ELECTROMAGNETIC COMPATIBILITY TEST REPORT

PREPARED FOR Intrinsyc Technologies Corporation
BY QAI LABORATORIES

CFR 47, Part 15, Subpart C - Intentional Radiators - 15.247 - FHS/DTS

Report Reference Number:	**E10702-1803-FDS**
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Product Tested ISED :	**9049A-ITCOQ626S**
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Applicable Test Standards:

CFR 47 FCC Part 15, Subpart C - 15.247	*Radio Frequency Devices - Subpart C - Intentional Radiators - §15.247 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.*
CFR 47 FCC Part 15, Subpart B	*Radio Frequency Devices - 47 CFR Subpart B - Unintentional Radiators*
RSS-247 Issue 2	*Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices*
RSS-Gen Issue 5	*General Requirements for Compliance of Radio Apparatus*
ICES-003 Issue 6	*Information Technology Equipment (including Digital Apparatus) - Limits and Methods of Measurement.*

Equipment Tested:	**Open-Q™ 626 SOM 802.11a/b/g/n/ac WiFi + BT/BLE**
Model Number:	**Open-Q™ 626 SOM**
Manufacturer:	**Intrinsyc Technologies Corporation**

REVISION HISTORY

Date	Report Number	Revision	Description	By
2019 May 9	E10702-1803-FDS	1.2	Changes after TCB Review	BB
2019 Apr 30	E10702-1803	1.1	Added DFS	BB
23 April 2019	E10702-1803	1.0	Initial Release	BB

All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.

REPORT AUTHORIZATION

The data documented in this report is for the equipment 2AFDI-ITCOQ626S/9049A-ITCOQ626S Open-Q 626(TM) SOM 802.11a/b/g/n/ac WiFi + BT/BLE' provided by Intrinsyc Technologies Corporation. Tests were performed on the sample equipment as requested by Intrinsyc Technologies Corporation for the purpose of demonstrating compliance with CFR 47 FCC Part 15, Subpart C - 15.247, CFR 47 FCC Part 15, Subpart B , RSS-247 Issue 2, RSS-Gen Issue 5, ICES-003 Issue 6 as agreed upon by Intrinsyc Technologies Corporation as per quotation 18SH05146R1.

Intrinsyc Technologies Corporation is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise a partial list of tests that are required for FCC, ISED and/or CE Mark Declaration of Conformity and can only be reproduced by the manufacturer.

This is to certify the following report true and correct to the best of our knowledge.

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QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities/services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

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10m Open Area Test Site (OATS)
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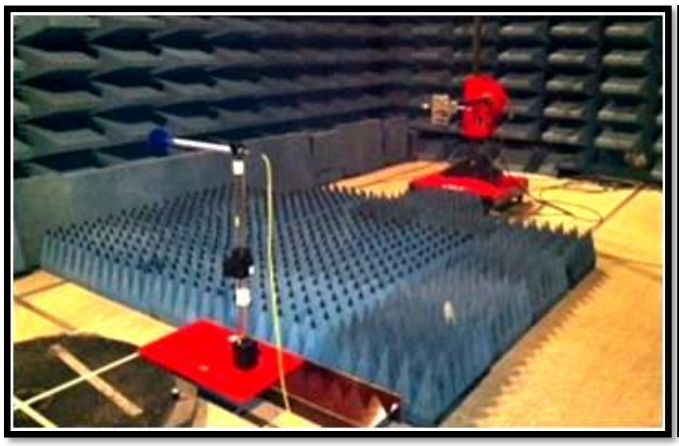
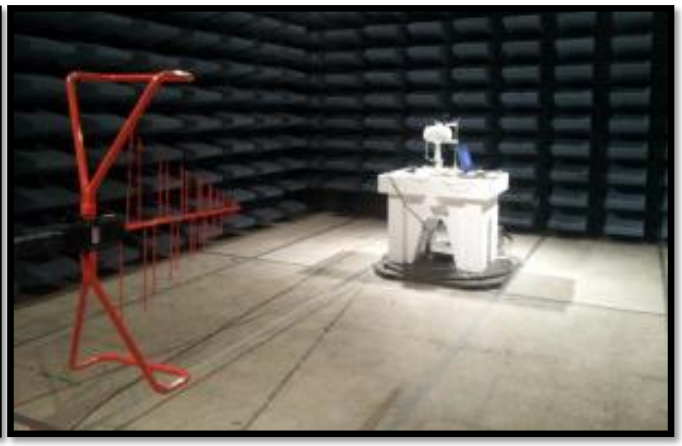


3m Semi-Anechoic Chamber (SAC)
Burnaby, BC



3m Semi-Anechoic Chamber (SAC)
Burnaby, BC

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Section I: EXECUTIVE SUMMARY

1.1 Scope

This report demonstrates and documents compliance of Open-Q 626(TM) SOM 802.11a/b/g/n/ac WiFi + BT/BLE Model 2AFDI-ITCOQ626S/9049A-ITCOQ626S to the applicable standards listed below for as described.

1.2 Applicable Standards

The information documented in this report is based on the test methods and levels as per quotation 18SH05146R1.

CFR 47 FCC Part 15, Subpart C - 15.247	*Radio Frequency Devices - Subpart C - Intentional Radiators - §15.247 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz*
CFR 47 FCC Part 15, Subpart B	*Radio Frequency Devices - 47 CFR Subpart B - Unintentional Radiators*
RSS-247 Issue 2	*Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices*
RSS-Gen Issue 5	*General Requirements for Compliance of Radio Apparatus*
ICES-003 Issue 6	*Information Technology Equipment (including Digital Apparatus) - Limits and Methods of Measurement.*

1.3 Reference Standards

The following standards are included as normative references.

ANSI C63.4(2014) - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.4:2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

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ANSI C63.4(2014) - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

KDB 558074 D01 v05r02 - Guidance for Performing Compliance Measurements on Digital Transmissions Systems (DTS) operating under §15.247

1.4 Summary of Results

This report demonstrates and documents compliance of Open-Q 626(TM) SOM 802.11a/b/g/n/ac WiFi + BT/BLE 2AFDI-ITCOQ626S/9049A-ITCOQ626S manufactured by Intrinsyc Technologies Corporation to CFR 47 FCC Part 15, Subpart C - 15.247, CFR 47 FCC Part 15, Subpart B , RSS-247 Issue 2, RSS-Gen Issue 5, ICES-003 Issue 6.

The following testing was performed pursuant to CFR 47 FCC Part 15, Subpart B - Emissions

Test or Measurement	Applicable Standard	Description	Result
Conducted Emissions AC Mains	15.107 Class B	*Conducted emissions measured on the AC power input (Mains) 150K - 30M Hz.*	Complies
Radiated Emissions Enclosure	15.109 Class B	*Radiated emissions of the enclosure measured 30M - 1G Hz (quasi-peak) and 1G - 40G Hz (average) as applicable.*	Complies

The following testing was performed pursuant to CFR 47 FCC Part 15, Subpart C, 15.247 - Emissions

Test or Measurement	Applicable Standard	Description	Result
Conducted Emissions AC Mains	15.207 Class B	*Conducted emissions measured on the AC power input (Mains) 150K - 30M Hz.*	Complies
Radiated Emissions Enclosure	15.209 Class B	*Radiated emissions of the enclosure measured 30M - 1G Hz (quasi-peak) and 1G Hz - 10th harmonic of fundamental or 40G Hz (average) as applicable.*	Complies
Antenna Requirement	15.203	*The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator.*	Complies
RF Peak Output Power	15.247(b)(3)	*Maximum peak conducted output power shall not exceed 1 W. EIRP shall not exceed 4 W.*	Complies
Modular Transmitters: Single Modular Device	15.212	*SINGLE modular transmitters consist of a completely self-contained radiofrequency transmitter device that is typically incorporated into another product, host or device. All single or split modular transmitters are approved with an antenna.*	Complies
Occupied Bandwidth	15.247(a)(2)	*The minimum 6 dB bandwidth shall be at least 500 kHz.*	Complies
Out of Band Emisisons (Bandedge)	15.247(d), 15.205(c)	*In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20 dBc (peak) or 30dBc (rms). 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).*	Complies
Power Spectral Density	15.247 (e)	*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.*	Complies
Conducted Spurious Emissions	15.247(d), 15.205, 15.209(a)	*Conducted emissions requirements as stated in the standard.*	Complies
Radiated Spurious Emissions	15.247(d), 15.205, 15.209(a)	*Radiated emissions requirements as stated in the standard.*	Complies
Frequency Stability	2.1055	*Ensure the normal functionality during temperature and input voltage fluctuations.*	Complies
RF Exposure	1.131	*RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm.*	Complies

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The following testing was performed pursuant to RSS-210 Issue 8 and RSS-247 Issue 2 - Emissions

Test or Measurement	Applicable Standard	Description	Result
Conducted Emissions AC Mains	RSS-Gen Issue 5	*Conducted emissions measured on the AC power input (Mains) 150K - 30M Hz.*	Complies
Radiated Emissions Enclosure	RSS 247 Issue 2	*Radiated emissions of the enclosure measured 30M - 1G Hz (quasi-peak) and 1G Hz - 10th harmonic of fundamental or 40G Hz (average) as applicable.*	Complies
Antenna Requirement	RSS-Gen Issue 5	*The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator.*	Complies
RF Peak Output Power	RSS 247 Issue 2	*Maximum peak conducted output power shall not exceed 1 W. The EIRP shall not exceed 4 W.*	Complies
Occupied Bandwidth	RSS 247 Issue 2	*The minimum 6 dB bandwidth shall be at least 500 kHz.*	Complies
Out of Band Emisisons (Bandedge)	RSS 247 Issue 2	*In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20 dBc (peak) or 30 dBc (rms).* *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).*	Complies
Power Spectral Density	RSS 247 Issue 2	*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.*	Complies
Frequency Hopping Requirements	RSS 247 Issue 2	*Frequency hopping systems in the 2400-2483.5 MHz band shall have channel carrier frequencies separated by a minimum of 25 kHz, use at least 15 hopping channels with an average time of occupancy of less than 400 msec per cycle.*	Complies
Conducted Spurious Emissions	RSS 247 Issue 2	*Conducted emissions requirements as stated in the standard.*	Complies
Radiated Spurious Emissions	RSS 247 Issue 2	*Radiated emissions requirements as stated in the standard.*	Complies
Frequency Stability	RSS-Gen Issue 5	*Ensure the normal frequency stability during temperature and input voltage fluctuations such as to remain in band.*	Complies
RF Exposure	RSS-102 Issue 5, Annex A, 9(d)	*RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm*	Complies

Section II: GENERAL INFORMATION

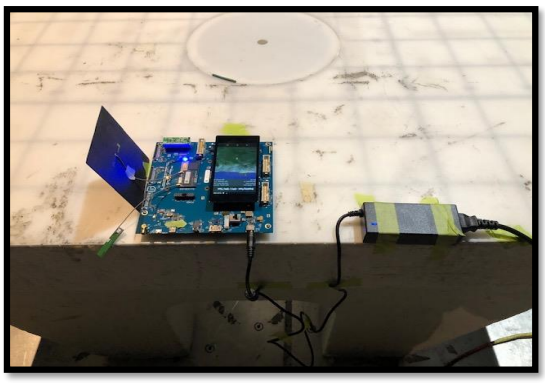
2.1 Product Description

The information provided in this section describes the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment (AE) required to perform the tests as complete system.

EUT Information

Equipment	Manufacturer		Description
EUT	Intrinsyc Technologies Corporation		*626 SOM - 802.11a/b/g/n/ac WiFi + Bluetooth Module*
		FCC ID:	2AFDI-ITCOQ626S
		IC#:	9049A-ITCOQ626S
Auxiliary 1	IBM		*Notebook PC*
Auxiliary 2	Qualcomm		*Qualcomm Radio Control Toolkit*
Auxiliary 3	Taoglas ALA.01.07.0095A		*1575MHz GPS-GALILEO Ceramic Active Loop Antenna*
Auxiliary 4	-		*USB cable*
Auxiliary 5			

Figure 1: Equipment Under Test



2.1.1 Test Configuration

The EUT was configured for 'normal operation' at maximum rate load unless otherwise specified. All accessory cables were attached unless defined as 'craftsman' port used for diagnostic and configuration. Auxiliary Equipment (AE) (notebook computer and USB cable) was present during compliance testing.

The EUT was configured for test using the internal test mode provided by the manufacturer to simulate data transmission. This utility includes all modulation modes, transmit frequencies and power levels and all other configuration options required for testing.

Refer to manufacturers documentation for additional details of modulation types, technology, applicable data transfer rates, channels and other information. Multiple antenna output (beamforming) does not apply.

Usage case (test modes) are defined in the following table. Specific configuration is listed for TX0 and TX1 for each case if applicable. Test cases may be omitted based on results, due diligence is performed on all of the modes listed in the table. Modulation modes for each case are also listed.

Co-location of transmitters is limited to BT with WiFi (2G4/5G/5G8) operation only.

Test Modes

		TX0				
Test Mode		Band		Frequency MHz	Frequency MHz	
2G4.11b		2G4-11b		2412, 2462		
2G4.11g		2G4-11g		2412, 2462		
2G4.11n		2G4-11n		2412, 2462		
The following configurations represent co-location of transmitters.						
BT	2G4.11b	2G4	2G4-11b	2402, 2480	2412, 2462	
BT	2G4.11g	2G4	2G4-11g	2402, 2480	2412, 2462	
BT	2G4.11n	2G4	2G4-11n	2402, 2480	2412, 2462	

Test Modulations

Band	Frequency MHz	Modulation	Modulation
2G4-11b	2412, 2462	CCK1ML	CCK11ML
2G4-11g	2412, 2462	xHT6M	xHT54M
2G4-11n	2412, 2462	HT20M0S(6M5)	HT20M0N(7M2)
2G4-11n	2412, 2462	HT20M7S(65M)	HT20M7N(72M)
2G4-11n	2412, 2462	HT40M0S(13M5)	HT40M0N(15M)
2G4-11n	2412, 2462	HT40M7S(135M)	HT40M7N(150M)
2G4-BT	2402, 2480	BT_DH5	BT2_DH5
2G4-BT	2402, 2480	BT3_DH5	
2G4-BLE	2402, 2480	BLE	BLE

2.1.2 Modifications

The following modifications were made to the EUT.

A	*The output power of the Bluetooth (BT) transmitter shall be reduced by to 2.5 dB during co-location operation. Operation of BT transmitter during standalone operation (BT only) is not affected.*

2.1.3 List of Ports

Craftsman ports are defined by the manufacturer and used for diagnostic and configuration by the manufacturer or installer.

2.1.4 Description of Antenna

The manufacturer's specified antenna gain in excess of 6dBi is used to reduce the overall conducted power limit as applicable in each specified frequency band.

Band	Manu.	Model/PN	Gain	Antenna Type	Connector
2G4	Taoglas	FXP.830.07.0100C	3.32	dipole	*IPEX MHF1 (U.FL compatible)*
5G/5G8	Taoglas	FXP.830.07.0100C	6.11	dipole	*IPEX MHF1 (U.FL compatible)*

2.1.5 Directional Gain (Beamforming)

The manufacturer's specified beamforming antenna gain in excess of 6dBi reduces the overall conducted power limit as applicable in each specified frequency band with a corresponding reduction of transmit power. For WiFi devices, beamforming if applicable, transmit signals are assumed to be correlated and the number of independent spatial streams (Nss) is assumed to be 1.

2.1.6 RF Output Power Tune-up Tolerance

The manufacturer has declared tune-up tolerance for the RF output power according to the following table. All measurements have been collected with a calibrated production unit with the RF power adjusted to the maximum output power including tune-up tolerance.

Frequency Band MHz	Manufacturer Declared Tune-up Tolerance dB	Maximum Setpoint Output Power dBm	Adjusted Maximum Output Power including Tune-up Tolerance dBm
2G4(BT)	2.5	13.0	15.5
2G4(11b/g/n)	2.0	19.0	21.0

Notes: 1. Maximum output power measured reflects data in Appendix D.
2. Output power is adjusted to include tune-up tolerance for all measurements.

2.2 Environmental Conditions

The EUT was operated and tested under the following environmental conditions.

Parameter	Condition
Location	Indoors
Temperature	22 - 28 C
Relative Humidity	39.8 - 54.5%

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions 30MHz-1GHz	±2.40 dB
Radiated Emissions 1GHz-40GHz	±2.48 dB
Radio Frequency	±15 Hz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1 C
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst-Case

When appropriate during radiated emissions and/or other testing, worst-case orientation or configuration was determined during exploratory investigation phase. The final radiated emissions or other measurements were then performed in the worst-case orientation or configuration.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions may be performed using automated measurement software. Correction factors for antenna factor, cable loss, amplifier gain, and other transducer factors are stored in the test templates used to perform measurements. Sample data generated from the automated software consisting of product details, emission plots and final data tables is shown below.

Sample Radiated Emission Table:

Frequency MHz	Quasi-Peak dBµV/m	Meas. Time ms	Bandwidth KHz	Antenna Height cm	Polarity	Turntable position deg	Correction dB	Margin dB	Limit dBµV/m
42.6639	33	1000	120	100	H	70	13.2	7.5	40.5

The Quasi-Peak/Average reading shown in the table above is corrected by the software using the correction factor shown. An amplifier may be used when required. The correction factor listed is calculated as:

Correction(dB) = Antenna Factor + Cable Loss - Amplifier Gain

The final Quasi-Peak/Average value for radiated emissions is calculated by the automated software using the following equation:

Corrected Quasi-Peak/Average(dBµV/m) = Raw Quasi-Peak/Average + Antenna Factor + Cable Loss - Amplifier Gain

Sample Conducted Emission Calculation:

Frequency MHz	Quasi-Peak dBµV	Meas. Time ms	Bandwidth KHz	Correction dB	Margin dB	Limit dBµV
0.15	44.3	1000	9	0.6	21.7	66

Frequency MHz	Average dBµV	Meas. Time ms	Bandwidth KHz	Correction dB	Margin dB	Limit dBµV
0.15	27.2	1000	9	0.6	28.8	56

The Quasi-Peak/Average reading shown in the table above is corrected by the software using the correction factor shown. The correction factor listed is calculated as:

Correction(dB) = Transducer Factor + Cable Loss

The final Quasi-Peak/Average value for radiated emissions is calculated by the automated software using following equation:

Corrected Quasi-Peak/Average(dBµV) = Raw Quasi-Peak/Average + Transducer Factor + Cable Loss

The margin, defined as the distance to the limit specified in the applicable standard is calculated as shown below for both radiated and conducted emissions.

Margin(dB) = Limit – Quasi-Peak/Average Measurement

2.6 List of Test Equipment

The tables below list the equipment used by QAI Laboratories in performing the tests on the Equipment Under Test (EUT). The calibration interval is 3 years or less as defined in the Quality Manual.

Emissions Test Equipment

Manufacturer	Model	Description	Serial No. / Asset	Calibration Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A
Sunol Sciences	JB3	Biconilog Antenna 30M-3G Hz	A120106	2020 Aug 16
ETS Lindgren	2165	Turntable	43677	N/A
ETS Lindgren	2125	Mast	77487	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	2019 Dec 1
Fischer	FCC-LISN-50-25-2-08	LISN 150k-30M Hz	2041	2018 Nov 19
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A
ETS Lindgren	DRH 3117	Horn Antenna 1G-18G Hz	75944	2019 Mar 10
AH Systems	PAM118	Amplifier 10k-18G Hz	189	Conditional Use
California Instruments	PACS-1	Harmonics and flicker analyzer	72569	2019 May 23
California Instruments	OMNI 1-18	Programmable Impedance Flicker Analyzer	317113	2017 Oct 19
California Instruments	3001ix	Programmable Power Supply	HK52117	2019 May 23

Measurement Software

Manufacturer	Model	Description	Serial No.
Rhode & Schwarz	EMC 32	Emissions Measurement	6.20.0

Section III: REQUIREMENTS FOR THE US MARKET (FCC) & THE CANADIAN MARKET (ISED)

3.1 AC Mains Conducted Emissions

This test ensures unintentional RF energy from the Equipment Under Test (EUT) conducted to its power source does not exceed the limits defined in the table below as specified in 15.107 and 15.207, Class B. This prevents the EUT from causing unwanted interference to other electronic devices.

This test is performed in accordance with ANSI C63.4(2014). A Line Impedance Stabilizing Network (LISN) was used to make conducted emissions measurements. Measurements were made by using instrumentation with 9 kHz measurement bandwidth, CISPR quasi-peak and average detector capabilities; measurement instrumentation requirements, including the measurement bandwidths used, are specified in CISPR 16-1-1.

The EUT was operated 120V/60Hz while in 'Continuous Mode' of operation.

Frequency Hz	Limit	
	Quasi-Peak dBµV	Average dBµV
150K - 500K	66 - 56 *	56 - 46 *
500K - 5M	56	46
5M - 30M	60	50

Notes: 1, The lower limit shall apply at the transition frequencies.
** Decreases linearly with the logarithm of the frequency.*

The EUT was tested without modification on March 10, 2019 and complies with Class B of 15.107 and 15.207.

Refer to Appendix A for AC Mains Conducted Emissions data.

3.2 Radiated Spurious Emissions

This test ensures the unintentional RF energy emitted (radiated) from the Equipment Under Test (EUT) does not exceed the limits defined in the table below as specified in 15.109 and 15.209, Class B. This prevents the EUT from causing unwanted interference to other electronic devices.

This test is performed in accordance with ANSI C63.4(2014).

The EUT was operated at 120V/60Hz while in 'Continuous Mode' of operation. All cables over 1 meter length were bundled and retained from the floor. Preliminary measurements were performed in the 3m Semi Anechoic Chamber (SAC) while final measurements were performed at the 10m Open Air Test Site (OATS) if required.

The device incorporates a "digital device" and applicable receive mode (RX) limits also apply.

The device includes co-location of transmitters, transmit mode (TX) limits are applicable while all transmitters are operating unless RF transmission of each device is exclusive. Preliminary investigation of intermodulation of transmitters to determine worst-case has been performed and final measurements for transmit mode have been performed independently and during simultaneous worst-case transmission of all devices.

Frequency MHz	Field Strength Limit at 3m	
	Quasi-Peak µV/m	Quasi-Peak dBµV/m
0.009 - 0.490	2400/F(kHz) (*1)	128.5 - 93.8
0.490 - 1.705	24000/F(kHz) (*1)	73.8 - 63.0
1.705 - 30	30 (*2)	69.5
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

Notes:
1. Measurement distance of 300m.
2. Measurement distance of 30m.
3. The lower limit shall apply at the transition frequencies.
4. The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector of 200Hz for 9k-150k Hz, 9kHz for 150k-30M Hz, and 120kHz for 30M-1G Hz except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000M Hz. Radiated emission limits in these three bands are based on measurements employing an average detector. CISPR average detector of 300Hz for 9k-150k Hz, and 30kHz for 150k-30M Hz, 300kHz for above 1G Hz.

#

Frequency MHz	Field Strength Limit at 3m	
	Quasi-Peak µV/m	Quasi-Peak dBµV/m
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0
Notes: *The lower limit shall apply at the transition frequencies.*		

Emissions in both horizontal and vertical planes (polarizations) were measured while rotating the EUT on the turntable to maximize signal strength. In the case of high ambient noises, the measurements are performed at a closer distance and the limit is adjusted using the equation below to ensure compliance.

20 Log (d1/d2); Where d1 = New distance
d2 = Required distance

The EUT was tested with the following modification on March 10, 2019 and complies with Class B of 15.109 and 15.209.	
MODIFICATION:	
A	*The output power of the Bluetooth (BT) transmitter shall be reduced by to 2.5 dB during co-location operation. Operation of BT transmitter during standalone operation (BT only) is not affected.*

Refer to Appendix B for Radiated Spurious Emissions data.

3.3 Conducted Spurious Emissions

This test ensures the RF peak power output of the Equipment Under Test (EUT) does not exceed the limits as specified in 15.247(b)(3), RSS-247 for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The EUT was operated at 120V/60Hz while in 'continuous transmit mode'. The test was performed as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer or power meter.

For systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz, spurious emissions in any 100 kHz bandwidth shall be reduced at least 20 dBc, based on either a peak conducted or radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging, the attenuation required shall be 30 dBc instead of 20 dBc. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified in 15.205

The device includes co-location of transmitters and transmit mode (TX) limits are applicable while all transmitters are operating unless RF transmission of each device is exclusive. Preliminary investigation of intermodulation of transmitters to determine worst-case has been performed and final measurements for transmit mode have been performed independently and during simultaneous worst-case transmission of all devices.

The EUT was tested without modification on March 1, 2019 and complies.

Refer to Appendix C for Conducted Spurious Emissions data.

3.4 Antenna Requirement

This requirement ensures no other antenna except as provided by the manufacturer shall be used with the Equipment Under Test (EUT) as defined in CFR 47 FCC Part 15.203, RSS-Gen Issue 5.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

The manufacturer declares the EUT complies on March 10, 2019 .

3.5 RF Peak Power Output

This test ensures the RF peak power output of the Equipment Under Test (EUT) does not exceed the limits as specified in 15.247(b)(3), RSS-247 for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The EUT was operated at 120V/60Hz while in 'continuous transmit mode'. The test was performed as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer or power meter. If necessary, duty cycle plots are used to establish correction for non-continuous operation.

The maximum peak conducted power for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz shall not exceed 1W. The Equivalent Isotropically Radiated Power (EIRP) shall not exceed 4 W unless otherwise specified in the standard.

The RF peak output power or EIRP is calculated using the maximum conducted output power increased by the directional antenna gain. The conducted RF peak output power is also corrected for duty cycle to provide the maximum transmit power.

Directional Antenna Gain (beamforming) reduces the power limit for directional antenna gains over 6dBi.

The EUT was tested without modification on March 16, 2019 and complies with 15.247(b)(3), RSS 247 Issue 2, ICES-003 Issue 6.

Refer to Appendix D for RF Peak Power Output data.
Refer to Appendix E for Duty Cycle Correction data.

3.6 Power Spectral Density

This test ensures the Power Spectral Density of the Equipment Under Test (EUT) does not exceed the limits as specified in 15.247(b)(3), RSS-247 for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The EUT was operated at 120V/60Hz while in 'continuous transmit mode'. The test was performed as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer or power meter.

For systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz., 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. The power spectral density is determined using the same method as is used to determine the conducted output power.

The EUT was tested without modification on March 16, 2019 and complies with 15.247(b)(3), RSS 247 Issue 2, ICES-003 Issue 6.

Refer to Appendix F for Power Spectral Density data.

3.7 Occupied Bandwidth

This test ensures the OBW of the Equipment Under Test (EUT) does not exceed the limits as specified in 15.247(b)(3), RSS-247 for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The test was conducted as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer. The minimum 6dB bandwidth of the EUT, as per the standards, shall be at least 500kHz. The 99% bandwidth was measured under the following circumstances.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

The EUT was tested without modification on March 16, 2019 and complies with 15.247(b)(3), RSS 247 Issue 2, ICES-003 Issue 6.

Refer to Appendix F for Occupied Bandwidth data.

3.8 Mask, Out-of-Band Emissions (Band Edge)

This test ensures the Out-of-Band Emissions (Band Edge) of the Equipment Under Test (EUT) does not exceed the limits as specified in 15.247(d), RSS-247 for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

The EUT was operated at 120V/60Hz while in 'continuous transmit mode'. The test was performed as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer or power meter.

The test was performed as defined by the standards above. 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, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified is not required.

In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits specified.

For conducted measurements above 1000 MHz within the restricted bands, the EIRP[dBm] shall be measured and then field strength E[dBuV/m} shall be calculated (see KDB Publication 789033 D02).

$$E[dB\mu V/m] = EIRP[dBm] - 20 \log (d[meters]) + 104.77 + A[dB]$$

where: E = field strength
d = distance at which field strength limit is specified in the rules
A[dB] = 2TX CDD Directional Gain (Beamforming) in excess of 6 dBi

The EUT was tested without modification on March 16, 2019 and complies with 15.247(b)(3), RSS 247 Issue 2, ICES-003 Issue 6.

Refer to Appendix F for Out-of-Band Emissions (Bandedge) data.

3.9 Frequency Stability

This requirement ensures the emission bandwidth remains in-band as defined in CFR 47 FCC Part 15.247, 15.205, 15.209(a), RSS 247 Issue 2.

The frequency stability shall be measured with variation of ambient temperature from -30° to + 50° centigrade for all equipment or as specified by the manufacturer. Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. Alternatively, the manufacturer's spceified temperature range shall be used.

The frequency stability shall be measured with variation of primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment. For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

With the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured at temperatures of -30°C, +20°C and +50°C, at the manufacturer's rated supply voltage or at a temperature of +20°C and at ±15 percent of the manufacturer's rated supply voltage.

Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 6.11. For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F) instead of at the temperatures specified in Section 6.11. If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.

The EUT was tested without modification on March 10, 2019 and complies.

Refer to Appendix G for Frequency Stability data.

3.10 Frequency Hopping Requirements

This requirement ensures no other antenna except as provided by the manufacturer shall be used with the Equipment Under Test (EUT) as defined in CFR 47 FCC Part 15.247(a)(1), RSS 247 Issue 2.

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 or +21 dBm.

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.

The EUT was tested without modification on March 11, 2019 and complies.

Refer to Appendix H for Frequency Hopping Requirements data.

3.11 RF Exposure Evaluation

This requirement ensures the Equipment Under Test (EUT) complies with the RF exposure requirements of CFR 47 FCC Part 1.131, RSS-102 Issue 5, Annex A, 9(d).

FCC Part 1.1310 defines radio frequency radiation exposure limits for General Population/Uncontrolled Exposure within frequency range 1500 - 100,000 MHz: as 1.0 mW/cm^2.

RSS-102 Section 2.5.2 defines RF exposure evaluation as required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates at or above 300 MHz and below 6 GHz , the source-based, time-averaged maximum EIRP of the device is equal to or less than 1.31 x 10-2 ƒ^0.6834 W (adjusted for tune-up tolerance), where ƒ is in MHz. In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

RF Exposure Limits

Band	Worst-Case (Lowest) Frequency in Band MHz	RSS-102-2.5.2 Power Density Limit at 20 cm mW/cm^2	CFR 47 FCC 1.1310 Power Density Limit at 20 cm mW/cm^2
2G4	2400	2.7	1.0

RF Exposure Evaluation

Power Density (mW/cm^2) = EIRP(mW) / (4 * PI * r^2)

Band	Highest Measured Conducted Power dBm	Antenna Gain dBi	EIRP mW	Power Density at 20 cm mW/cm^2
2G4(WiFi)	20.8	3.32	259.1	0.052
2G4(BT)	11.5	3.32	30.6	0.006
2G4(BLE)	3.8	3.32	5.2	0.001

In all cases, the Power Density reported is significantly less than the applicable limits.

The measurements and calculations for RF Exposure were performed on March 5, 2019 and the EUT complies with CFR 47 FCC Part 1.131 and RSS-102 Issue 5, Annex A, 9(d).

3.12 Modular Transmitters

This requirement ensures modular device requirements as declared by manufacturer and defined in CFR 47 FCC Part 15.212 and Radio Standards Procedure RSP-100, Certification of Radio Apparatus are met.

Single modular transmitters consist of a completely self-contained radio frequency transmitter device that is typically incorporated into another product, host or device. Split modular transmitters consist of two components: a radio front end with antenna (or radio devices) and a transmitter control element (or specific hardware on which the software that controls the radio operation resides). All single or split modular transmitters are approved with an antenna.

Single modular transmitters must meet the following requirements to obtain a modular transmitter approval. The radio elements of the modular transmitter must have their own shielding. The physical crystal and tuning capacitors may be located external to the shielded radio elements. The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation. The modular transmitter must have its own power supply regulation.

The modular transmitter must be tested in a stand-alone configuration, i.e., the module must not be inside another device during testing for compliance with part 15 requirements. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in § 15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see § 15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to ensure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see § 15.31(i)).

The manufacturer has declared compliance with the requirements for a SINGLE modular transmitter on March 10, 2019 .

Appendix A: CONDUCTED EMISSIONS DATA

Figure A1: AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L1

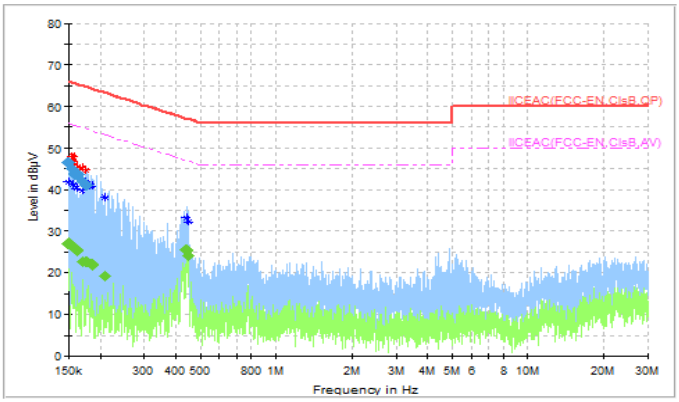


Table A1-1: Quasi-Peak Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L1

Frequency MHz	*	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
0.150450	46.5	1000	9	L1	12.0	66.0	19.5	PASS
		1000	9	L1			0.0	PASS
		1000	9	L1			0.0	PASS
		1000	9	L1			0.0	PASS
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

Table A1-2: Average Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L1

Frequency MHz	Average dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
No emissions found within 20dB of limit.								
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

Figure A2: AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L2

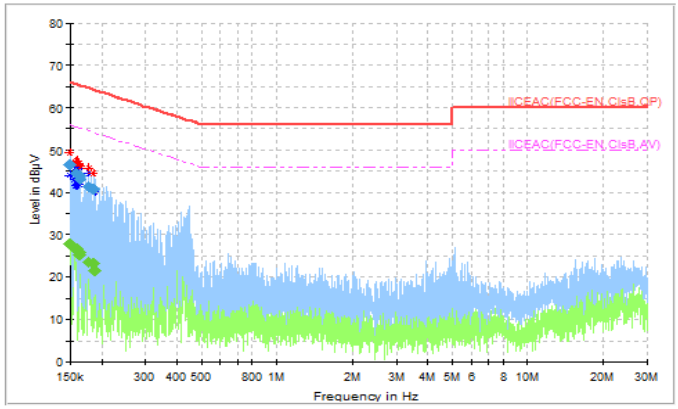


Table A2-1: Quasi-Peak Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L2

Frequency MHz	Quasi-Peak dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
0.150601	46.6	1000	9	L2	12.0	66.0	19.4	PASS
		1000	9	L2			0.0	PASS
		1000	9	L2			0.0	PASS
		1000	9	L2			0.0	PASS

Notes: 1. Peak data may be compared to average limit.
2. Emissions above noise floor or within 20dB of limit are reported.

Table A2-2: Average Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - RX - L2

Frequency MHz	Average dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
No emissions found within 20dB of limit.								

Notes: 1. Peak data may be compared to average limit.
2. Emissions above noise floor or within 20dB of limit are reported.

Figure A3: AC Mains Conducted Emissions for FCC/ISED 120V/60H - TX - Worst-Case - L1

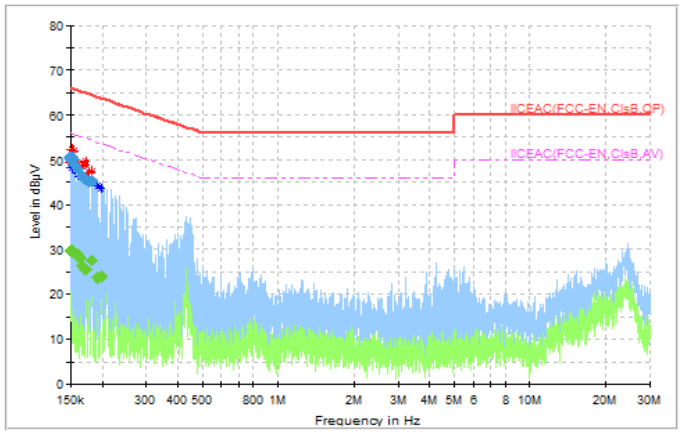


Table A3-1: Quasi-Peak Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - TX Worst-Case - L1

Frequency MHz	Quasi-Peak dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
0.150450	46.5	1000	9	L1	12.0	66.0	19.5	PASS
		1000	9	L1			0.0	PASS
		1000	9	L1			0.0	PASS
		1000	9	L1			0.0	PASS
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

0

Table A3-2: Average Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - TX - Worst-Case - L1

Frequency MHz	Average dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
No emissions found within 20dB of limit.								
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

Figure A4: AC Mains Conducted Emissions for FCC/ISED 120V/60H - TX - Worst-Case - L2

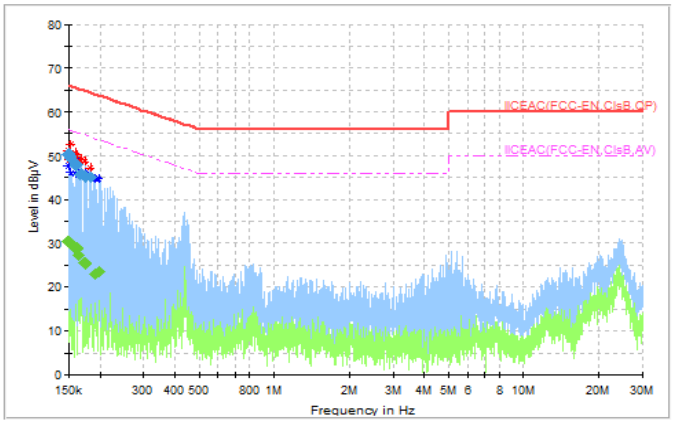


Table A4-1: Quasi-Peak Data AC Mains Conducted Emissions for FCC/ISED 120V/60HC

Frequency MHz	Quasi-Peak dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
0.150601	46.6	1000	9	L2	12.0	66.0	19.4	PASS
		1000	9	L2			0.0	PASS
		1000	9	L2			0.0	PASS
		1000	9	L2			0.0	PASS
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

Table A4-2: Average Data AC Mains Conducted Emissions for FCC/ISED 120V/60H - Worst-Case - L2

Frequency MHz	Average dBµV	Meas. Time msec	Bandwidth kHz	Line	Correction dB	Limit dBµV	Margin dB	
No emissions found within 20dB of limit.								
Notes: 1.	*Peak data may be compared to average limit.*							
2.	*Emissions above noise floor or within 20dB of limit are reported.*							

Appendix B: RADIATED EMISSIONS DATA

Figure B1: Radiated Emissions 30M-1G Hz for FCC/ISED - RX

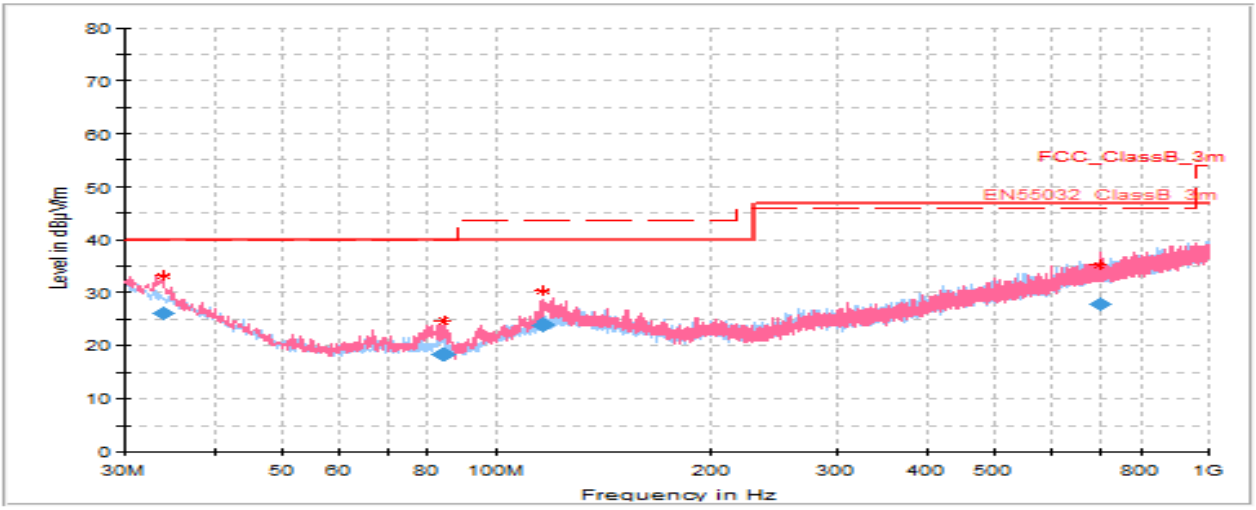


Table B1-1: Radiated Emissions 30M-1G Hz Data for FCC/ISED - RX

Frequency MHz	Quasi-Peak dBµV	Meas. Time ms	Bandwidth KHz	Polarity	Correction dB	Margin dB	Limit dBµV/m	
33.992	26.1	1000	120	VERT	25.7	13.9	40.0	PASS
84.464	18.2	1000	120	VERT	16.2	21.8	40.0	PASS
115.776	24.0	1000	120	VERT	21.1	19.5	43.5	PASS
700.137	27.8	1000	120	VERT	30.7	18.2	46.0	PASS

Notes: 1. Peak data may be compared to quasi-peak limit.
2. Emissions above noise floor are reported.

Figure B2: Radiated Emissions 1G-18G Hz for FCC/ISED - RX

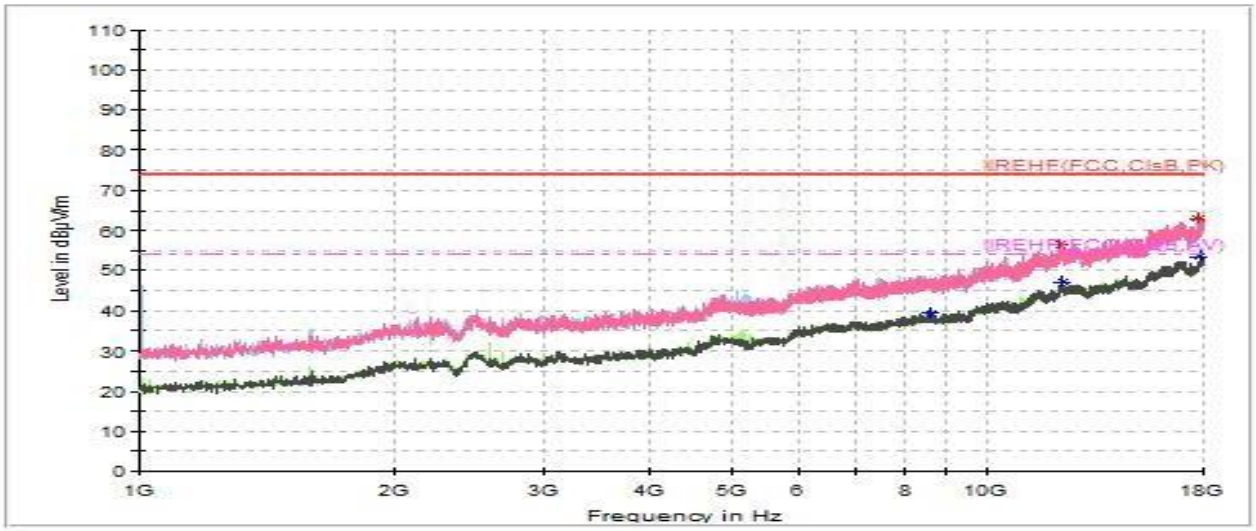


Table B2-1: Radiated Emissions 1G-18G Hz Data for FCC/ISED - RX

Frequency MHz	Peak dBµV/m	Average dBµV/m	Meas. Time ms	Bandwidth Hz	Polarity	Correction dB	Margin dB	Limit dBµV/m	
No emissions found above measurement noise floor.									
Notes: 1. *Peak data may be compared to average limit.* 2. *Emissions above noise floor are reported.*									

Figure B3: Radiated Emissions 30M-1G Hz for FCC/ISED - TX Worst-Case

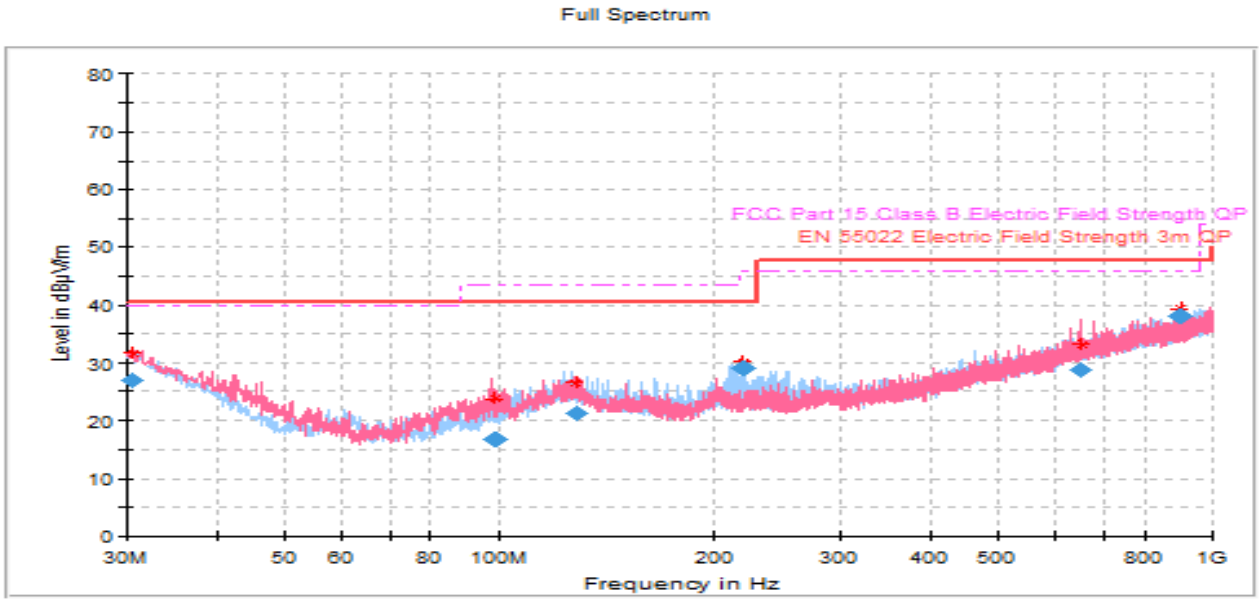


Table B3-1: Radiated Emissions 30M-1G Hz Data for FCC/ISED - TX Worst-Case

Frequency MHz	Quasi-Peak dBµV	Meas. Time ms	Bandwidth KHz	Polarity	Correction dB	Margin dB	Limit dBµV/m	
30.621	27.0	1000	120	VERT	25.4	29.3	40.0	PASS
98.960	16.9	1000	120	VERT	18.3	17.1	43.5	PASS
128.595	21.3	1000	120	HORZ	20.2	21.2	43.5	PASS
219.363	29.1	1000	120	HORZ	34.2	19.1	46.0	PASS
653.678	28.8	1000	120	VERT	34.2	29.0	46.0	PASS
896.019	38.0	1000	120	HORZ	34.2	32.2	46.0	PASS

Notes 1. Peak data may be compared to quasi-peak limit.
2. Emissions above noise floor are reported.
3. Transmit mode emission sweeps including co-location if applicable were performed using test configuration matrix to determine worst-case (section 2.1).

Figure B4: Radiated Emissions 1G-18G Hz for FCC/ISED - TX Worst-Case

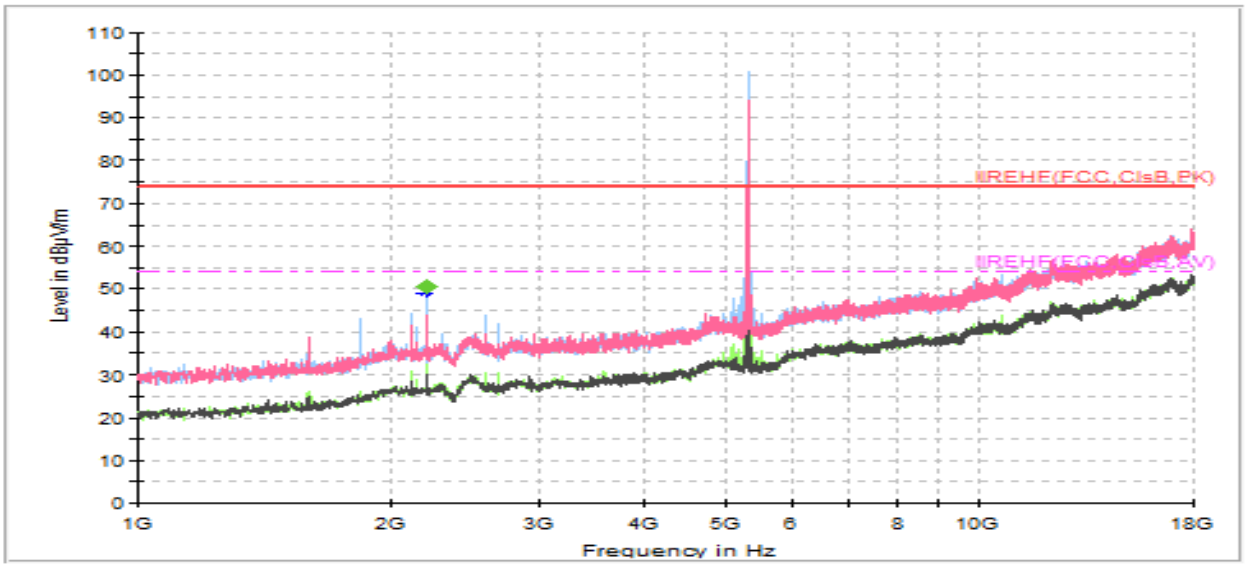


Table B4-1: Radiated Emissions 1G-18G Hz Data for FCC/ISED - TX Worst-Case

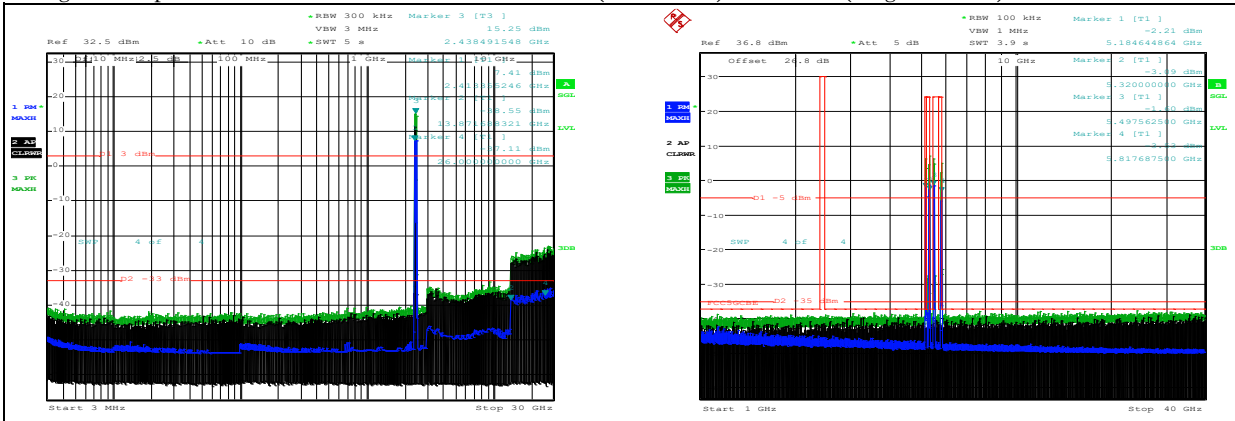
Frequency MHz	Peak dBµV/m	Average dBµV/m	Meas. Time ms	Bandwidth Hz	Polarity	Correction dB	Margin dB	Limit dBµV/m	
5825	---	---	1000	1M	VERT	-4.5			TX
1597.1956	---	33.6	1000	1M	VERT	-0.2	20.4	54.0	PASS
2210.0124	---	52.8	1000	1M	HORZ	-0.1	1.2	54.0	PASS

Notes:
1. *Notch filter used to remove fundamental for 2.4G, fundamental at 5G8 shown.*
2. *Emissions above noise floor are reported; emissions less 20dBc are not reported.*
3. *Transmit mode emission sweeps including co-location if applicable were performed using test configuration matrix to determine worst-case (section 2.1).*

Co-location Worst-case:	The worst-case mode for co-located transmitters was determined to be Bluetooth(BTDH5) and 802.11n (HT40MS0) operating in 2G4 band at 2452MHz.

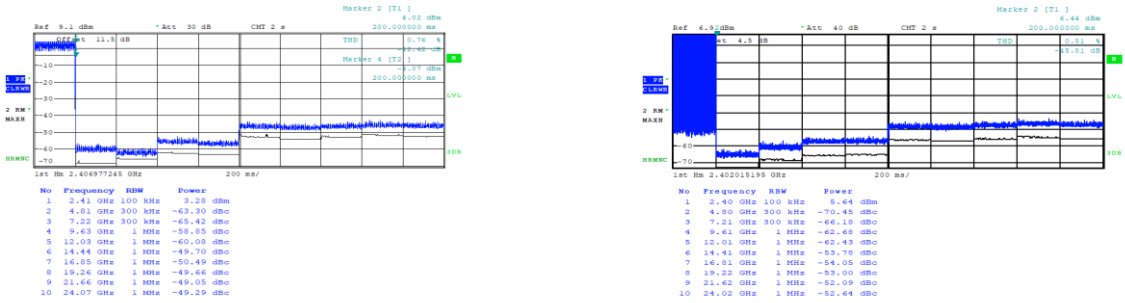
Appendix C: SPURIOUS CONDUCTED EMISSIONS DATA

Figure C1: Spurious Conducted Emissions for FCC/ISED - TX(2G4/5G/5G8), Worst-Case(11b/g/n, BT/BLE)



Notes:
1. *Plot shown is cumulative, multiple modulation/transmit frequencies shown, see test mode for description.*
2. *No significant emissions found above noise floor, all emissions greather than (<30)dBc.*
3. *All spurious emissions in Restricted Bands are calculated to be within 54AV/74PK limit based on extrapolation of conducted emission measurement using KDB 412172.*

Figure C2: Harmonic Conducted Emissions for FCC/ISED - TX(2G4/5G/5G8) - Sample



Notes:
1. *Typical measurement shown.*
2. *All harmonic emissions greater than 30dBc.*

Table CI: Conducted Harmonic Emissions for FCC/ISED - TX(2G4), Worst-Case(11b/g/n, BT/BLE)

Frequency MHz	H2	H3	H4	H5	H6	H7	H8	H9	H10	
2412	70	68	63	64	54	54	55	53	53	11b-CCK
2412	63	58	55	56	46	47	46	47	46	11g-xHT
2412	62	59	55	56	45	46	45	44	45	11n-HT20M
2422	56	51	49	50	40	40	39	36	39	11n-HT40M
2480	71	69	62	63	54	55	54	53	53	BT
2480	66	64	58	59	49	50	49	48	48	BLE

Notes:
1. *All harmonic content is less than 30 dBc.*
2. *Harmonic emissions for 11b, 11g were measured at both high and low data rates and worst-case data reported.*
3. *Harmonic emissions for BT/BLE were measured at each modulation supported and worst-case data reported.*
4. *Harmonic emissions for 11n were measured at both high and low data rates at each of two modulation modes and worst-case data reported.*
   Example measurement case: 11n-HT-40M - HT40M-MCS0(13M5), HT40M-MCS7(135M), HT40M-MCS0(15M), HT40M-MCS7(150M).

Appendix D: CONDUCTED RF OUTPUT POWER & EIRP DATA

Table D1: RF Conducted Output Power Maximum (Worst-Case), Corrected for Duty Cycle & EIRP - FCC/ISED - 2G4

Band	2G4 Channel Frequency LO/HI MHz	Output Power Watt	Antenna Gin dBi	Output Power mW	Output Power dBm	EIRP dBm	EIRP Limit dBm	Margin dB	
2G4(WiFi)	2412, 2462	0.12066	3.32	120.7	20.8	24.1	36.0	11.9	PASS
2G4-BT	2402, 2480	0.01424	3.32	14.2	11.5	14.9	36.0	21.1	PASS
2G4-BLE	2402, 2480	0.00242	3.32	2.42	3.8	7.2	36.0	28.8	PASS

Band	2G4 Frequency MHz	Modulation	Output Power dBm	Limit dBm	Margin dB		Max Output Power dBm
2G4-11b	2412, 2437, 2462	CCK1ML, CCK11ML	20.8	30.0	9.2	PASS	20.8
2G4-11g	2412, 2437, 2462	xHT6M, xHT54M	17.5	30.0	12.5	PASS	
2G4-11n(20M)	2412, 2437, 2462+C53	HT20M0-L/H, HT20M19-L/H	17.0	30.0	13.0	PASS	
2G4-11n(40M)	2412, 2437, 2462	HT40M0-L/H, HT40M19-L/H	15.8	30.0	14.2	PASS	
2G4-BT	2402, 2442, 2480	BTDH5	11.5	30.0	18.5	PASS	11.5
2G4-BT	2402, 2442, 2480	BT2DH5	9.3	30.0	20.7	PASS	
2G4-BT	2402, 2442, 2480	BT3DH5	9.3	30.0	20.7	PASS	
2G4-BLE	2402, 2442, 2480	BLE	3.8	30.0	26.2	PASS	3.8

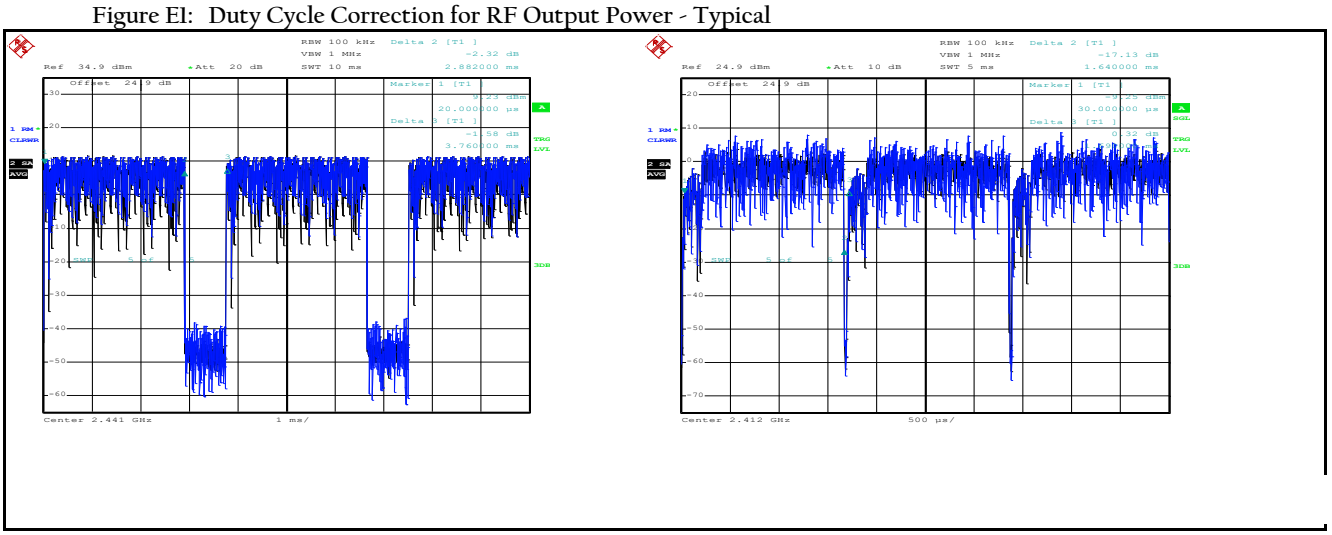
Notes: 1. Reported Output Power dBm includes duty cycle correction (Appendix E) for specific modulation to be determined as worst-case.
2. EIRP limit is reduced by the amount the antenna exceeds 6dBi.

Appendix E: DUTY CYCLE CORRECTION DATA

Table E1: Duty Cycle Correction for RF Output Power

Frequency MHz	Modulation	Frequency MHz	T2 (OFF) usec or msec	T1 (ON+OFF) usec or msec	Duty Cycle dB	Max Duty Cycle dB
2G 11b	CCK1ML	2412	16.238	16.296	0.02	0.22
2G 11b	CCK11ML	2412	1.64	1.69	0.13	
2G 11g	xHT6M	2412	2.71	2.76	0.08	
2G 11g	xHT54M	2412	312	328	0.22	
2G 11n	HT20(MS0)	2412	2.500	2.534	0.06	0.33
2G 11n	HT20(MS7)	2412	282	304	0.33	
2G 11n	HT20(MN0)	2412	2252	2278	0.05	
2G 11n	HT20(MN7)	2412	264	284	0.32	
BT	BT_DH5	2402	2.88	3.76	1.16	1.16
BT	BT2_DH5	2402	2.88	3.76	1.16	
BT	BT3_DH5	2402	2.88	3.76	1.16	
BLE	BLE	2402	362	620	2.34	2.34
5G 11a	xHT6M	5230	2700	2722	0.04	0.26
5G 11a	xHT54M	5230	326	346	0.26	
Notes: 1.						

Figure E1: Duty Cycle Correction for RF Output Power - Typical



Appendix F: OBW, MASK & BANDEDGE, PSD DATA

Table F1: Occupied Bandwidth for FCC/ISED

Band	Frequency MHz	Modulation	Occupied Bandwidth MHz	Limit OBW 6dB >500kHz		
2G4-11b	2412, 2437, 2462	CCK1ML, CCK11ML	14.1	PASS		
2G4-11g	2412, 2437, 2462	xHT6M, xHT54M	16.6	PASS		
2G4-11n	2412, 2437, 2462	HT20M0-L/H, HT20M19-L/H	17.8	PASS		
2G4-11n	2412, 2437, 2462	HT40M0-L/H, HT40M19-L/H	36.1	PASS		
2G4-BT	2402, 2442, 2480	BTDH5	0.954	PASS		
2G4-BT	2402, 2442, 2480	BT2DH5	1.215	PASS		
2G4-BT	2402, 2442, 2480	BT3DH5	1.236	PASS		
2G4-BLE	2402, 2442, 2480	BLE	1.088	PASS		

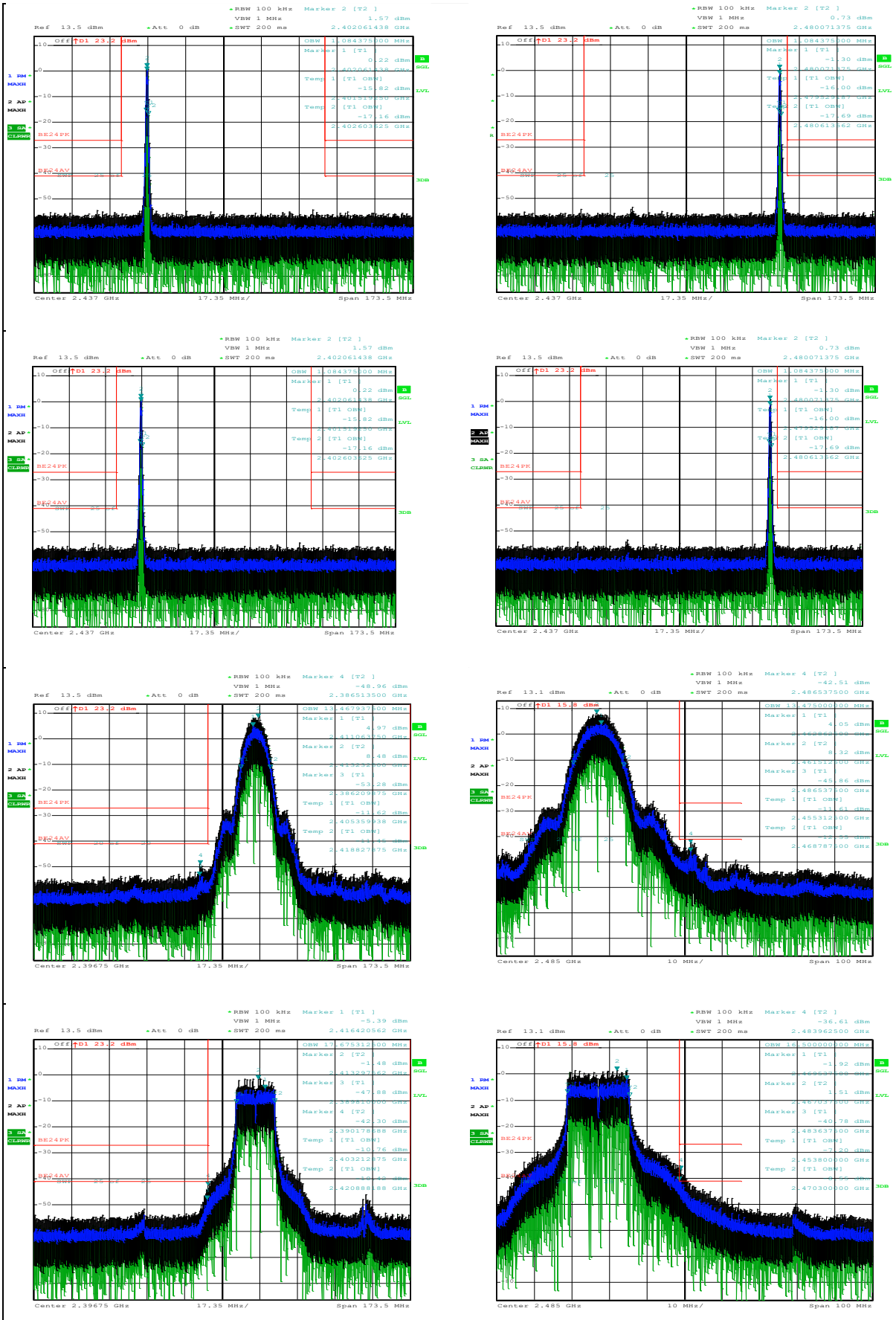
Table F2: Power Spectral Density for FCC/ISED

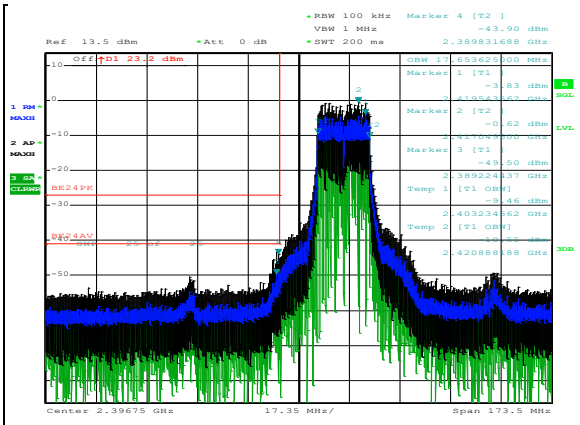
Band	2G4 Frequency MHz	Modulation	Power Spectral Density dBm/3kHz	PSD Limit dBm/3kHz	Margin dB	
2G4-11b	2412, 2437, 2462	CCK1ML, CCK11ML	-6.8	8.0	14.8	PASS
2G4-11g	2412, 2437, 2462	xHT6M, xHT54M	-10.9	8.0	18.9	PASS
2G4-11n	2412, 2437, 2462	HT20M0-L/H, HT20M19-L/H	-10.7	8.0	18.7	PASS
2G4-11n	2412, 2437, 2462	HT40M0-L/H, HT40M19-L/H	-17.0	8.0	25.0	PASS
2G4-BT	2402, 2442, 2480	BTDH5	1.3	8.0	6.7	PASS
2G4-BT	2402, 2442, 2480	BT2DH5	-0.9	8.0	8.9	PASS
2G4-BT	2402, 2442, 2480	BT3DH5	-1.4	8.0	9.4	PASS
2G4-BLE	2402, 2442, 2480	BLE	-13.6	8.0	21.6	PASS

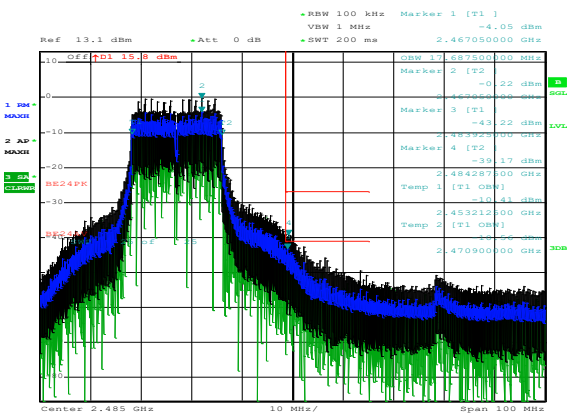
Table F3: Out-of-Band and 2G4 Radiated Bandedge Emissions for FCC/ISED - TX 2G4 Worst-Case

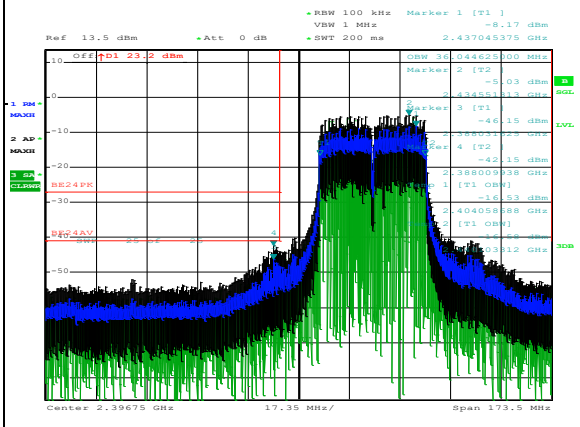
Frequency MHz	Radiated Bandedge Measurement dBuV/m @3m	Correction dB	Meas. Time ms	Bandwidth Hz	Average Limit dBuV/m	Margin dB	Notes
2390	49.8	28.5	1000	1M	54.0	4.2	*PASS Restricted Bandedge*
2483.5	52.8	28.6	1000	1M	54.0	1.2	*PASS Restricted Bandedge*
Spurious emissions for all test cases not reported are attenuated by at least 30dBc (RMS method).							
Peak data for all test cases was determined to be greater than 14dB margin to peak limit of 74 dBuV/m using conducted method.							
Radiated measurement all restricted band emissions within 6dB of 54 dBuV/m limit performed.							
Notes: 1. *Spurious emissions are required to be attenuated by 30dB (RMS method) or 20dB (PK method) unless emissions fall within restricted bands.* 2. *Restricted bandedge conducted emissions at 2190MHz and 2483.5MHz converted to field reading in accordance with KDB 789033 D02 to determine worst-case.* 3. *Worst-case radiated bandedge measurement(s) performed on worst-case as determined from conducted emission plots shown.*							

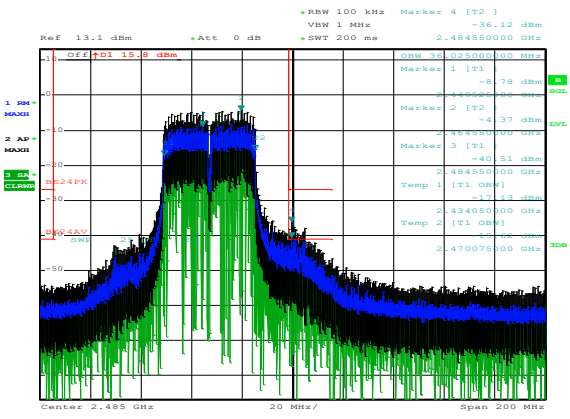
Figure FI: PSD, OBW, Mask, Bandedge Emissions for FCC/ISED - TX 2G4 Typical




RBW 100 kHz
VBW 1 MHz
SWT 200 ms
Marker 4 [T2]
-43.90 dBm
2.389831688 GHz
Ref 13.5 dBm
Att 0 dB
Center 2.39675 GHz
17.35 MHz/
Span 173.5 MHz


RBW 100 kHz
VBW 1 MHz
SWT 200 ms
Marker 1 [T1]
-4.05 dBm
2.467050000 GHz
Ref 13.1 dBm
Att 0 dB
Center 2.485 GHz
10 MHz/
Span 100 MHz


RBW 100 kHz
VBW 1 MHz
SWT 200 ms
Marker 1 [T1]
-8.17 dBm
2.437045375 GHz
Ref 13.5 dBm
Att 0 dB
Center 2.39675 GHz
17.35 MHz/
Span 173.5 MHz


RBW 100 kHz
VBW 1 MHz
SWT 200 ms
Marker 4 [T2]
-36.12 dBm
2.484550000 GHz
Ref 13.1 dBm
Att 0 dB
Center 2.485 GHz
20 MHz/
Span 200 MHz

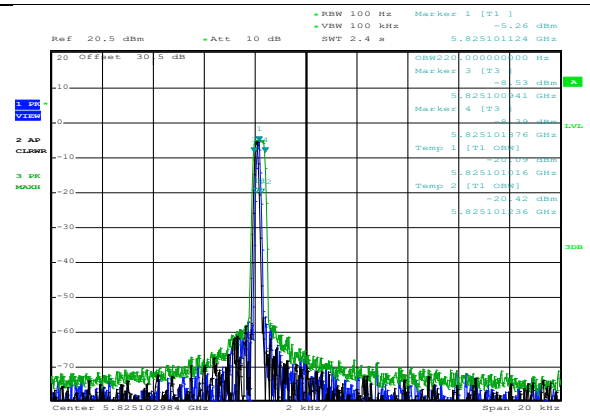
Appendix G: FREQUENCY STABILITY DATA

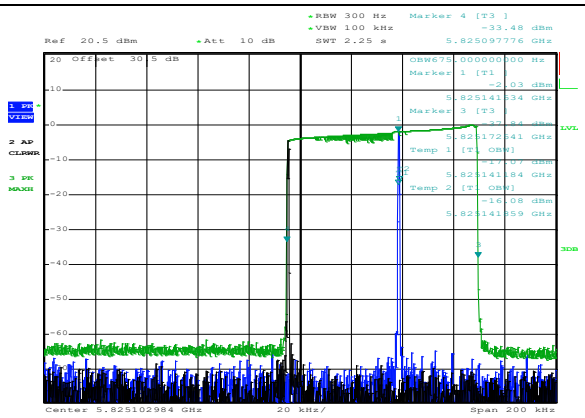
Table G1: Frequency Stability Variation Data

Procedure	Reference Frequency MHz	Cursor 1 Hz	Cursor 2 Hz	Delta Hz	OBW Hz	Deviation Hz	Deviation Hz	Deviation ppm
Input voltage variation	5825.100	941	1276	335	220	941	115	0.02
Temperature variation	5825	141534	172541	31007	675	141534	30332	5.21

Notes:
1. *Frequency stability performed with CW signal or randomly selected modulated signal and is assumed to represent all TX modes.*
2. *Variation over input voltage range of 85 - 115% of AC or DC input.*
3. *Variation over temperature over manufacturer declared temperature range or -20C - +50C.*
4. *EUT monitored continuously using maxhold to record frequency deviation envelope.*
5. *Multiple part (CC) devices may show compliance based on frequency stability data from an alternate band if manufacturer declares single oscillator used as reference for both TX paths.*

Figure G1: Frequency Stability Plots



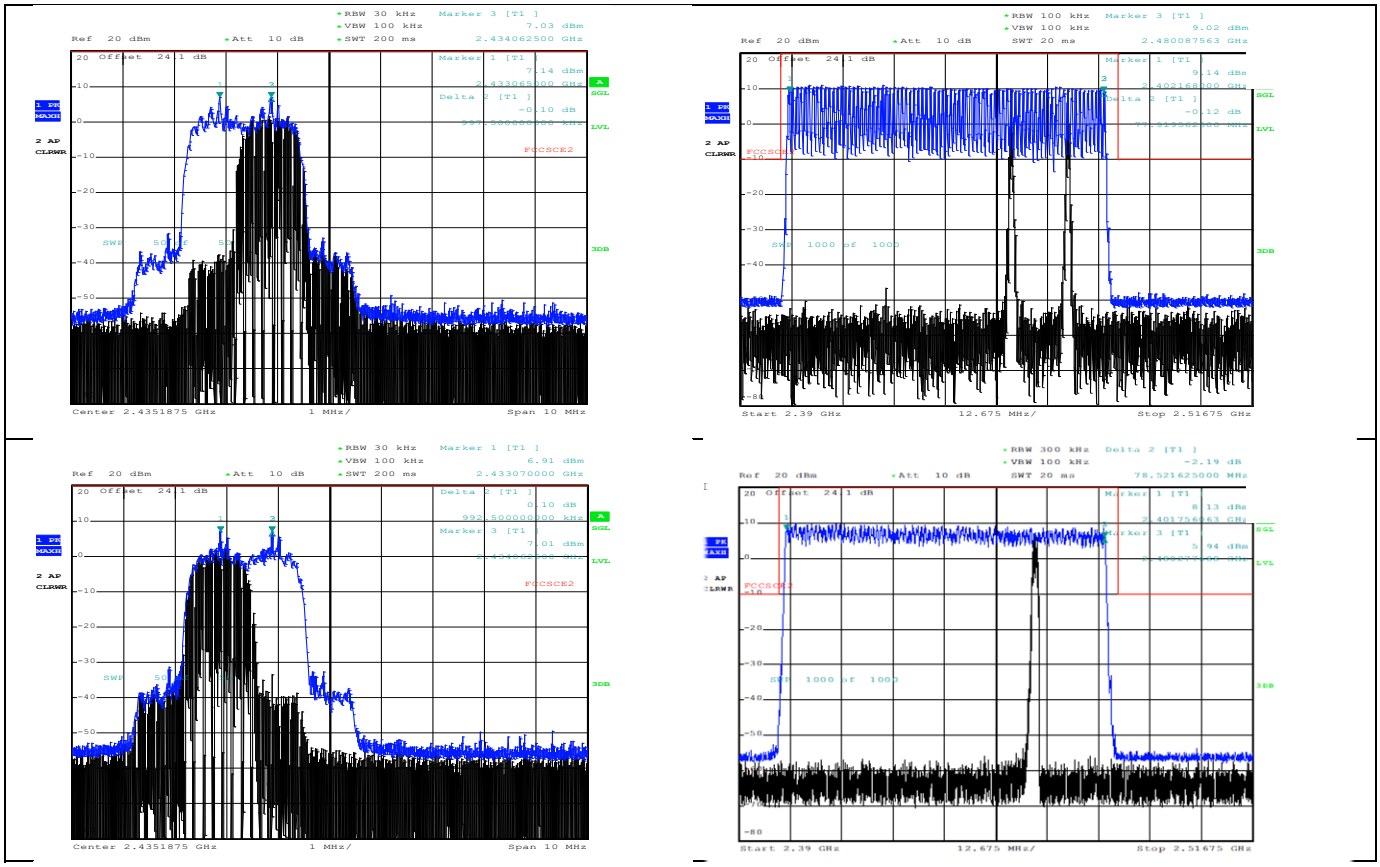


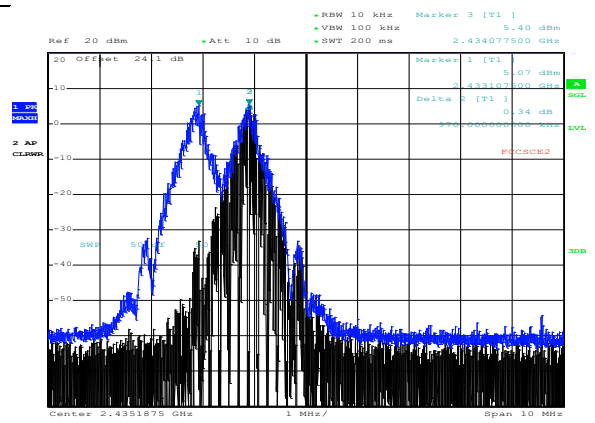
Appendix H: FREQUENCY HOPPING DATA

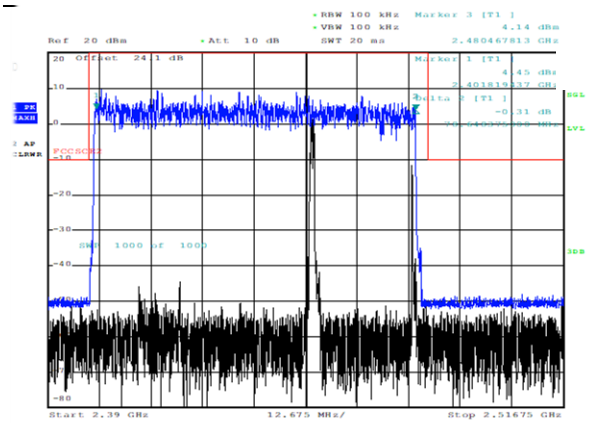
Table H1: Frequency Hopping Requirements

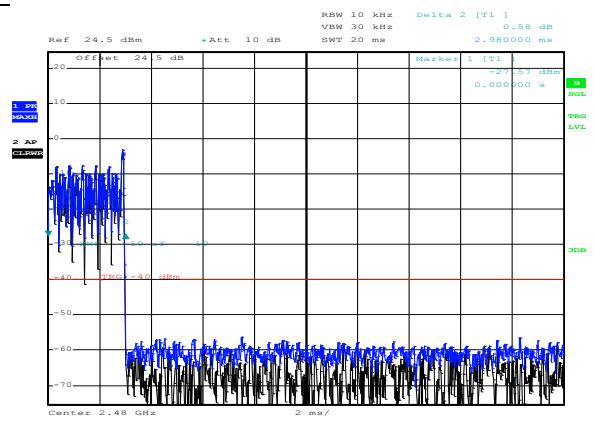
5700-5850 MHz - Frequency Hopping Systems (FHS)					*Not Applicable*
902-928 MHz Frequency Hopping Systems (FHS) with OBW‹250kHz					*Not Applicable*
902-928 MHz Frequency Hopping Systems (FHS) with OBW›250kHz					*Not Applicable*
2400-2483.5 MHz Frequency Hopping Systems (FHS)					*Applicable*
Minimum Channel Carrier Frequency Separation of 25kHz or 2/3 OBW (kHz)	BTDH5			997.5	PASS
Minimum Channel Carrier Frequency Separation of 25kHz or 2/3 OBW (kHz)	BT2DH5			992.5	PASS
Minimum Channel Carrier Frequency Separation of 25kHz or 2/3 OBW (kHz)	BT3DH5			970.0	PASS
Channel occupancy of less 400 msec per cycle (msec) (pulses) (msec)	BTDH5	2.98	22	65.6	PASS
Channel occupancy of less 400 msec per cycle (msec) (pulses) (msec)	BT2DH5	2.98	26	77.5	PASS
Channel occupancy of less 400 msec per cycle (msec) (pulses) (msec)	BT3DH5	2.98	24	71.5	PASS
15 or more hopping channels	BTDH5			80	PASS
15 or more hopping channels	BT2DH5			80	PASS
15 or more hopping channels	BT3DH5			80	PASS
Notes: 1.					

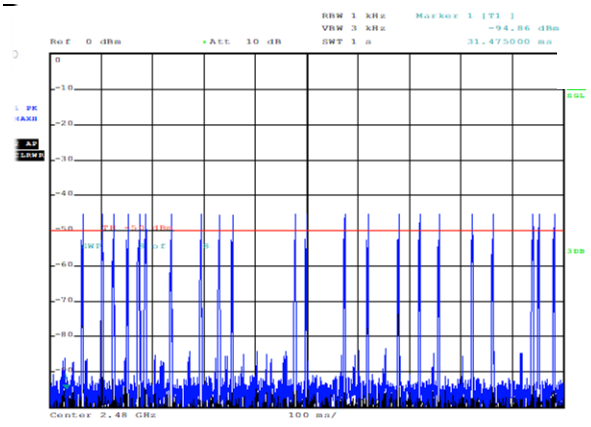
Figure H1: Frequency Hopping Requirement Plots

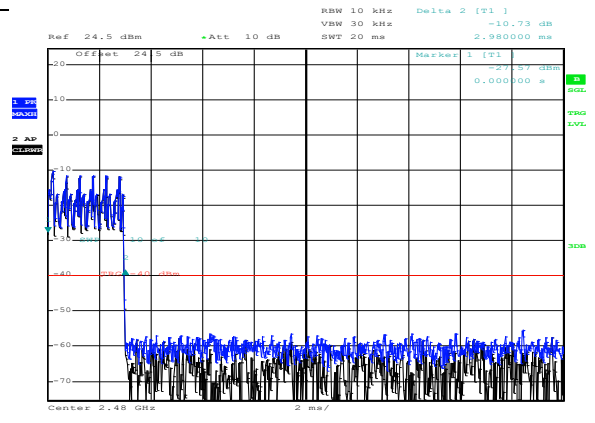


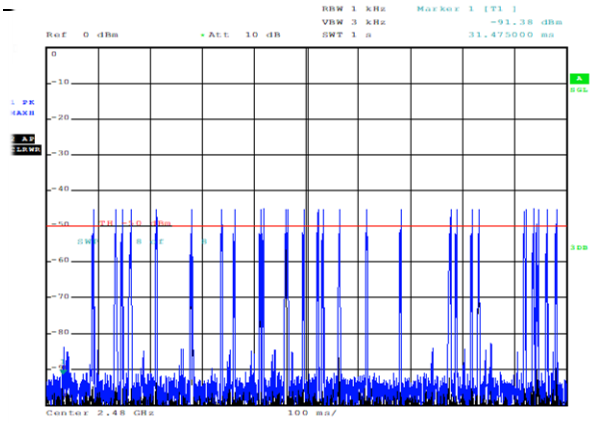

RBW 10 kHz
VBW 100 kHz
SWT 200 ms
Marker 3 [T1]
5.40 dBm
2.434077500 GHz
Ref 20 dBm
Att 10 dB
Offset 24.1 dB
Marker 1 [T1]
5.07 dBm
2.433107500 GHz
Delta 2 [T1]
0.34 dB
870.000000000 kHz
FCCSCE2
Center 2.4351875 GHz
1 MHz/
Span 10 MHz

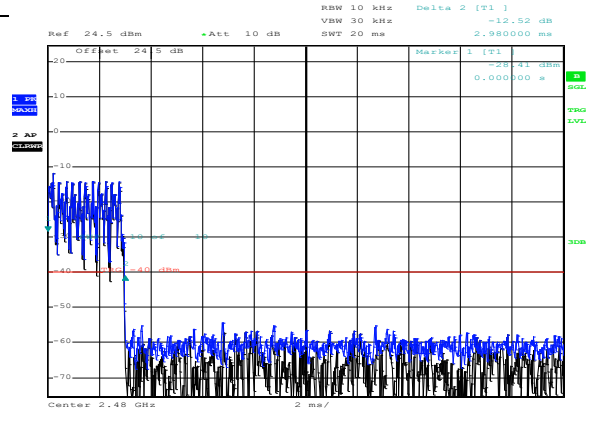

RBW 100 kHz
VBW 100 kHz
SWT 20 ms
Marker 3 [T1]
-4.14 dBm
2.480467813 GHz
Ref 20 dBm
Att 10 dB
Offset 24.1 dB
Marker 1 [T1]
-4.45 dBm
2.401819237 GHz
Delta 2 [T1]
-0.31 dB
78.640376 MHz
FCCSCE2
SWT 1000 of 1001
Start 2.39 GHz
12.675 MHz/
Stop 2.51675 GHz

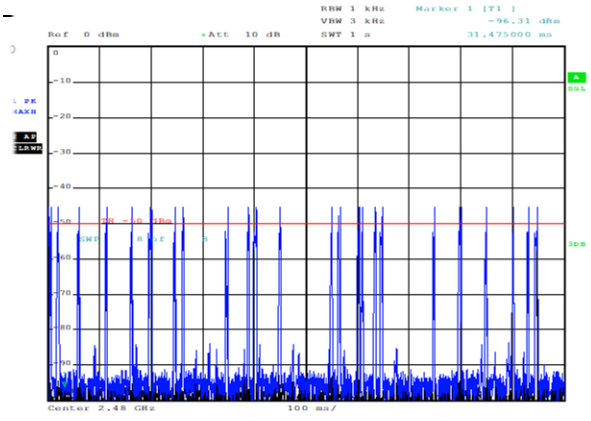

RBW 10 kHz
VBW 30 kHz
SWT 20 ms
Delta 2 [T1]
0.58 dB
2.980000 ms
Ref 24.5 dBm
Att 10 dB
Offset 24.5 dB
Marker 1 [T1]
-27.57 dBm
0.000000 s
TRG -40 dBm
Center 2.48 GHz
2 ms/


RBW 1 kHz
VBW 3 kHz
SWT 1 s
Marker 1 [T1]
-94.86 dBm
31.475000 ms
Ref 0 dBm
Att 10 dB
Center 2.48 GHz
100 ms/


RBW 10 kHz
VBW 30 kHz
SWT 20 ms
Delta 2 [T1]
-10.73 dB
2.980000 ms
Ref 24.5 dBm
Att 10 dB
Offset 24.5 dB
Marker 1 [T1]
-27.57 dBm
0.000000 s
TRG -40 dBm
Center 2.48 GHz
2 ms/


RBW 1 kHz
VBW 3 kHz
SWT 1 s
Marker 1 [T1]
-91.38 dBm
31.475000 ms
Ref 0 dBm
Att 10 dB
Center 2.48 GHz
100 ms/


RBW 10 kHz
VBW 30 kHz
SWT 20 ms
Delta 2 [T1]
-12.52 dB
2.980000 ms
Ref 24.5 dBm
Att 10 dB
Offset 24.5 dB
Marker 1 [T1]
-28.41 dBm
0.000000 s
TRG -40 dBm
Center 2.48 GHz
2 ms/


RBW 1 kHz
VBW 3 kHz
SWT 1 s
Marker 1 [T1]
-96.31 dBm
31.475000 ms
Ref 0 dBm
Att 10 dB
Center 2.48 GHz
100 ms/

Appendix R: TEST SETUP PHOTOS

Figure R1: EUT Radiated Emissions Cable Layout

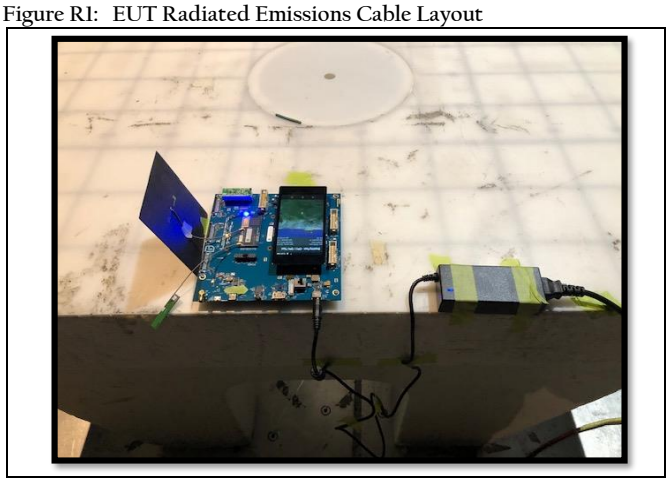


Figure R2: Radiated Emissions Test Setup w/ AE

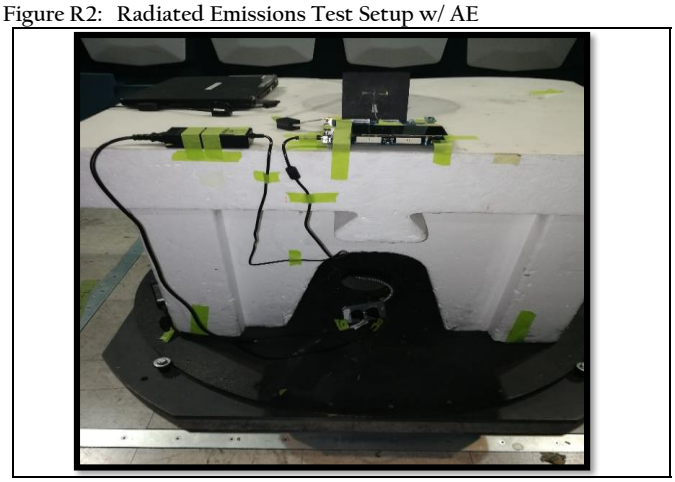


Figure R3: Conducted Emissions Test Setup

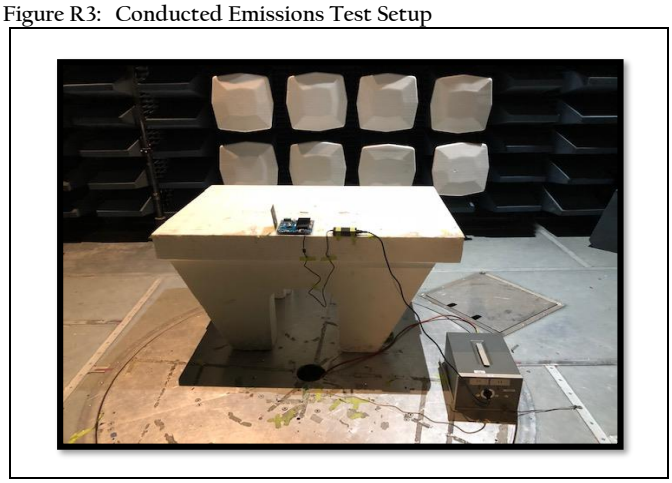


Figure R4: Radiated Emissions 30M-1G Test Setup

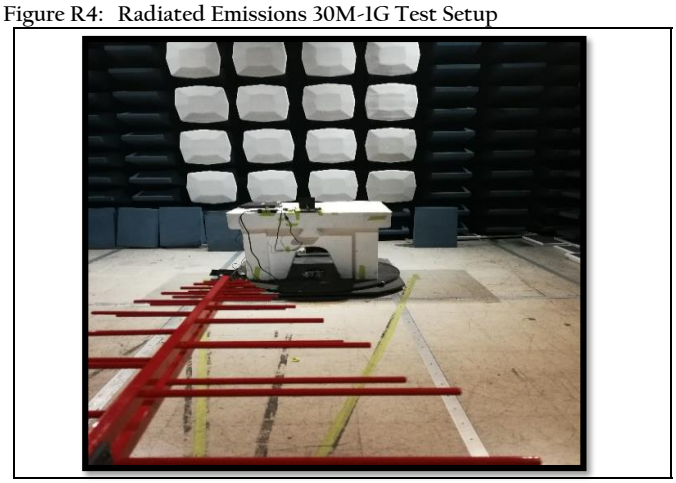


Figure R5: Radiated Emissions 1G-18G Test Setup

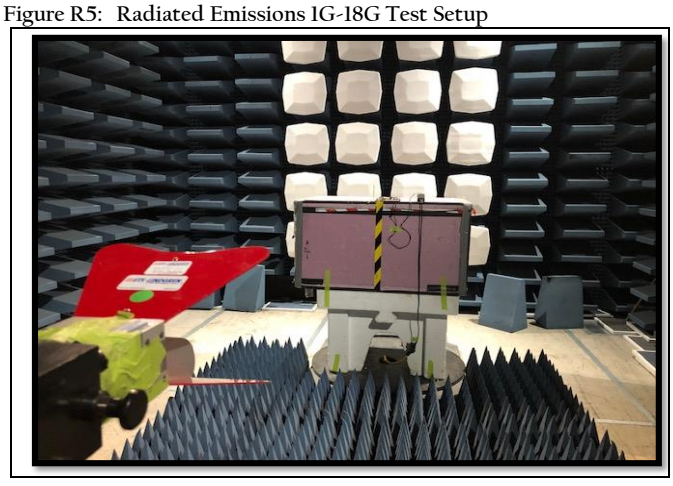
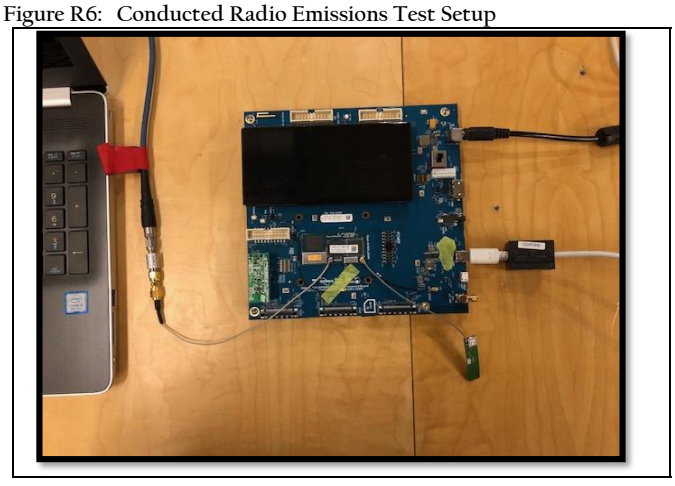


Figure R6: Conducted Radio Emissions Test Setup



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Appendix S: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AE	Auxiliary Equipment
CDN	Coupling/Decoupling Network
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
EIRP	Equivalent Isotropic Radiated Power
ESD	Electro-Static Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
IC	Industry Canada
ICES	Interference Causing Equipment Standard
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

[END OF REPORT]