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ELECTROMAGNETIC COMPATIBILITY TEST REPORT

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Laboratory Accreditations (per ISO/IEC 17025:2017)

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Manufacturer:	**Proxxi Technology Corporation**
Address:	600 - 401 West Georgia Vancouver, BC V6B 5A1, Canada
Equipment Tested:	**ProxxiBand - Electric field sensor wristband for worker protection**
Model Number(s):	10-0001K
FCC ID:	2ALVP-100001
ISED ID:	22666-100001
ISED PMN	ProxxiBand

REVISION HISTORY

Date	Report Number	Details	Author's Initials
April 20, 2020	E11080-1902_Proxxi Band_FCCID_ICID_Rev1.1	Add CEAC	MK
March 4, 2020	E11080-1902_Proxxi Band_FCCID_ICID_Rev1.0	Final	MK
November 15, 2019	E11080-1902_Proxxi Band_FCCID_ICID_Rev0.1	Update data	MK
November 1, 2019	E11080-1902_Proxxi Band_FCCID_ICID_Rev0.0	Initial release	MK
All previous versions of this report have been superseded by the latest dated revision as listed in the above table.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 test equipment provided by the manufacturer. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section I of this report as agreed upon by the Manufacturer under the quote 19SH06103.

The Manufacturer is responsible for the tested product configurations, 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 and ISED. Declaration of Conformity can only be produced by the manufacturer.
This is to certify that the following report is true and correct to the best of our knowledge.

Testing and report by
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EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
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EMC Facility Burnaby BC, Canada

TABLE OF CONTENTS

Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of ProxxiBand Tracker as per Sections 1.2 & 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 19SH06103:

FCC Title 47 Part 15 - 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 Title 47 FCC Part 15 - Radio Frequency Devices, 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 and Information for the Certification of Radio Apparatus

ICES-003 Issue 6 – Information Technology Equipment (Including Digital Apparatus) – Limits and Methods of Measurement

The tests documented in this report were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013, FCC KDB 558074 D01 DTS Meas Guidance v05 and KDB 447498 D01 General RF Exposure Guidance v06.

1.3 Summary of Results

The following tests were performed pursuant to the FCC/IC Unintentional Radiated Emissions, Intentional Radiated Emissions, and Radio Testing Standards:

No.	Test Description	Standard Clause	Result
1	Antenna Requirement	FCC 47 CFR Part 15.203; IC RSS-Gen Issue 5 Section 7.1.2	Complies
2	Test Duty Cycle	KDB 558074 Measurement Guide for DTS Operating Under 15.247 v04 Section 9.2	N/A
3	6-dB Bandwidth	FCC Title 47 CFR Part 15: Subpart C - §15.247 (2) RSS-247 Issue 2: 5.2 (a)	Complies
4	RF Peak Output Pwer	FCC Title 47 CFR Part 15: Subpart C - §15.247 (b)(3) RSS-247 Issue 2 (5.4)(b)	Complies
5	Power Spectral Density	FCC Title 47 CFR Part 15: Subpart C §15.247 (e), RSS-247 Issue 2: 5.2 (b)	Complies
6	Out-of-Band Emissions (Bandedge)	FCC Title 47 CFR Part 15: Subpart C - §15.247 (d) RSS-247-Issue 2: 5.5	Complies
7	Radiated Unintentional/Spurious Emissions	FCC Subpart C §15.205(a), §15.209 (a) & §15.247 (d) FCC Title 47 CFR Part 15: Subpart B - §15.109 RSS-Gen Issue 5 (8.9),(8.10); ICES-003 Issue 6	Complies
8	Spurious Emimssions – Receiver Mode	FCC Title 47 CFR Part 15: Subpart B - §15.109 ICES-003 Issue 6	Complies
9	Frequency Stability	FCC 47 CFR §2.1055 , §15.215 (c) RSS_Gen Issue 5 (8.8)	Complies
10	RF Exposure Evaluation	FCC 47 CFR 2.1093 (e) & 1.1310 (d); KDB 447498 D01 v06 RSS-102 (2.5.1)	Complies
11	Conducted Emissions	FCC 47 CFR Part 15.207(c); ICES-003 Issue 6	Complies

Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

Equipment Under Test (EUT) Information

Equipment	Item/Description	Manufacturer	Model No.
ProxxiBand	Electric field sensor wristband for worker protection.	Proxxi Technology Corporation	10-0001K
Note: Lowest frequency generated or tuned upon within the EUT: 32.768 kHz Highest frequency generated or tuned upon within the EUT: 2.4835 GHz			

Test Units

ID	Serial #	Test	Antenna – Test type	Test Modes
B9F1	1936KC0015	Unintentional Emissions	Integrated - Radiated	FW-configured
9FE4	N/A	Intentional radiator	Removed - Conducted	FW-configured

EUT Test Modes

Mode	EUT Test Configuration/Operation
1	Battery operated
2	Charging

Equipment Under Test (EUT) Information

EUT	ProxxiBand
Description	**Electric field sensor wristband for worker protection**
Manufacturer	Proxxi Technology Corporation
FCC ID	2ALVP-100001
ISED ID	22666-100001
ISED PMN	ProxxiBand
Transmitter Type	Bluetooth Low Energy 4.0
Operating Frequency	2402 MHz to 2483.5 MHz
Transmit Power	4.83 dBm
Modulation Type	GFSK
Adaptive	No
Test Channels	2402, 2440 and 2480 MHz
Data Rate	2 Mbps
Antenna Type	SMT, integral
Antenna Peak Gain	0.5 dBi

EUT Ports

Port Type	Count	Connection
Micro USB	1	Battery charger

EUT Cabling Configuration

EUT has no cables.

EUT Input Power

Type	Count	Description	Output	Manufacturer	Model #
Battery	1	220mAH lithium polymer	Xx VDC	-	DCR80-30A

Ancillary Equipment Information

Equipment	Count	Specification	Manufacturer	Model No.	Serial No.
Wireless battery charger pad	1	N/A	Proxxi	60-0002 1912E	N/A
AC/DC adaptor for charging pad	1	Input: 100-240 V 50/60Hz, Output: 5V-1000mA	LX	LX050100	N/A

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	21ºC
Relative Humidity	43%
Atmospheric Pressure	101 kPa

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rhodes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi-Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi-Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi-Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

2.5 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.

Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
2	ETS Lindgren	2125	Mast	00077487	N/A	N/A
3	EMCO	6502	Loop Antenna 9 kHz – 30 MHz	2016	N/A	2022-Feb-19
4	Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A042004	N/A	2020-Nov-10
5	ETS-Lindgren	3117	Horn Antenna 1GHz-18GHz	75944	N/A	2020-Aug-29
6	EMCO	3160-09	Pyramidal Antenna 18 - 26.5 GHz	9701-1071	N/A	2020-Sep-13
7	Rohde & Schwarz	ESU40	EMI Receiver	100011	EMC32 v10.35.10/ FV 4.73 SP4	2019-Dec-01
8	Hewlett Packard	8449B OPT H02	Preamplifier (1-26.5GHz)	2933A00198	N/A	2022-Jun-22
9	Rohde & Schwarz	FSU	Spectrum Analyzer 20 Hz – 67 GHz	101388	N./A	2022-Jan-19
10	Rohde & Schwarz	FSP	Spectrum Analyzer 9 kHz – 67 GHz	100184	N/A	2021-Mar-16
11	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A

Note: Equipment listed above have 3 years calibration interval.

Measurement Software List

Sl. No.	Manufacturer	Model	Version	Description
1	Rhode & Schwarz	EMC 32	6.20.0	Emissions Test Software

Section III: DATA & TEST RESULTS

3.1 Antenna Requirements

- **Test Standard:** FCC 47 CFR Part 15.203 and RSS-Gen Issue 5 (7.1.2)

- **Requirement:**

  The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in FCC CFR 47 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." … "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

- **Antenna Information:**

Manufacturer	Johanson Technology
Part number	2450AT18B100
Max. RF power	2 Watts CW
Compact size	3.20(L) x 1.60(W) x 1.30(H) mm
Antenna type	SMT
Return loss	> 9.5 dB
RoHS	N/A
Frequency range	2400-2500 MHz
Peak gain	0.5 dBi
Impedance	50 Ohms
Average efficiency	76 %

Result:
An integrated antenna is used on this product and it is not field-replaceable.
EUT Complies.

3.2 Test Duty Cycle

- **Date Performed:** September 12, 2019
- **Test Standard:** KDB 558074 Measurement Guide for DTS Operating Under 15.247 v04: 9.2
- **Requirement:**
  If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle;
- **Test Set-up:**
  Conducted measurement at antenna port using spectrum analyzer.
  Span = 0 Hz.
  Sweep time: 1 s.
- **Modifications:**
  EUT configured using firmware to transmit at 100% duty cycle. Integrated antenna removed.
- **Result:**
  EUT transmits continuously at 100 % duty cycle.
- **Data:**
  Refer to Appendix A for Duty Cycle plot.

3.3 6-dB Bandwidth

- **Date Performed:** September 12, 2019
- **Test Standard:** FCC Title 47 CFR Part 15: Subpart C - §15.247 (2), RSS-247 Issue 2 (5.2)(a)
- **Test Requirement:**
  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.
- **Test Set-up:**
  Conducted measurement at antenna port using spectrum analyzer.
- **Modifications:**
  EUT configured using firmware to transmit at 100% RF duty cycle. Integrated antenna removed.
- **Result:**
  The EUT complies with the applicable standard.
- **Data:**

Frequency MHz	System Loss (dB)*	6-dB BW (MHz)	Min. Limit (kHz)	Results
2402	7.6	1.35	500	PASS
2440	7.6	1.31	500	PASS
2480	7.6	1.23	500	PASS

*Largest across the three channels.

Refer to Appendix B for 6-dB Bandwidth plots.

3.4 RF Peak Output Power

- **Date Performed:** September 12, 2019
- **Test Standard:** FCC Title 47 CFR Part 15: Subpart C - §15.247 (b)(3), RSS-247 Issue 2 (5.4)(b)
- **Test Requirement:**
  For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 W (30dB).
- **Test Set-up:**
  Conducted measurement at antenna port using a spectrum analyzer.
- **Modifications:**
  EUT configured using firmware to transmit at 100% RF duty cycle. Integrated antenna removed.
- **Result:**
  The EUT complies with the applicable standard.
- **Data:**

Frequency MHz	System Loss (dB)[1]	Measured Conducted Power (dBm)	Correction Factor (dB)[2]	RF Peak Output Power (dBm)[3]	Limit (dBm)	Results	RF Peak Output Power (Watts)
2402	7.2	4.33	0.5	4.83	30	PASS	0.003
2440	7.2	4.26	0.5	4.76	30	PASS	0.003
2480	7.2	3.91	0.5	4.41	30	PASS	0.0028

1) Largest across the three channels.

2) 1 MHz to 3 MHz: maximum of multiple 2MHz-BLE measurements.

3) RF Peak Output Power (dBm) = Measured Conducted Power (dBm) + Correction Factor (dB)

Refer to Appendix C for RF Peak Power plots.

3.5 Power Spectral Density (PSD)

- **Date Performed:** September 12, 2019
- **Test Standard:** FCC Title 47 CFR Part 15: Subpart C - §15.247 (e), RSS-247 Issue 2 (5.2)(b)
- **Test Requirement:**
  For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 W (30dB).
- **Test Set-up:**
  Conducted measurement at antenna port using a spectrum analyzer.
- **Modifications:**
  EUT configured using firmware to transmit at 100% RF duty cycle. Integrated antenna removed.
- **Result:**
  The EUT complies with the applicable standard.
- **Data:**

Frequency MHz	System Loss (dB)*	PSD (dBm)	Limit (dBm)	Results
2402	7.2	-11.21	8	PASS
2440	7.2	-11.19	8	PASS
2480	7.2	-12.44	8	PASS

*Largest across the three channels.

Refer to Appendix D for Power Spectral Density plots.

3.6 Out-of-Band Emissions (Bandedge)

- **Date Performed:** September 12, 2019
- **Test Standard:** FCC Title 47 CFR Part 15: Subpart C - §15.247 (d), RSS-247-Issue 2 (5.5)
- **Test Method:** ANSI C63.10:2013
- **Test Requirement:**

3) §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required.

- **Test Set-up:**

Conducted measurement at antenna port using a spectrum analyzer.

- **Modifications:**

EUT configured using firmware to transmit at 100% RF duty cycle. Integrated antenna removed.

- **Result:**

The EUT complies with the applicable standard.

- **Data:**

Intentional Radiator Frequency MHz	System Loss (dB)*	Num. Of pts.	Relative to Intentional Radiator (dBc)	Minimum Limit (dBc)	Results
2402	7.2	3201	52.13	20	PASS
2480	7.2	3201	53.73	20	PASS

*Largest across the three channels.

Refer to Appendix E for Out-of-band Emissions plots.

3.7 Spurious Emissions

- **Test Standards:**

Test or Measurement	Applicable Standards	Description
Radiated Emissions	ICES-003 Issue 6 CFR Title 47 FCC Part 15 Subpart B	The radiated emissions are measured in the 30-1000MHz range or **upto 5x** the highest EUT frequency whichever is higher.
	RSS-247-Issue 2, RSS-Gen Issue 5 (8.9) & (8.10) FCC Subpart C §15.205 (a), 15.209 (a) & 15.247 (d)	

- **Required Limits:**

1) Radiated emission limits; general requirements (Class B);
The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	(20*log(2400/*f* (kHz))) + 40 dB
0.490 – 1.705	(20*log(24000/*f* (kHz))) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.	

Maximum Field Strength (dB mV/m at 3 m)		
Frequency (GHz)	**Peak**	**Average**
1-40	74	54
Note 1: The lower limit shall apply at the transition frequency **Note 2**: Additional provisions may be required for cases where interference occurs		

2) Restricted bands of operation:

Unwanted emissions that fall into the restricted bands specified on the table below shall comply with the limits specified on the table limits above as per §15.209 and Clause 8.9 of RSS-Gen.

MHz	MHz	GHz
0.090 - 0.110	149.9 - 150.05	9.0 - 9.2
0.495 - 0.505	156.52475 - 156.52525	9.3 - 9.5
2.1735 - 2.1905	156.7 - 156.9	10.6 - 12.7
3.020 - 3.026	162.0125 - 167.17	13.25 - 13.4
4.125 - 4.128	167.72 - 173.2	14.47 - 14.5
4.17725 - 4.17775	240 - 285	15.35 - 16.2
4.20725 - 4.20775	322 - 335.4	17.7 - 21.4
5.677 - 5.683	399.9 - 410	22.01 - 23.12
6.215 - 6.218	608 - 614	23.6 - 24.0
6.26775 - 6.26825	960 - 1427	31.2 - 31.8
6.31175 - 6.31225	1435 - 1626.5	36.43 - 36.5
8.291 - 8.294	1645.5 - 1646.5	Above 38.6
8.362 - 8.366	1660 - 1710	
8.37625 - 8.38675	1718.8 - 1722.2	
8.41425 - 8.41475	2200 - 2300	
12.29 - 12.293	2310 - 2390	
12.51975 - 12.52025	2483.5 - 2500	
12.57675 - 12.57725	2655 - 2900	
13.36 - 13.41	3260 - 3267	
16.42 - 16.423	3332 - 3339	
16.69475 - 16.69525	3345.8 - 3358	
16.80425 - 16.80475	3500 - 4400	
25.5 - 25.67	4500 - 5150	
37.5 - 38.25	5350 - 5460	
73 - 74.6	7250 - 7750	
74.8 - 75.2	8025 - 8500	
108 - 138	--	

* Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Restricted Bands – RSS Gen Issue 5

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

Restricted Bands – FCC Part

Measurement Method:

The EUT was positioned at the edge of the turntable in the 3m SAC with all cables draped down the side 40 cm off the ground plate. Emissions were measured in the frequency range of 10 kHz – 26 GHz using the appropriate receivers, antennas, amplifiers, attenuators and filters. 10 kHz- 18 GHz measurements were made using an EMI receiver. 18-26 GHz measurements were made using a spectrum analyzer.

Emissions in both horizontal and vertical polarizations and antenna height ranging 1-4 m were measured while rotating the Equipment Under Test (EUT) 360° on the turntable, to maximize measured emissions.

Refer to Section 1.4 of this report for Sample Calculations of Emissions Data.

- **Test Configurations:**

Modes	1) Battery-operated, 2) charging
Test channels	2402, 2440, 2480 MHz
Test voltage	120V60Hz
EUT orientation	xy, yz and xz planes

- **Modifications:**

EUT with integrated antenna configured using firmware to transmit at 100% RF duty cycle at fixed test frequencies - modulated.

Result: The EUT complies with the applicable standards.

Measurement Data:

Only data for settings in Test Configurations yielding the worst case presented for each section.

Part 1 - 10kHz – 30 MHz

- **Date performed:** September 9, 2019
- **Worst case:** Low channel, charging.

Results: No emissions observed within 30 dB of the limit line.

Part 2 - 30 MHz – 1 GHz

- **Date performed:** September 9 , 2019
- **Worst case:** Mid channel, charging.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.003360	34.61	40.50	5.89	1000	120	118.0	H	2.0	27.8
73.630240	20.49	40.50	20.01	1000	120	160.0	V	71.0	13.0
119.324800	26.18	40.50	14.32	1000	120	188.0	V	242.0	19.3
319.228440	27.46	47.50	20.04	1000	120	237.0	V	67.0	19.9

Table 1: Quasi-Peak Data of Radiated Emissions measured at 3m–FCC /ISED Class B Limit−for reference only

Part 3 - 1 – 18 GHz

- **Date performed:** September 10, 2019
- **Worst case:** mid channel, battery operated.
- **Notes:** 2.4-2.5 GHz filter used at pre-amp input.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Corr. (dB)
1631.569600	41.61	---	70.00	28.39	1000.0	1000.000	112.0	-4.3
2499.369200	---	36.46	50.00	13.54	1000.0	1000.000	112.0	1.1
4880.165600	55.79	---	74.00	18.21	1000.0	1000.000	127.0	6.9
7320.258800	59.59	---	74.00	14.41	1000.0	1000.000	112.0	10.3

Table 2: Max-peak and Average Data of Radiated Emissions measured at 3m–FCC /ISED Class B Limit−for reference only

Part 4 - 18 – 26 GHz

- **Date performed:** September 11, 2019
- **Worst Case**: results of the three channels comparable.

Results: No emissions observed above the noise floor.

Refer to Appendix F for Spurious Emissions plots.

3.8 Spurious Emissions – Receiver Mode

- **Date Performed:**

  N/A

- **Test Standard:**

  FCC Title 47 CFR Part 15: Subpart B - §15.109
  ICES-003 Issue 6

- **Test Method:**

  ANSI C63.4-2014

- **Required Limit:**

  The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency, *f* (MHz)	Field strength (dBµV/m)
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Note 2: The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

- **Method of Measurement:**

  N/A

Test Setup:
Transmitter of the EUT cannot be turned off.

- **Result:**

  EUT in transmitter mode complies with receiver mode limits.
  EUT complies with the applicable standard.

3.9 Frequency Stability

- **Date Performed:**

  February 28, 2019

- **Test Standard:**

  FCC 47 CFR §2.1055, §15.215 (c)

- **Test Method:**

  ANSI C63.10 2013
  CISPR 11:2009/A1:2010

- **Required Limit:**
  The carrier frequency stability shall be maintained within band. The carrier frequency shall be maintained over a temperature variation of −20C to +55C.

- **Method of Measurement:**

  The equipment was operated and tested while in "Continuous Transmit" mode of operation. The fundamental was monitored while the temperature was varied from +5C to +45C in an environmental chamber and appropriate data reported.

  - **Test Set-up:**
    Radiated measurement using a spectrum analyzer and a sniffer probe.
    Temperature stabilization time: 10 minutes.
    EUT battery powered.

  - **Modifications:**
    EUT configured using firmware to transmit at fixed frequency CW.
    Manufacturer specified operating temperature range of the EUT: +5 - +45C.

Result:

EUT complies with the applicable standard.

Data:

Temperature (°C)	Channel Freq. (MHz)	20-dB BW edge freq. (MHz)*	Applicable band limit (MHz)	Results
+5	2402	2402.087719	2400	Drift within band
	2480	2480.091187	2483.5	Drift within band
+15	2402	2402.085375	2400	Drift within band
	2480	2480.089188	2483.5	Drift within band
+20	2402	2402.082469	2400	Drift within band
	2480	2480.086031	2483.5	Drift within band
+25	2402	2402.082437	2400	Drift within band
	2480	2480.085406	2483.5	Drift within band
+35	2402	2402.077125	2400	Drift within band
	2480	2480.080750	2483.5	Drift within band
+45	2402	2402.074281	2400	Drift within band
	2480	2480.077500	2483.5	Drift within band

3.10 RF Exposure Evaluation

- **Date Performed:**

  September 26, 2019

- **Test Standard:** FCC 47 CFR §2.1093 (d) & 1.1310 (e), RSS-102 (2.5.2)

- **Evaluation Method:** KDB 447498 D01 General RF Exposure Guidance v06 (4.3.1)(a)

- **Requirements:**

A) CC CFR 47 §1.1310:

Radiofrequency radiation exposure limits for General Population/Uncontrolled Exposure at Frequency range 1500 - 100000 MHz: 5 mW/cm^2.

TABLE 1 - LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	* 100	6
3.0-30	1842/f	4.89/f	* $900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* 100	30
1.34-30	824/f	2.19/f	* $180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

(e)(1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure.

B) KDB 447498 D01 General RF Exposure Guidance v06:

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,30 where f(GHz) is the RF channel transmit frequency in GHz.

C) RSS-102 Section 2.5.1:

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is less than or equal to 20 cm, except when the device operates as follows:

- above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use;

- **Calculations:**

Carrier Frequency	RF Peak Output Power Conducted	Peak Antenna Gain	EIRP	
MHz	dBm	dBi	dBm	mW
2402	4.83	0.5	5.33	3.42
2440	4.76	0.5	5.26	3.36
2480	4.41	0.5	4.91	3.10

EIRP (dBm) = RF Peak Output Power (from Report section 3.4)(dBm) + Antenna Gain (dBi)

A) CC CFR 47 §1.1310:

Frequency (MHz)	Min. separation (r)(cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Result
2402	0.3	3.03	5	EXEMPT
2440	0.3	2.98	5	EXEMPT
2480	0.3	2.75	5	EXEMPT

$$\text{Power Density} = \frac{EIRP}{4\pi r2} \text{ mW/cm}^2$$

B) KDB 447498:

Frequency (GHz)	Min. separation (r)(mm)	Exclusion Thresholds	Limit 1-g SAR	Limit 10-g SAR	Result
2.402	3	1.77	3.0	7.5	EXEMPT
2.440	3	1.75	3.0	7.5	EXEMPT
2.480	3	1.63	3.0	7.5	EXEMPT

D) RSS-102:

Frequency (MHz)	Peak EIRP (mW)*	Limit General Public (mW)	Limit Controlled Use (mW)	Result
2402	3.42	20	100	EXEMPT
2440	3.36	20	100	EXEMPT
2480	3.10	20	100	EXEMPT

*Time-averaged EIRP < Peak EIRP

3.11 AC Mains Conducted Emissions

- **Date Performed:**

  September 9, 2019

- **Test Standard:**

  FCC Title 47 CFR Part §18.307(b)
  FCC Title 47 CFR Part 15.207: Subpart B – Class B
  RSS-216 Issue 2 – Type 1 Device
  ICES-003 Issue 6 – Class B

- **Test Method:**

  ANSI C63.10-2013

- **Input Voltage:** 120V 60Hz

- **Required Limit:**

  The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the following limits

Frequency (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15 – 0.50	66 to 56	56 to 46
0.50 – 5	56	46
5.0 – 30.0	60	50
Note 1: *The lower limit shall apply at the transition frequencies.*		

Class B Limits

- **Method of Measurement:**

  Measurements were made using an EMI receiver with 9kHz bandwidth, CISPR Quasi-Peak and Average detector.

- **Modifications:**

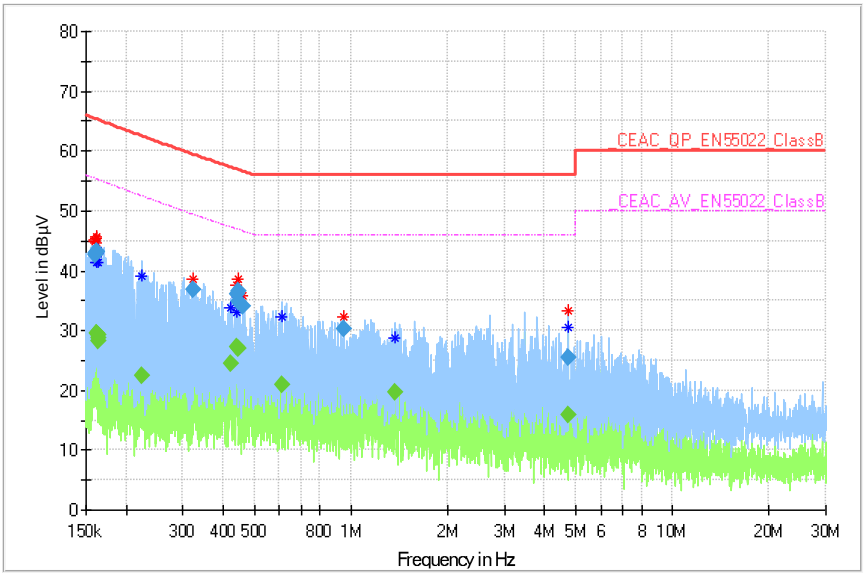
  No modifications required for this test.

- **Result:**

  The EUT complies with the applicable standard.

Measurement Data:

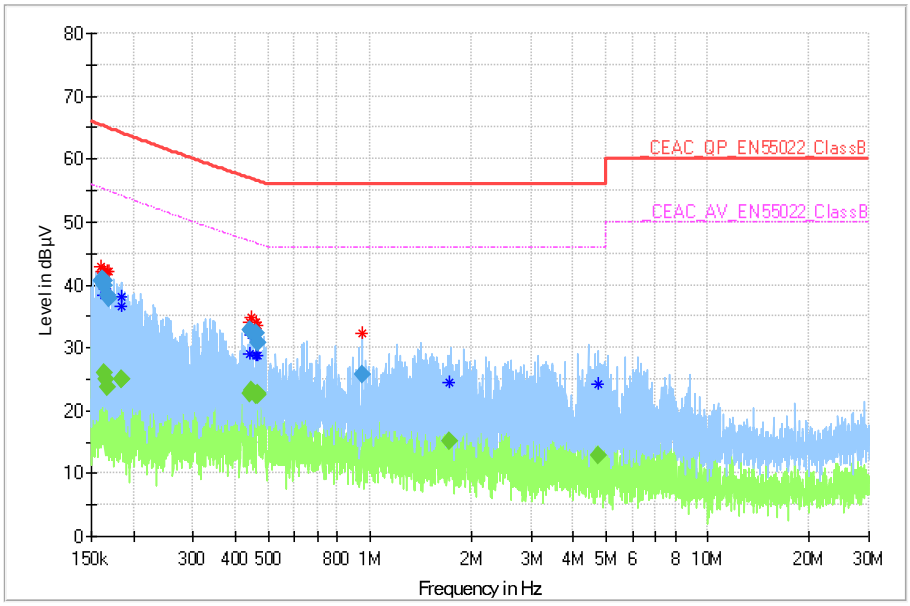
Worst case: loaded with B9F1, low channel.



Conducted emissions (150 kHz – 30 MHz) – Line 1

Line 1:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.159749	42.53	---	65.44	22.90	1000.0	9.000	L1	GND	10.3
0.160389	42.98	---	65.40	22.42	1000.0	9.000	L1	GND	10.3
0.161032	43.19	---	65.36	22.17	1000.0	9.000	L1	GND	10.3
0.161677	---	29.61	55.32	25.71	1000.0	9.000	L1	GND	10.3
0.161677	43.20	---	65.33	22.12	1000.0	9.000	L1	GND	10.3
0.162324	43.08	---	65.29	22.21	1000.0	9.000	L1	GND	10.3
0.162324	---	29.41	55.28	25.88	1000.0	9.000	L1	GND	10.3
0.162975	---	29.28	55.25	25.97	1000.0	9.000	L1	GND	10.3
0.163627	---	28.80	55.21	26.41	1000.0	9.000	L1	GND	10.3
0.164283	---	28.37	55.17	26.81	1000.0	9.000	L1	GND	10.3
0.222836	---	22.39	52.49	30.11	1000.0	9.000	L1	GND	10.2
0.323517	36.72	---	59.43	22.71	1000.0	9.000	L1	GND	10.2
0.421626	---	24.53	47.30	22.77	1000.0	9.000	L1	GND	10.1
0.440582	---	27.19	46.96	19.77	1000.0	9.000	L1	GND	10.1
0.441023	36.19	---	56.97	20.78	1000.0	9.000	L1	GND	10.1
0.444119	---	26.96	46.90	19.94	1000.0	9.000	L1	GND	10.1
0.444119	36.55	---	56.91	20.36	1000.0	9.000	L1	GND	10.1
0.447685	34.71	---	56.85	22.15	1000.0	9.000	L1	GND	10.1
0.462697	34.05	---	56.60	22.54	1000.0	9.000	L1	GND	10.1
0.607247	---	20.92	46.00	25.08	1000.0	9.000	L1	GND	10.1
0.949289	30.32	---	56.00	25.68	1000.0	9.000	L1	GND	10.2
1.365942	---	19.73	46.00	26.27	1000.0	9.000	L1	GND	10.3
4.736141	25.56	---	56.00	30.44	1000.0	9.000	L1	GND	10.4
4.736141	---	15.80	46.00	30.20	1000.0	9.000	L1	GND	10.4

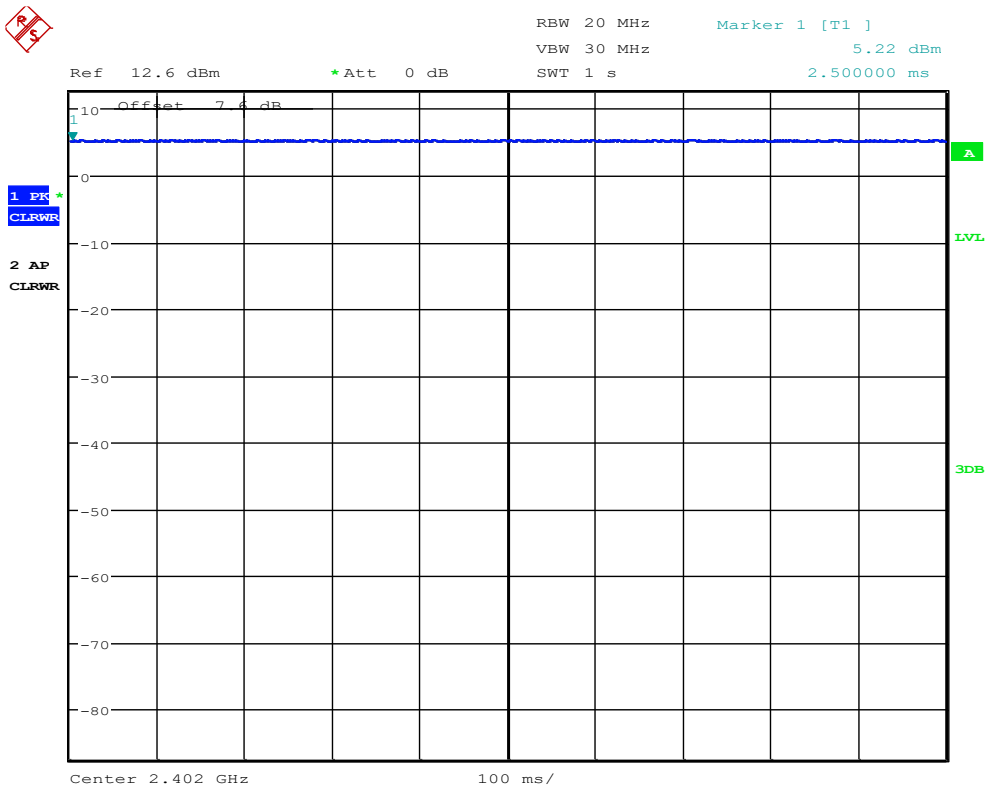


Conducted emissions (150 kHz – 30 MHz) – Line 2

Line 2:

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.160229	40.66	---	65.41	24.75	1000.0	9.000	L2	GND	10.3
0.161515	40.85	---	65.34	24.49	1000.0	9.000	L2	GND	10.3
0.162812	40.63	---	65.27	24.63	1000.0	9.000	L2	GND	10.3
0.164119	---	25.93	55.18	29.25	1000.0	9.000	L2	GND	10.3
0.164119	39.79	---	65.20	25.40	1000.0	9.000	L2	GND	10.3
0.165436	---	25.11	55.11	30.00	1000.0	9.000	L2	GND	10.3
0.166764	38.48	---	65.05	26.57	1000.0	9.000	L2	GND	10.3
0.166764	---	23.83	55.04	31.21	1000.0	9.000	L2	GND	10.3
0.168103	37.85	---	64.98	27.13	1000.0	9.000	L2	GND	10.3
0.183192	---	24.96	54.20	29.24	1000.0	9.000	L2	GND	10.2
0.183926	---	24.95	54.17	29.22	1000.0	9.000	L2	GND	10.2
0.441023	32.73	---	56.97	24.24	1000.0	9.000	L2	GND	10.1
0.441023	---	22.71	46.95	24.24	1000.0	9.000	L2	GND	10.1
0.444119	---	23.11	46.90	23.79	1000.0	9.000	L2	GND	10.1
0.444119	32.60	---	56.91	24.31	1000.0	9.000	L2	GND	10.1
0.462697	32.20	---	56.60	24.40	1000.0	9.000	L2	GND	10.1
0.462697	---	22.34	46.59	24.25	1000.0	9.000	L2	GND	10.1
0.464551	---	22.64	46.56	23.91	1000.0	9.000	L2	GND	10.1
0.466411	30.83	---	56.53	25.70	1000.0	9.000	L2	GND	10.1
0.466411	---	22.37	46.53	24.15	1000.0	9.000	L2	GND	10.1
0.951188	25.66	---	56.00	30.34	1000.0	9.000	L2	GND	10.2
1.720696	---	15.12	46.00	30.88	1000.0	9.000	L2	GND	10.3
4.731409	---	12.84	46.00	33.16	1000.0	9.000	L2	GND	10.4

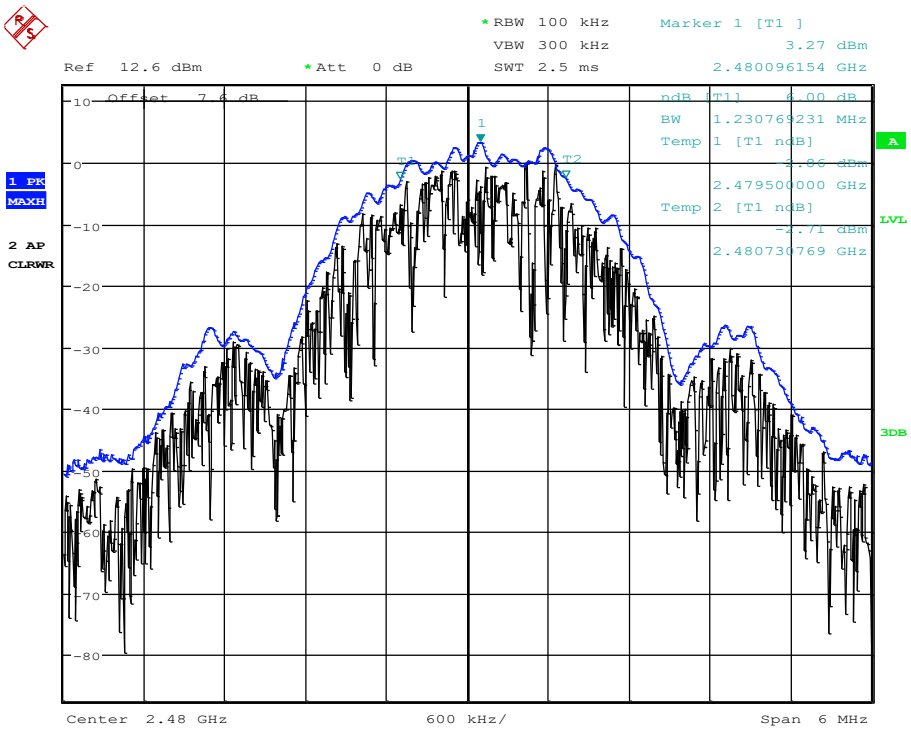
Appendix A: Test Duty Cycle Plot



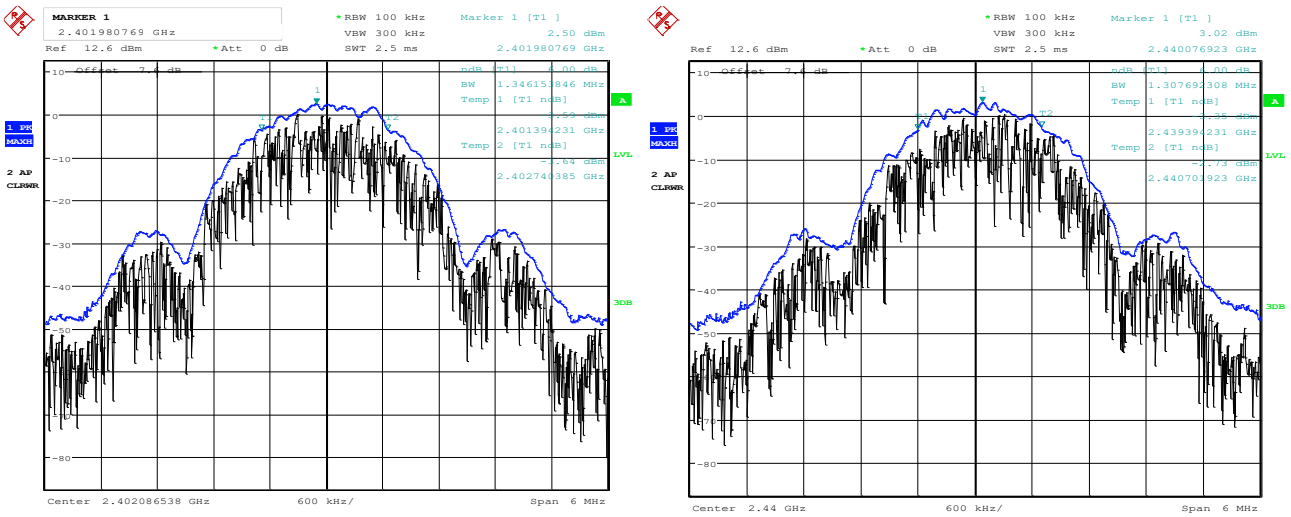
Low, Mid and High Channels

Similar

Appendix B: 6-dB Bandwidth Plots

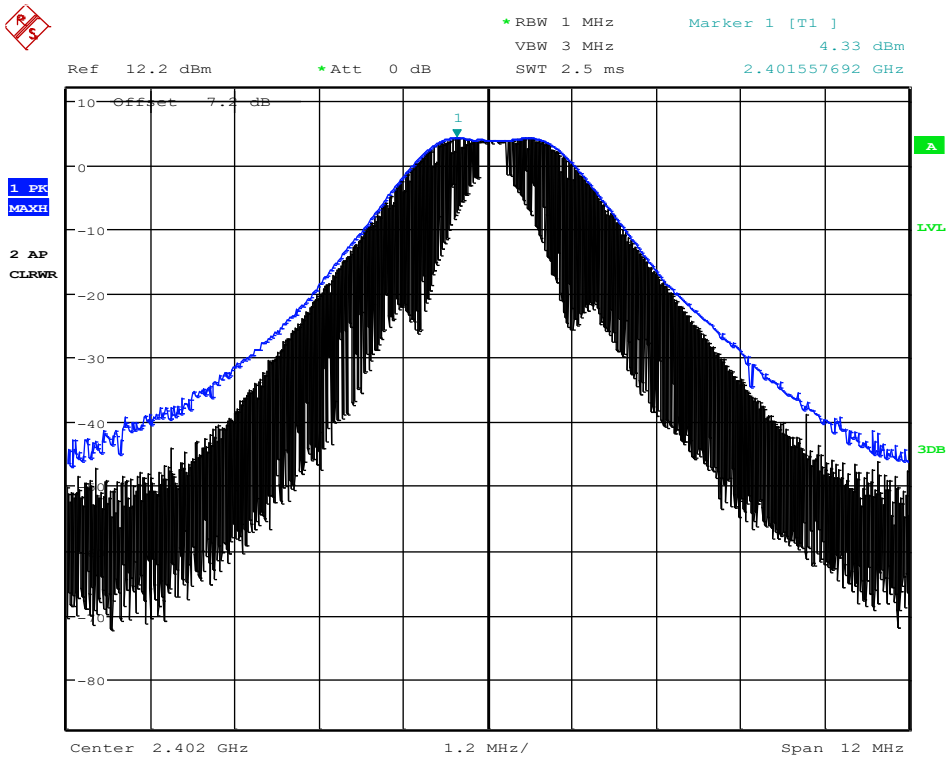


High Channel

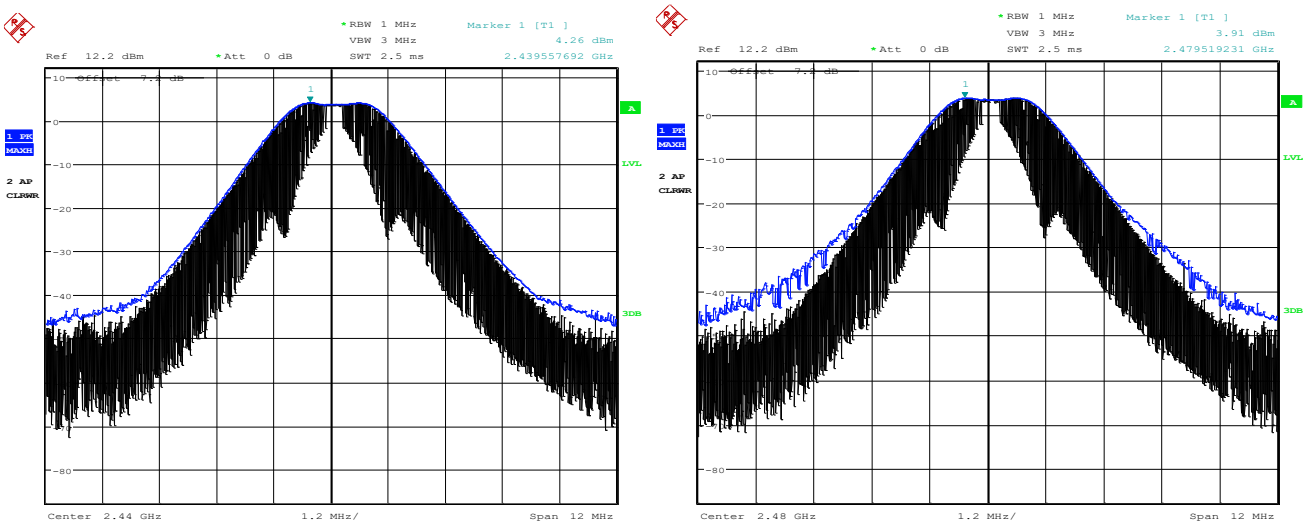


Low and Mid channels

Appendix C: RF Peak Output Power Plots

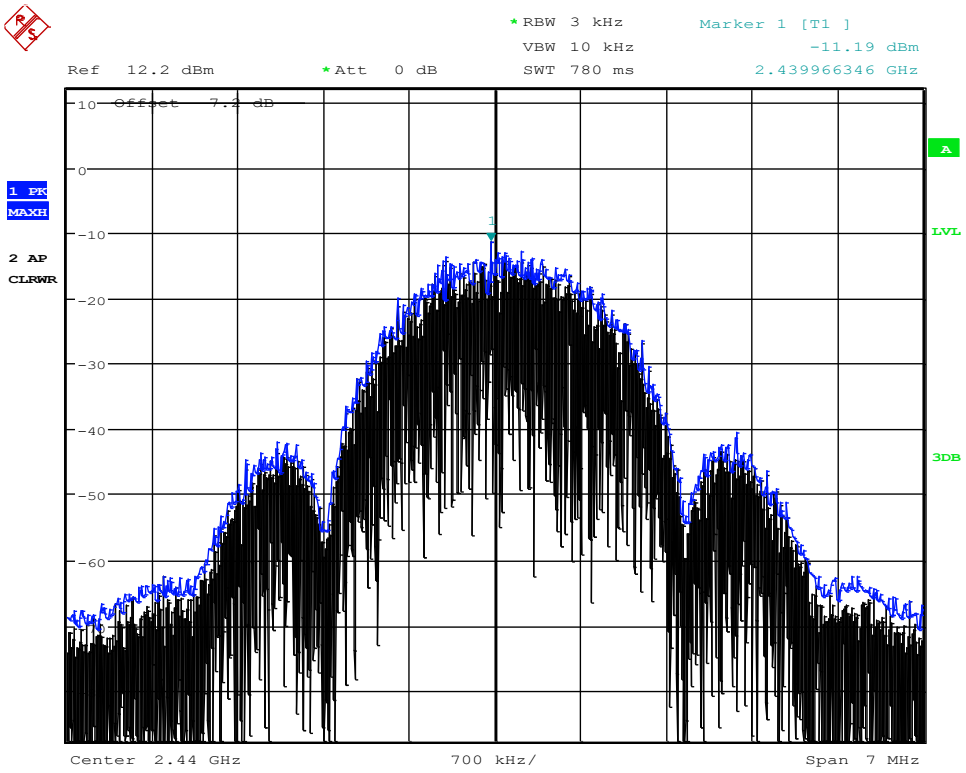


Low channel

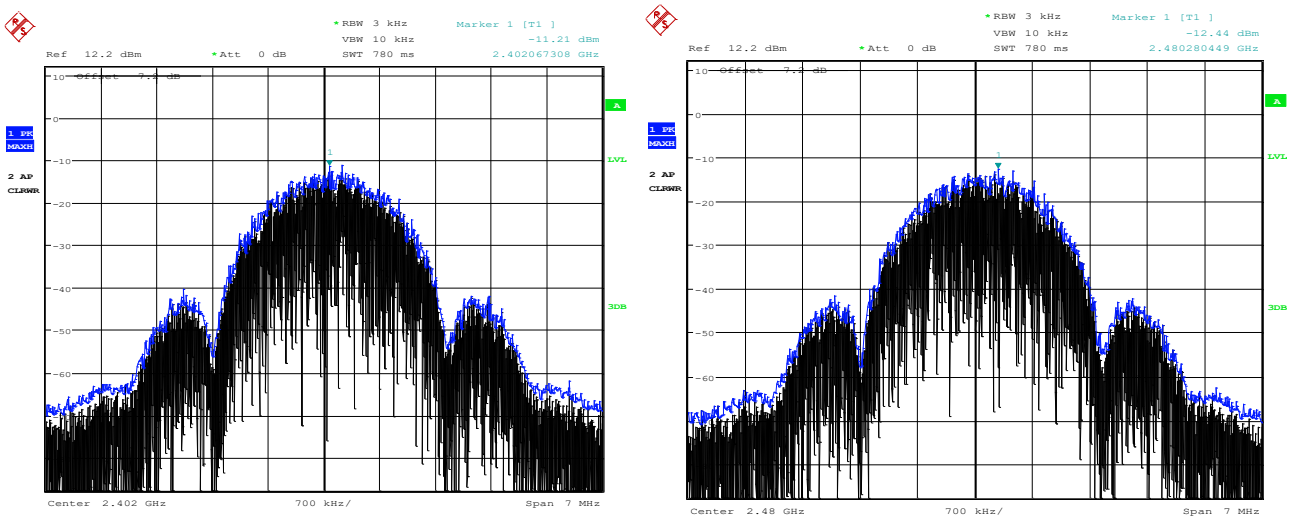


Mid and High channels

Appendix D: Power Spectral Density Plots

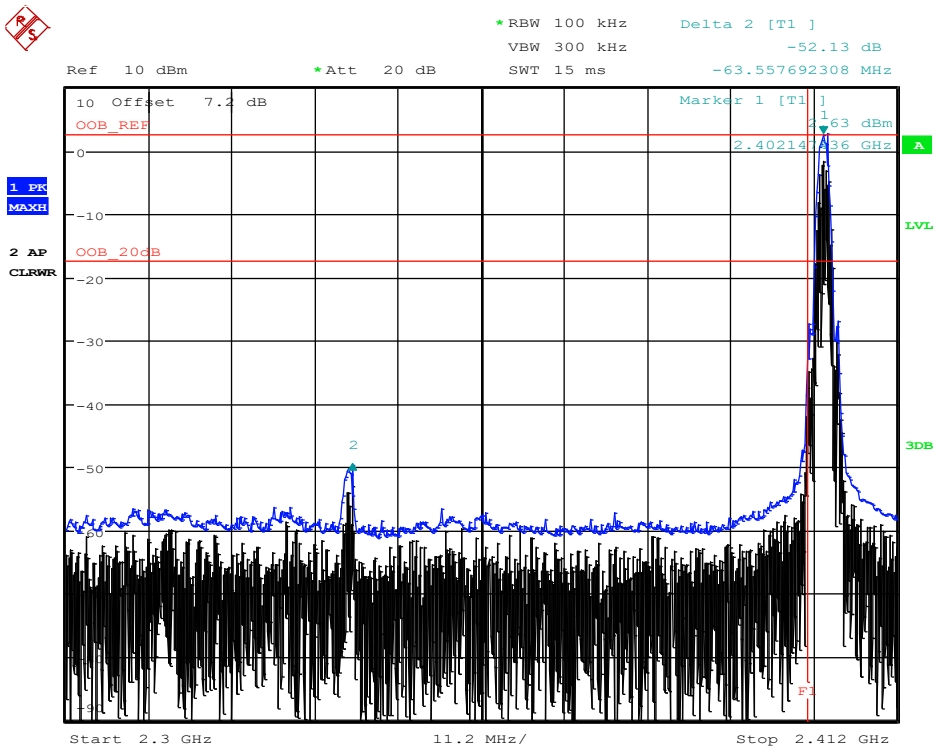


Mid channel

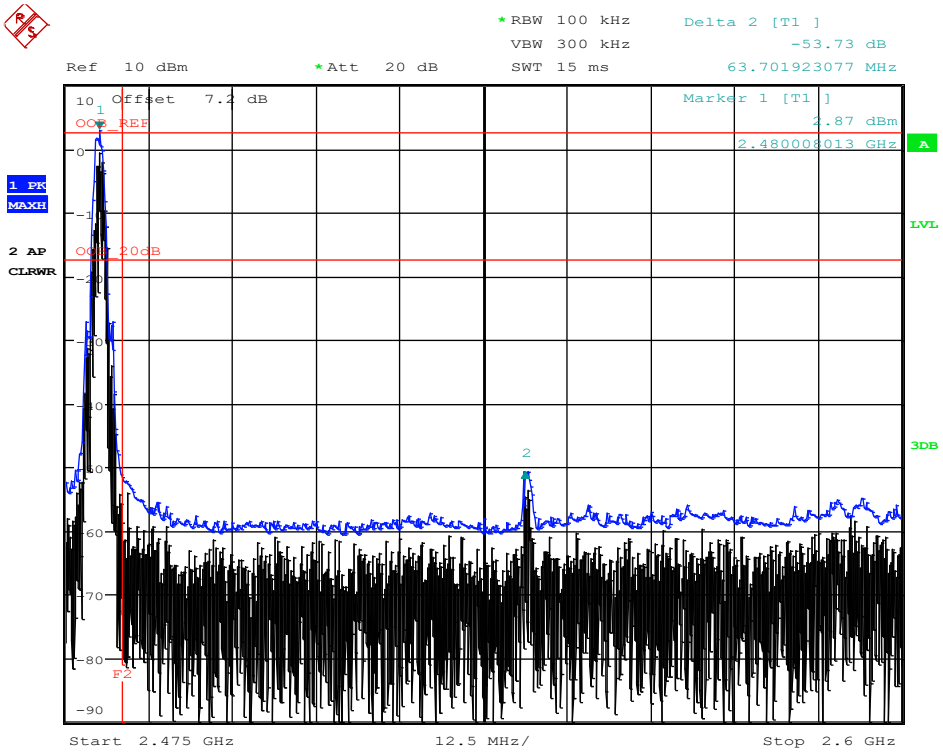


Mid and High Channels

Appendix E: Out-of-band Emissions Plots



Low channel



High channel

Appendix F: Unintentional Spurious Emissions Plots

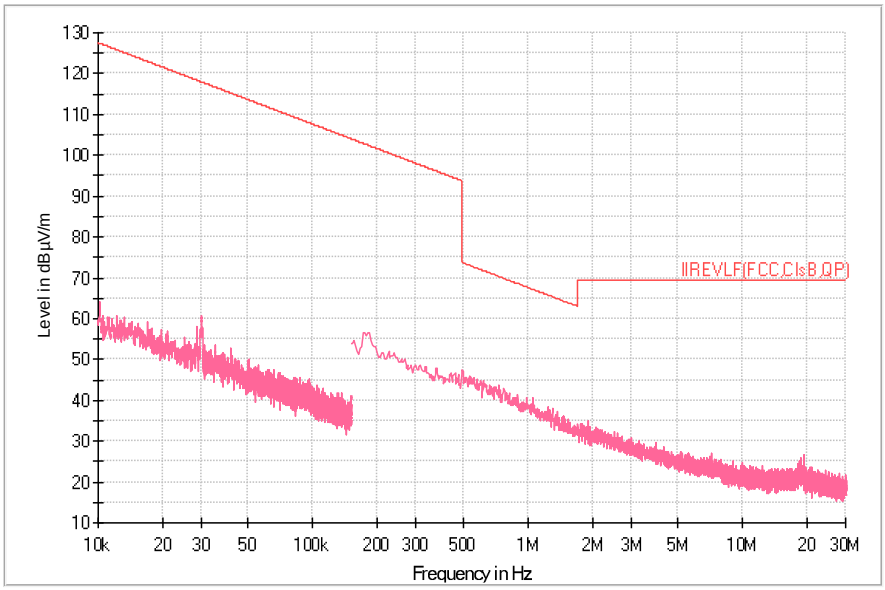


Figure 1: Radiated Emissions (10 kHz – 30 MHz)-Parallel Polarization

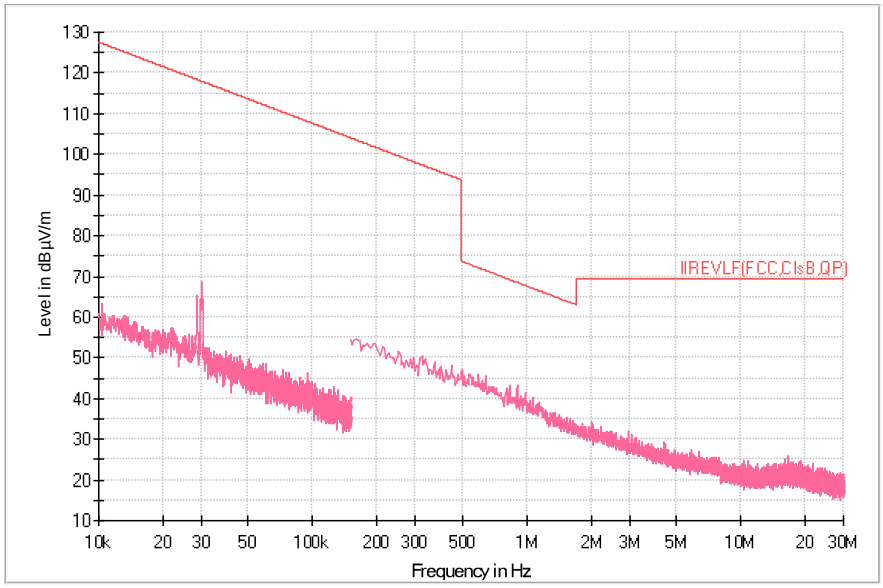


Figure 2: Radiated Emissions (10 kHz – 30 MHz)-Perpendicular Polarization

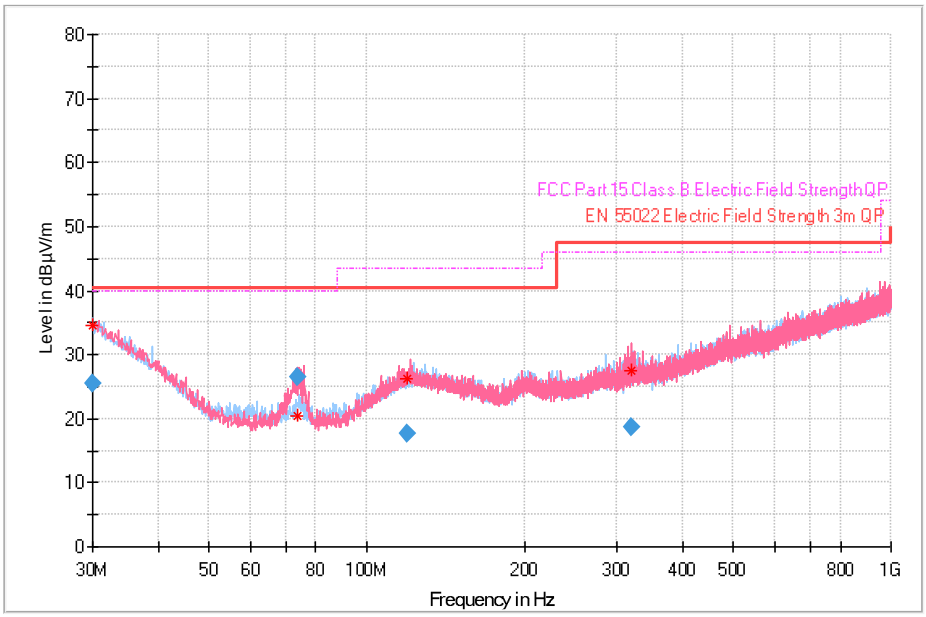


Figure 1: ***Radiated Emissions (30 MHz – 1 GHz)***

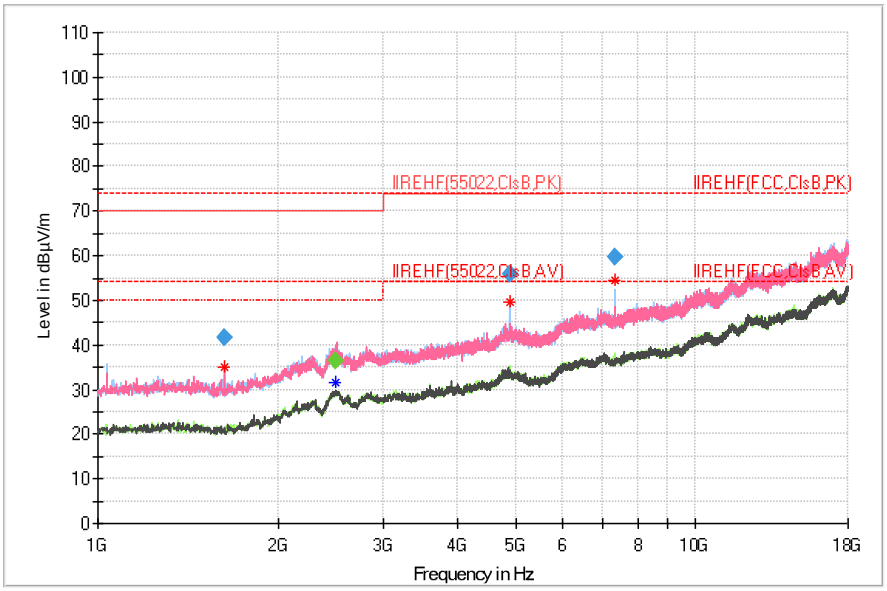
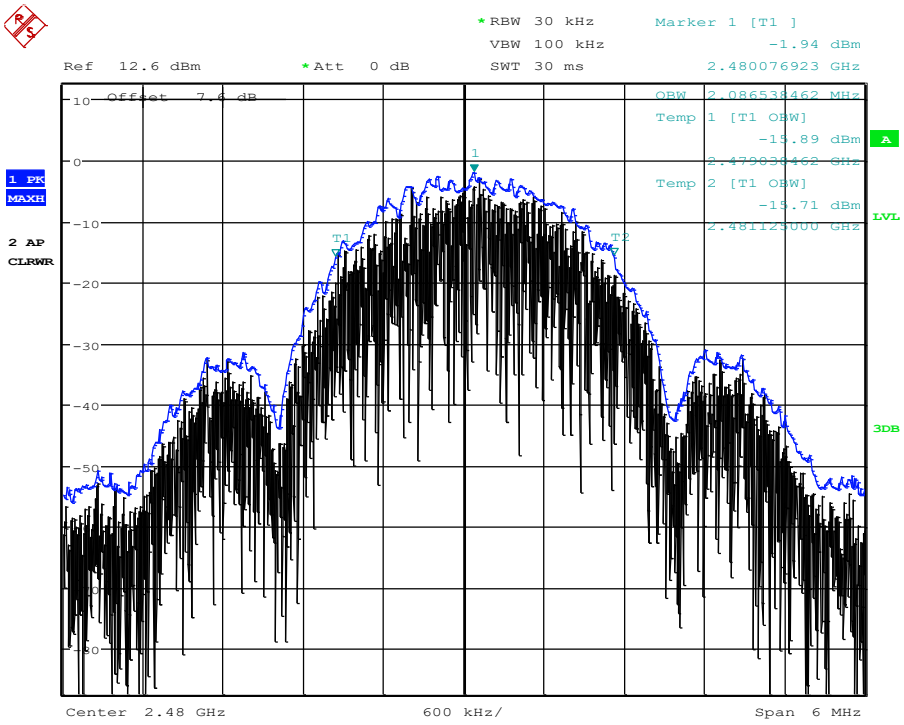
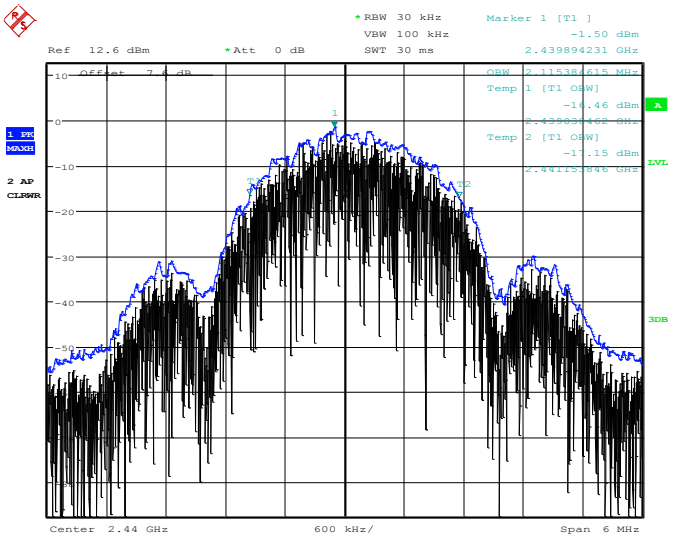


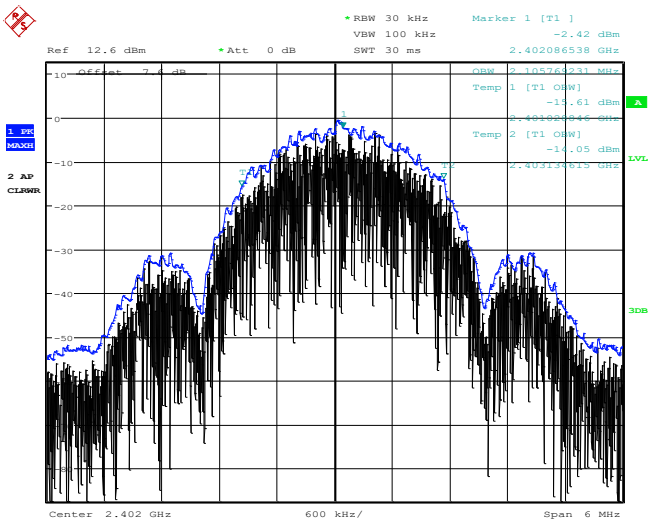
Figure 3: ***Radiated Emissions (1 – 18 GHz)***

Note: No graph for *Radiated Emissions (18 – 26 GHz); No emissions observed above the noise floor.*

Appendix G: 99% Occupied Bandwidth Plots – for reference







Appendix H: Test Set-up Photos

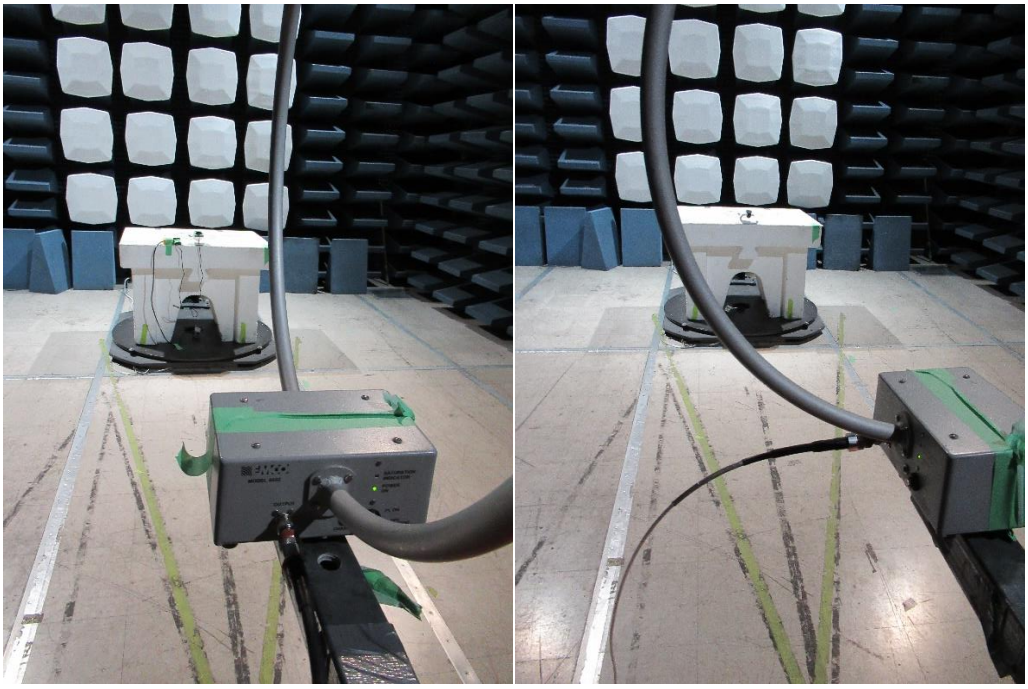


Figure 1: Radiated Emissions (10 kHz – 30 MHz)

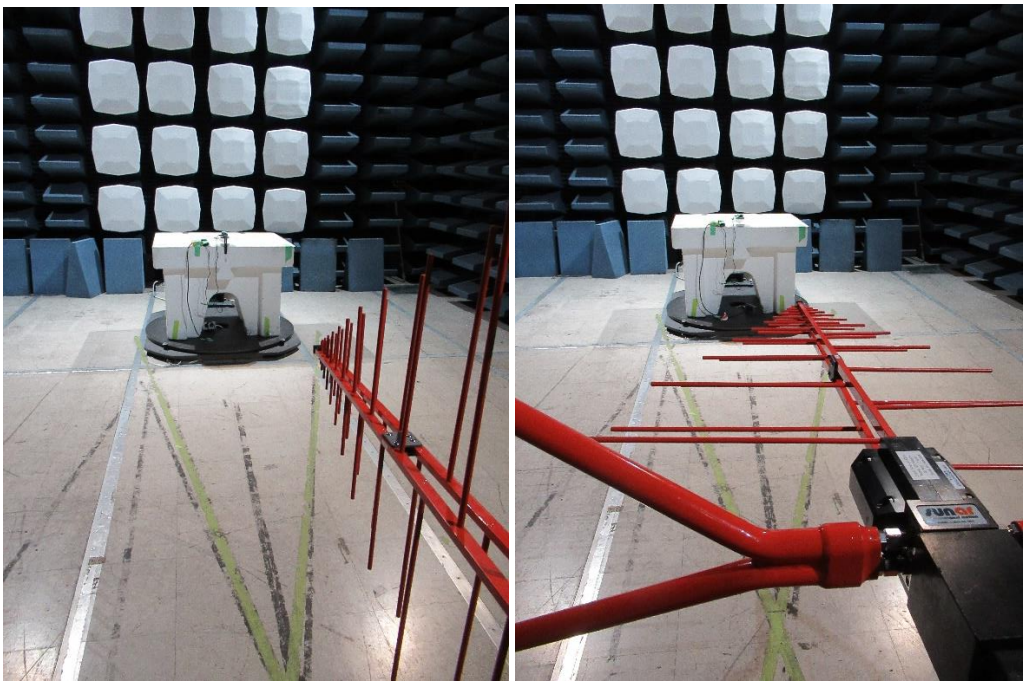


Figure 2: ***Radiated Emissions (30 MHz – 1 GHz)***

Figure 3: ***Radiated Emissions (1 – 18 GHz)***

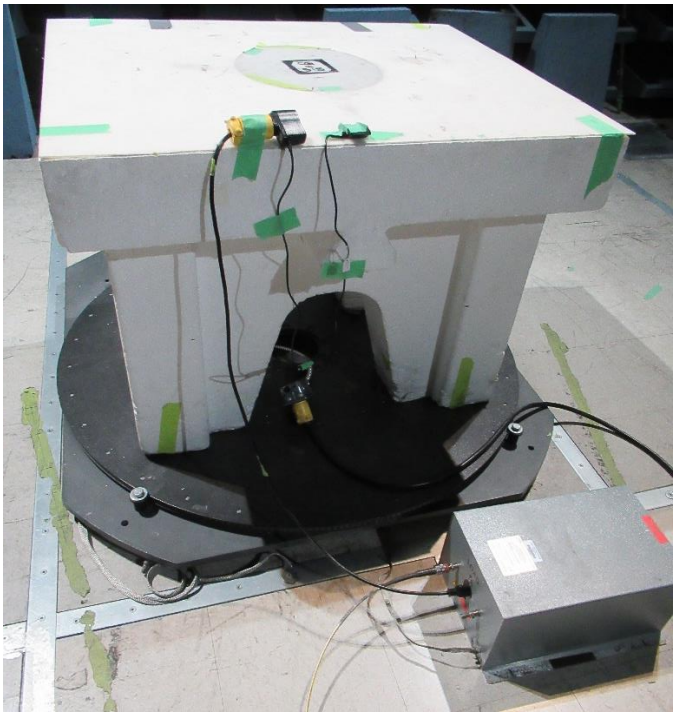


Figure 4: ***AC Mains Conducted Emissions (150 kHz – 30 MHz)***

Appendix I: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
BW	Bandwidth
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
CW	Continuos Wave
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FW	Firmware
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

END OF REPORT