Certification Test Report

FCC ID: HSW2832
IC: 4492A-2832

FCC Rule Part: 15.247

Report Number: AT72154633-1P1

Manufacturer: Murata Electronics North America
Model: MBN52832

Test Begin Date: November 14, 2019
Test End Date: March 2, 2020

Report Issue Date: March 10, 2020

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared By:

Ryan McGann
Senior Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Jeremy Pickens
Senior Wireless Engineer
TÜV SÜD America Inc.

This report contains 29 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 Certification for Class II Permissive Change.

The purpose of this Class II Permissive Change is to add a new data-rate to the existing certification.

1.2 Product Description

The MBN52832 is a Bluetooth Low Energy (BLE) module designed for IoT applications. The module consists of an nRF52832 SoC from Nordic Semiconductor. This SoC contains a 2.4 GHz BLE radio along with an integrated microprocessor to run the BLE software stack. Customers can load application software into the device that allows the module to do various tasks – measure a voltage, set an output bit, transmit data to another unit, etc. Basic radio operation (output power, channelization, etc.) is operated by the lower levels of the BLE stack and is not accessible to the module user.

Technical Information:

Detail	Description
Frequency Range	2402-2480 MHz
Number of Channels	40
Channel Spacing	2 MHz
Modulation Format	GFSK
Data Rates	1Mbps / 2 Mbps (new)
Operating Voltage	Coin Cell Battery: 3Vdc External Power Supply: 5Vdc Universal Serial Bus: 5Vdc
Antenna Type(s) / Gain(s)	Printed Trace Antenna: -2.5 dBi Cisco AIR-ANT2460P-R* Patch Antenna: 6 dBi LCom HG2407RD-RSP Dipole Antenna: 7dBi

*Cisco AIR-ANT2460P-R replaces CUSHCRAFT S2406PL of same type and gain.

Manufacturer Information:
Murata Electronics North America
2200 Lake Park Drive
Smyrna, GA 30080

Test Sample Serial Number: Not Labeled

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT is capable of being powered from a coin cell battery, commercially available wall-wart power supply, and the USB communication cable from a laptop. All modes of operation, including all data rates, were evaluated and the data presented in this report represents the worst case where applicable. The module was tested in a standalone condition on an evaluation board.

For radiated emissions, the EUT was evaluated in three orthogonal orientations with the PCB Trace Antenna to determine the worst-case orientation. The worst-case orientation used for all antennas was X-orientation. The EUT was evaluated with power supplied via USB from a representative laptop computer.

For AC power line conducted emissions, the EUT was evaluated with a commercially available wall-wart power supply and over USB from a laptop computer. The worst-case power mode was over USB from a laptop computer and was evaluated in the worst-case antenna configuration from the original filing.

For RF Conducted Emissions, the EUT was evaluated using the external U.FL antenna connector with suitable attenuation. The coupling cable and external attenuation were considered for all RF conducted measurements.

Software power setting during test: 4

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20’ x 30’ x 18’ shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5’ in diameter and is located 5’6” from the back wall of the chamber. The chamber is grounded via 1 - 8’ copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3’ x 6’ x 4’ deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4” PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit, so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

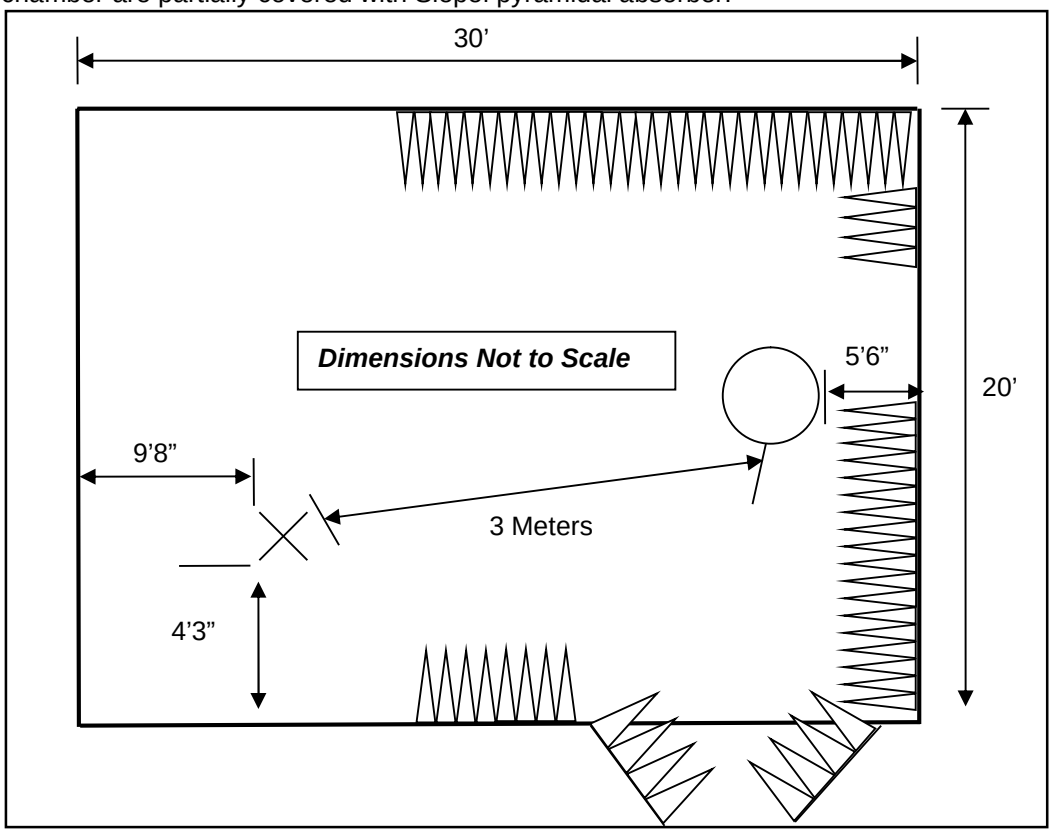


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

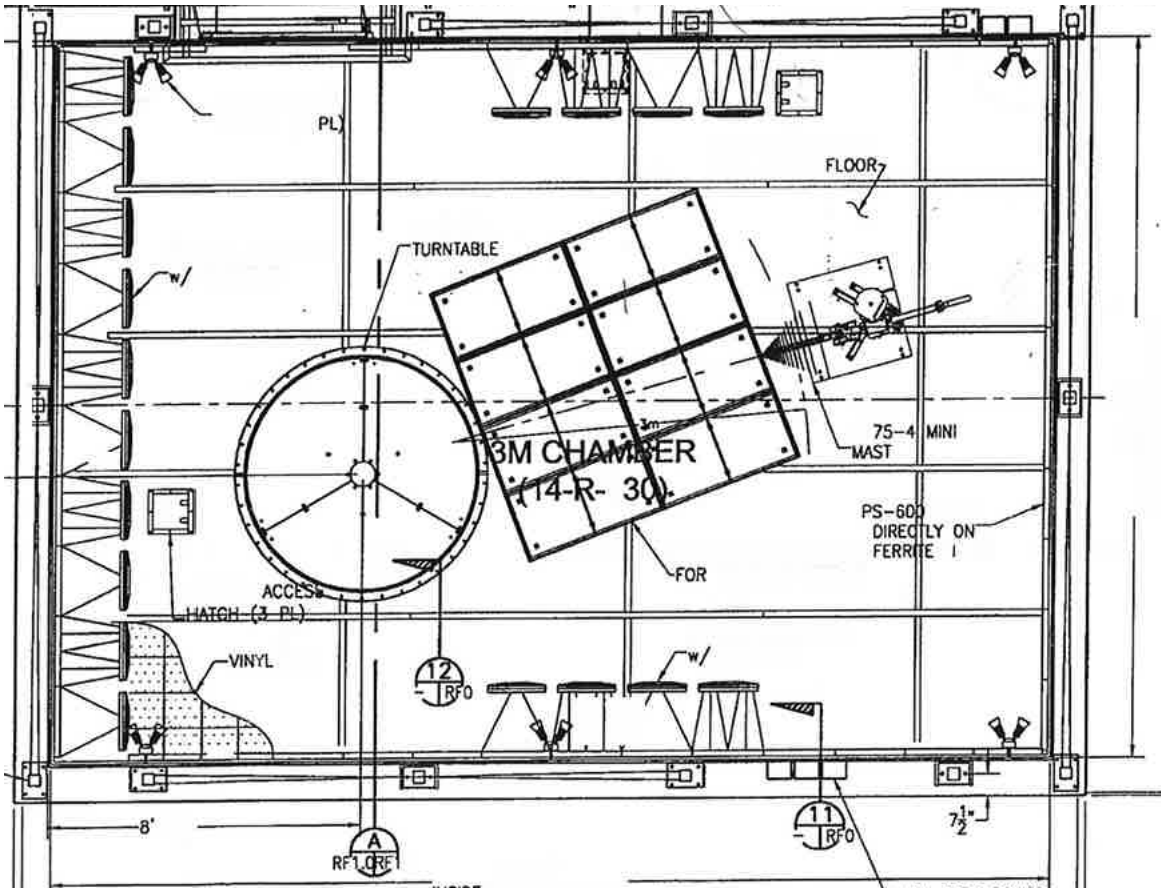


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

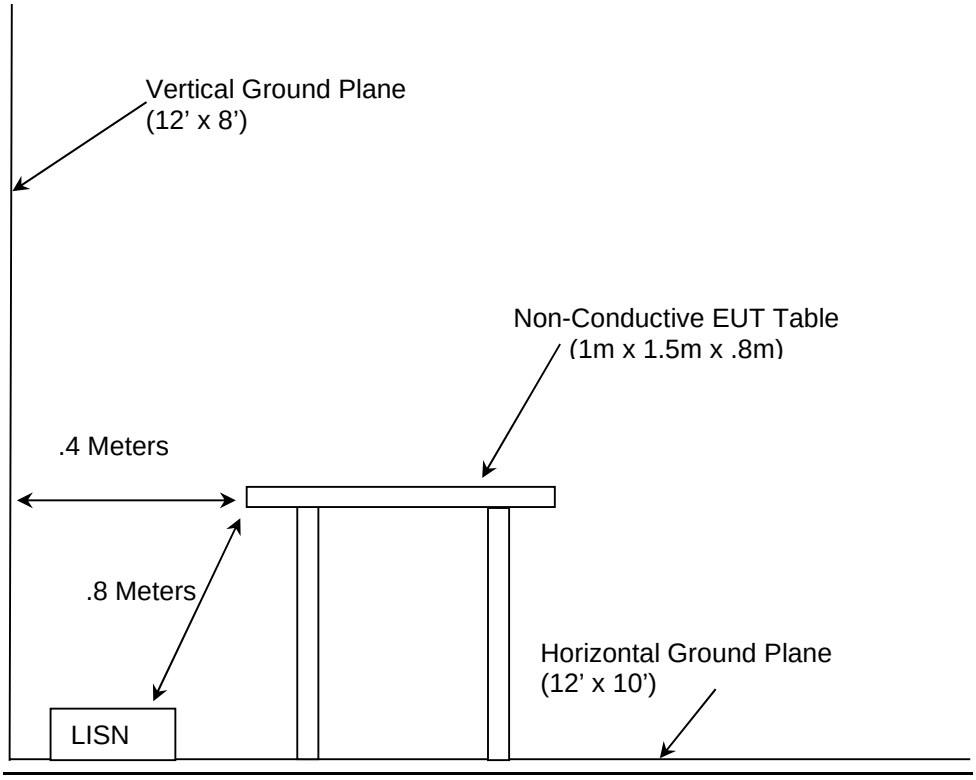


Figure 2.4.1-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 20120
- FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 2, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, Feb 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, March 2019 with Amendment 1.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
213	TEC	PA 102	Amplifier	44927	07/22/2019	07/22/2020
324	ACS	Belden	Conducted EMI Cable	8214	03/19/2019	03/19/2020
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2029	07/15/2021
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/31/2019	05/31/2020
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/30/2018	07/30/2020
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
638	Rohde & Schwarz	OSP 120	Open Switch and Control Unit	101229	06/11/2019	06/11/2021
651	Rohde & Schwarz	TS-PR26	18GHz to 26.5GHz Pre-Amplifier	100023	07/10/2019	07/10/2020
652	Sorensen	3160-09	High Frequency Antenna 18GHz to 26.5GHz	060922-21894	NCR	NCR
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz;	697WW30606	02/25/2019	02/25/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/07/2018	05/01/2020
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	05/01/2019	05/01/2020
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/01/2019	05/01/2020
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
857	ETS Lindgren	3117	Horn Antenna 1-18GHz	00153608	11/12/2019	11/12/2021
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/10/2019	07/10/2020
RE880	Rhode & Schwarz USA	Test Recever	R&S ESW44	1206247	11/06/2019	11/06/2020

NOTE: All test equipment was used only during active calibration cycles.
NCR = No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Laptop	Dell	Latitude E7250	BBQDF72
2	Power Supply	Dell	Not Provided	Not Provided
3	Headphones	1800 Tequila	Not Provided	Not Provided
4	External Antenna	Cisco (Patch Antenna)	AIR-ANT2460P-R	FOC1349R0PC
		LCom (Dipole Antenna)	HG2407RF-RSP	Not Provided

Table 5-2: Cable Description

Cable	Cable Type	Length	Shield	Termination
A	USB	4m (Radiated) 1m (AC Conducted)	Yes	EUT to Laptop
B	DC Power Cable	2m	No	Power Supply to Computer
C	AC Power Cable	1m	No	Power Supply to AC Mains
D	Stereo Audio	1.2m	No	Laptop to Headphones
E	RF Coaxial Cable	1m (Patch Antenna) 0.1m (Dipole Antenna)	Yes	EUT to External Antenna

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

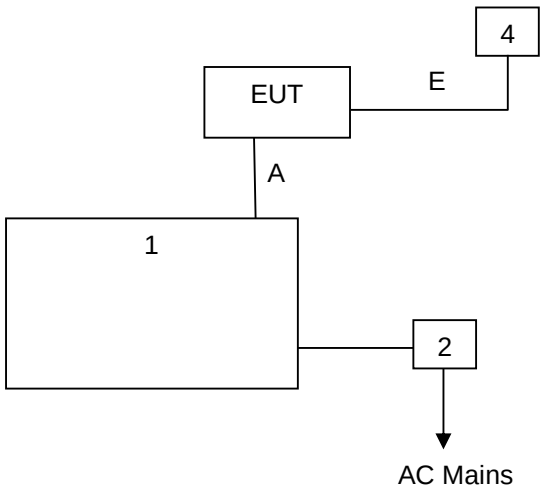


Figure 6-1: Test Setup Block Diagram – Radiated Emissions

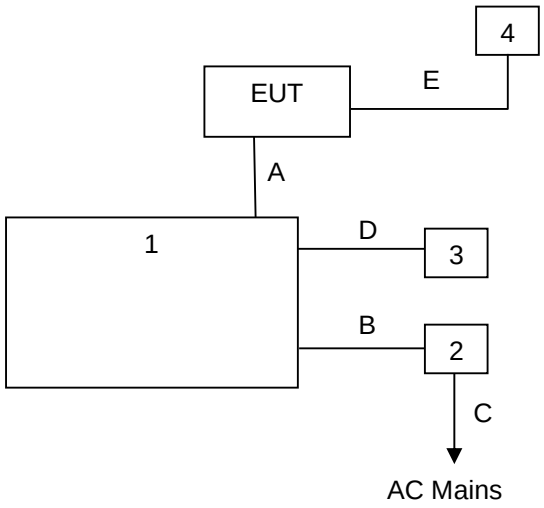


Figure 6-2: Test Setup Block Diagram – AC Line Conducted Emissions

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The internal antenna is integrated to the PCB and cannot be removed without damage to the EUT, therefore satisfying the requirements of Section 15.203. The gain of the internal antenna is -2.5 dBi. The external patch antenna and external dipole antenna interface with the EUT via a coax cable and U.FL connector. The gain of the patch antenna is 6 dBi. The gain of the dipole antenna is 7 dBi.

7.2 Power Line Conducted Emissions – FCC: Section 15.207

7.2.1 Measurement Procedure

ANSI C63.10 was the guiding document for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Performed by: Arthur Sumner

Table 7.2.2-1: Conducted EMI Results – PCB Antenna - Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	47.6	27.04	66	56	18.4	28.96	9.45
0.17	44.67	23.13	64.96	54.96	20.29	31.83	9.46
0.182	44.47	22.63	64.39	54.39	19.92	31.76	9.46
0.202	42.75	22.54	63.53	53.53	20.78	30.99	9.47
0.394	43.72	22.2	57.98	47.98	14.26	25.78	9.5
0.41	47.96	24.94	57.65	47.65	9.69	22.71	9.5
0.442	47.96	26.64	57.02	47.02	9.06	20.38	9.51
0.454	48.79	28.26	56.8	46.8	8.01	18.54	9.53
0.482	46.14	22.29	56.3	46.3	10.16	24.01	9.53
0.494	39.73	22.29	56.1	46.1	16.37	23.81	9.54

Table 7.2.2-2: Conducted EMI Results – PCB Antenna - Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	45.75	27.28	66	56	20.25	28.72	9.43
0.162	45.09	26.81	65.36	55.36	20.27	28.55	9.43
0.17	45.52	27.47	64.96	54.96	19.44	27.49	9.43
0.222	44.35	25.63	62.74	52.74	18.39	27.11	9.44
0.386	42.55	23.67	58.15	48.15	15.6	24.48	9.47
0.426	47.05	26.01	57.33	47.33	10.28	21.32	9.47
0.454	47.71	26.13	56.8	46.8	9.09	20.67	9.48
0.466	48.88	29.33	56.58	46.58	7.7	17.25	9.48
0.498	48.15	22.23	56.03	46.03	7.88	23.8	9.48
0.606	35.36	22.31	56	46	20.64	23.69	9.5

7.3 6dB / 99% Bandwidth – FCC 15.247(a)(2), ISED Canada: RSS-247 5.2(a), RSS-GEN 6.7

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 Section 8.2 which references Subclause 11.8 of ANSI C63.10. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

7.3.2 Measurement Results

Performed by: Ryan McGann

Table 7.3.2-1: 6dB / 99% Bandwidth

Modulation	Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
GFSK	2402	1.212	2.030
	2440	1.188	2.060
	2480	1.188	2.030

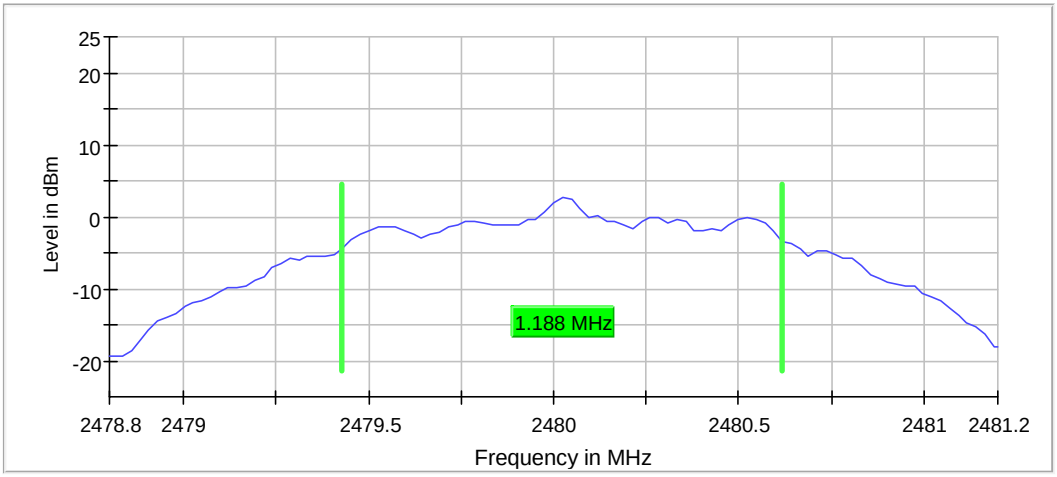


Figure 7.3.2-1: Sample Plot - 6dB BW

Table 7.3.2-2: Sample Measurement Settings (6dB BW)

Setting	Instrument Value	Target Value
Start Frequency	2.47880 GHz	2.47880 GHz
Stop Frequency	2.48120 GHz	2.48120 GHz
Span	2.400 MHz	2.400 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 48
Sweeptime	18.905 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	12 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.17 dB	0.50 dB

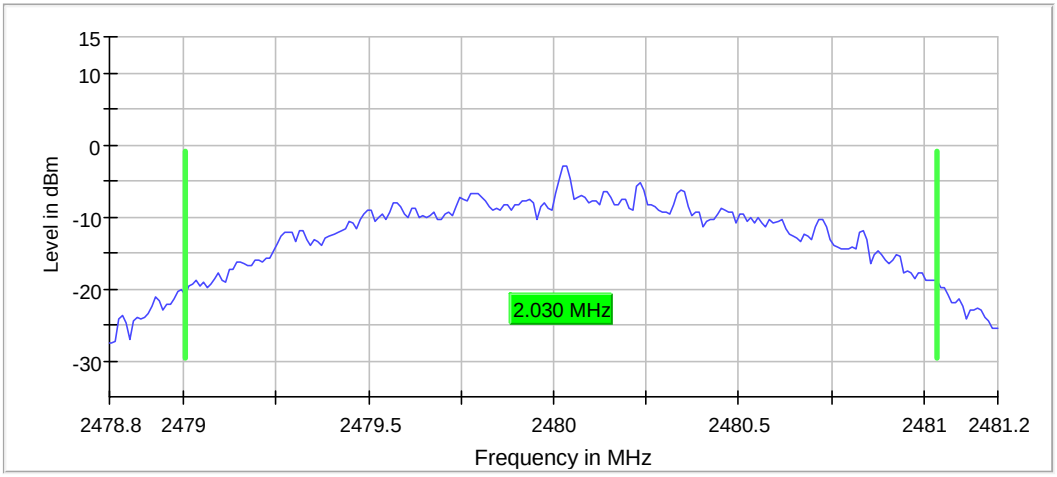


Figure 7.3.2-2: Sample Plot - 99% OBW

Table 7.3.2-3: Sample Measurement Settings (OBW)

Setting	Instrument Value	Target Value
Start Frequency	2.47880 GHz	2.47880 GHz
Stop Frequency	2.48120 GHz	2.48120 GHz
Span	2.400 MHz	2.400 MHz
RBW	20.000 kHz	>= 12.000 kHz
VBW	100.000 kHz	>= 60.000 kHz
SweepPoints	240	~ 240
Sweeptime	94.727 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	7 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.18 dB	0.30 dB

7.4 Fundamental Emission Output Power – FCC 15.247(b)(3), ISED Canada: RSS-247 5.4(d)

7.4.1 Measurement Procedure

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 utilizing the RBW ≥ DTS Bandwidth method. The RF output of the equipment under test was directly connected to the input of the analyzer applying suitable attenuation. Worst-case power across all data rates is reported.

7.4.2 Measurement Results

Performed by: Ryan McGann

Table 7.4.2-1: Conducted Output Power

Modulation	Frequency [MHz]	Peak Power [dBm]
GFSK	2402	2.7
	2440	3.0
	2480	2.7

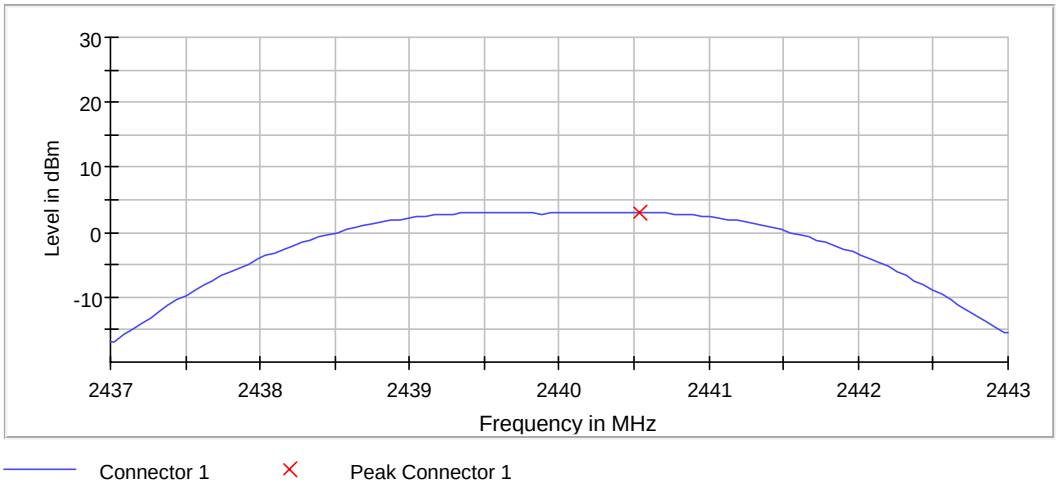


Figure 7.4.2-1: Sample Plot

Table 7.4.2-2: Sample Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.43700 GHz	2.43700 GHz
Stop Frequency	2.44300 GHz	2.44300 GHz
Span	6.000 MHz	6.000 MHz
RBW	2.000 MHz	>= 1.188 MHz
VBW	10.000 MHz	>= 6.000 MHz
SweepPoints	101	~ 101
Sweeptime	953.450 ns	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.50 dB

7.5 Emission Levels

7.5.1 Emissions into Non-restricted Frequency Bands – FCC 15.247(d); ISED Canada: RSS-247 5.5

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 Section 8.5. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. The worst-case for each modulation was investigated at the lower and upper band edges.

7.5.1.2 Measurement Results

Performed by: Jeremy Pickens

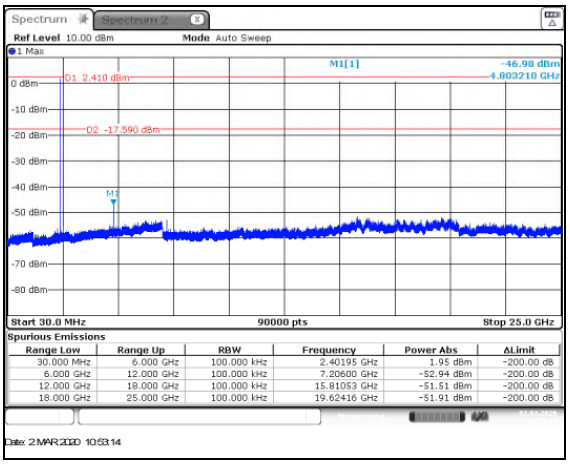


Figure 7.5.1.2-1: LCH – 30MHz–25GHz

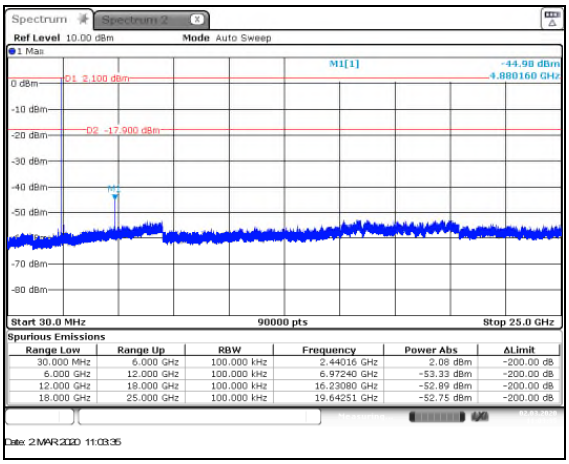


Figure 7.5.1.2-2: MCH – 30MHz–25GHz

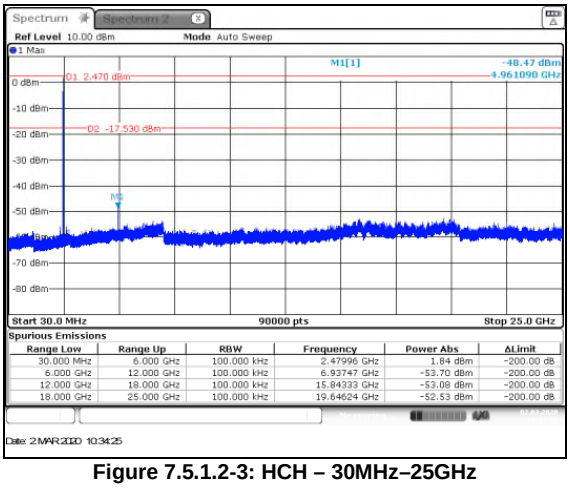


Figure 7.5.1.2-3: HCH – 30MHz–25GHz

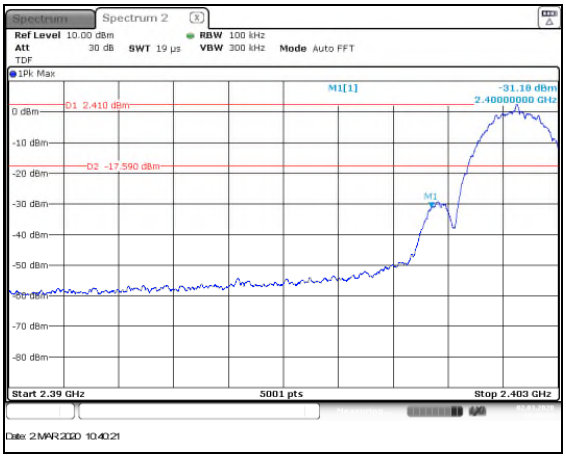


Figure 7.5.1.2-4: Lower Band-edge

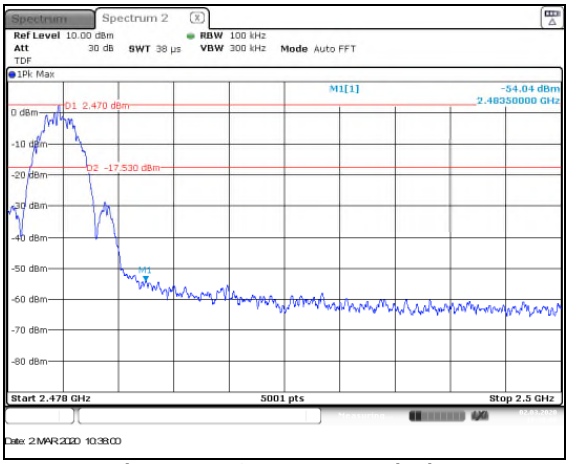


Figure 7.5.1.2-5: Upper Band-edge

7.5.2 Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 9 kHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209. Emissions not reported were below the noise floor of the measurement system. Peak data below 30MHz was more than 20dB below the applicable limits.

7.5.2.2 Duty Cycle Correction

For average radiated measurements, using a 2.12% duty cycle, the measured level was reduced by a factor of 33.47 dB. The duty cycle correction factor is determined using the formula: 20log (2.12/100) = -33.47 dB. A detailed analysis of the duty cycle timing is provided in the Theory of Operations accompanying the original application for certification.

7.5.2.3 Measurement Results

Performed by: Jeremy Pickens

Table 7.5.2.3-1: Radiated Spurious Emissions Tabulated Data – PCB Trace Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
2390	48.50	34.50	H	-1.17	47.33	-0.15	74.0	54.0	26.7	54.1
2390	47.30	34.10	V	-1.17	46.13	-0.55	74.0	54.0	27.9	54.5
4804	46.00	33.40	H	3.29	49.29	3.22	74.0	54.0	24.7	50.8
4804	46.80	34.00	V	3.29	50.09	3.82	74.0	54.0	23.9	50.2
Middle Channel										
4880	47.1	33.9	H	3.34	50.44	3.76	74.0	54.0	23.6	50.2
4880	47.7	34.5	V	3.34	51.04	4.36	74.0	54.0	23.0	49.6
7320	50.5	37.8	H	6.95	57.45	11.27	74.0	54.0	16.6	42.7
7320	48.2	35.6	V	6.95	55.15	9.07	74.0	54.0	18.9	44.9
Highest Channel										
2483.5	56.70	40.20	H	-0.96	55.74	5.77	74.0	54.0	18.3	48.2
2483.5	56.50	40.70	V	-0.96	55.54	6.27	74.0	54.0	18.5	47.7
4960	47.2	34	H	3.38	50.58	3.91	74.0	54.0	23.4	50.1
4960	47.2	34.3	V	3.38	50.58	4.21	74.0	54.0	23.4	49.8
7440	48.3	35.9	H	7.06	55.36	9.49	74.0	54.0	18.6	44.5
7440	47.5	34.4	V	7.06	54.56	7.99	74.0	54.0	19.4	46.0

Table 7.5.2.3-2: Radiated Spurious Emissions Tabulated Data – Dipole Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
2390	47.00	34.00	H	-1.17	45.83	-0.65	74.0	54.0	28.2	54.6
2390	51.30	36.10	V	-1.17	50.13	1.45	74.0	54.0	23.9	52.5
4804	51.60	42.80	H	3.29	54.89	12.62	74.0	54.0	19.1	41.4
4804	57.10	49.00	V	3.29	60.39	18.82	74.0	54.0	13.6	35.2
Middle Channel										
4880	53.5	43.2	H	3.34	56.84	13.06	74.0	54.0	17.2	40.9
4880	57	47.7	V	3.34	60.34	17.56	74.0	54.0	13.7	36.4
7320	49.3	38	H	6.95	56.25	11.47	74.0	54.0	17.8	42.5
7320	48.5	36	V	6.95	55.45	9.47	74.0	54.0	18.6	44.5
Highest Channel										
2483.5	50.20	36.00	H	-0.96	49.24	1.57	74.0	54.0	24.8	52.4
2483.5	60.80	45.00	V	-0.96	59.84	10.57	74.0	54.0	14.2	43.4
4960	52.5	43	H	3.38	55.88	12.91	74.0	54.0	18.1	41.1
4960	55.8	47.2	V	3.38	59.18	17.11	74.0	54.0	14.8	36.9
7440	48.6	37	H	7.06	55.66	10.59	74.0	54.0	18.3	43.4
7440	47.7	35.1	V	7.06	54.76	8.69	74.0	54.0	19.2	45.3

Table 7.5.2.3-3: Radiated Spurious Emissions Tabulated Data – Patch Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
2390	48.50	35.40	H	-1.17	47.33	0.75	74.0	54.0	26.7	53.2
2390	55.60	38.40	V	-1.17	54.43	3.75	74.0	54.0	19.6	50.2
4804	54.90	44.90	H	3.29	58.19	14.72	74.0	54.0	15.8	39.3
4804	57.50	48.00	V	3.29	60.79	17.82	74.0	54.0	13.2	36.2
Middle Channel										
4880	58.5	48.7	H	3.34	61.84	18.56	74.0	54.0	12.2	35.4
4880	55	45.7	V	3.34	58.34	15.56	74.0	54.0	15.7	38.4
7320	50.6	38.5	H	6.95	57.55	11.97	74.0	54.0	16.5	42.0
7320	49.7	36.3	V	6.95	56.65	9.77	74.0	54.0	17.4	44.2
Highest Channel										
2483.5	51.20	36.30	H	-0.96	50.24	1.87	74.0	54.0	23.8	52.1
2483.5	60.80	45.30	V	-0.96	59.84	10.87	74.0	54.0	14.2	43.1
4960	54.7	46.2	H	3.38	58.08	16.11	74.0	54.0	15.9	37.9
4960	54	44.5	V	3.38	57.38	14.41	74.0	54.0	16.6	39.6
7440	48.9	36.7	H	7.06	55.96	10.29	74.0	54.0	18.0	43.7
7440	47.9	34.7	V	7.06	54.96	8.29	74.0	54.0	19.0	45.7

7.5.2.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak – Dipole Antenna Lowest Channel

Corrected Level: 57.10 + 3.29 = 60.39dBuV/m
Margin: 74dBuV/m – 60.39dBuV/m = 13.6dB

Example Calculation: Average – Dipole Antenna Lowest Channel

Corrected Level: 49.00 + 3.29 – 33.47 = 18.82dBuV
Margin: 54dBuV – 18.82dBuV = 35.2dB

7.6 Maximum Power Spectral Density in the Fundamental Emission – FCC 15.247(e) ISED Canada: RSS-247 5.2(b)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 utilizing Section 8.4. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 10 kHz. The Video Bandwidth (VBW) was set to 30 kHz. Span was set to 1.5 times the channel bandwidth. The trace was set to max hold with the peak detector active.

7.6.2 Measurement Results

Performed by: Ryan McGann

Table 7.6.2-1: Power Spectral Density

Modulation	Frequency [MHz]	PSD [dBm]
GFSK	2402	-8.096
	2440	-6.411
	2480	--6.196

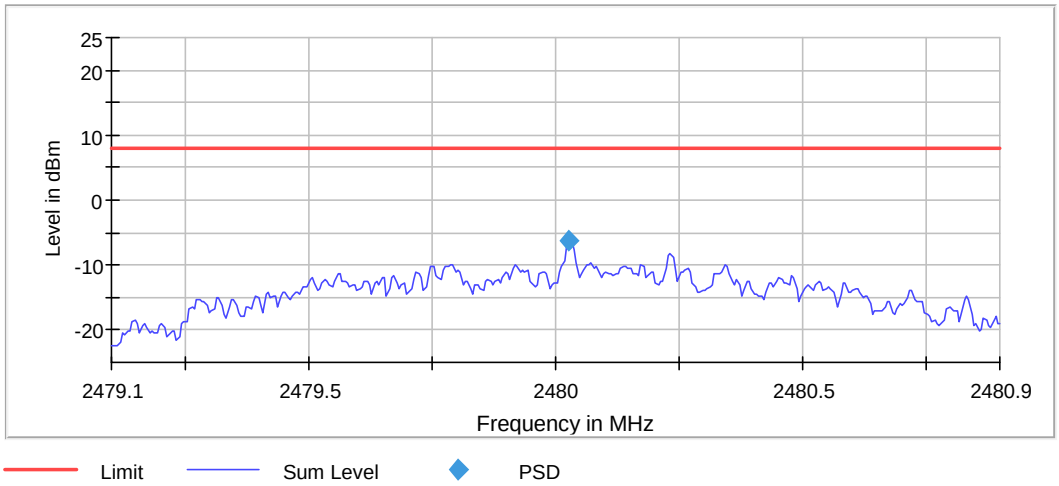


Figure 7.6.2-1: Sample PSD Plot

Table 7.6.2-2: Sample Measurement Settings (PSD)

Setting	Instrument Value	Target Value
Start Frequency	2.47910 GHz	2.47910 GHz
Stop Frequency	2.48090 GHz	2.48090 GHz
Span	1.800 MHz	1.800 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	360	~ 360
Sweeptime	1.800 ms	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.14 dB	0.50 dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the MBN52832, manufactured by Murata Electronics North America meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for Class II Permissive Change for the tests documented in this test report.

Appendix A: Plots

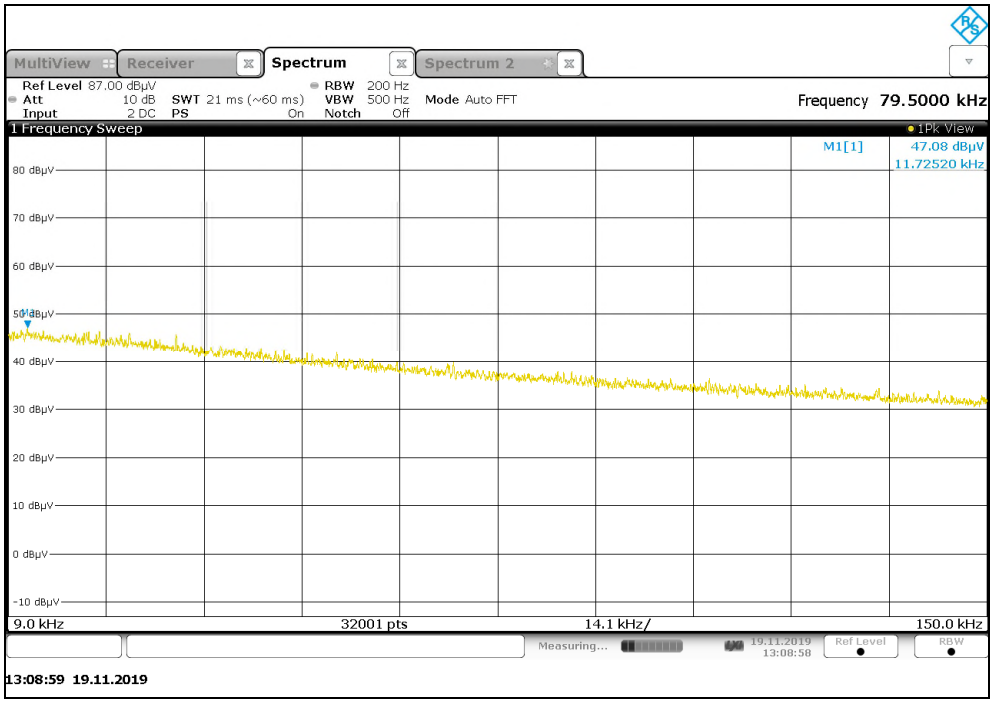
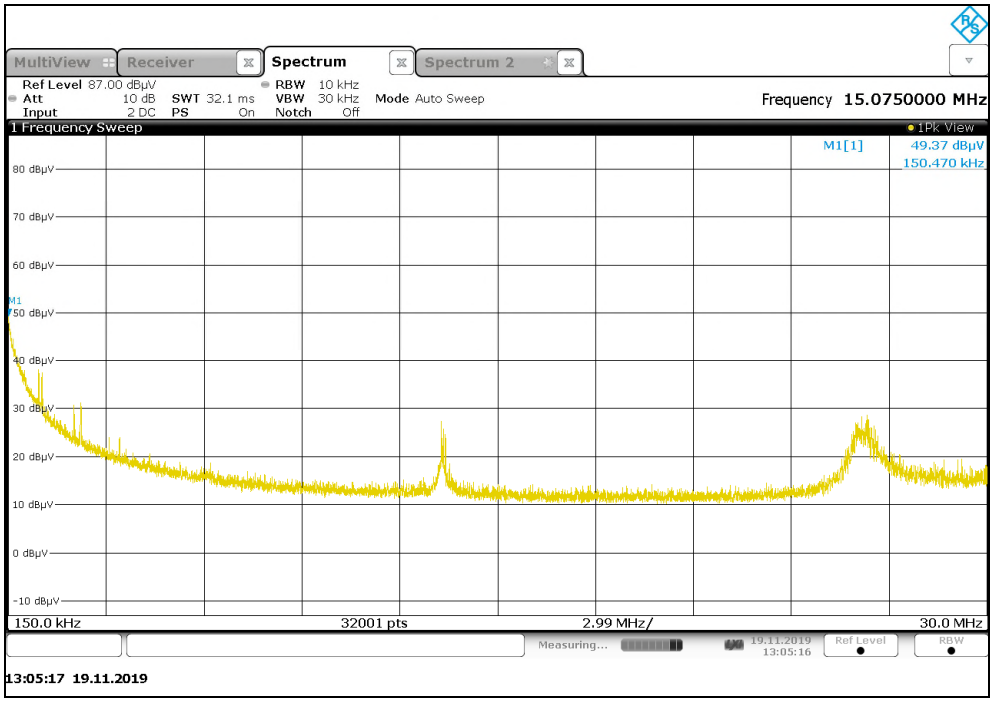
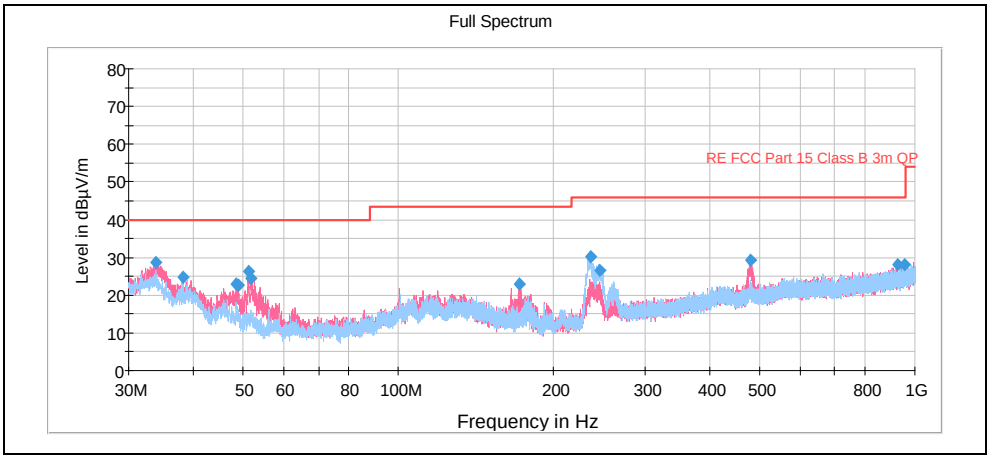


Figure A-1: 9kHz-150kHz



Note: Emissions above the noise floor are related to the accessory equipment and not associated with the DUT.

Figure A-2: 150kHz-30MHz



Note: Emissions above the noise floor are related to the accessory equipment and not associated with the DUT.

Figure A-3: 30MHz-1GHz

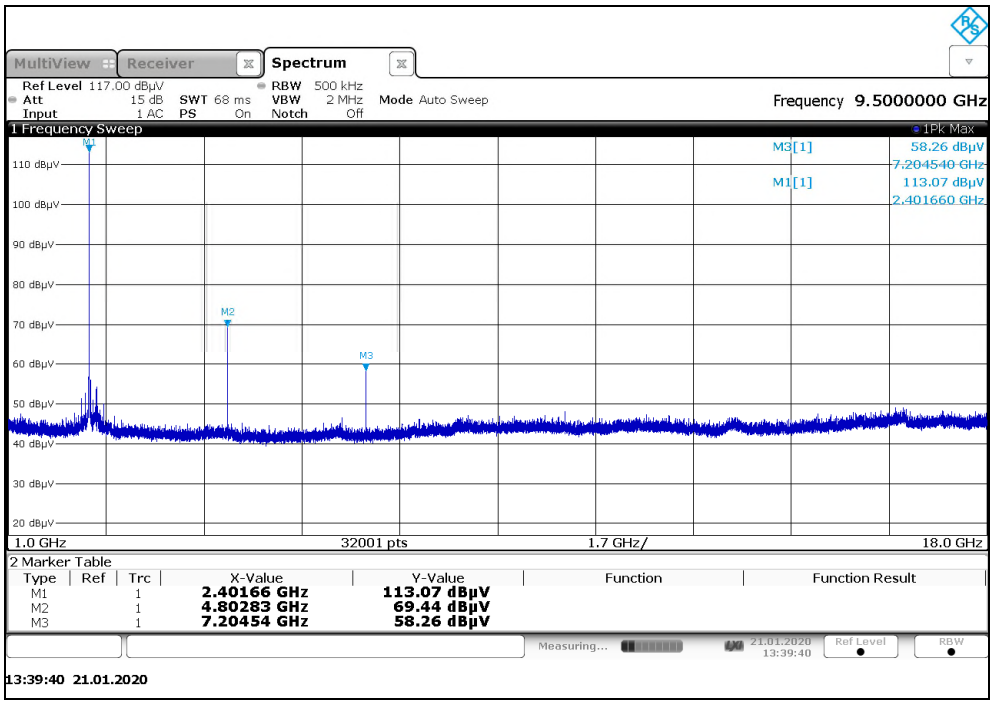


Figure A-4: 1GHz-18GHz

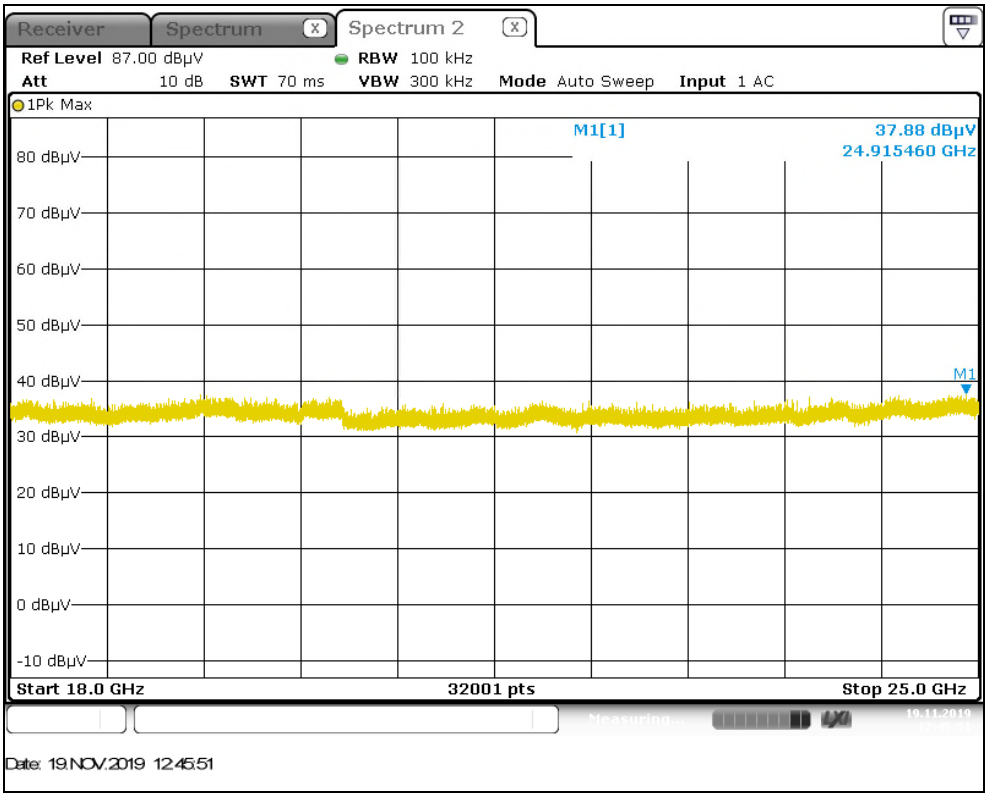


Figure A-5: 18GHz-25GHz

END REPORT