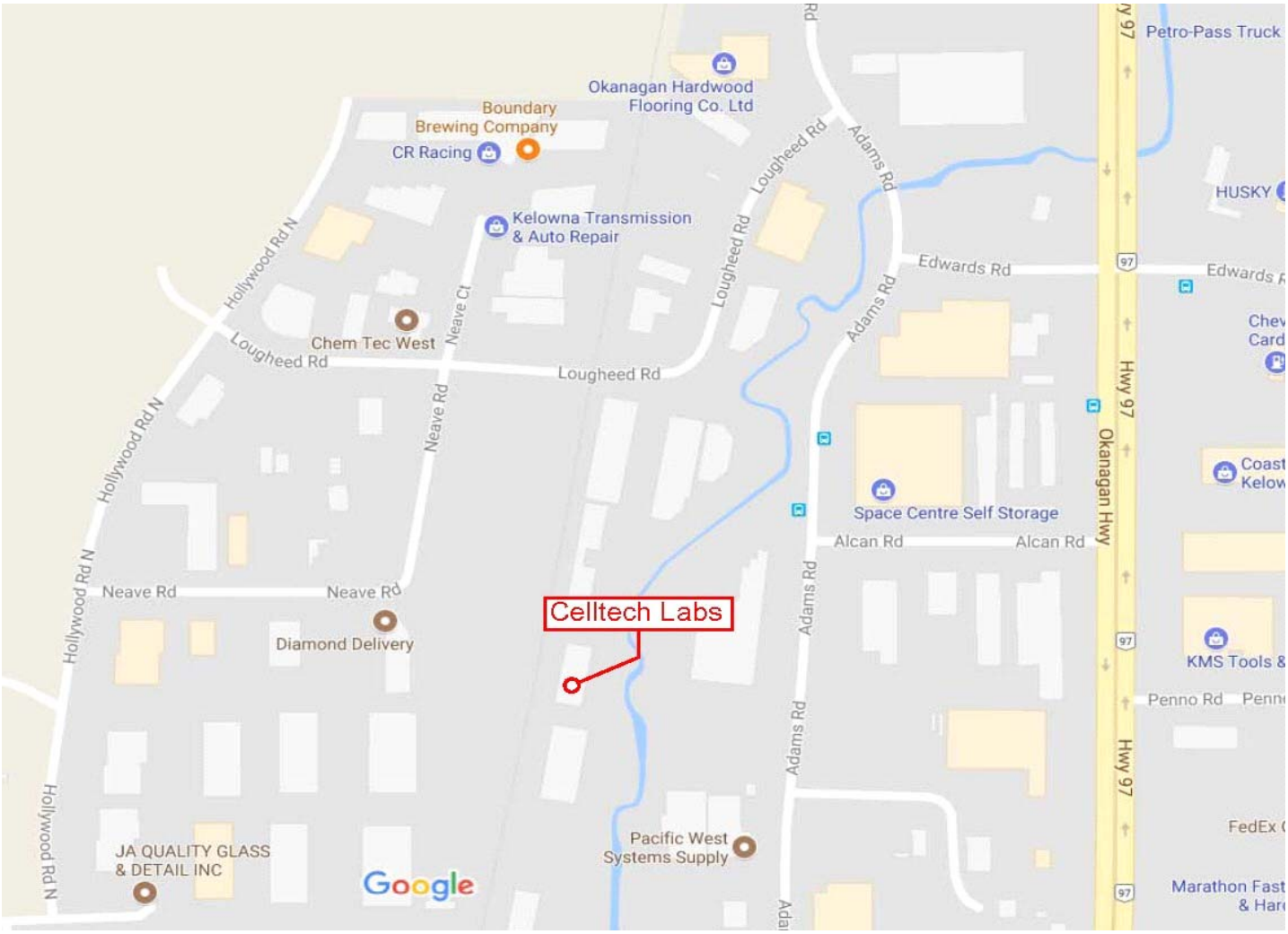
5.0 NORMATIVE REFERENCES

Normative References	
ISO/IEC 17025:2017	General requirements for the competence of testing and calibration laboratories
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR Title 47: Part 2:	Code of Federal Regulations Telecommunication Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR Title 47: Part 15: Sub Part C (15.247)	Code of Federal Regulations Telecommunication Radio Frequency Devices Intentional Radiators
CFR Title 47: Part 15: Subpart B:	Code of Federal Regulations Telecommunication Radio Frequency Devices Unintentional Radiators
FCC KDB 558074 D01v05r02	OET Major Guidance Publications, Knowledge Data Base Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247
ISED RSS-Gen Issue 5: Amendment 1: March 2019	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment
ISED RSS-247 Issue 2: February 2017	Innovation, Science and Economic Development Canada Spectrum Management and Telecommunications Radio Standards Specification Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licensed-Exempt Local Area Network (LE_LAN) Devices

6.0 FACILITIES AND ACCREDITATIONS

Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 3874A-1. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



7.0 OCCUPIED BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3)

General Procedure	
KDB 558074 (8.3.2.1)	**8.3.2.1 General** Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.
C63.10 (6.9.3)	**6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure** The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth: a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW. b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement. c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2. d) Step a) through step c) might require iteration to adjust within the specified range. e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used. f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

Test Setup	Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded and used for the basis for measuring the Conducted Output Power (See Section 10.0) and Power Spectral Density (See Section 11.0).

Table 7.1 – Summary of Occupied Bandwidth Measurements (WiFi)

See Appendix D for Measurement Plots

99% Occupied Bandwidth Measurement Results - 802.11b/g/n						
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured OBW (MHz)	Emission Designator	Result
2437.00	802.11b - CCK	1.00	100	14.56	n/a	Complies
	802.11b - CCK	2.00		14.48		Complies
	802.11b - DSSS	5.50		13.92		Complies
	802.11b - DSSS	11.00		14.08		Complies
	802.11g - OFDM	6.00		17.28		Complies
	802.11g - OFDM	9.00		17.20		Complies
	802.11g - OFDM	12.00		17.04		Complies
	802.11g - OFDM	18.00		16.88		Complies
	802.11g - OFDM	24.00		16.96		Complies
	802.11g - OFDM	36.00		16.96		Complies
	802.11g - OFDM	48.00		16.96		Complies
	802.11g - OFDM	54.00		16.88		Complies
	802.11n - MCS0	-		18.00		Complies
	802.11n - MCS1	-		18.00		Complies
	802.11n - MCS2	-		18.00		Complies
	802.11n - MCS3	-		17.92		Complies
	802.11n - MCS4	-		17.92		Complies
	802.11n - MCS5	-		18.00		Complies
	802.11n - MCS6	-		18.08		Complies
	802.11n - MCS7	-		18.00		Complies

Table 7.2 – Summary of Occupied Bandwidth Measurements (BlueTooth)

See Appendix D for Measurement Plots

99% Occupied Bandwidth Measurement Results - 802.15						
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured OBW (MHz)	Emission Designator	Result
2402.00	GFSK	-	17.9	0.935	n/a	Complies
2441.00	GFSK	-		0.935		Complies
2480.00	GFSK	-		0.950		Complies
2402.00	Pi/4-DQPSK	-	100	1.62		Complies
2441.00	Pi/4-DQPSK	-		1.90		Complies
2480.00	Pi/4-DQPSK	-		2.03		Complies

8.0 DTS BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a),
	KDB 558074 (8.2), ANSI C63.10 (11.8.2)

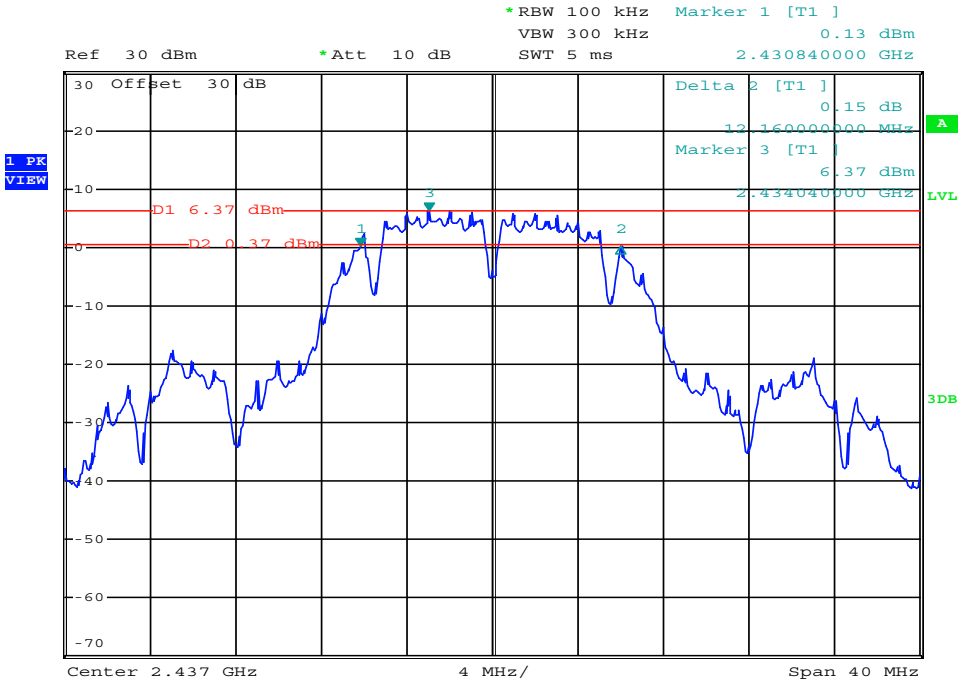
Limits	
47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
RSS-247 (5.2)(a)	5.2 Digital transmission systems DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz: a) The minimum 6 dB bandwidth shall be 500 kHz.
KDB 558074 (8.2) C63.10 (11.8.2)	**8.2 Option 2** The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
Test Setup	**Appendix A Figure A.1**

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as above using the Automatic 6dB Cursor Bandwidth measurement. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle.

Plot 8.1 – 6dB DTS Bandwidth 802.11b

6dB Bandwidth

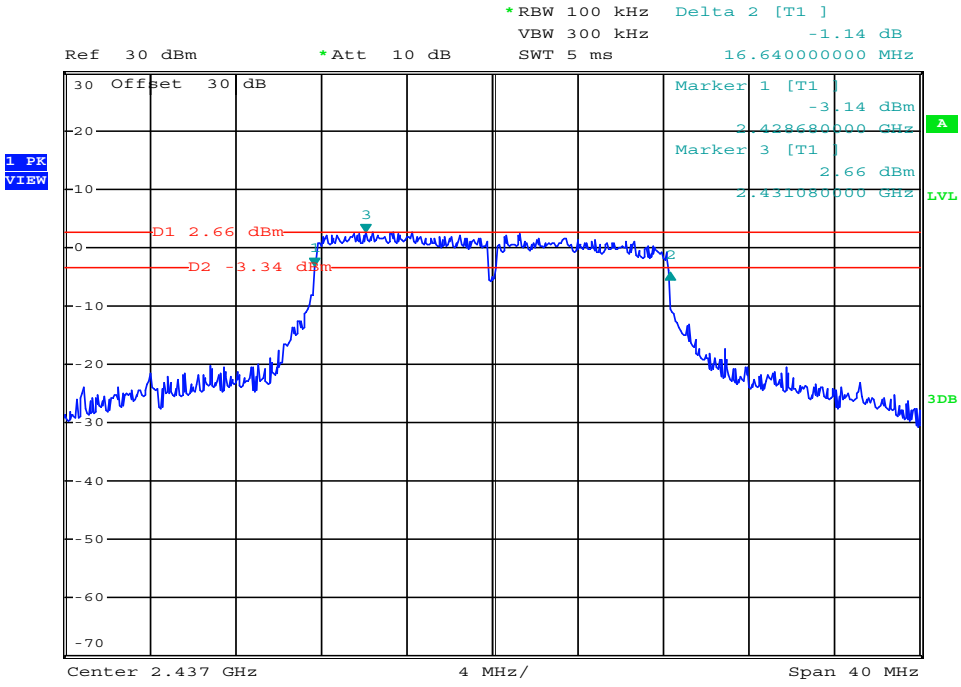


Date: 17.MAR.2020 16:02:46

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2437.00 MHz	**1** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
802.11b - CCK	**Max** dBm	**12.160** MHz

Plot 8.2 – 6dB DTS Bandwidth 802.11g

6dB Bandwidth

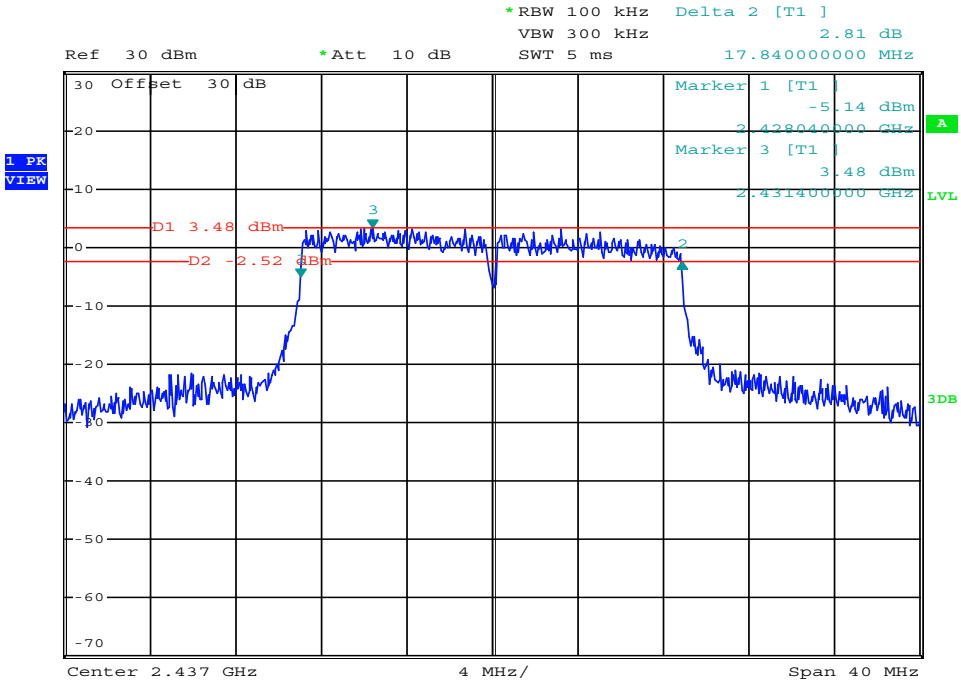


Date: 18.MAR.2020 08:55:17

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2437.00 MHz	**6** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
802.11g - OFDM	**Max** dBm	**16.640** MHz

Plot 8.3 – 6dB DTS Bandwidth 802.11n

6dB Bandwidth



Date: 18.MAR.2020 09:05:17

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2437.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
802.11n - MCS0	**Max** dBm	**17.840** MHz

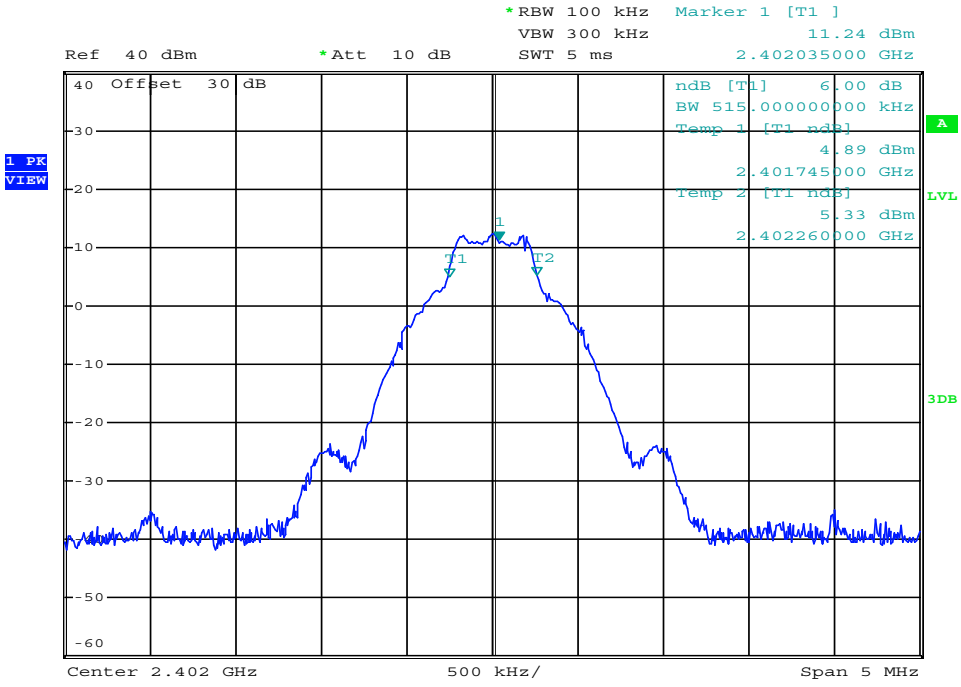
Table 8.1 – Summary of 6dB DTS Bandwidth Measurements, (WiFi)

6dB Bandwidth Measurement Results - 802.11							
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured 6dB BW [BW_{Meas}] (MHz)	Minimum 6dB BW [BW_{Min}] (MHz)	Margin (MHz)	Result
2437.00	802.11b - CCK	1.00	100	12.160	0.5	11.660	Complies
2437.00	802.11g - OFDM	5.50	100	16.640	0.5	16.140	Complies
2437.00	802.11n - MCS0	-	100	17.840	0.5	17.340	Complies

Margin = BW_{Meas} - BW_{Min}

Plot 8.4 – 6dB DTS Bandwidth BT BR, 2402MHz

6dB Bandwidth

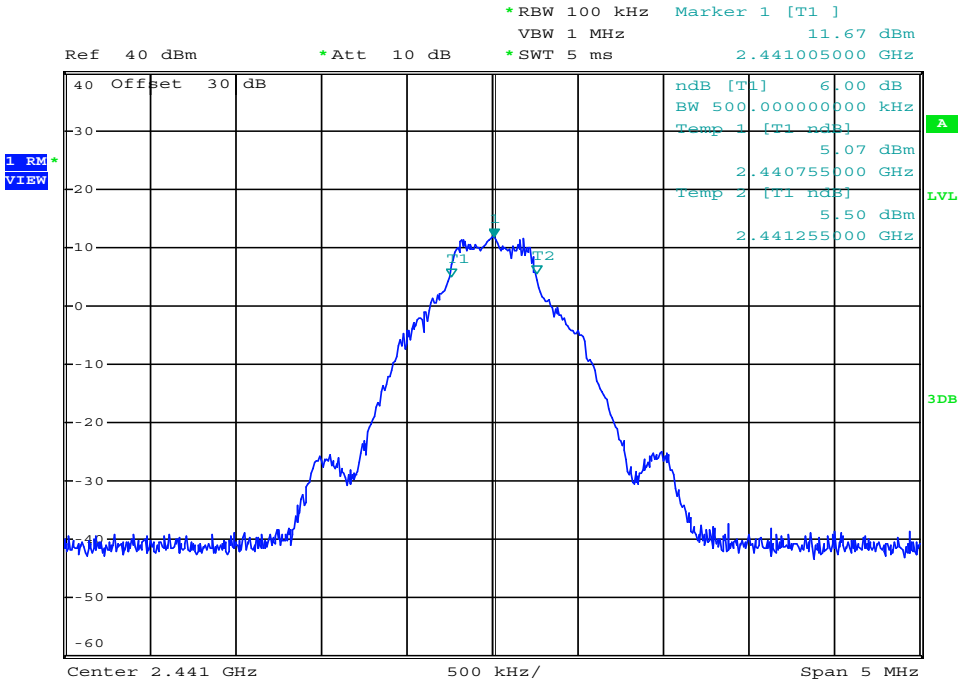


Date: 18.MAR.2020 10:58:07

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
GFSK	**Max** dBm	**0.515** MHz

Plot 8.5 – 6dB DTS Bandwidth BT BR, 2441MHz

6dB Bandwidth

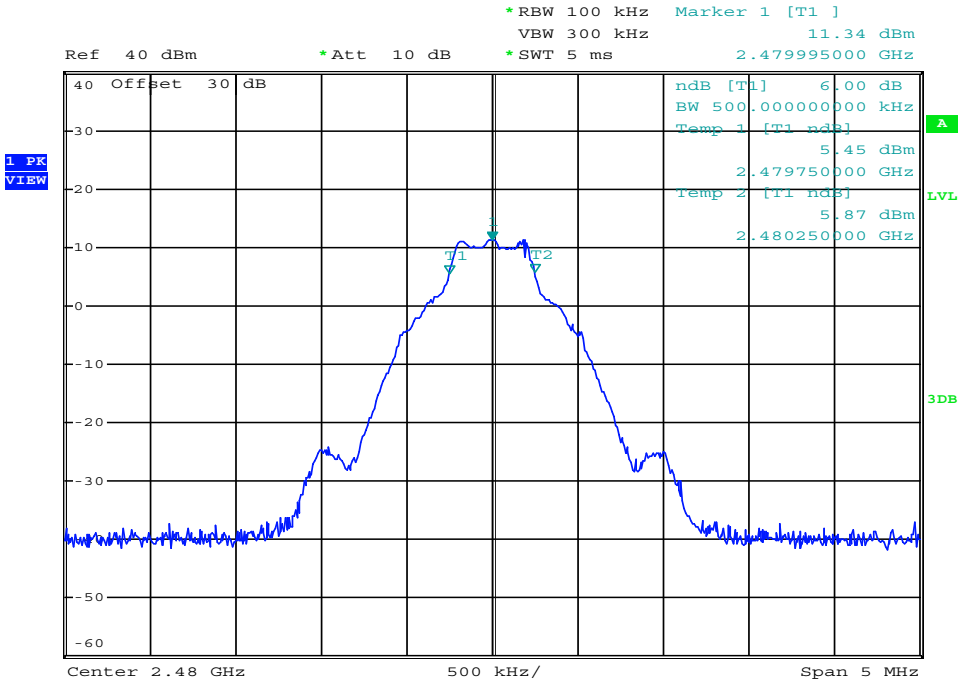


Date: 18.MAR.2020 11:05:59

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
GFSK	**Max** dBm	**0.500** MHz

Plot 8.6 – 6dB DTS Bandwidth BT BR, 2480MHz

6dB Bandwidth

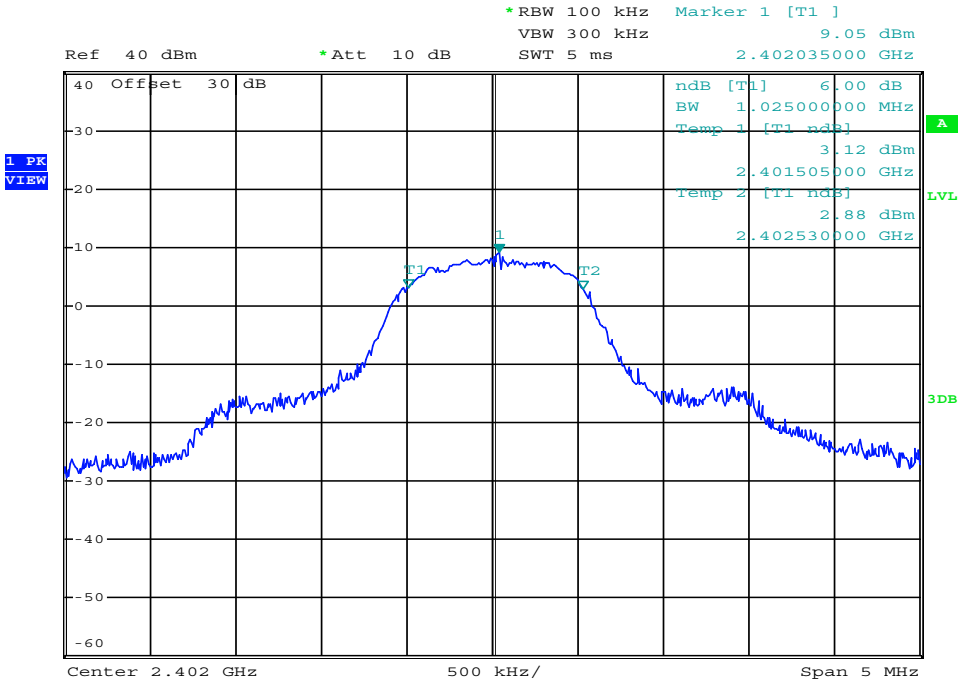


Date: 18.MAR.2020 11:08:54

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
GFSK	**Max** dBm	**0.500** MHz

Plot 8.7 – 6dB DTS Bandwidth BT EDR, 2402MHz

6dB Bandwidth

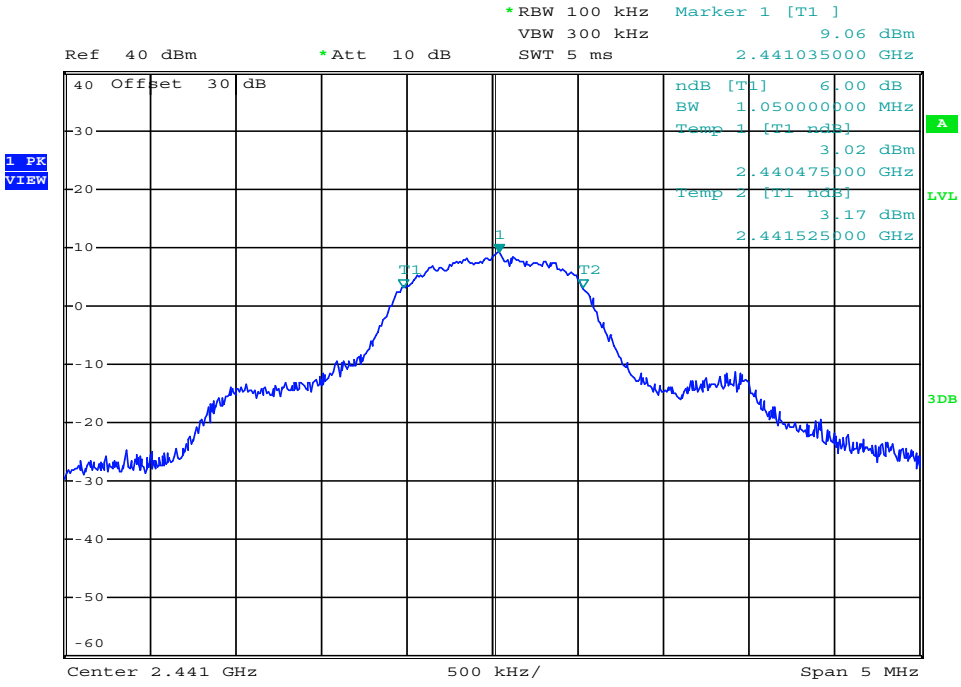


Date: 18.MAR.2020 10:55:32

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.025** MHz

Plot 8.8 – 6dB DTS Bandwidth BT EDR, 2441MHz

6dB Bandwidth

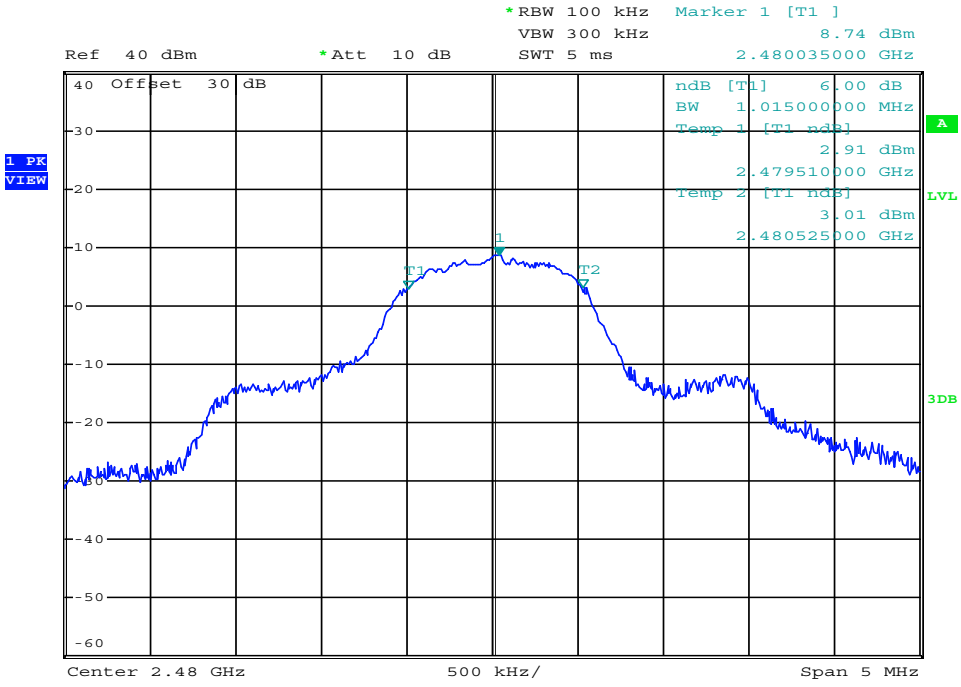


Date: 18.MAR.2020 10:38:26

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.050** MHz

Plot 8.9 – 6dB DTS Bandwidth BT EDR, 2480MHz

6dB Bandwidth



Date: 18.MAR.2020 10:40:51

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 6dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.015** MHz

Table 8.2 – Summary of 6dB DTS Bandwidth Measurements, (BlueTooth)

6dB Bandwidth Measurement Results - 802.15							
Frequency (MHz)	**Modulation**	**Bit Rate (Mbps)**	**Transmit Duty Cycle (%)**	**Measured 6dB BW [BW_{Meas}] (MHz)**	**Minimum 6dB BW [BW_{Min}] (MHz)**	**Margin (MHz)**	**Result**
2402.00	GFSK	-	17.9	0.515	0.5	0.015	Complies
2441.00	GFSK	-	17.9	0.500	0.5	0.000	Complies
2480.00	GFSK	-	17.9	0.500	0.5	0.000	Complies
2402.00	Pi/4-DQPSK	-	100	1.025	0.5	0.525	Complies
2441.00	Pi/4-DQPSK	-	100	1.050	0.5	0.550	Complies
2480.00	Pi/4-DQPSK	-	100	1.015	0.5	0.515	Complies

Margin = BW_{Meas} - BW_{Min}

9.0 20DB BANDWIDTH

Test Procedure	
Normative Reference	FCC 47 CFR §2.1049, §15.247(a)(1), RSS-Gen (6.7), RSS-247 (5.1)(b), KDB 558074 (8.2), ANSI C63.10 (11.8.2)

Limits	
47 CFR §15.247(a)(2)	(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (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 2400- 2483.5 MHz band 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 125 mW.
RSS-247 (5.1)(b)	**5.1 Frequency hopping systems (FHS)** The following applies to FHSs in each of the three bands: 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.

General Procedure	
KDB 558074 (8.2) C63.10 (11.8.2)	**11.8.2 Option 2** The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

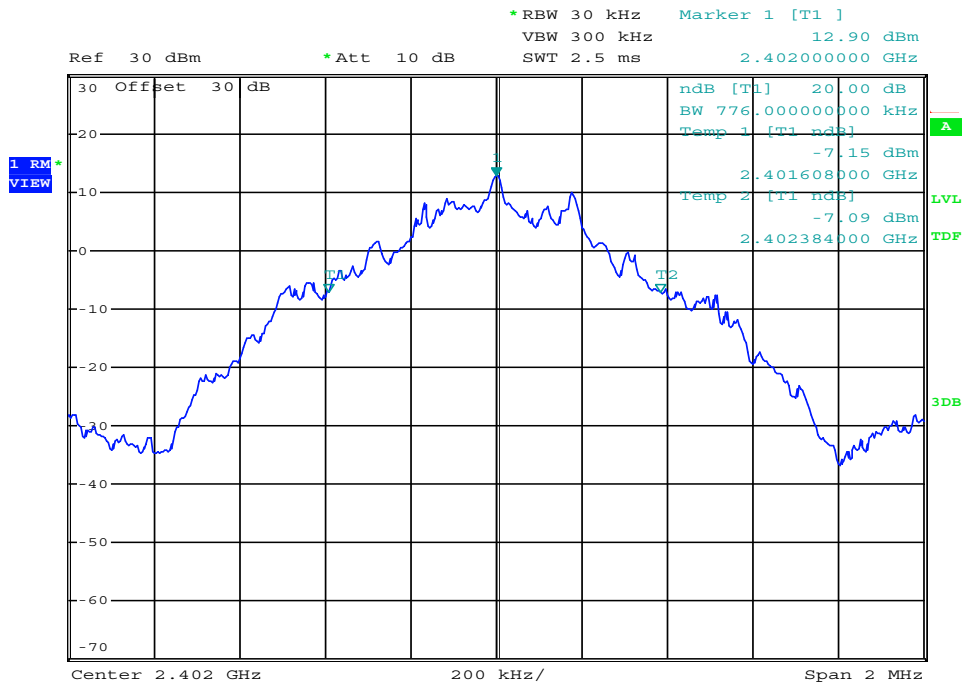
Test Setup	Appendix A - Figure A.1

Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as above using the Automatic 6dB Cursor Bandwidth measurement. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle.

Plot 9.1 – 20dB Bandwidth BT BR, 2402MHz

20dB Bandwidth

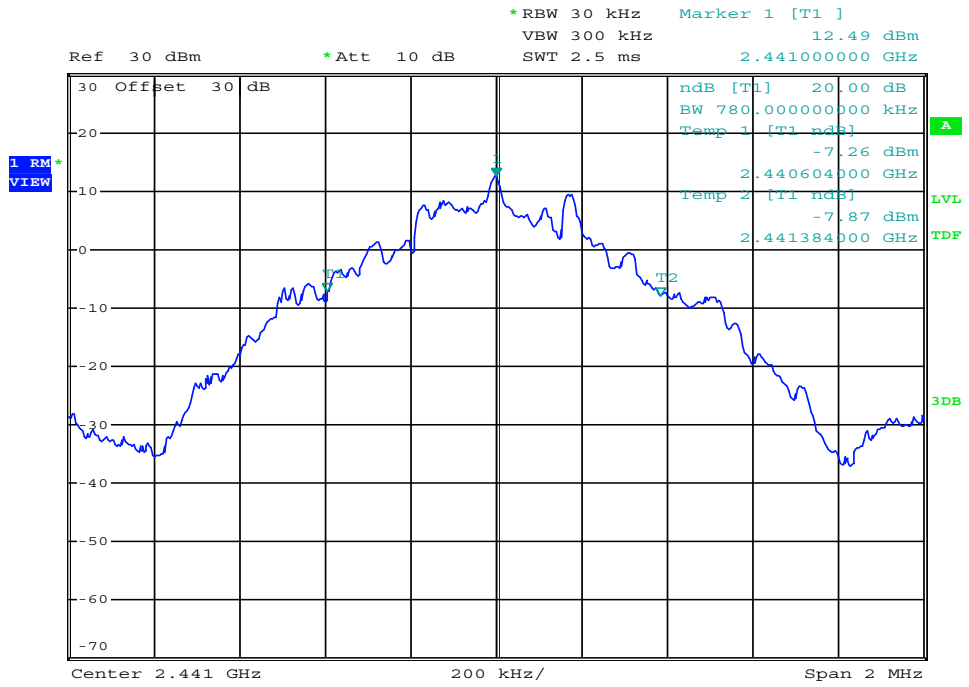


Date: 25.MAR.2020 14:39:41

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
GFSK	**Max** dBm	**0.776** MHz

Plot 9.2 – Occupied Bandwidth BT BR, 2441MHz

20dB Bandwidth

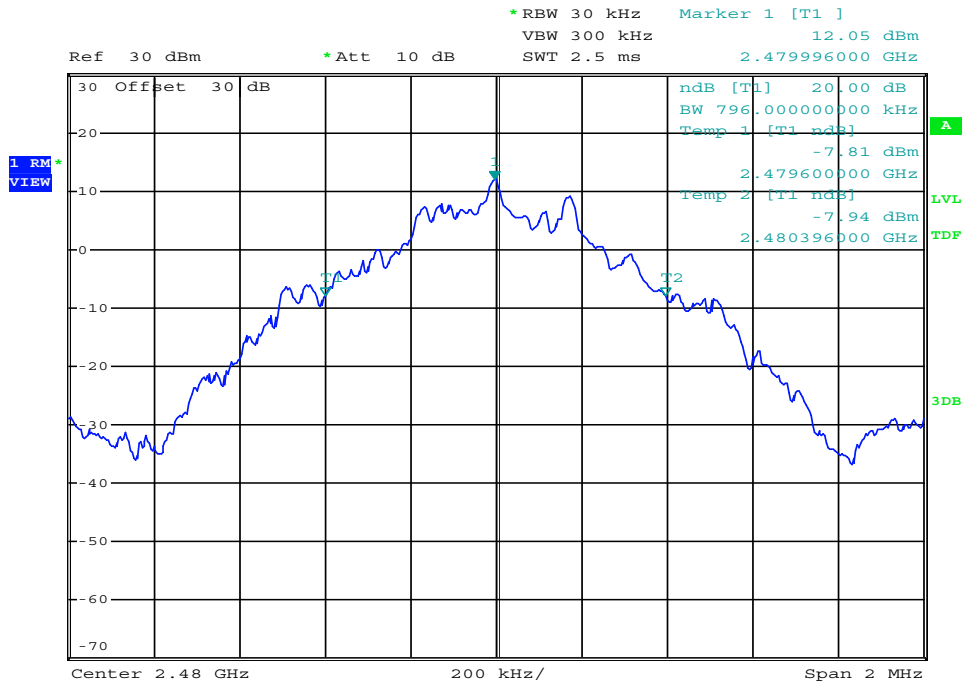


Date: 25.MAR.2020 14:41:25

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
GFSK	**Max** dBm	**0.780** MHz

Plot 9.3 – Occupied Bandwidth BT BR, 2480MHz

20dB Bandwidth

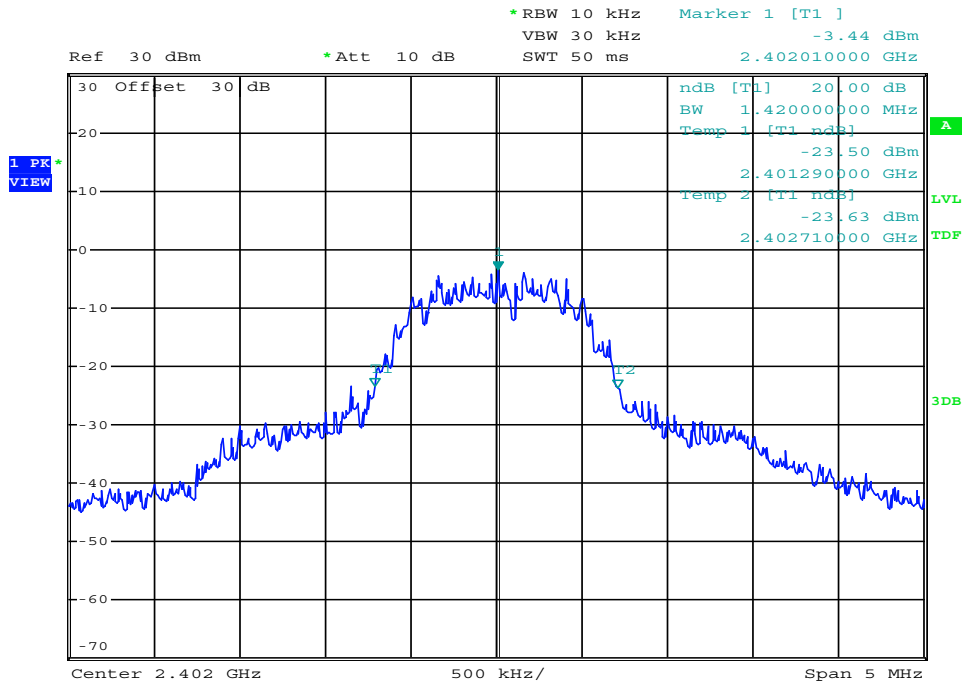


Date: 25.MAR.2020 14:42:46

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
GFSK	**Max** dBm	**0.796** MHz

Plot 9.4 – Occupied Bandwidth BT EDR, 2402MHz

20dB Bandwidth

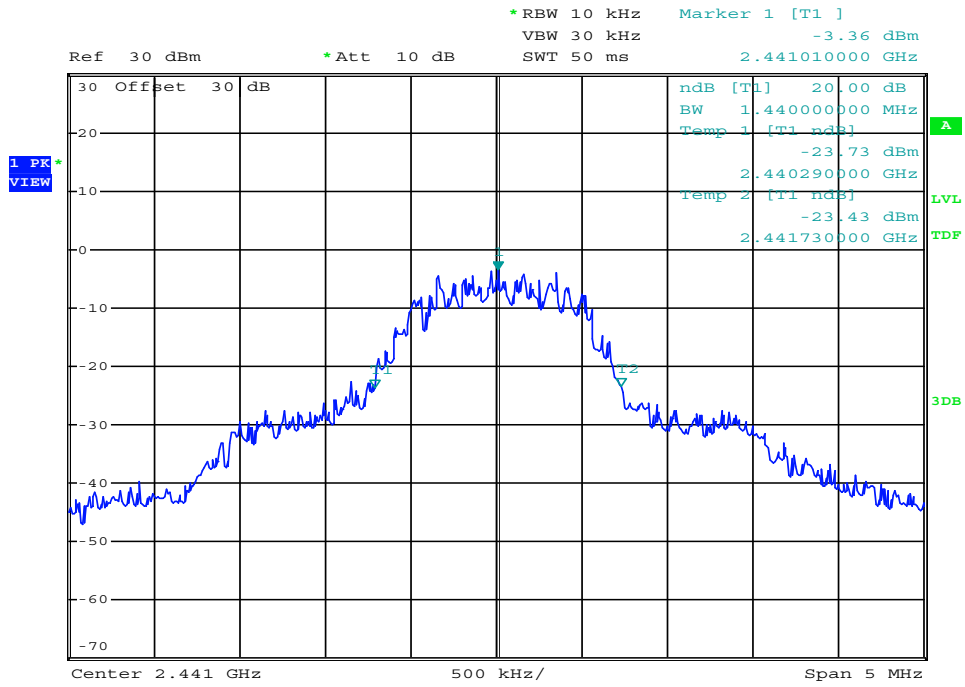


Date: 25.MAR.2020 15:57:19

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.420** MHz

Plot 9.5 – Occupied Bandwidth BT EDR, 2441MHz

20dB Bandwidth

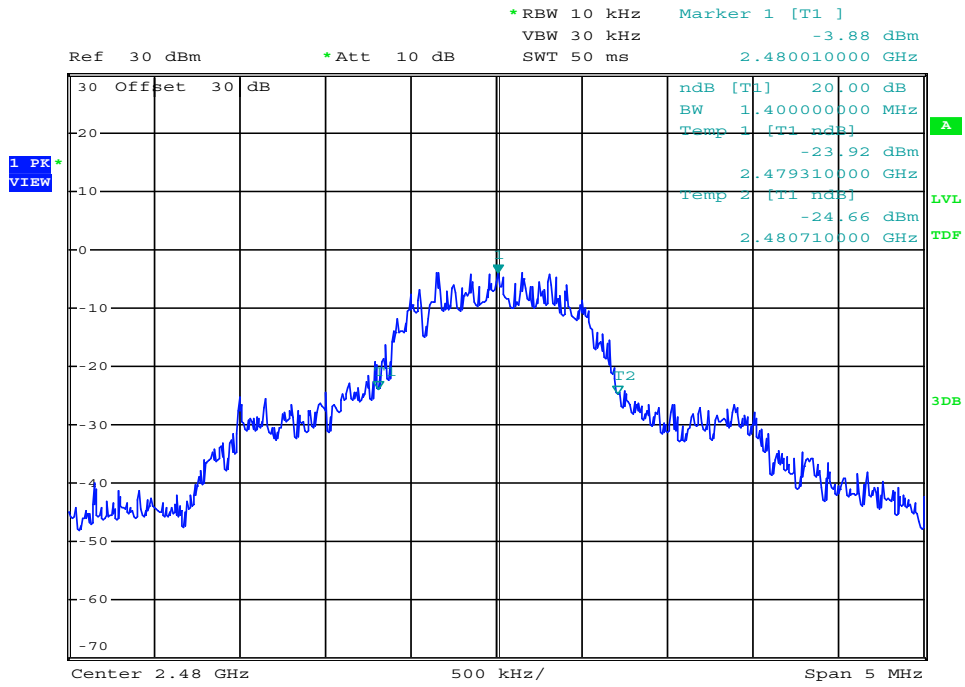


Date: 25.MAR.2020 15:58:21

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.440** MHz

Plot 9.6 – Occupied Bandwidth BT EDR, 2480MHz

20dB Bandwidth



Date: 25.MAR.2020 15:56:05

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured 20dB BW:**
Pi/4-DQPSK	**Max** dBm	**1.400** MHz

Table 9.1 – Summary 20dB Bandwidth Measurements

20dB Bandwidth Measurement Results - 802.15						
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured 20dB BW [BW_{Meas}] (MHz)	Minimum Channel Separation (MHz)	Result
2402.00	GFSK	-	17.9	0.776	0.776	Complies
2441.00	GFSK	-	17.9	0.780	0.780	Complies
2480.00	GFSK	-	17.9	0.796	0.796	Complies
2402.00	Pi/4-DQPSK	-	100	1.420	0.947 (1)	Complies
2441.00	Pi/4-DQPSK	-	100	1.440	0.960 (1)	Complies
2480.00	Pi/4-DQPSK	-	100	1.400	0.933 (1)	Complies

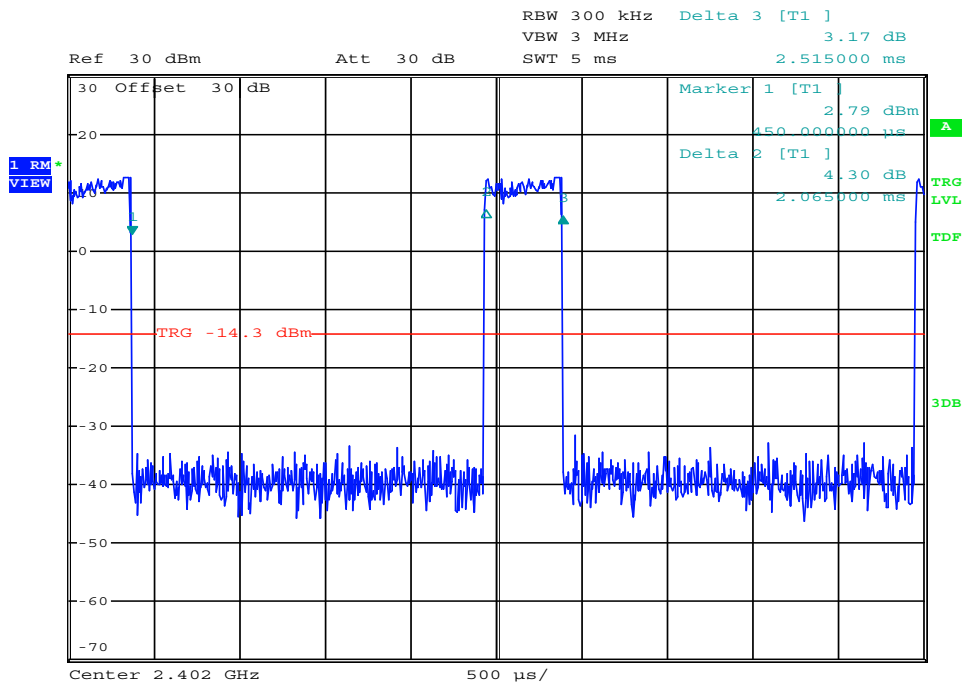
(1) Per FCC §15.247(a)(1) and ISED RSS-247 (5.1)(a):
Alternatively, frequency hopping systems operating in the 2400- 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The output power of this device is not greater than 125mW.

(1) Minimum Channel Separation = BW_{Meas} x 2/3

10.0 DUTY CYCLE AND TRANSMISSION DURATION

Plot 10.1 – Duty Cycle – BT BR, 2402MHz

Transmit Duty Cycle



Date: 20.MAR.2020 12:30:35

Channel Frequency:	Modulation Setting:	Measured Duty Cycle:
2402.00 MHz	**GFSK**	**17.9** %

Table 10.1 – Summary Duty Cycle Measurement

Transmit Duty Cycle Results 802.15		
Frequency (MHz)	**Modulation**	**Measured Duty Cycle Cycle (%)**
2402.00	GFSK	17.9

The variation of the transmit duty cycle was less than 2%

11.0 ANTENNA PORT CONDUCTED POWER, (WIFI)

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Table 11.1 – Summary of Conducted Power Measurements, (WiFi)

See Appendix E for Measurement Plots

Conducted Power Measurement Results - 802.11											
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured Power [P_{Meas}] (dBm)	Conducted Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)	Result
2412.00	802.11b - DSSS	5.5	100	15.64	30	14.360	0.6	16.24	36	19.760	Complies
2417.00	802.11b - DSSS	5.5	100	17.82	30	12.180	0.6	18.42	36	17.580	Complies
2422.00	802.11b - DSSS	5.5	100	17.66	30	12.340	0.6	18.26	36	17.740	Complies
2427.00	802.11b - DSSS	5.5	100	17.64	30	12.360	0.6	18.24	36	17.760	Complies
2432.00	802.11b - DSSS	5.5	100	17.77	30	12.230	0.6	18.37	36	17.630	Complies
2437.00	802.11b - DSSS	5.5	100	17.84	30	12.160	0.6	18.44	36	17.560	Complies
2442.00	802.11b - DSSS	5.5	100	17.80	30	12.200	0.6	18.40	36	17.600	Complies
2447.00	802.11b - DSSS	5.5	100	17.78	30	12.220	0.6	18.38	36	17.620	Complies
2452.00	802.11b - DSSS	5.5	100	17.76	30	12.240	0.6	18.36	36	17.640	Complies
2457.00	802.11b - DSSS	5.5	100	17.83	30	12.170	0.6	18.43	36	17.570	Complies
2462.00	802.11b - DSSS	5.5	100	15.44	30	14.560	0.6	16.04	36	19.960	Complies
2417.00	802.11b - CCK	1.0	100	17.43	30	12.570	0.6	18.03	36	17.970	Complies
2437.00	802.11b - CCK	1.0	100	17.56	30	12.440	0.6	18.16	36	17.840	Complies
2457.00	802.11b - CCK	1.0	100	17.49	30	12.510	0.6	18.09	36	17.910	Complies
2417.00	802.11b - DSSS	11.0	100	17.60	30	12.400	0.6	18.20	36	17.800	Complies
2437.00	802.11b - DSSS	11.0	100	17.66	30	12.340	0.6	18.26	36	17.740	Complies
2457.00	802.11b - DSSS	11.0	100	17.62	30	12.380	0.6	18.22	36	17.780	Complies

Conducted Margin = $P_{Limit} - P_{Meas}$

EIRP Margin = $E_{Limit} - E_{Meas}$

Table 11.1 – Summary of Conducted Power Measurements, (WiFi) Cont.

See Appendix E for Measurement Plots

Conducted Power Measurement Results - 802.11											
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured Power [P_{Meas}] (dBm)	Conducted Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)	Result
2437.00	802.11g - OFDM	6.0	100	16.40	30	13.600	0.6	17.00	36	19.000	Complies
2437.00	802.11g - OFDM	9.0	100	16.34	30	13.660	0.6	16.94	36	19.060	Complies
2437.00	802.11g - OFDM	12.0	100	16.28	30	13.720	0.6	16.88	36	19.120	Complies
2437.00	802.11g - OFDM	18.0	100	16.26	30	13.740	0.6	16.86	36	19.140	Complies
2437.00	802.11g - OFDM	24.0	100	16.13	30	13.870	0.6	16.73	36	19.270	Complies
2437.00	802.11g - OFDM	36.0	100	16.12	30	13.880	0.6	16.72	36	19.280	Complies
2437.00	802.11g - OFDM	48.0	100	16.11	30	13.890	0.6	16.71	36	19.290	Complies
2437.00	802.11g - OFDM	54.0	100	15.92	30	14.080	0.6	16.52	36	19.480	Complies
2437.00	802.11n - MCS0	-	100	16.11	30	13.890	0.6	16.71	36	19.290	Complies
2437.00	802.11n - MCS1	-	100	16.08	30	13.920	0.6	16.68	36	19.320	Complies
2437.00	802.11n - MCS4	-	100	16.22	30	13.780	0.6	16.82	36	19.180	Complies
2437.00	802.11n - MCS7	-	100	16.03	30	13.970	0.6	16.63	36	19.370	Complies

Conducted Margin = P_{Limit} - P_{Meas}

EIRP Margin = E_{Limit} - E_{Meas}

12.0 ANTENNA PORT CONDUCTED POWER, (BLUETOOTH)

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

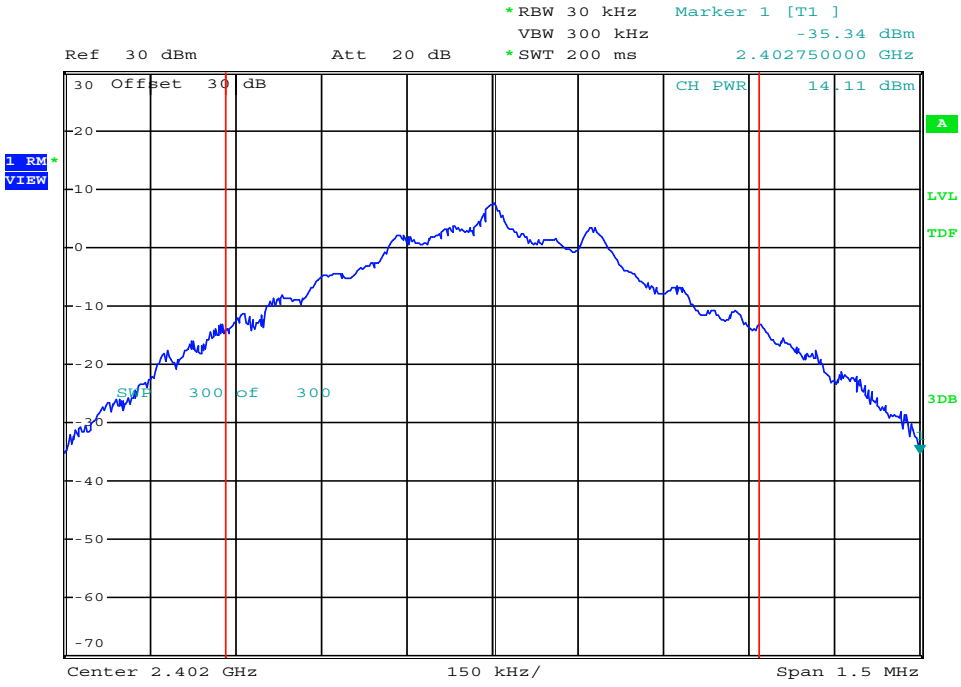
Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Test Procedure	
Normative Reference	FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d),
	KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2)

Limits	
47 CFR §15.247(b)(3)	(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.
RSS-247 (5.4)(d)	**5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)** Devices shall comply with the following requirements, where applicable: 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.

Plot 12.1 – Conducted Power BT BR, 2402MHz

Conducted Power

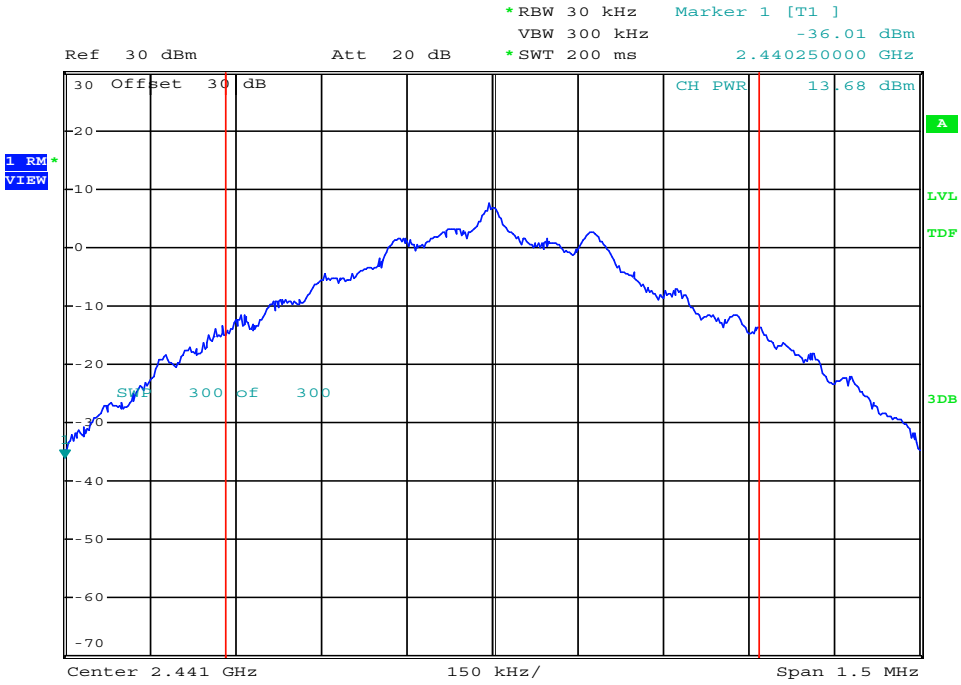


Date: 20.MAR.2020 15:08:29

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
GFSK	**Max** dBm	**14.11** dBm

Plot 12.2 – Conducted Power BT BR, 2441MHz

Conducted Power

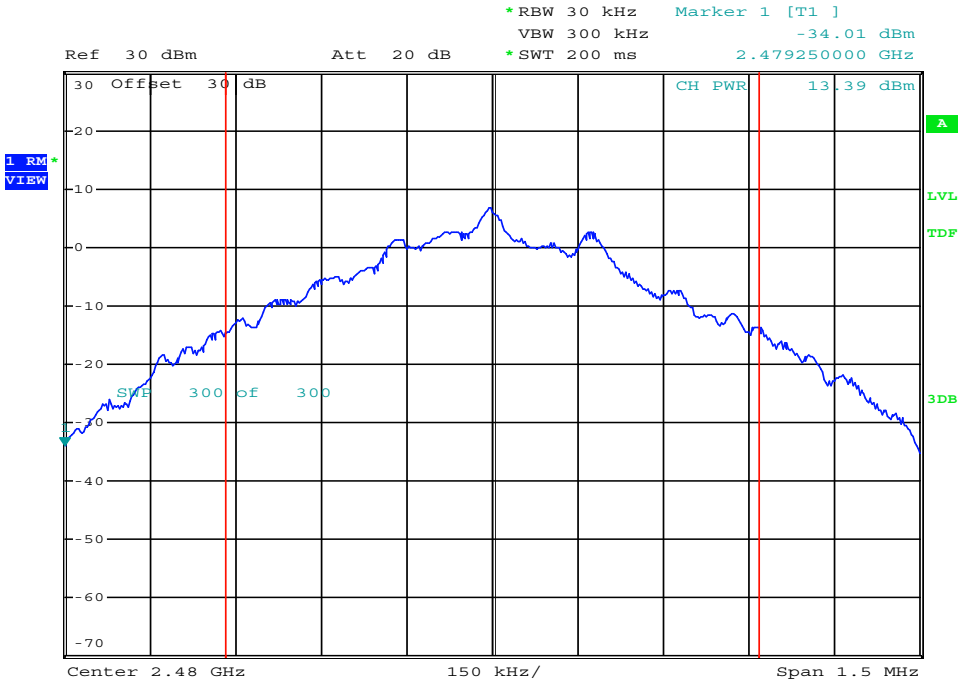


Date: 20.MAR.2020 15:23:13

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
GFSK	**Max** dBm	**13.60** dBm

Plot 12.3 – Conducted Power BT BR, 2480MHz

Conducted Power

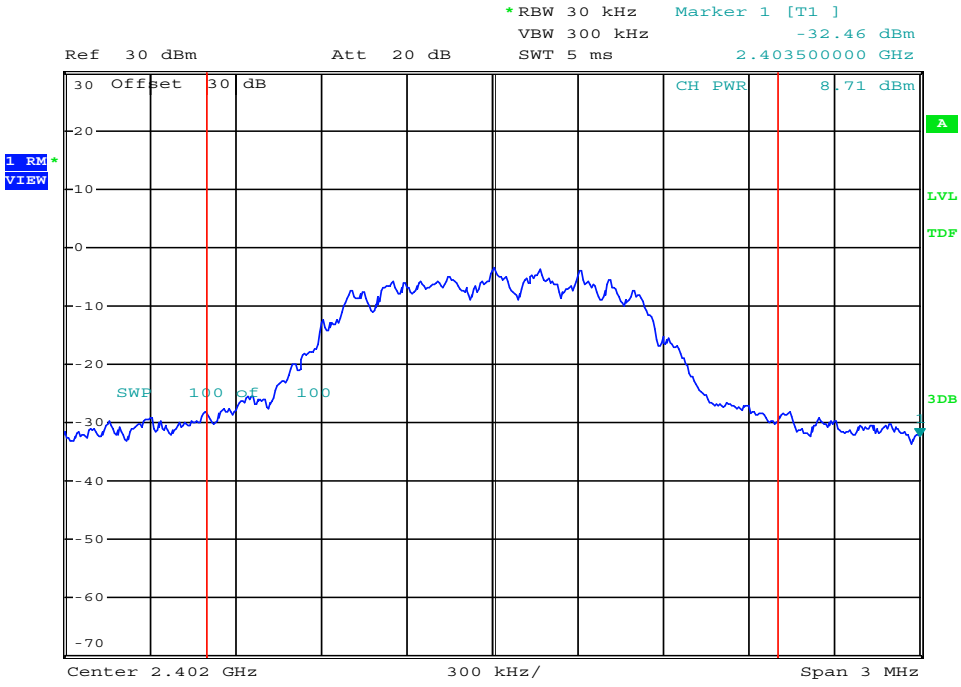


Date: 20.MAR.2020 15:25:10

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**18** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
GFSK	**Max** dBm	**13.39** dBm

Plot 12.4 – Conducted Power BT EDR, 2402MHz

Conducted Power

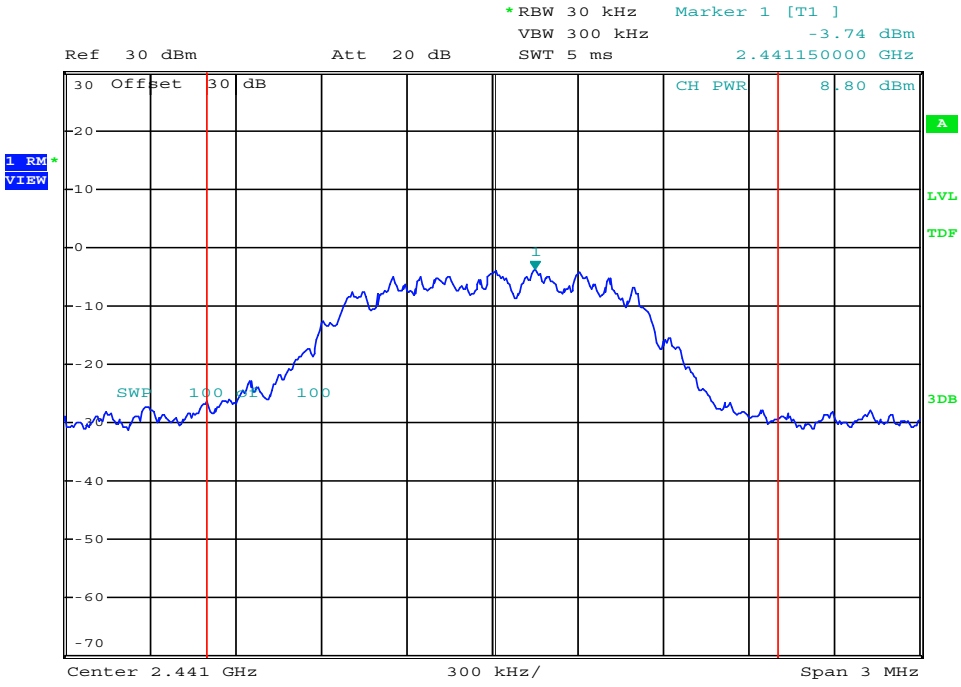


Date: 20.MAR.2020 15:34:26

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
Pi/4-DQPSK	**Max** dBm	**8.71** dBm

Plot 12.5 – Conducted Power BT EDR, 2441MHz

Conducted Power

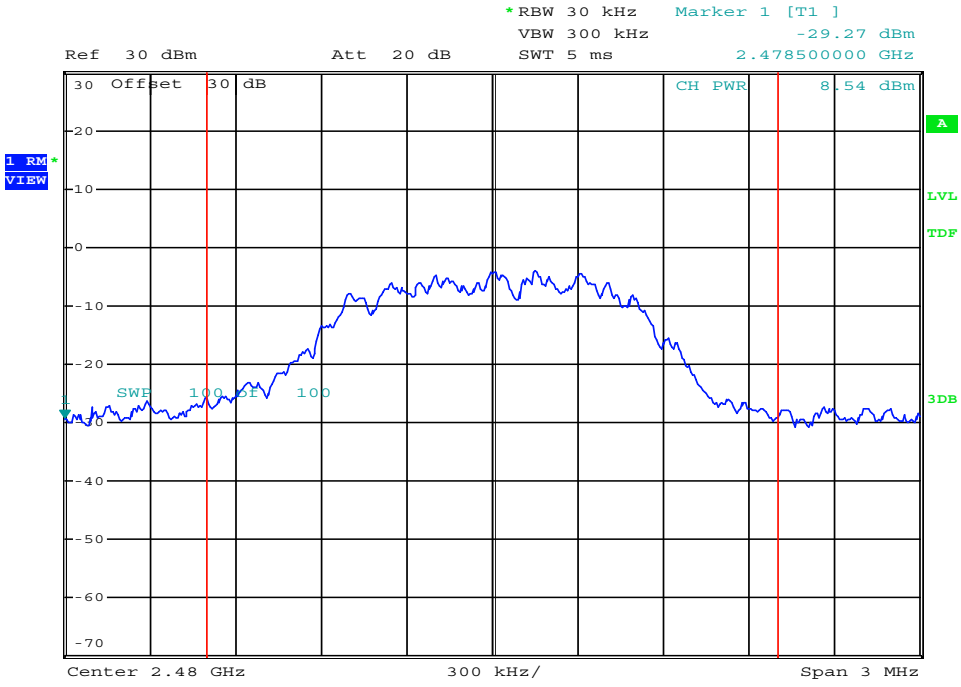


Date: 20.MAR.2020 15:32:25

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
Pi/4-DQPSK	**Max** dBm	**8.80** dBm

Plot 12.6 – Conducted Power BT EDR, 2480MHz

Conducted Power



Date: 20.MAR.2020 15:33:36

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** Mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Channel Power:**
Pi/4-DQPSK	**Max** dBm	**8.54** dBm

Table 12.1 – Summary of Conducted Power Measurements, BlueTooth)

Conducted Power Measurement Results - 802.15											
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured Power [P_{Meas}] (dBm)	Conducted Limit [P_{Lim}] (dBm)	Conducted Margin (dB)	Antenna Gain (dBi)	EIRP [E_{Meas}] (dBm)	EIRP Limit [E_{Lim}] (dBm)	EIRP Margin (dB)	Result
2402.00	GFSK	-	17.9	14.11	21	6.890	0.6	14.71	36	21.290	Complies
2441.00	GFSK	-	17.9	13.60	21	7.400	0.6	14.20	36	21.800	Complies
2480.00	GFSK	-	17.9	13.39	21	7.610	0.6	13.99	36	22.010	Complies
2402.00	Pi/4-DQPSK	-	100	8.71	21	12.290	0.6	9.31	36	26.690	Complies
2441.00	Pi/4-DQPSK	-	100	8.80	21	12.200	0.6	9.40	36	26.600	Complies
2480.00	Pi/4-DQPSK	-	100	8.54	21	12.460	0.6	9.14	36	26.860	Complies

Conducted Margin = $P_{Limit} - P_{Meas}$

EIRP Margin = $E_{Limit} - E_{Meas}$

13.0 POWER SPECTRAL DENSITY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247(e), RSS-247 (5.2)(b),
	KDB 558074 (10.3), ANSI C63.10 (11.10.3)

Limits	
47 CFR §15.247(e)	(e) For digitally modulated systems, 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.
RSS-247 (5.2)(b)	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. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).
KDB 558074 (10.3) C63.10 (11.10.3)	**Method AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each sweep) This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle ≥ 98 %); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered). a) Set instrument center frequency to DTS channel center frequency. b) Set span to at least 1.5 X OBW. c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. . d) Set VBW ≥ 3 X RBW. e) Detector = RMS f) Ensure that the number of measurement points in the sweep ≥ 2 X span/RBW. g) Sweep time = auto couple. h) Employ trace averaging (RMS) mode over a minimum of 100 traces. i) Use the peak marker function to determine the maximum amplitude level. j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).
Test Setup	**Appendix A Figure A.1**

Measurement Procedure
The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above. Number of Sweep Points ≥ 2 X Span / RBW = 2 X (1.5MHz / 3kHz) = 1000, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Power Spectral Density was measured and recorded.

Table 13.1 – Summary of Power Spectral Density Measurements, (WiFi)

See Appendix F for Power Density Measurement Plots

Power Spectral Density Measurement Results - 802.11							
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	PSD Limit [PSD_{Lim}] (dBm)	Margin (dB)	Result
2412.00	802.11b - CCK	1.0	100	-3.77	8	11.770	Complies
2417.00	802.11b - CCK	1.0	100	-1.33	8	9.330	Complies
2437.00	802.11b - CCK	1.0	100	-1.17	8	9.170	Complies
2457.00	802.11b - CCK	1.0	100	-1.25	8	9.250	Complies
2462.00	802.11b - CCK	1.0	100	-3.49	8	11.490	Complies
2417.00	802.11b - CCK	2.0	100	-1.24	8	9.240	Complies
2437.00	802.11b - CCK	2.0	100	-0.91	8	8.910	Complies
2457.00	802.11b - CCK	2.0	100	-0.98	8	8.980	Complies
2417.00	802.11b - DSSS	5.5	100	-1.71	8	9.710	Complies
2437.00	802.11b - DSSS	5.5	100	-1.42	8	9.420	Complies
2457.00	802.11b - DSSS	5.5	100	-1.24	8	9.240	Complies
2417.00	802.11b - DSSS	11.0	100	-1.67	8	9.670	Complies
2437.00	802.11b - DSSS	11.0	100	-1.47	8	9.470	Complies
2457.00	802.11b - DSSS	11.0	100	-1.64	8	9.640	Complies
2417.00	802.11g - OFDM	6.0	100	-3.73	8	11.730	Complies
2437.00	802.11g - OFDM	6.0	100	-3.82	8	11.820	Complies
2457.00	802.11g - OFDM	6.0	100	-3.93	8	11.930	Complies
2437.00	802.11g - OFDM	9.0	100	-3.73	8	11.730	Complies
2437.00	802.11g - OFDM	12.0	100	-3.88	8	11.880	Complies
2437.00	802.11g - OFDM	18.0	100	-3.97	8	11.970	Complies
2437.00	802.11g - OFDM	24.0	100	-4.24	8	12.240	Complies
2437.00	802.11g - OFDM	36.0	100	-4.00	8	12.000	Complies
2437.00	802.11g - OFDM	48.0	100	-3.97	8	11.970	Complies
2437.00	802.11g - OFDM	54.0	100	-3.83	8	11.830	Complies
2417.00	802.11n- MCS0	-	100	-4.08	8	12.080	Complies
2437.00	802.11n - MCS0	-	100	-4.06	8	12.060	Complies
2457.00	802.11n - MCS0	-	100	-4.33	8	12.330	Complies
2437.00	802.11n - MCS1	-	100	-4.31	8	12.310	Complies
2437.00	802.11n - MCS4	-	100	-4.17	8	12.170	Complies
2437.00	802.11n - MCS7	-	100	-4.20	8	12.200	Complies

Margin = PSD_{Limit} - PSD_{Meas}

Table 13.2 – Summary of Power Spectral Density Measurements, (BlueTooth)

See Appendix F for Power Density Measurement Plots

Power Spectral Density Measurement Results - 802.15							
Frequency (MHz)	Modulation	Bit Rate (Mbps)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	PSD Limit [PSD_{Lim}] (dBm)	Margin (dB)	Result
2402.00	GFSK	-	17.9	1.57	8	6.430	Complies
2441.00	GFSK	-	17.9	1.33	8	6.670	Complies
2480.00	GFSK	-	17.9	0.91	8	7.090	Complies
2402.00	Pi/4-DQPSK	-	100	1.21	8	6.790	Complies
2441.00	Pi/4-DQPSK	-	100	0.86	8	7.140	Complies
2480.00	Pi/4-DQPSK	-	100	0.79	8	7.210	Complies

Margin = PSD_{Limit} - PSD_{Meas}

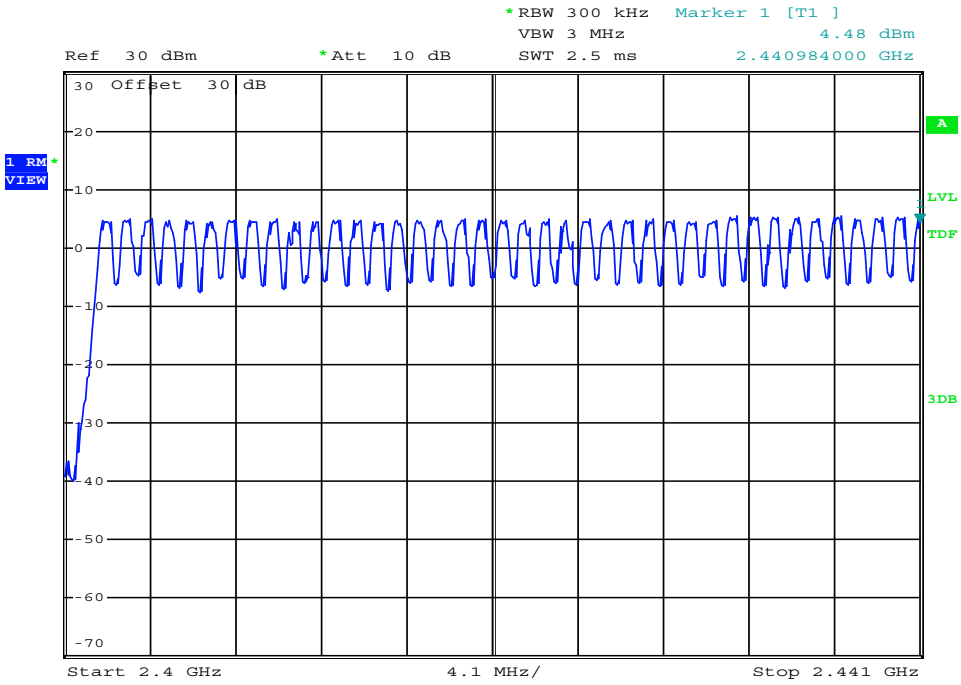
14.0 FHSS NUMBER OF HOPPING CHANNELS

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	**5.1 Frequency hopping systems (FHS)** The following applies to FHSs in each of the three bands: FHSs 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 at least 15 hopping channels are used.

Plot 14.1 – Number of Hopping Channels, 2400-2441MHz

Number of Hopping Channels

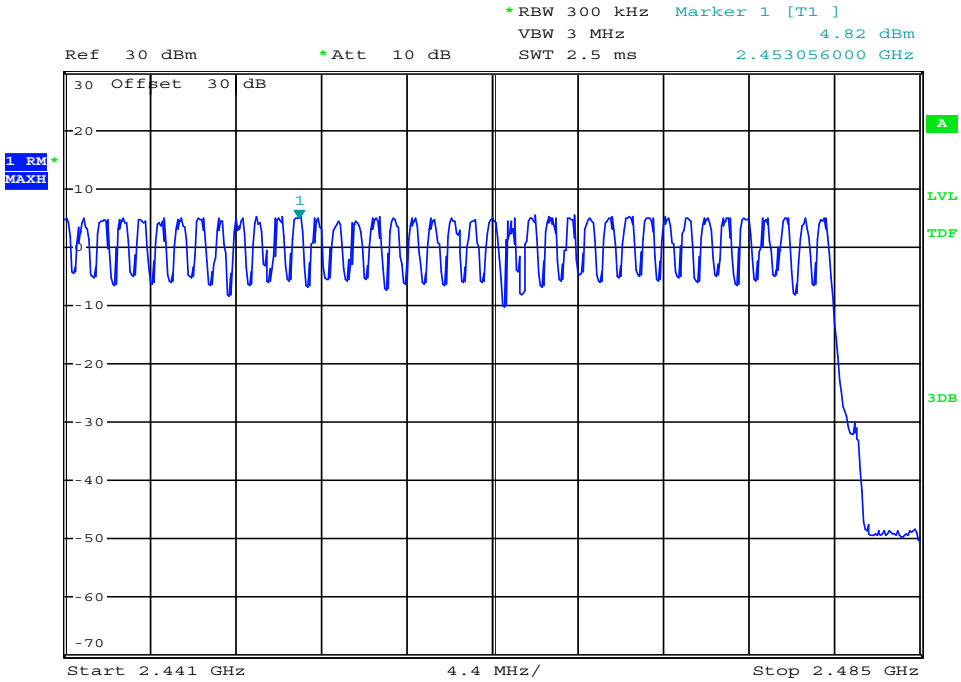


Date: 25.MAR.2020 10:49:43

Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2400-2441 MHz	**Pi/4-DQPSK**	**40**

Plot 14.2 – Number of Hopping Channels, 2441 – 2485MHz

Number of Hopping Channels



Date: 25.MAR.2020 11:57:44

Frequency Range:	Modulation Setting:	Number of Hopping Channels:
2441-2485 MHz	**Pi/4-DQPSK**	**39**

Table 14.2 – Summary of FHSS Number of Hopping Channels

Hopping Channel Results 802.15		
Frequency Range (MHz)	**Modulation**	**Number of Hopping Channels**
2400-2441	Pi/4-DQPSK	40
2441-2485	Pi/4-DQPSK	39
	Total:	79
	Result:	**Complies**

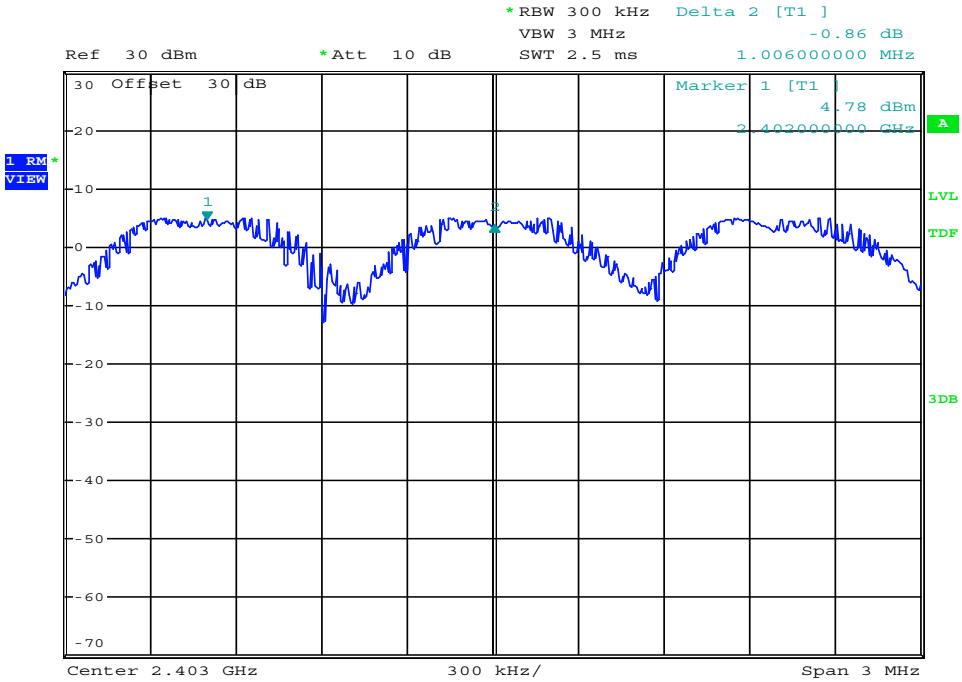
15.0 FHSS CHANNEL SEPARATION

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(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 2400- 2483.5 MHz band 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 125 mW.
RSS-247 (5.1)(db)	**5.1 Frequency hopping systems (FHS)** The following applies to FHSs in each of the three bands: 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.

Plot 15.1 – FHSS Channel Separation, 2403MHz

Channel Separation

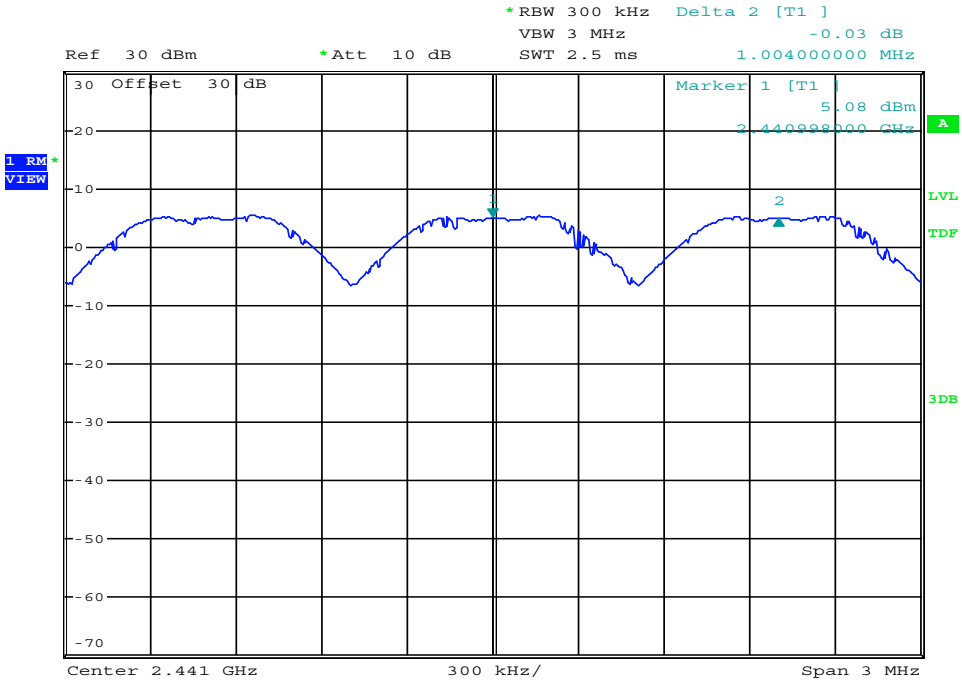


Date: 25.MAR.2020 12:52:40

Channel Frequency:	Modulation Setting:	Channel Separation:
2403.00 MHz	**Pi/4-DQPSK**	**1.006** MHz

Plot 15.2 – FHSS Channel Separation, 2441MHz

Channel Separation

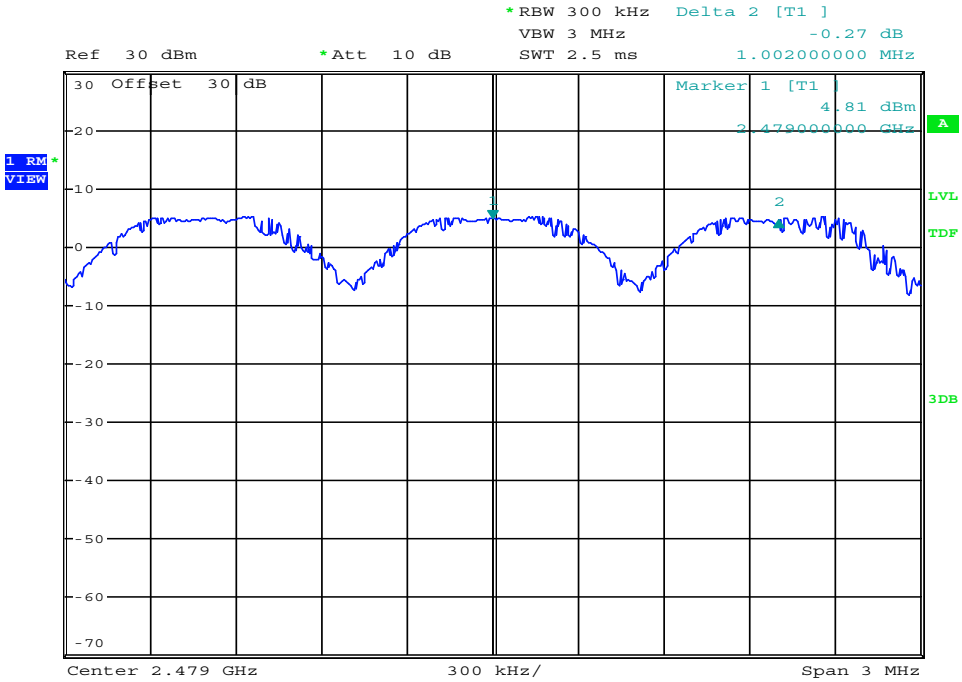


Date: 25.MAR.2020 12:30:38

Channel Frequency:	Modulation Setting:	Channel Separation:
2441.00 MHz	**Pi/4-DQPSK**	**1.004** MHz

Plot 15.3 – FHSS Channel Separation, 2480MHz

Channel Separation



Date: 25.MAR.2020 13:07:58

Channel Frequency:	Modulation Setting:	Channel Separation:
2479.00 MHz	**Pi/4-DQPSK**	**1.002** MHz

Table 15.1– Summary of FHSS Channel Separation

Hopping Channel Separation Results 802.15		
Channel Frequency (MHz)	**Modulation**	**Channel Separation (MHz)**
2403.00	Pi/4-DQPSK	1.006
2441.00		1.004
2479.00		1.002
Result:		**Complies**

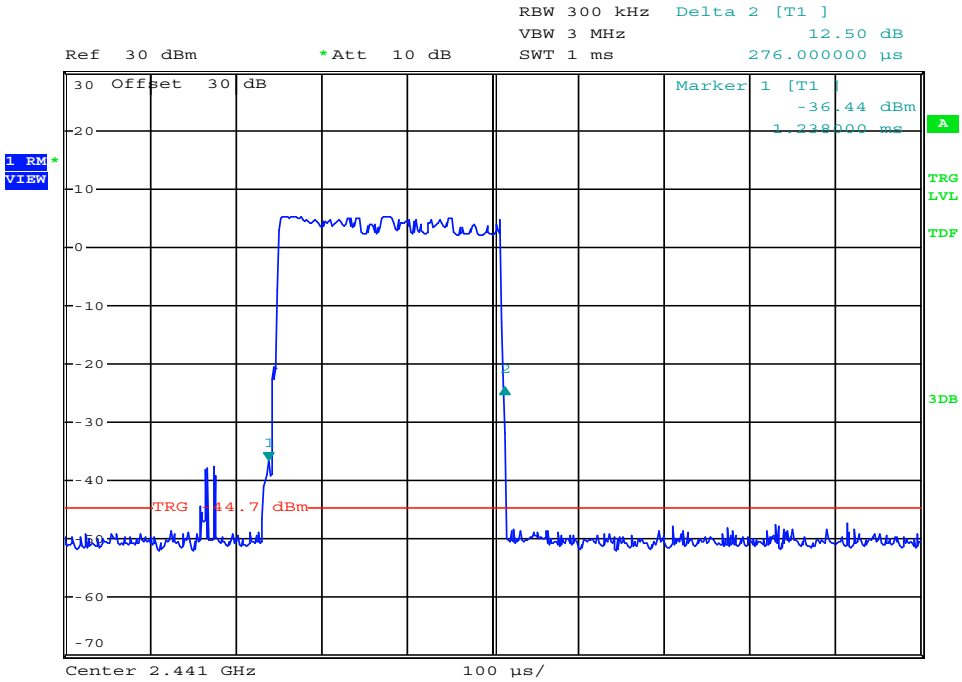
16.0 FHSS TIME OF OCCUPANCY

Test Procedure	
Normative Reference	FCC 47 CFR §15.247, RSS-247
	KDB 558074, ANSI C63.10

Limits	
47 CFR §15.247(a)(1)	(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
RSS-247 (5.1)(d)	**5.1 Frequency hopping systems (FHS)** FHSs 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 at least 15 hopping channels are used.

Plot 16.1 – FHSS Time of Occupancy

Time of Occupancy



Date: 25.MAR.2020 14:18:48

Channel Frequency:	Modulation Setting:	Channel Separation:
2441.00 MHz	**Pi/4-DQPSK**	**1.240** mSec

Table 16.1– Summary of FHSS Time of Occupancy

Hopping Channel Time of Occupancy 802.15		
Channel Frequency (MHz)	**Modulation**	**Occupancy Time (mSec)**
2441.00	Pi/4-DQPSK	1.238
	Result:	**Complies**

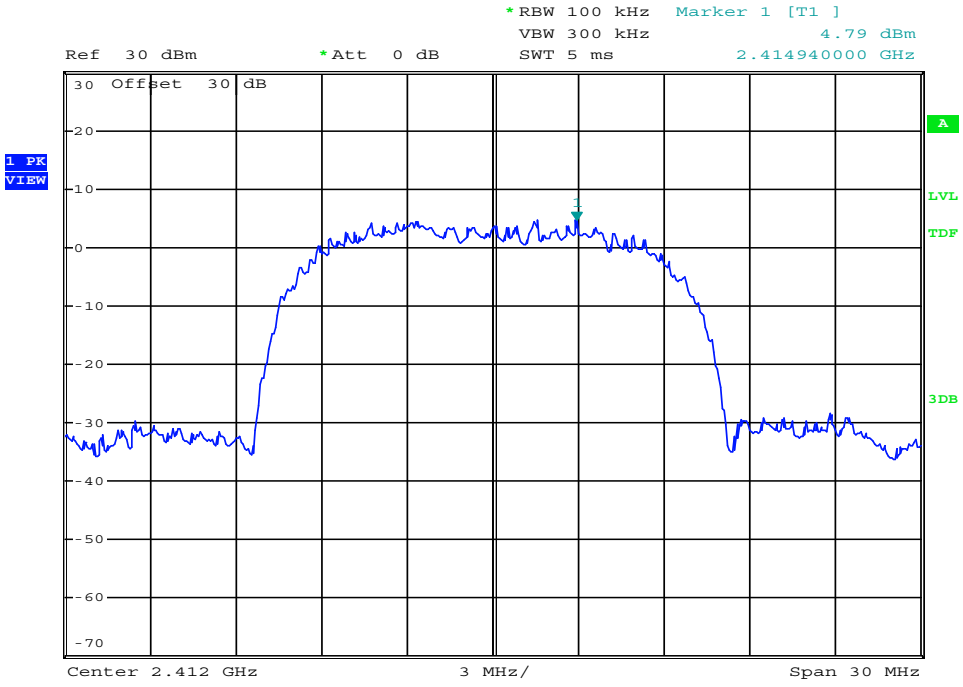
17.0 CONDUCTED SPURIOUS EMISSIONS & BAND EDGE

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (11.3), ANSI C63.10 (11.11.3)

Limits	
47 CFR §15.247(d)	(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.
RSS-247 (5.5)	**5.5 Unwanted emissions** 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(d), 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. 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.
KDB 558074 (11.3) C63.10 (11.11.3)	**11.1 General** The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). **11.2 Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

Plot 17.1 – Reference Level Measurement (WiFi), 2412MHz

Reference Level Measurement

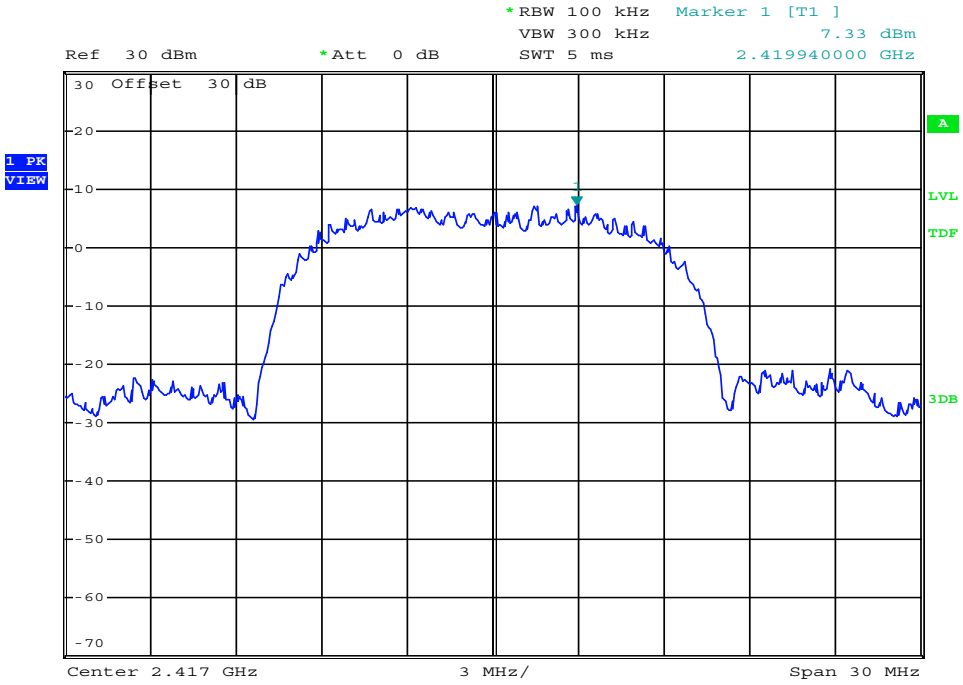


Date: 31.MAR.2020 11:09:07

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2412.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
DSSS	**Max** dBm	**4.79** dBm

Plot 17.2 – Reference Level Measurement (WiFi), 2417MHz

Reference Level Measurement

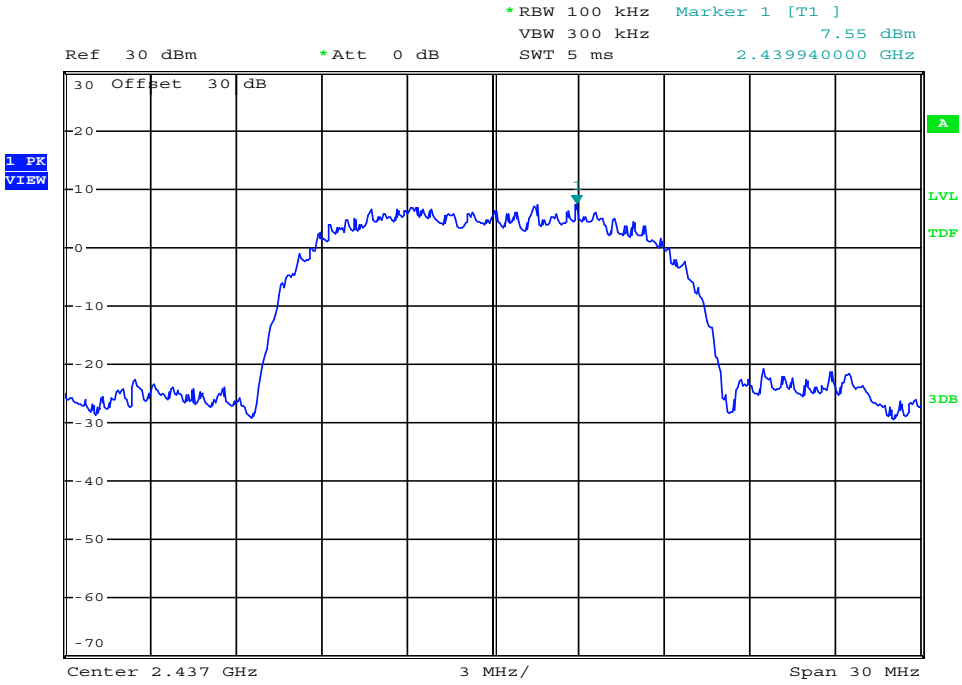


Date: 31.MAR.2020 11:10:11

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2417.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
DSSS	**Max** dBm	**7.33** dBm

Plot 17.3 – Reference Level Measurement (WiFi), 2437MHz

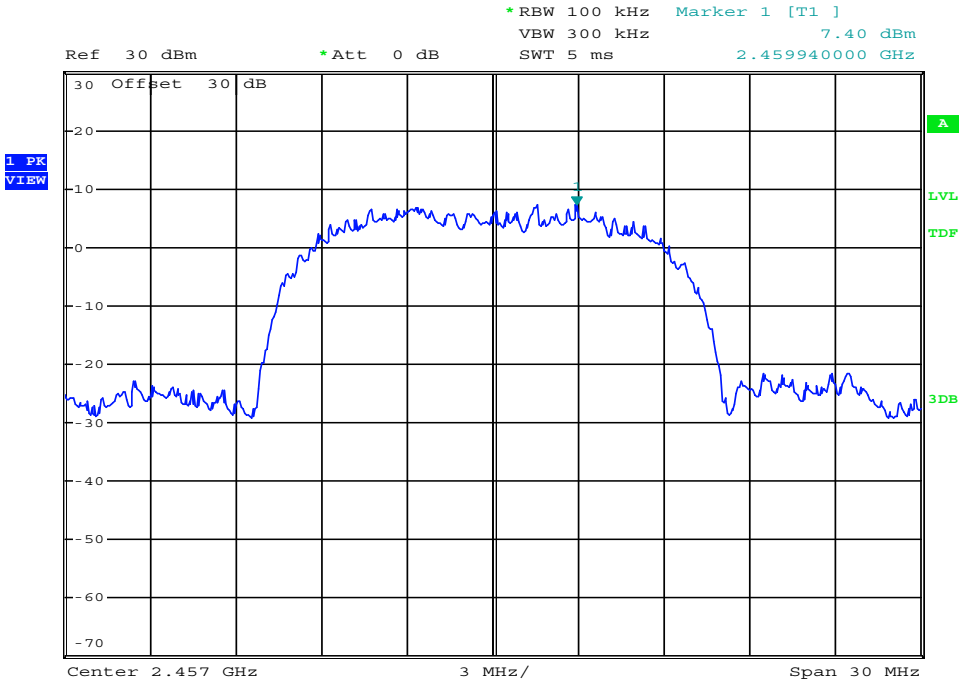
Reference Level Measurement



Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
DSSS	**Max** dBm	**7.55** dBm

Plot 17.4 – Reference Level Measurement (WiFi), 2457MHz

Reference Level Measurement

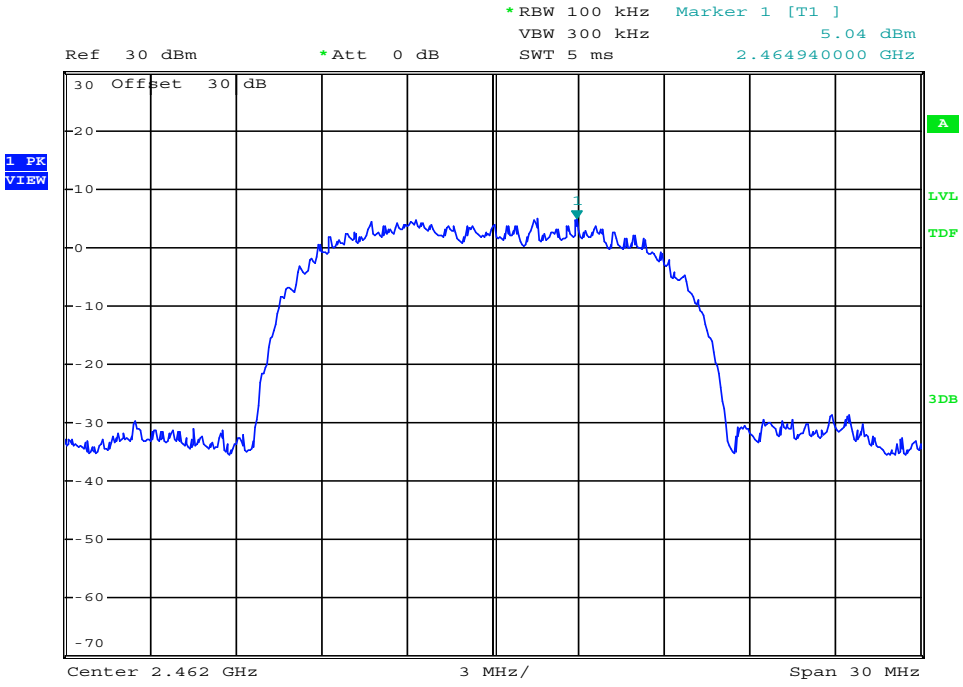


Date: 31.MAR.2020 11:12:28

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2457.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
DSSS	**Max** dBm	**7.40** dBm

Plot 17.5 – Reference Level Measurement (WiFi), 2462MHz

Reference Level Measurement



Date: 31.MAR.2020 11:13:15

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2462.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
DSSS	**Max** dBm	**5.04** dBm

Table 17.1 – Summary of Reference Level Measurements, (WiFi)

Reference Level Measurement							
Frequency (MHz)	Bit Rate (mbps)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	Required Attenuation(2) [A_A] (dBc)	Limit Line [A_L] (dBm)
2412.0	5.5	DSSS	Max	100	4.79	30.00	-22.45
2417.0					7.33		
2437.0					7.55		
2457.0					7.40		
2462.0					5.04		

(1) The output power is factory set to maximum

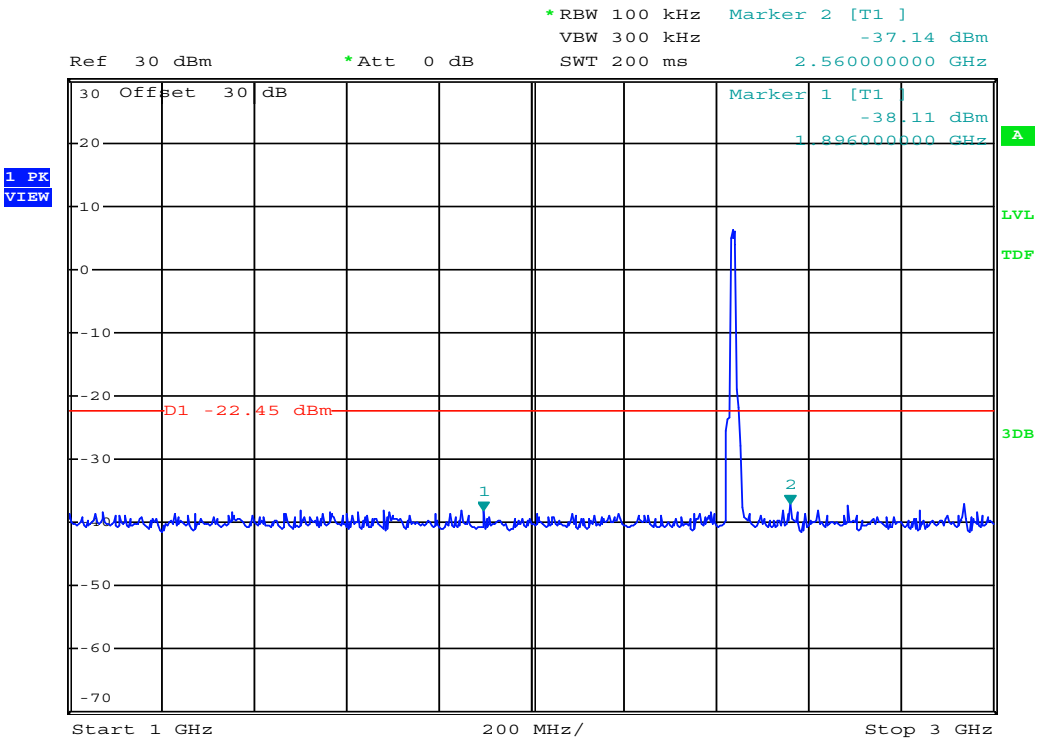
(2) The Maximum Conducted (average) output power was used for compliance therefore the required attenuation is 30dBc.

* The highest 100kHz PSD is used to demonstrate compliance.

Limit Line (A_L) = A_A - PSD_{meas}

Plot 17.6 – Spurious Emission Measurement, (WiFi), 1-3GHz

Conducted Spurious Emissions



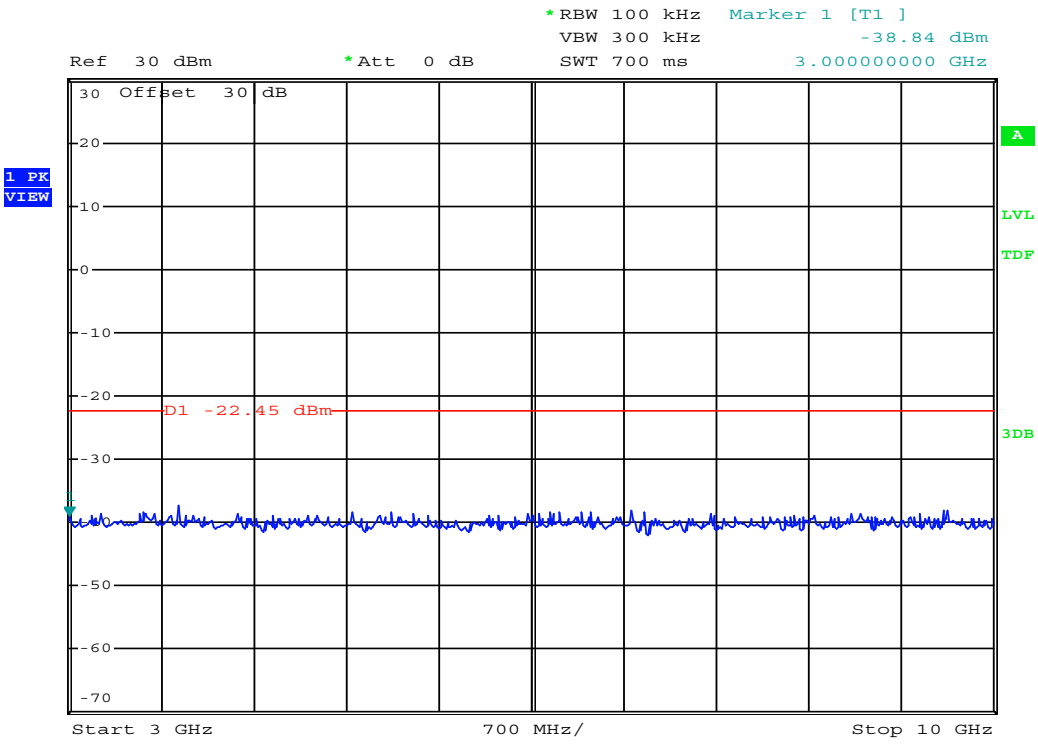
Date: 31.MAR.2020 14:28:19

Emission shown is fundamental

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
DSSS	**Max** dBm	**-37.14** dBm

Plot 17.7 – Spurious Emission Measurement, (WiFi), 3-10GHz

Conducted Spurious Emissions

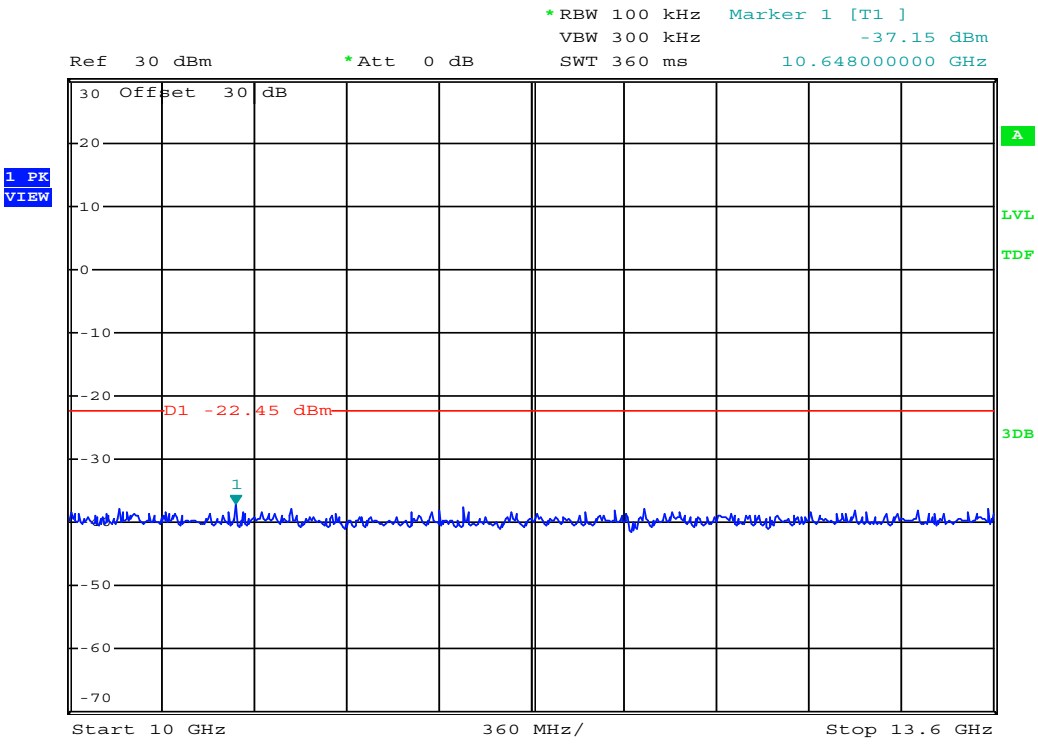


Date: 31.MAR.2020 14:29:36

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
DSSS	**Max** dBm	**-38.84** dBm

Plot 17.8 – Spurious Emission Measurement, (WiFi), 10-13.6GHz

Conducted Spurious Emissions

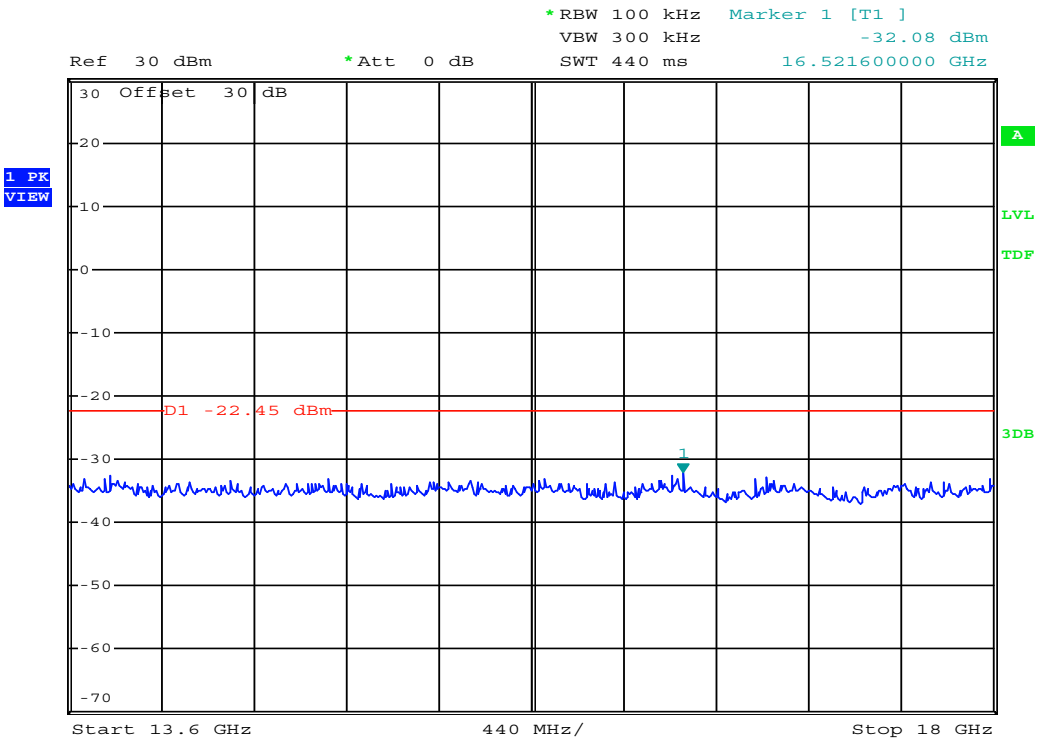


Date: 31.MAR.2020 14:30:27

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
DSSS	**Max** dBm	**-37.15** dBm

Plot 17.9 – Spurious Emission Measurement, (WiFi), 13.6-18GHz

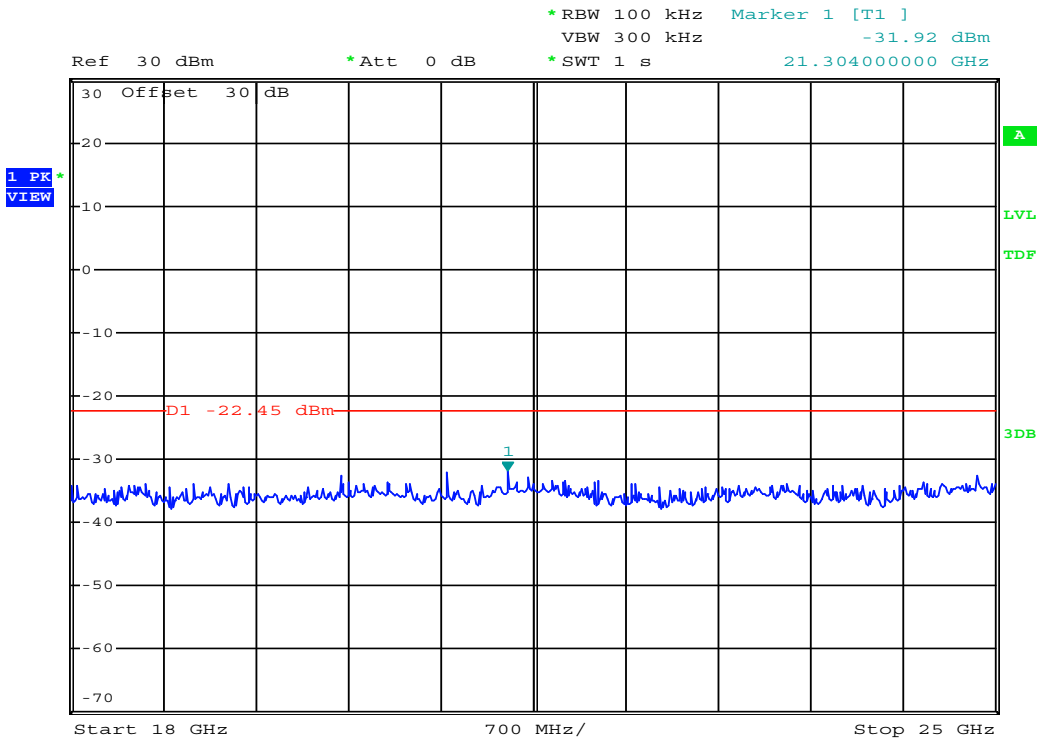
Conducted Spurious Emissions



Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
DSSS	**Max** dBm	**-32.08** dBm

Plot 17.10 – Spurious Emission Measurement, (WiFi), 18-25GHz

Conducted Spurious Emissions



Date: 31.MAR.2020 14:35:52

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2437.00 MHz	**5.50** mbps	**100** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
DSSS	**Max** dBm	**-31.92** dBm

Table 17.2 – Summary of Spurious Emission Measurements, (WiFi)

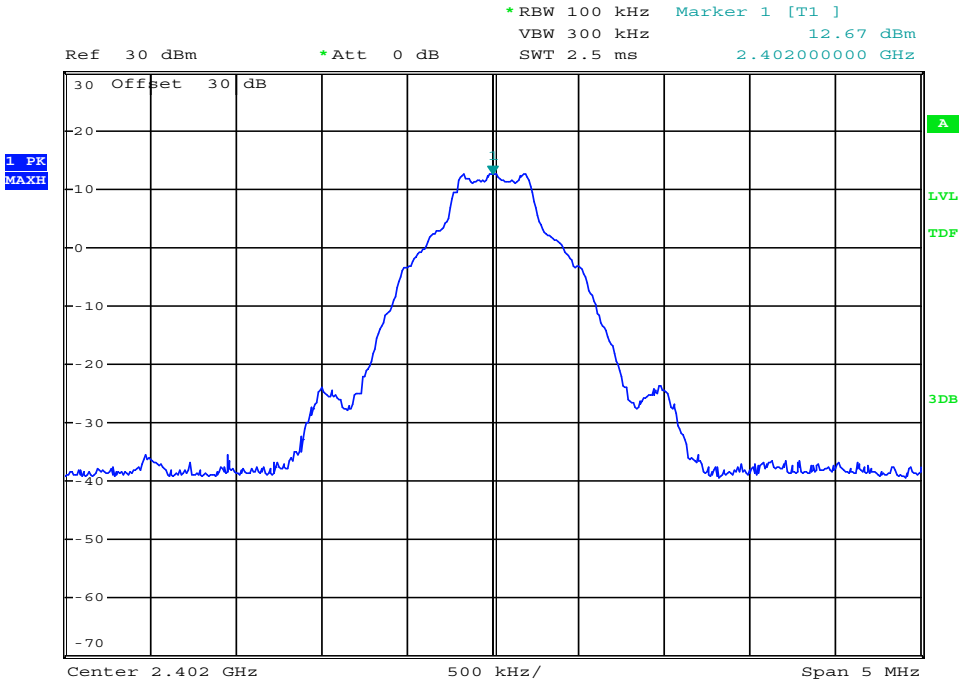
Emission Level Measurement							
Frequency Range (GHz)	Bit Rate (mbps)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line [A_L] (dBm)	Margin (dB)
1 - 3	5.5	DSSS	Max	100	-37.14	-22.45	**14.69**
3 - 10					-38.84		**16.39**
10 - 13.6					-37.15		**14.70**
13.6 - 18					-32.08		**9.63**
18 - 25					-31.92		**9.47**
					Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

Plot 17.11 – Reference Level Measurement (BlueTooth), 2402MHz

Reference Level Measurement

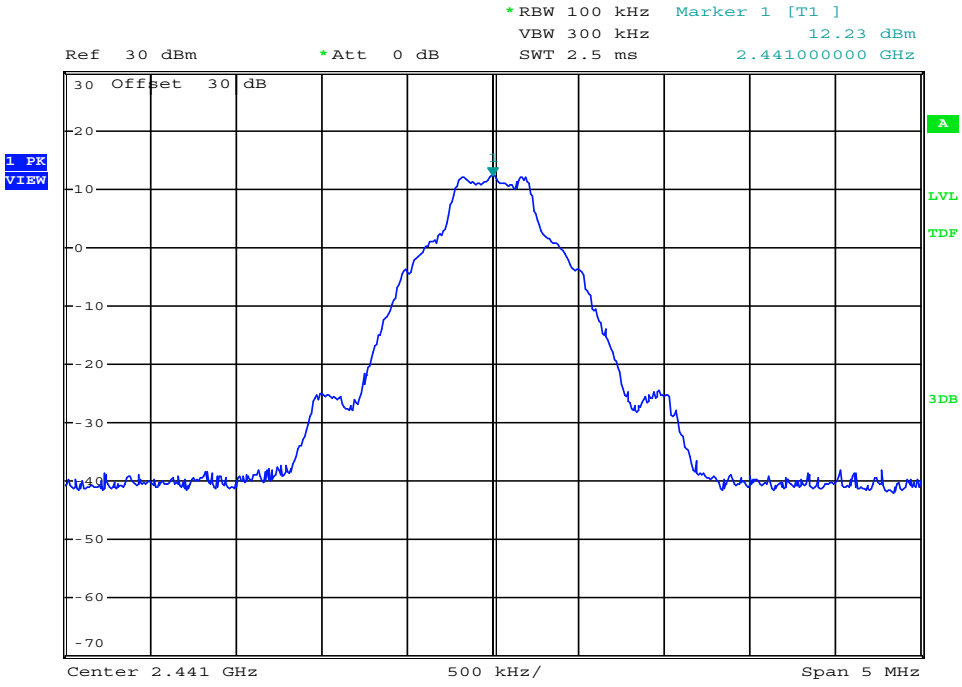


Date: 31.MAR.2020 12:45:54

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2402.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
GFSK	**Max** dBm	**12.67** dBm

Plot 17.12 – Reference Level Measurement (BlueTooth), 2441MHz

Reference Level Measurement

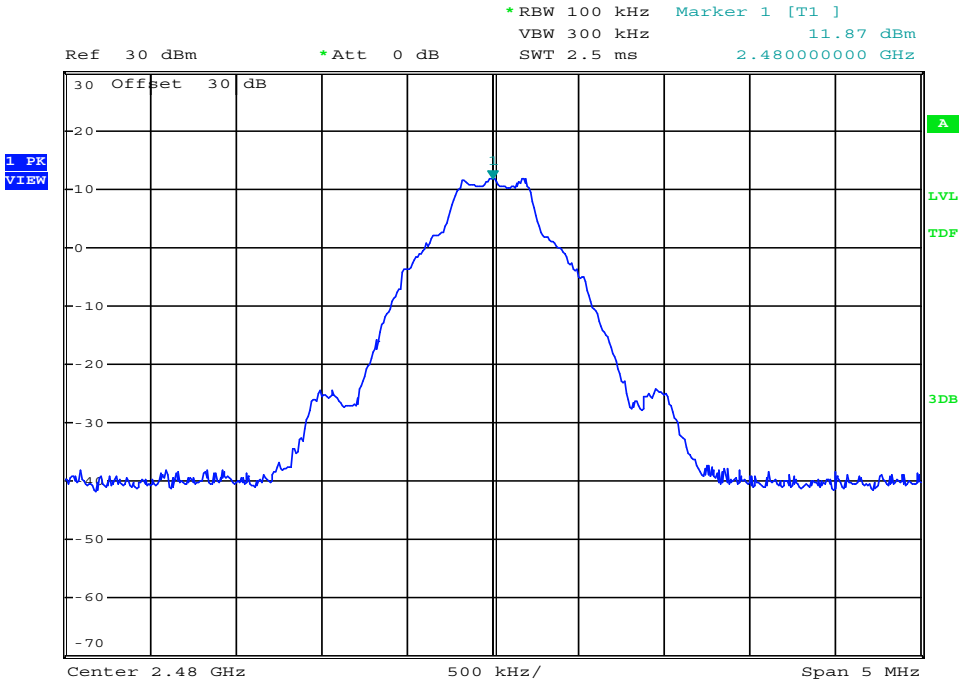


Date: 31.MAR.2020 12:47:13

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
GFSK	**Max** dBm	**12.23** dBm

Plot 17.13 – Reference Level Measurement (BlueTooth), 2480MHz

Reference Level Measurement



Date: 31.MAR.2020 12:48:28

Channel Frequency:	Bit Rate	Transmit Duty Cycle:
2480.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured PSD:**
GFSK	**Max** dBm	**11.87** dBm

Table 17.3 – Summary of Reference Level Measurements, (BlueTooth)

Reference Level Measurement							
Frequency (MHz)	Bit Rate (mbps)	Modulation	Power Setting(1) (dBm)	Transmit Duty Cycle (%)	Measured PSD [PSD_{Meas}] (dBm)	Required Attenuation(2) [A_A] (dBc)	Limit Line [A_L] (dBm)
2402.0	-	GFSK	Max	17.9	12.67	30.00	-17.33
2441.0					12.23		
2480.0					11.87		

(1) The output power is factory set to maximum

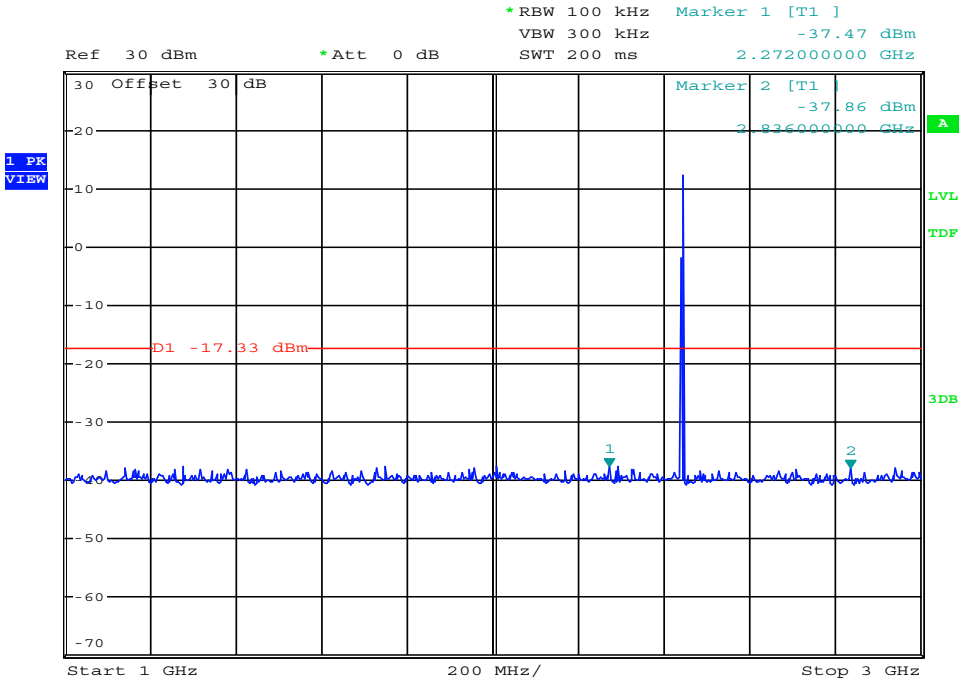
(2) The Maximum Conducted (average) output power was used for compliance therefore the required attenuation is 30dBc.

* The highest 100kHz PSD is used to demonstrate compliance.

Limit Line (A_L) = A_A - PSD_{meas}

Plot 17.14– Spurious Emission Measurement, (BlueTooth), 1-3GHz

Conducted Spurious Emissions



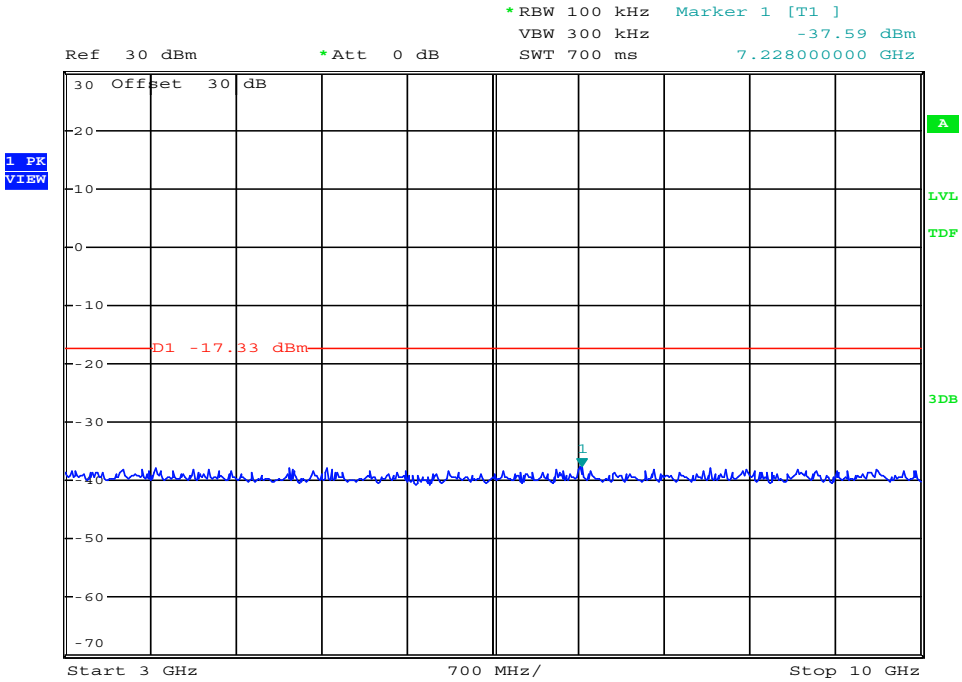
Date: 31.MAR.2020 14:05:20

Emission shown is fundamental

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
GFSK	**Max** dBm	**-37.47** dBm

Plot 17.15– Spurious Emission Measurement, (BlueTooth), 3-10GHz

Conducted Spurious Emissions

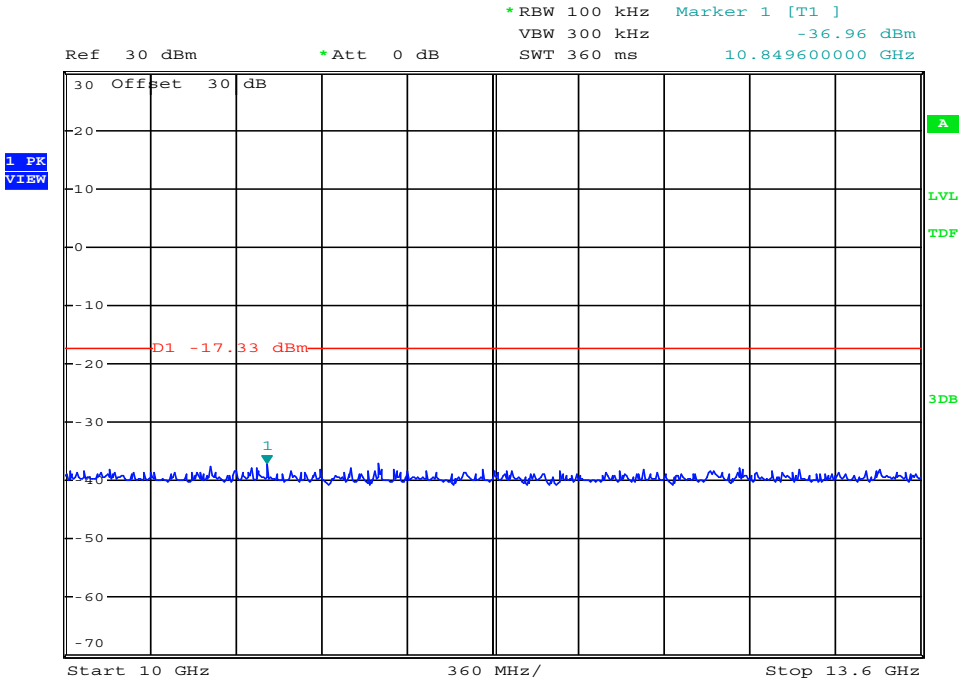


Date: 31.MAR.2020 14:06:39

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
GFSK	**Max** dBm	**-37.59** dBm

Plot 17.16– Spurious Emission Measurement, (BlueTooth), 10-13.6GHz

Conducted Spurious Emissions

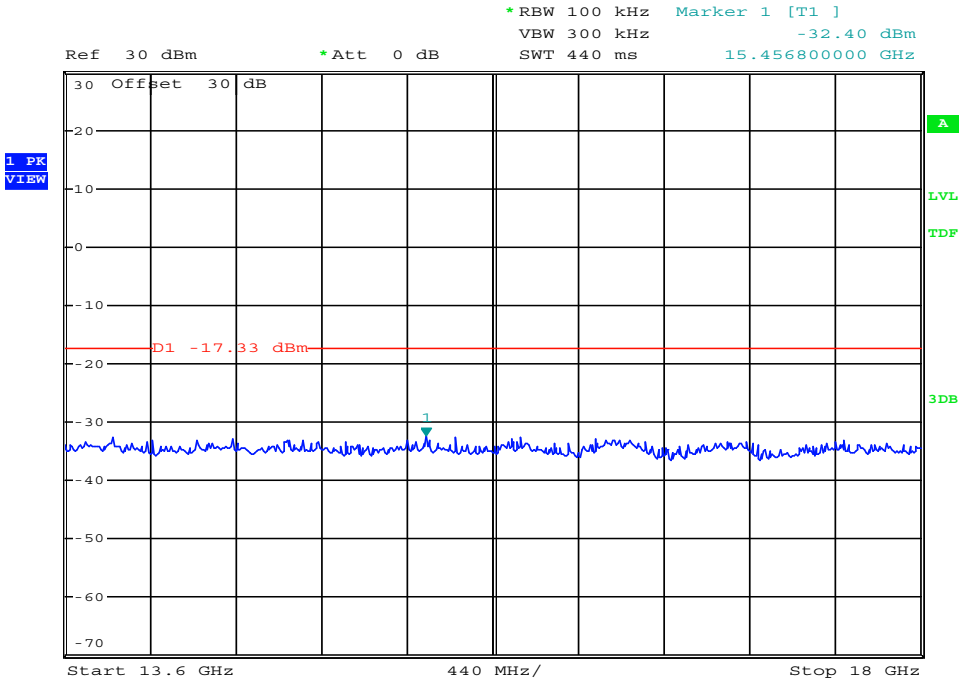


Date: 31.MAR.2020 14:07:49

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
GFSK	**Max** dBm	**-36.96** dBm

Plot 17.17– Spurious Emission Measurement, (BlueTooth), 13.6-18GHz

Conducted Spurious Emissions

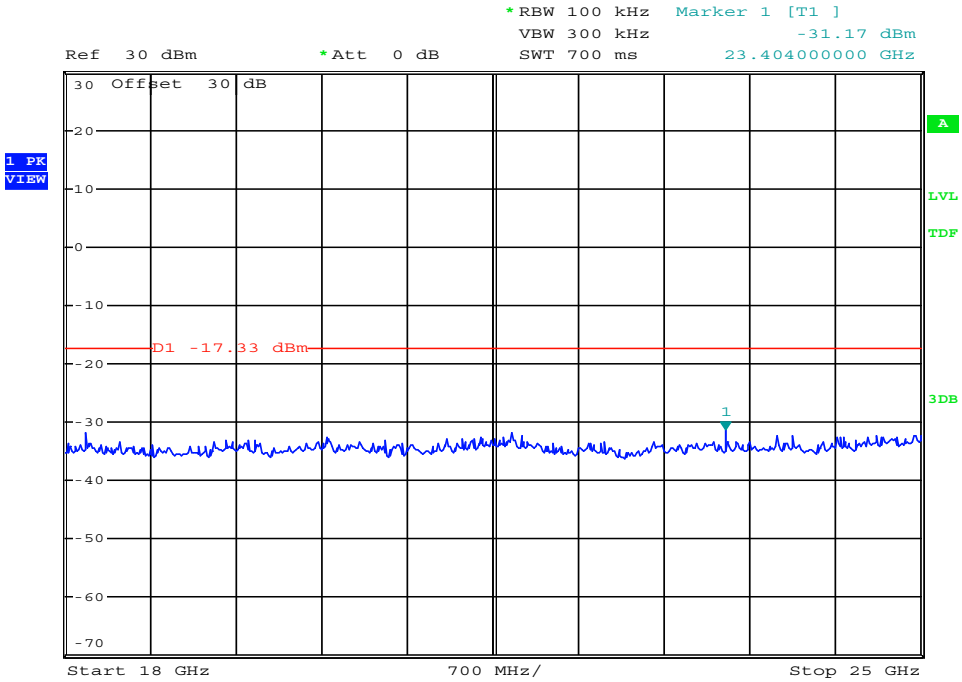


Date: 31.MAR.2020 14:10:11

Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
GFSK	**Max** dBm	**-32.40** dBm

Plot 17.18– Spurious Emission Measurement, (BlueTooth), 18-25GHz

Conducted Spurious Emissions



Channel Frequency:	Bit Rate:	Transmit Duty Cycle:
2441.00 MHz	**-** mbps	**17.9** %
Modulation Setting:	**Channel Power Setting:**	**Measured Emission Level**
GFSK	**Max** dBm	**-31.17** dBm

Table 17.4 – Summary of Spurious Emission Measurements, (BlueTooth)

Emission Level Measurement 802.15							
Frequency Range (GHz)	Bit Rate (mbps)	Modulation	Power Setting[1] (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line [A_L] (dBm)	Margin (dB)
1 - 3	-	GFSK	Max	17.9	-37.47	-22.45	**15.02**
3 - 10					-37.59		**15.14**
10 - 13.6					-36.96		**14.51**
13.6 - 18					-32.40		**9.95**
18 - 25					-31.17		**8.72**
1 - 3	-	Pi/4-DQPSK	Max	100	-37.57	-22.45	**15.12**
3 - 10					-37.12		**14.67**
10 - 13.6					-37.30		**14.85**
13.6 - 18					-32.07		**9.62**
18 - 25					-32.19		**9.74**
					Results:	**Complies**	

(1) The output power is factory set to maximum

Margin = A_L - E_{MEAS}

18.0 CONDUCTED SPURIOUS EMISSIONS, BAND EDGE

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5),
	KDB 558074 (11.3), ANSI C63.10 (11.11.3)

Limits	
47 CFR §15.247(d)	(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.
RSS-247 (5.5)	**5.5 Unwanted emissions** 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(d), 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. 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 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power.
KDB 558074 (11.3) C63.10 (11.11.3)	**11.1 General** The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions: b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). **11.2 Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 X *DTS bandwidth.* c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 X RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference

Table 18.1 – Summary of Conducted Spurious Emissions, Band Edge, (WiFi)

See Appendix G for Band Edge Measurement Plots

Band Edge Emission Measurement							
Channel Frequency (MHz)	Modulation	Bit Rate (mbps)	Power Setting[1] (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line[2] [A_L] (dBm)	Margin (dB)
2412	802.11b - CCK	1	Max	100	-36.27	-22.45	**13.82**
2462					-41.10		**18.65**
2412	802.11b - CCK	2			-35.32		**12.87**
2462					-40.72		**18.27**
2412	802.11b - DSSS	5.5			-32.01		**9.56**
2462					-40.17		**17.72**
2412	802.11b - DSSS	11			-29.51		**7.06**
2462					-41.23		**18.78**
2412	802.11g - OFDM	6			-33.85		**11.40**
2462					-37.19		**14.74**
2412	802.11g - OFDM	24			-33.24		**10.79**
2462					-37.92		**15.47**
2412	802.11b - CCK	54			-32.84		**10.39**
2462					-39.23		**16.78**
2412	802.11n - MCS0	-			-32.17		**9.72**
2462					-37.17		**14.72**
2412	802.11n - MCS7	-			-33.56		**11.11**
2462					-39.12		**16.67**
					Result:	**Complies**	

(1) The output power is factory set to maximum

(2) From Reference Measurement in Section 17.0

Margin = A_L - E_{MEAS}

Table 18.2 – Summary of Conducted Spurious Emissions, Band Edge, (BlueTooth)

See Appendix G for Band Edge Measurement Plots

Band Edge Emission Measurement 802.15							
Channel Frequency (MHz)	Modulation	Bit Rate (mbps)	Power Setting[1] (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Limit Line[2] [A_L] (dBm)	Margin (dB)
2402	802.15 - GFSK	-	Max	17.9	-36.12	-17.33	**18.79**
2480					-41.08		**23.75**
2402	802.15 - Pi/4 - DQPSK	-		100	-27.65		**10.32**
2480					-32.45		**15.12**
					Result:	**Complies**	

(1) The output power is factory set to maximum

(2) From Reference Measurement in Section 17.0

Margin = A_L - E_{MEAS}

19.0 RADIATED TX SPURIOUS EMISSIONS, RESTRICTED BAND

Test Procedure	
Normative Reference	FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c), §15.209(a)
	KDB 558074 (8.6), ANSI C63.10 (11.12)

Limits

47 CFR §15.247(d)

(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) (see §15.205(c)).

47 CFR §15.209(a)

§15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)
0.009 - 0.490	2400/F (kHz) @300m
0.490 - 1.705	24000/F (kHz) @30m
1.705 - 30	30 @ 30m
30 - 88	100 @3m
88 - 216	150 @3m
216 - 960	200 @3m
Above 960	500 @3m

Table 19.1 – Summary of Radiated Tx Spurious Emissions, Restricted Band, (WiFi)

See Appendix H Radiated Tx Spurious Measurement Plots

Measurement Results								
Frequency Range	Antenna Polarization	Bit Rate (Mbps)	Modulation	Power Setting[1] (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Worst Case Limit[4] [A_L] (dBuV @ 3m)	Margin (dB)
9kHz - 30MHz	Front	5.5	802.11b-DSSS	Max	100	ND	69.5	n/a
30-1000MHz	Horizontal					ND	40.0	n/a
1 - 3GHz						ND	54.0	n/a
3 - 13.6GHz						ND	54.0	n/a
13.6 - 18GHz						ND	54.0	n/a
18-25GHz						ND	54.0	n/a
9kHz - 30MHz	Side					ND	69.5	n/a
30-1000MHz	Vertical					ND	40.0	n/a
1 - 3GHz						ND	54.0	n/a
3 - 13.6GHz						ND	54.0	n/a
13.6 - 18GHz						ND	54.0	n/a
18-25GHz						ND	54.0	n/a

Table 19.2 – Summary of Radiated Tx Spurious Emissions, Restricted Band, (BlueTooth)

See Appendix H Radiated Tx Spurious Measurement Plots

Measurement Results								
Frequency Range	Antenna Polarization	Bit Rate (Mbps)	Modulation	Power Setting[1] (dBm)	Transmit Duty Cycle (%)	Measured Emission [E_{Meas}] (dBm)	Worst Case Limit[4] [A_L] (dBuV @ 3m)	Margin (dB)
9kHz - 30MHz	Front	-	Pi/4-DQPSK	Max	100	ND	69.5	n/a
30-1000MHz	Horizontal					ND	40.0	n/a
1 - 3GHz						ND	54.0	n/a
3 - 13.6GHz						ND	54.0	n/a
13.6 - 18GHz						ND	54.0	n/a
18-25GHz						ND	54.0	n/a
9kHz - 30MHz	Side					ND	69.5	n/a
30-1000MHz	Vertical					ND	40.0	n/a
1 - 3GHz						ND	54.0	n/a
3 - 13.6GHz						ND	54.0	n/a
13.6 - 18GHz						ND	54.0	n/a
18-25GHz						ND	54.0	n/a

20.0 RADIATED RX SPURIOUS EMISSIONS

Test Procedure	
Normative Reference	**FCC 47 CFR §15.109, ICES-003(6.2)** **ANSI C63.4:2014**

Limits	
47 CFR §15.109	(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values: 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m
ICES-003(6.2.1)	6.2.1 - Radiated Emissions Limits Below 1 GHz Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 5 determined at a distance of 3 metres. 30-88MHz: 40dBuV/m 88-216MHz: 43.5dBuV/m 216-960MHz: 46dBuV/m > 960MHz: 54dBuV/m

Test Setup	Appendix A Figure A.2

Measurement Procedure
The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions.

Table 20.1 – Summary of Radiated Rx Spurious Emissions

See Appendix I Radiated Rx Spurious Measurement Plots

Measurement Results								
Frequency Range	**Antenna Polarization**	**Bit Rate (Mbps)**	**Modulation**	**Power Setting[1] (dBm)**	**Transmit Duty Cycle (%)**	**Measured Emission [E_{Meas}] (dBm)**	**Worst Case Limit[4] [A_L] (dBuV @ 3m)**	**Margin (dB)**
9kHz - 30MHz	Front	n/a	n/a	n/a	n/a	ND	69.5	**n/a**
30-1000MHz	Horizontal					ND	40.0	**n/a**
1 - 3GHz						ND	54.0	**n/a**
3 - 13.6GHz						ND	54.0	**n/a**
13.6 - 18GHz						ND	54.0	**n/a**
9kHz - 30MHz	Side					ND	69.5	**n/a**
30-1000MHz	Vertical					ND	40.0	**n/a**
1 - 3GHz						ND	54.0	**n/a**
3 - 13.6GHz						ND	54.0	**n/a**
13.6 - 18GHz						ND	54.0	**n/a**
						Results:	**Complies**	

APPENDIX A – TEST SETUP DRAWINGS

Table A.1 – Conducted Measurement Setup

Equipment List					
(*)	Asset Number	Manufacturer	Model Number	Serial Number	Description
*	00241	R&S	FSU40	100500	Spectrum Analyzer
*	00263	Koaxis	KP10-1.00M-TD	263	1m Armoured Cable

Figure A.1 – Test Setup – Conducted Measurements

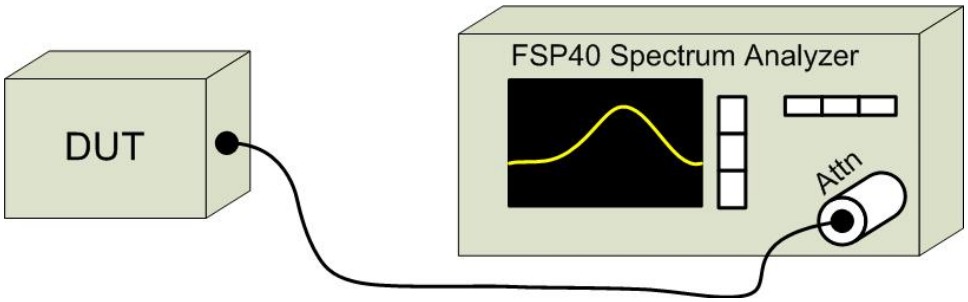


Table A.2 – Radiated Emissions Measurement Equipment

Equipment List					
(*)	Asset Number	Manufacturer	Model Number	Serial Number	Description
*	00050	Chase	CBL-6111A	1607	Bilog Antenna
*	00034	ETS	3115	6267	Double Ridged Guide Horn
*	00035	ETS	3115	6276	Double Ridged Guide Horn
*	00085	EMCO	6502	9203-2724	Loop Antenna
*	00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz
*	00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz
*	00047	HP	85685A	2837A00826	RF Preselector
*	00049	HP	85650A	2043A00162	Quasi-peak Adapter
*	00051	HP	8566B	2747A05510	Spectrum Analyzer
*	00241	R&S	FSU40	100500	Spectrum Analyzer
*	00005	HP	8648D	3847A00611	Signal Generator
*	00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier
*	00071	EMCO	2090	9912-1484	Multi-Device Controller
*	00072	EMCO	2075	0001-2277	Mini-mast
*	00073	EMCO	2080	0002-1002	Turn Table
*	00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable
*	00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable
*	00275	TMS	LMR400	n/a	25m Cable
*	00276	TMS	LMR400	n/a	4m Cable
*	00277	TMS	LMR400	n/a	4m Cable
*	00278	TILE	34G3	n/a	TILE Test Software

Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz

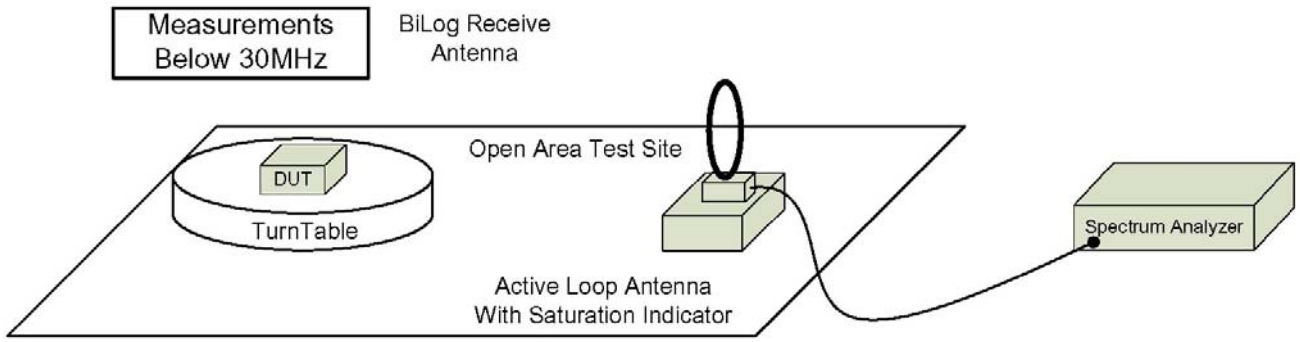


Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz

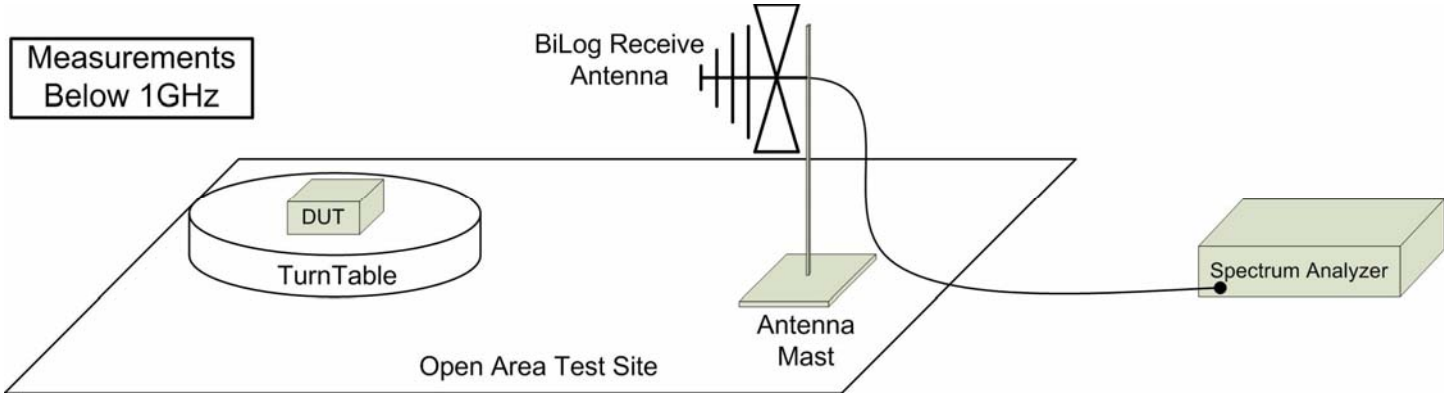
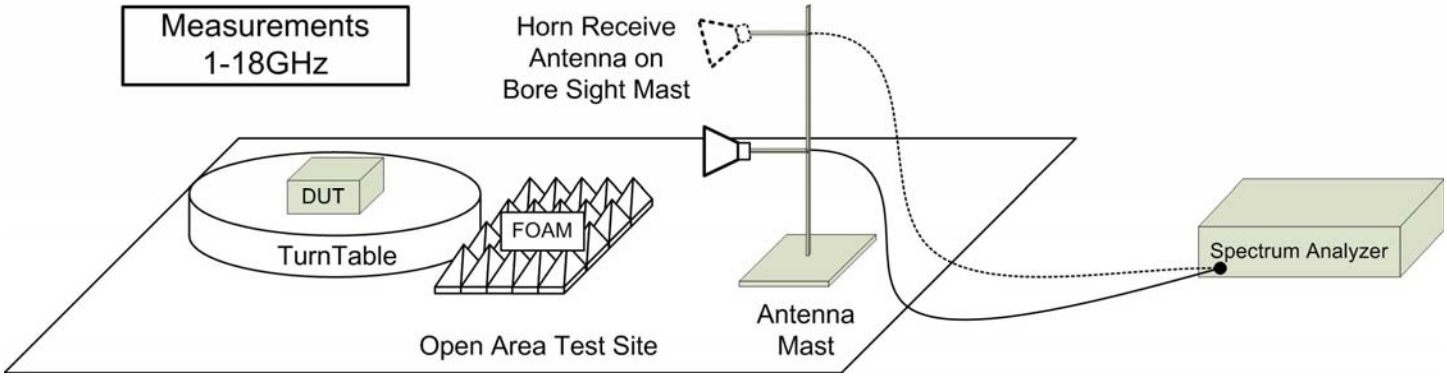


Figure A.4 – Test Setup Radiated Measurements Above 1GHz



APPENDIX B – EQUIPMENT LIST AND CALIBRATION

Equipment List								
(*)	Asset Number	Manufacturer	Model Number	Serial Number	Description	Last Calibrated	Calibration Interval	Calibration Due
*	00050	Chase	CBL-6111A	1607	Bilog Antenna	3 Jan 2019	Triennial	3 Jan 2022
*	00034	ETS	3115	6267	Double Ridged Guide Horn	26 Nov 2018	Triennial	26 Nov 2021
*	00035	ETS	3115	6276	Double Ridged Guide Horn	22 Mar 2019	Triennial	21 Mar 2022
*	00085	EMCO	6502	9203-2724	Loop Antenna	11 Jun 2019	Triennial	11 Jun 2022
*	00161	Waveline Inc.	889		Standard Gain Horn 18-26GHz	NCR	n/a	NCR
*	00165	Waveline Inc.	801-KF		Waveguide Adapter 18-26GHz	NCR	n/a	NCR
*	00047	HP	85685A	2837A00826	RF Preselector	23 Jun 2017	Triennial	23 Jun 2020
*	00049	HP	85650A	2043A00162	Quasi-peak Adapter	23 Jun 2017	Triennial	23 Jun 2020
*	00051	HP	8566B	2747A05510	Spectrum Analyzer	23 Jun 2017	Triennial	23 Jun 2020
*	00241	R&S	FSU40	100500	Spectrum Analyzer	15 May 2018	Triennial	15 May 2021
*	00005	HP	8648D	3847A00611	Signal Generator	21 Jun 2017	Triennial	21 Jun 2020
*	00265	Miteq	JS32-00104000-58-5P	1939850	Microwave L/N Amplifier	COU	n/a	COU
*	00071	EMCO	2090	9912-1484	Multi-Device Controller	n/a	n/a	n/a
*	00072	EMCO	2075	0001-2277	Mini-mast	n/a	n/a	n/a
*	00073	EMCO	2080	0002-1002	Turn Table	n/a	n/a	n/a
*	00263B	Koaxis	KP10-1.00M-TD	263B	1m Armoured Cable	COU	n/a	COU
*	00264	Koaxis	KP10-7.00M-TD	264	7m Armoured Cable	COU	n/a	COU
*	00275	TMS	LMR400	n/a	25m Cable	COU	n/a	COU
*	00276	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00277	TMS	LMR400	n/a	4m Cable	COU	n/a	COU
*	00278	TILE	34G3	n/a	TILE Test Software	NCR	n/a	NCR

* Used during the course of this investigation
NCR: No Calibration Required
COU: Calibrate On Use

APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

CISPR 16-4 Measurement Uncertainty (U_{LAB})	
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of k=2	
30MHz - 200MHz	
U_{LAB} = 5.14dB U_{CISPR} = 6.3dB	
200MHz - 1000MHz	
U_{LAB} = 5.90dB U_{CISPR} = 6.3dB	
1GHz - 6GHz	
U_{LAB} = 4.80dB U_{CISPR} = 5.2dB	
6GHz - 18GHz	
U_{LAB} = 5.1dB U_{CISPR} = 5.5dB	
If the calculated uncertainty **U_{lab}** is **less** than **U_{CISPR}** then:	
1	Compliance is deemed to occur if **NO** measured disturbance exceeds the disturbance limit
2	Non-Compliance is deemed to occur if **ANY** measured disturbance **EXCEEDS** the disturbance limit
If the calculated uncertainty **U_{lab}** is **greater** than **U_{CISPR}** then:	
3	Compliance is deemed to occur if **NO** measured disturbance, increased by (**U_{lab} - U_{CISPR}**), exceeds the disturbance limit
4	Non-Compliance is deemed to occur if **ANY** measured disturbance, increased by (**U_{lab} - U_{CISPR}**), **EXCEEDS** the disturbance limit

END OF REPORT

APPENDIX D – OCCUPIED BANDWIDTH MEASUREMENT PLOTS

APPENDIX E – ANTENNA PORT CONDUCTED POWER MEASUREMENT PLOTS

APPENDIX F – POWER SPECTRAL DENSITY MEASUREMENT PLOTS

APPENDIX G – CONDUCTED SPURIOUS EMISSIONS, BAND EDGE MEASUREMENT PLOTS

APPENDIX H – RADIATED TX SPURIOUS EMISSIONS, RESTRICTED BAND MEASUREMENT PLOTS

APPENDIX I – RADIATED RX SPURIOUS EMISSIONS MEASUREMENT PLOTS

