



Canada

EMC & RF Test Report

As per

RSS-247 Issue 2:2017 & FCC Part 15 Subpart 15.247

Unlicensed Intentional Radiators

on the

MDF-1019 Zigbee Module

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for

Prepared by:

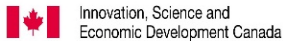
Amir Emami,
Project Engineer



See Appendix A for full client &
EUT details.

Reviewed by:

Min Xie,
Sr. Project Engineer



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



R-14023, G-20072
C-14498, T-20060



Registration #
CA6844



Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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Report Scope

This report addresses the EMC verification testing and test results of the **MDF-1019 Zigbee Module** and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:


RSS-247 Issue 2:2017

FCC Part 15 Subpart C 15.247

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.


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Product	MDF-1019	
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Summary

The results contained in this report relate only to the item(s) tested.

EUT:	MDF-1019 Zigbee Module
FCC Certification #, FCC ID:	2ABFD-MDF1019
Industry Canada Certification #, IC:	1156A-MDF1019
EUT passed all tests performed	Yes
Tests conducted by	Amir Emami
Report reviewed by	Min Xie


For testing dates, see "Testing Environmental Conditions and Dates".

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Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4(d)	Max Output Power	< 1 Watt	Pass
FCC 15.247(b)4 RSS-247 5.4(d)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna Conducted Spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
Overall Result			Pass

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

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Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.4(d)), the unit uses a reverse polarity antenna (5 dBi peak gain – Pulse W1038) with less than 6 dBi gain.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5 MHz.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However the 15.247 (d) requirement of power density were met and are detailed later in this test report.

The EUT was mounted in three orthogonal axes. Worst case results were obtained with the EUT in the X-axis. Worst case results are presented. See Appendix B for setup details.

The EUT has a fixed (source based) duty cycle of 13% (13ms on time/100ms) which cannot be changed or modified by either the device or the end user. As per KDB 558074 section 12.2.5.2, for the average radiated emission measurements of the band edges and of the spurious emissions in the restricted bands, a duty cycle correction factor of 13% [$20\log(13\%) = -17.72$] was applied to the peak measurement to obtain the average measurement.

Power line conducted emissions was not applicable since the EUT was a battery operated module. All tests were performed with new batteries.

Sample Calculation(s)

Radiated Emission Test

E-Field Level = Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain


E-Field Level = 50dB μ V + 10dB/m + 2dB – 20dB

E-Field Level = 42dB μ V/m

Margin = Limit – E-Field Level


Margin = 50dB μ V/m – 42dB μ V/m

Margin = 8.0 dB (pass)

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Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074: 2019	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
FCC KDB 447498: 2015	RF exposure procedures and equipment authorization policies for mobile and portable devices
ICES-003 Issue 6 2019	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5 2019	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 2:2017	Digital Transmission Systems (DTSSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

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Document Revision Status

Revision	Date	Description	Initials
000	May 26, 2021	Initial Release	AE
-	-	-	-

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Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

DTS – Digital Transmission System
LISN – Line Impedance Stabilization Network
NCR – No Calibration Required
NSA – Normalized Site Attenuation
N/A – Not Applicable
RF – Radio Frequency

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.


BW – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

ITE – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.


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Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m Open Area Test Site (OATS). The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the vertical ground plane if applicable.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Innovation, Science and Economic Development Canada (ISED, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-14023, G-20072, C-14498, and T-20060). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc. is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or biennial basis as listed for each respective test.

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Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
April 21, 2021	Radiated Emissions	AE	23.7	19.6	99.2
April 21, 2021	Antenna Conducted Emissions	AE	23.7	19.6	99.2

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Detailed Test Results Section

Client	Mircom Technologies Ltd.	
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6dB Bandwidth of Digitally Modulated Systems

Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits and Method

The limit is as specified in FCC Part 15.247(a)2 and RSS-247 5.2(a).

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. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

The method is given in FCC KDB 558074 Section 8.1 and ANSI C63.10.


Results

The EUT passed.

The minimum 6 dB Bandwidth measured was 1571 kHz

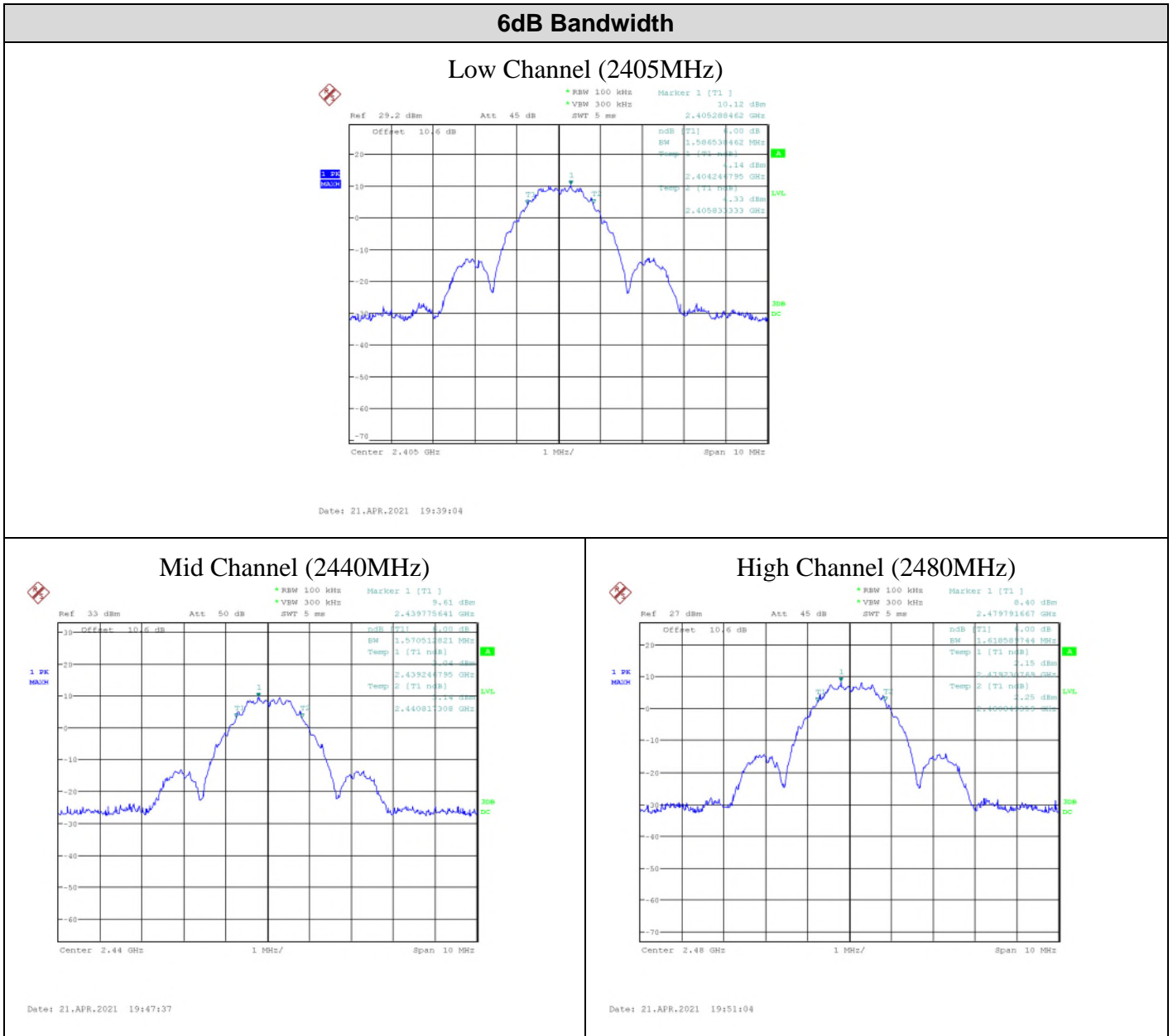
The maximum 99% Occupied Bandwidth was 2580 kHz.


Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2405	1.587	2.55
Mid	2440	1.571	2.52
High	2480	1.619	2.58

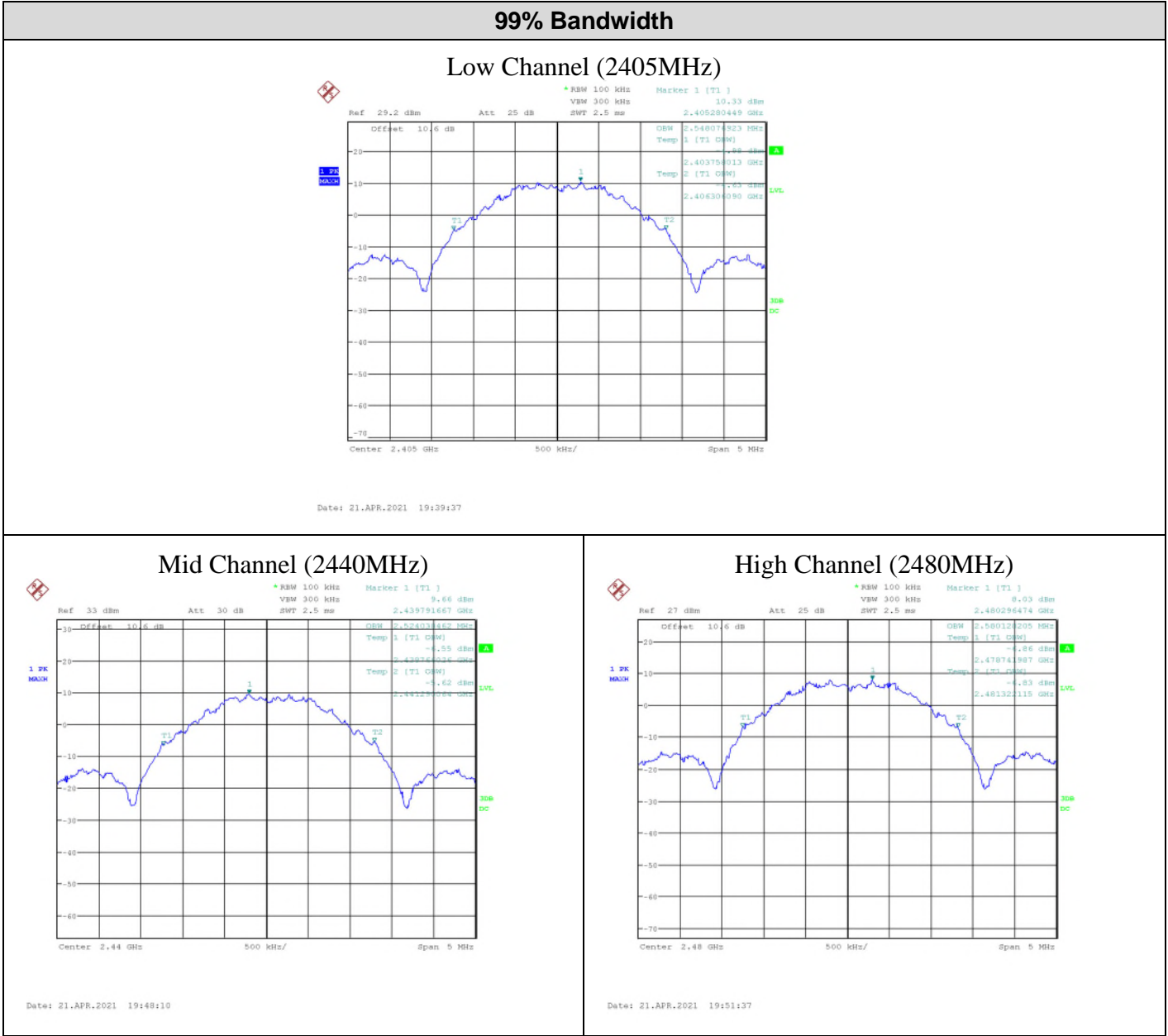
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Graphs


The graphs shown below show the OBW of the device during the conducted measurement operation of the EUT. This is measured by a max hold on the spectrum analyzer.



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Note: See 'Appendix B – EUT & Test Setup Photos' for photos showing the test set-up.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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Maximum Peak Envelope Conducted Power

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, the maximum power does not exceed an amount which may create an excessive power level.

Limits and Method

The limits are defined in FCC Part 15.247(b) and RSS-247 5.4(d).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (30 dBm).

The method is given in FCC KDB 558074 Section 9.1.2 and ANSI C63.10.

Results


The EUT passed.

Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2405	13.81	24.04
Mid	2440	13.04	20.14
High	2480	11.95	15.67

Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer


Graphs

The graphs shown below show the peak power output of the device during the conducted measurement operation of the EUT. The measurement RBW is \geq than the DTS bandwidth.

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Mircom Technologies Ltd.	
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Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.


Limits and Method

The limits are defined in 15.247(d) and RSS-247 5.5. In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

The method is given in FCC KDB 558074 Section 11 and ANSI C63.10

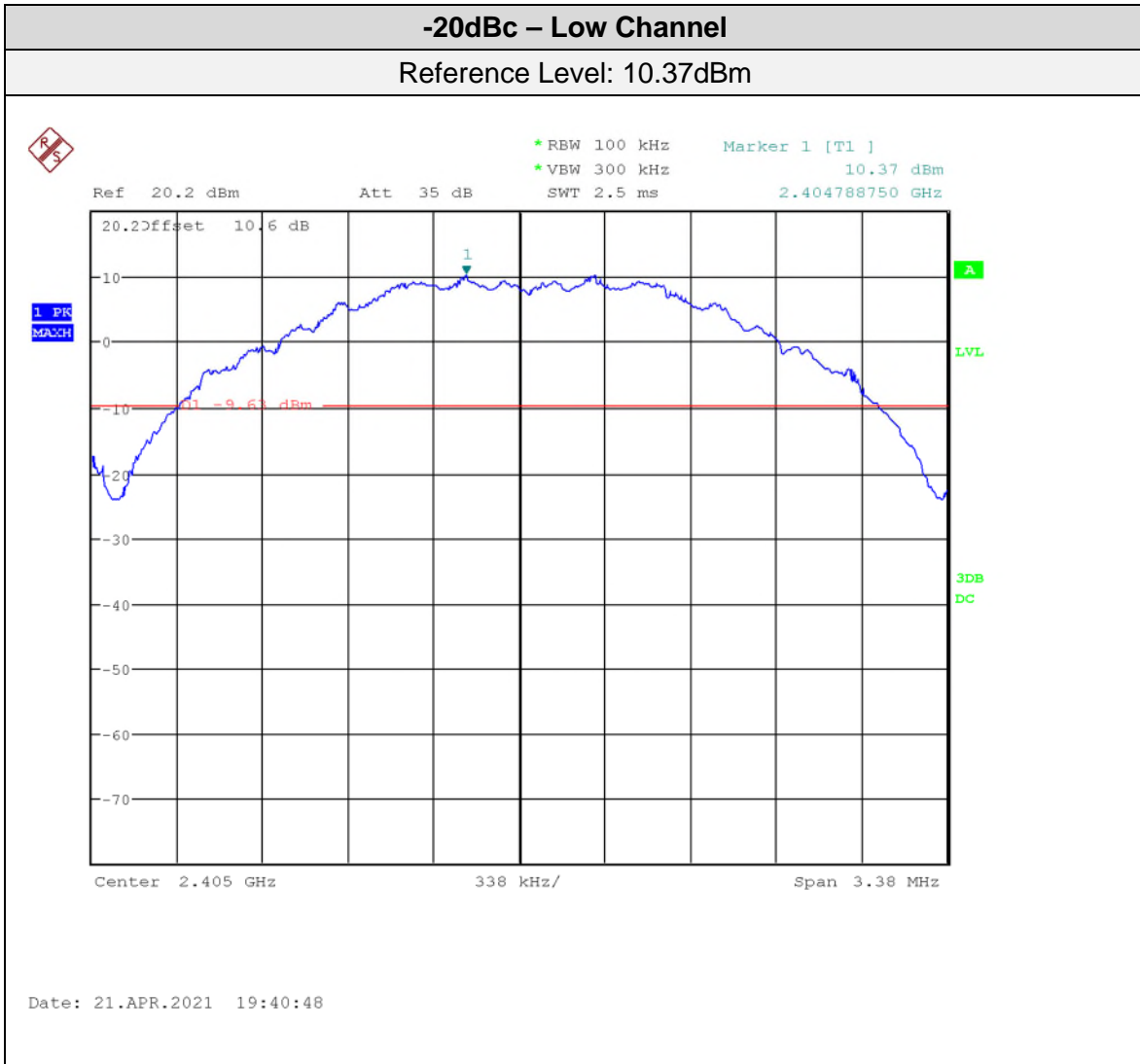
Results


The EUT passed. Low, middle and high bands were measured. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band.

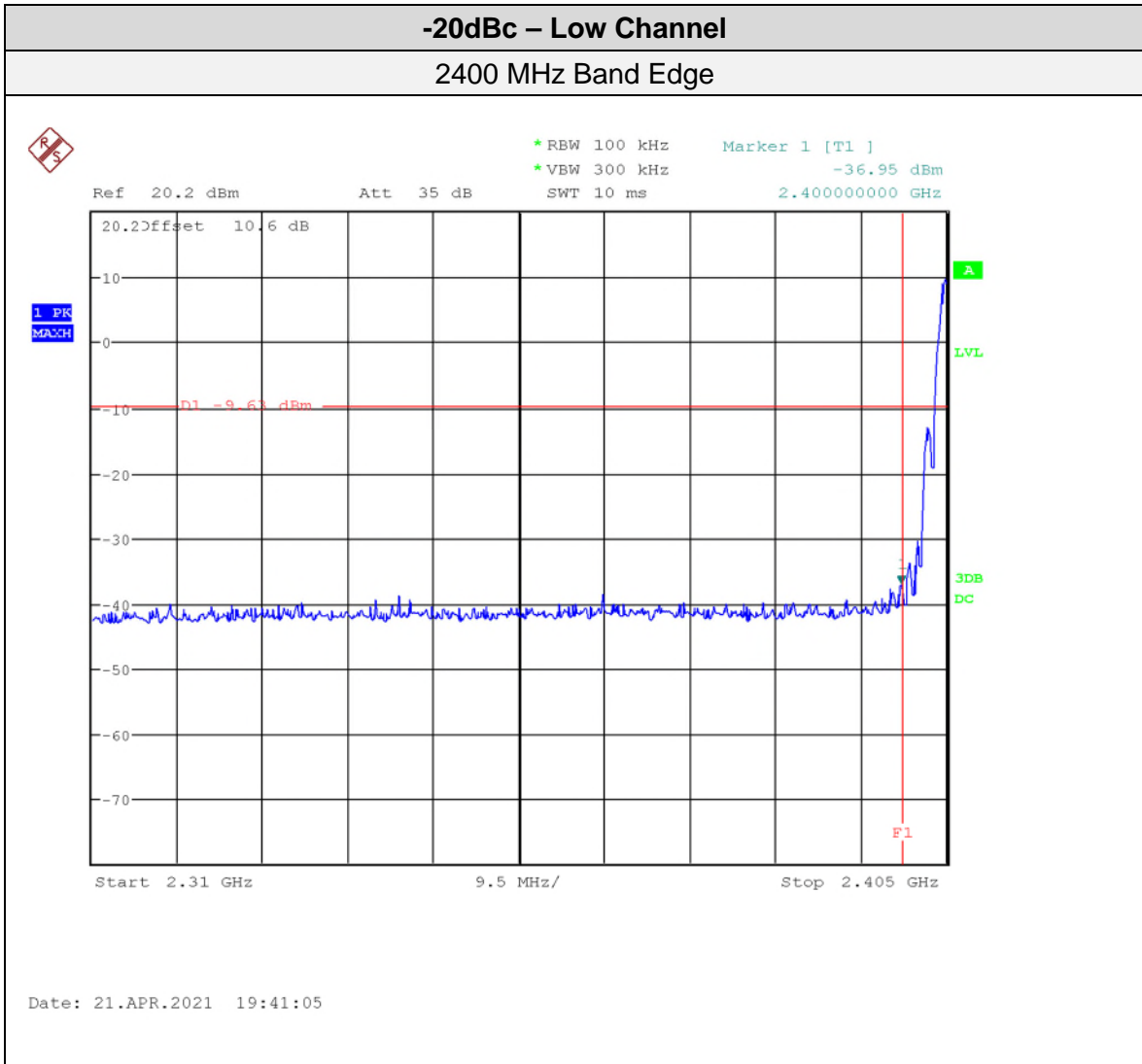
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Graphs

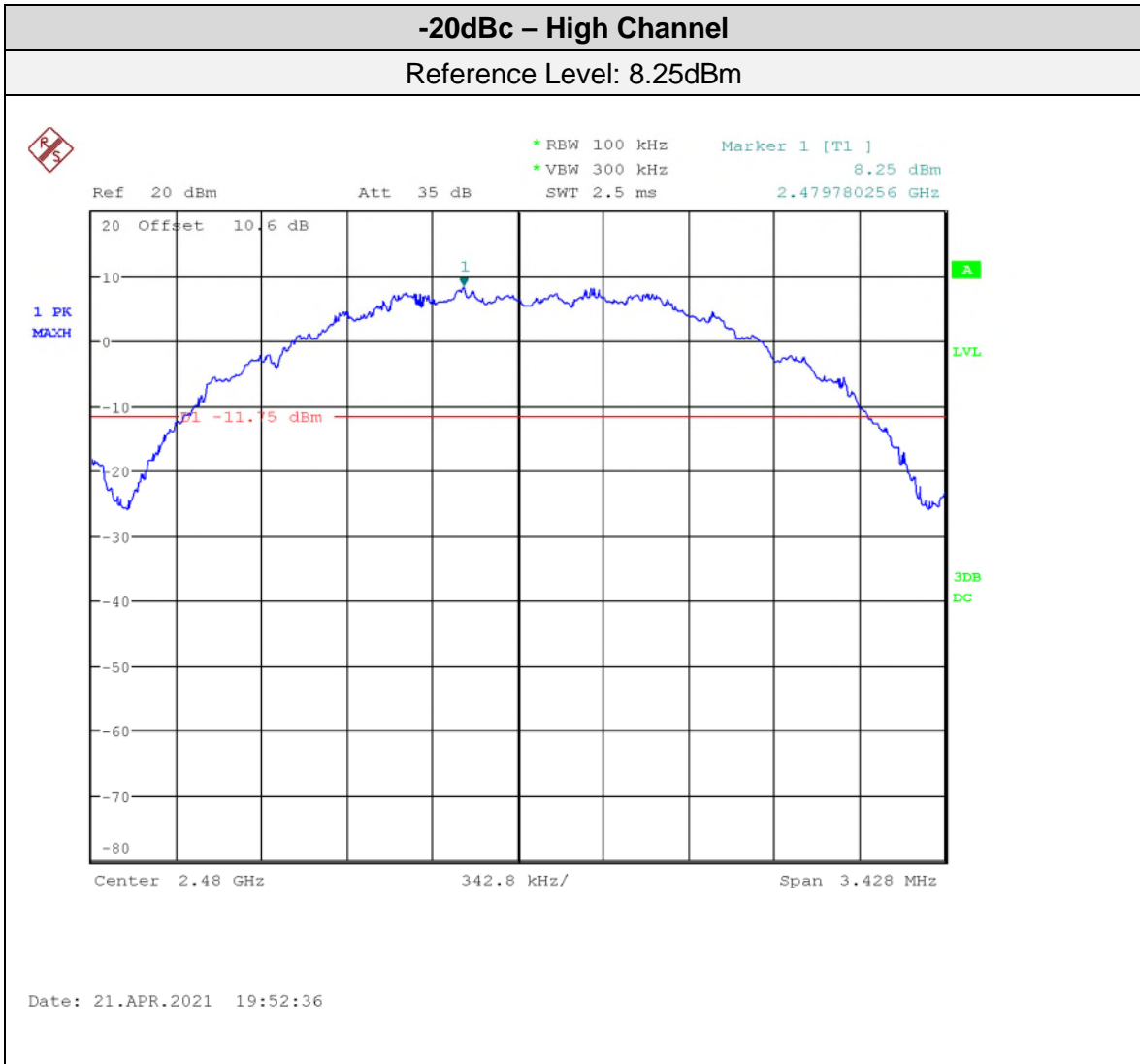
The graphs shown below show the power output of the device during the conducted measurement operation of the EUT.




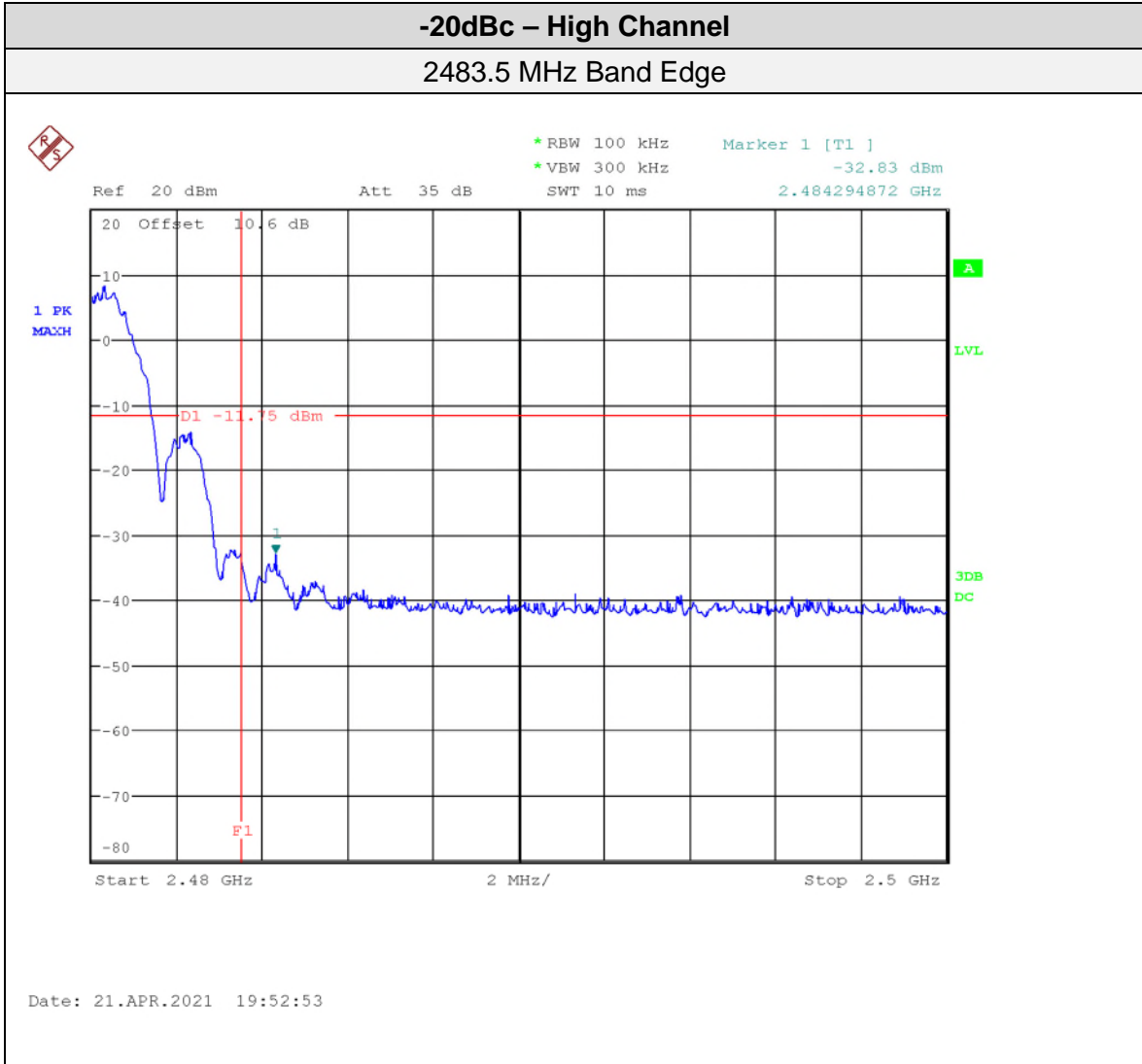
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See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
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Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Mircom Technologies Ltd.	
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Transmitter Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limits and Method

The method is as defined in FCC KDB 558074 Section 12.2 and ANSI C63.10.

The limits, as defined in 15.247(d) for unintentional radiated emissions, apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the ‘Spurious Conducted Emissions’ requirements of -20 dBc or greater. See also ‘Antenna Spurious Conducted Emissions (-20dBc)’ for further details.


Frequency	Field Strength Limit ($\mu\text{V/m}$)	Field Strength at 3m ($\text{dB}\mu\text{V/m}$)
0.009 MHz – 0.490 MHz	2400/F(kHz) ^a (at 30m)	128.5 to 93.8 ^a
0.490 MHz – 1.705 MHz	24000/F(kHz) ^a (at 30m)	73.8 to 63.0 ^a
1.705 MHz – 30 MHz	30 ^a (at 30m)	69.5 ^a
30 MHz – 88 MHz	100 ^a (at 3m)	40.0 ^a
88 MHz – 216 MHz	150 ^a (at 3m)	43.5 ^a
216 MHz – 960 MHz	200 ^a (at 3m)	46.0 ^a
Above 960 MHz	500 ^a (at 3m)	54.0 ^a
Above 1000 MHz	500 ^b (at 3m)	54.0 ^b
Above 1000 MHz	5 mV/m ^c (at 3m)	74.0 ^c

^aLimit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

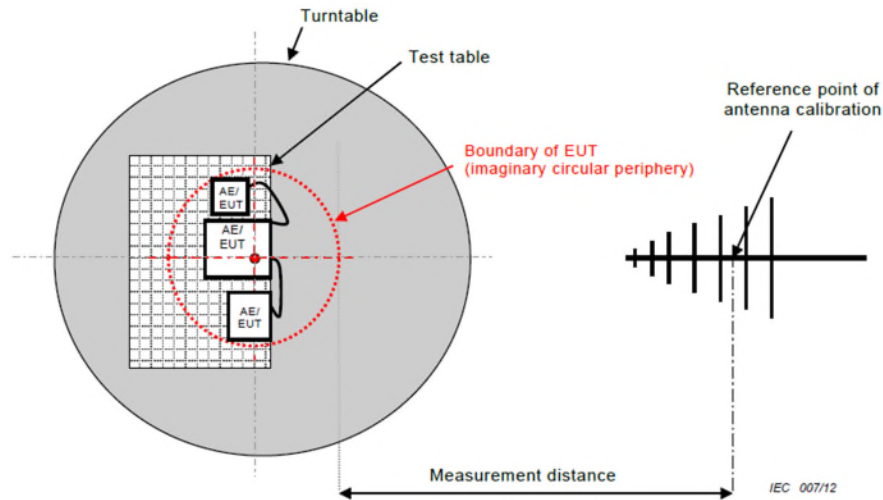
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^cLimit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

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Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is $\pm 5.67\text{dB}$ for 30MHz – 1GHz and $\pm 4.58\text{dB}$ for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.


Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of 24.835 GHz).

Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

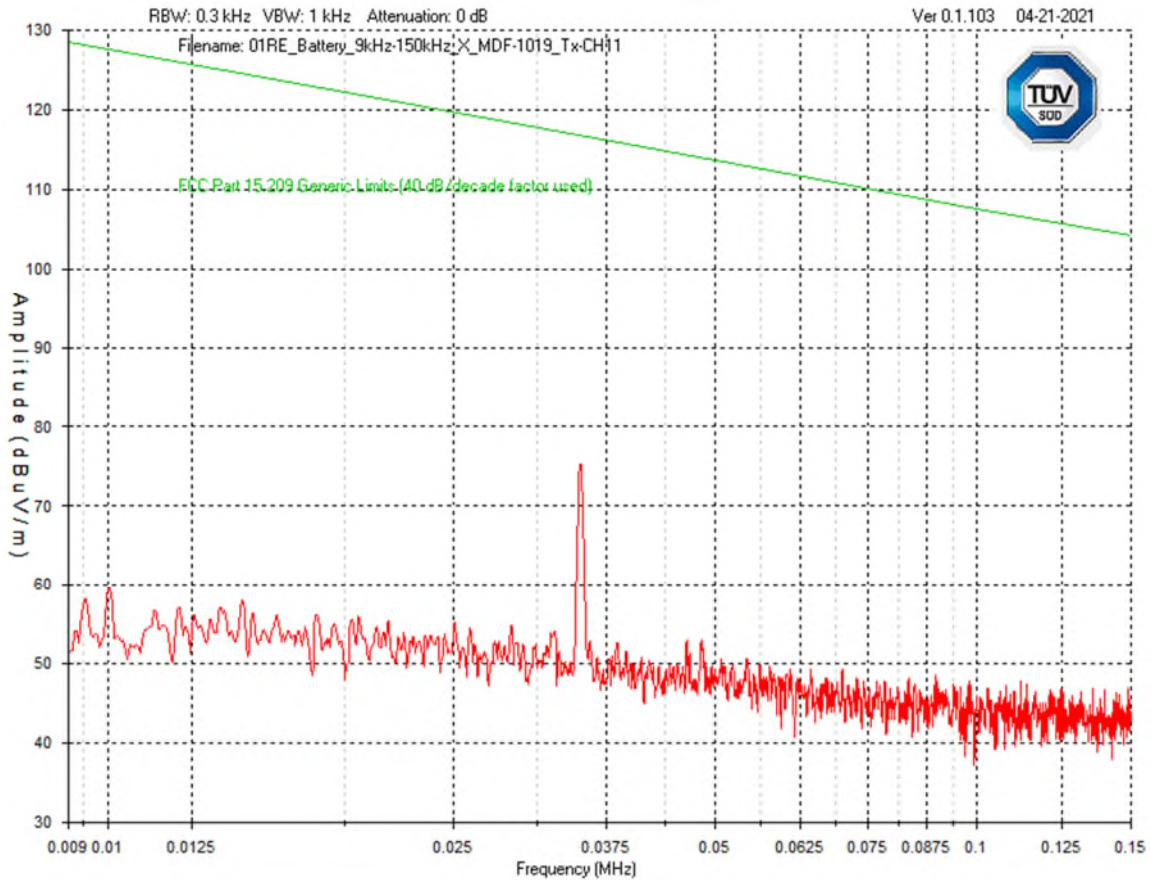
Peak output power for three orthogonal axes were checked. The worst case was used for the spurious emissions which was on the low channel and in the X-axis.


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Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements. Graphs for the worst-case, X-axis, are presented.

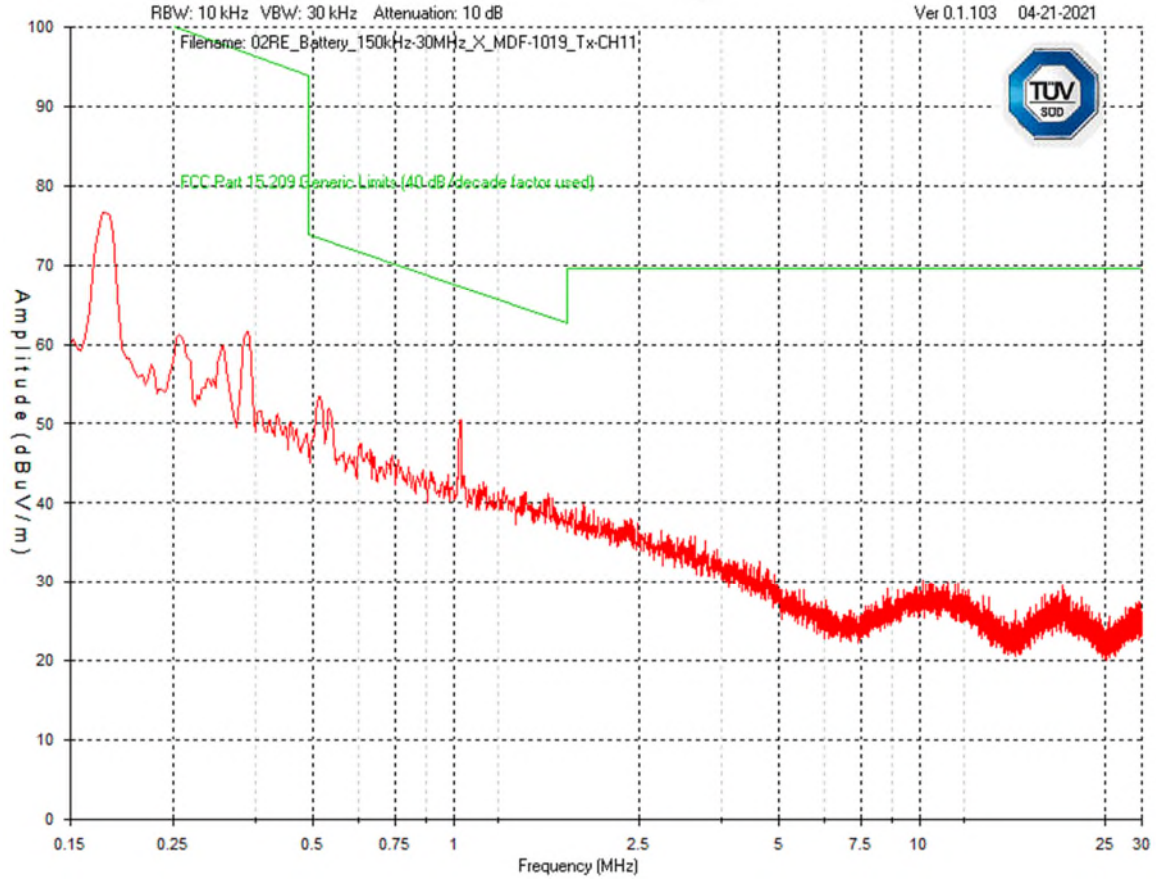
Spurious Emissions


Low Channel
9 kHz – 150 kHz
Peak Emission Graph



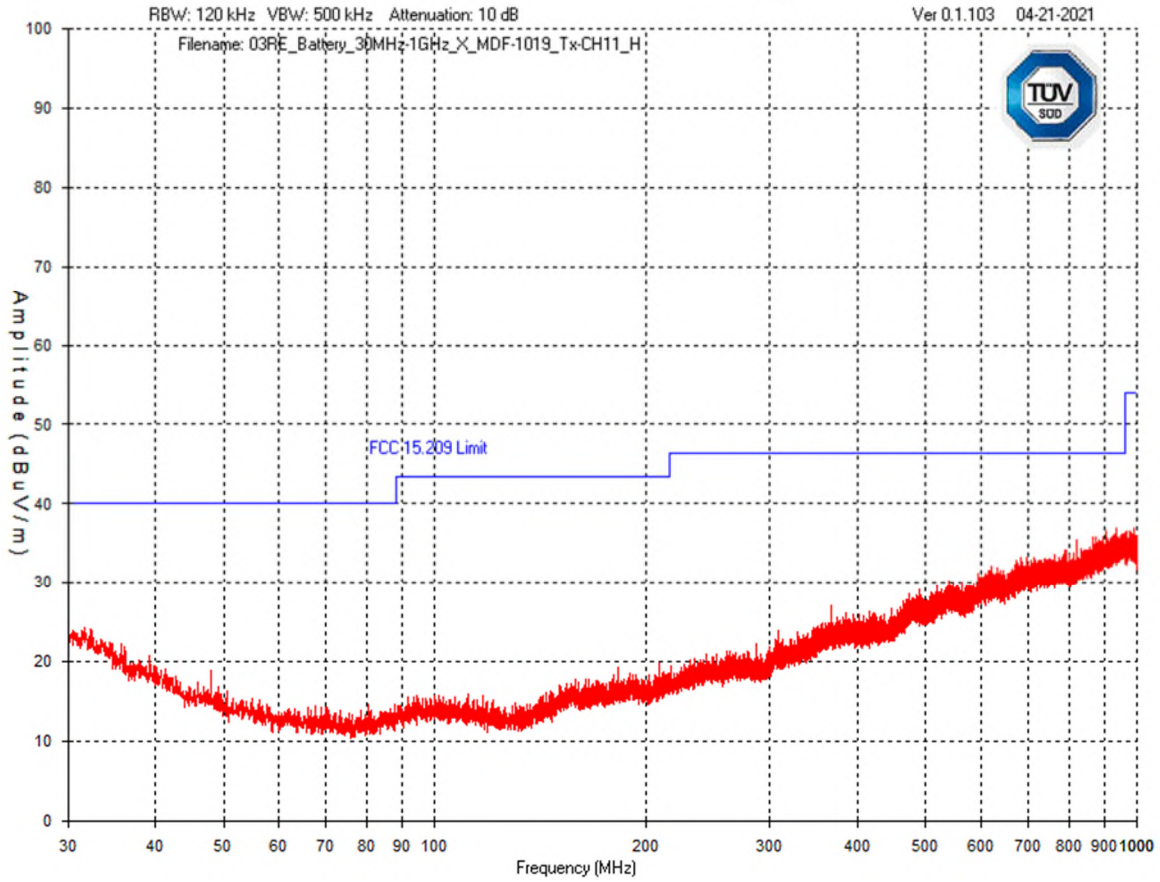
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Low Channel
150 kHz – 30 MHz
Peak Emission Graph



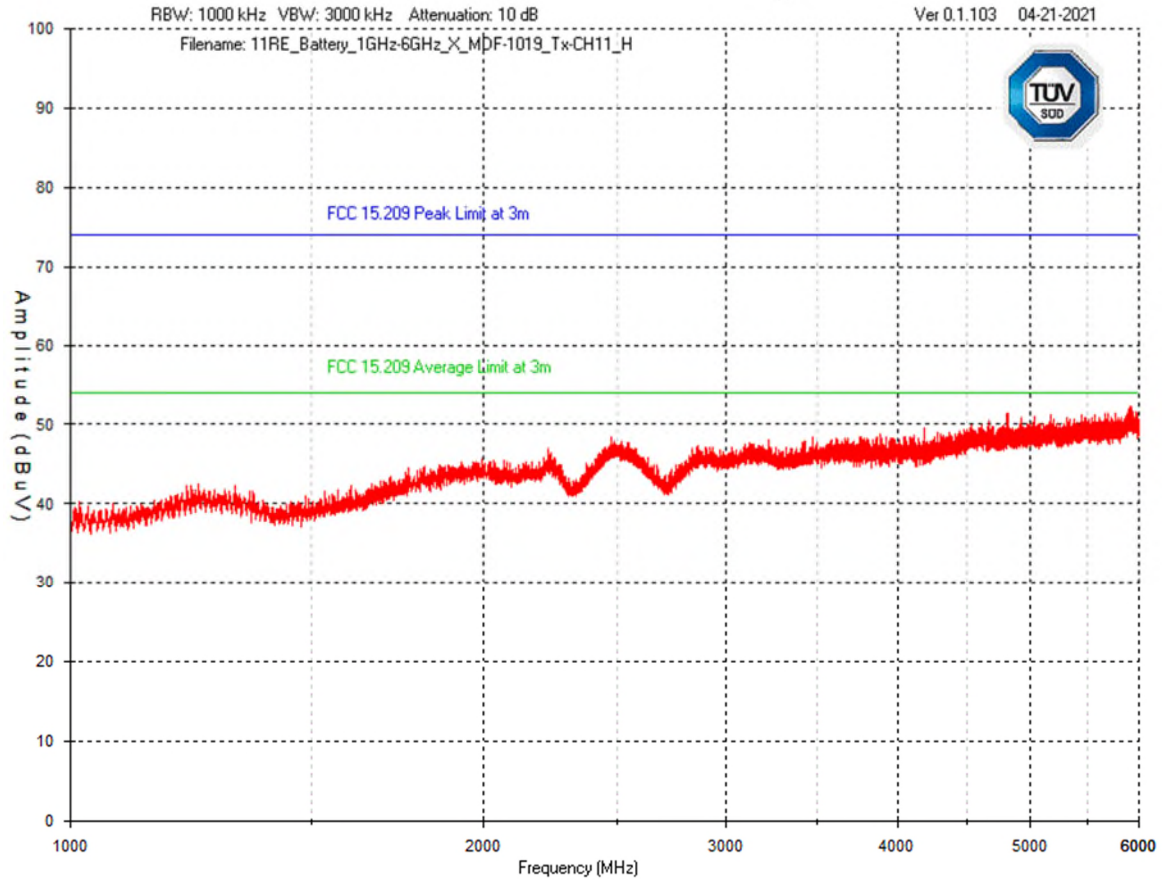
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Low Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



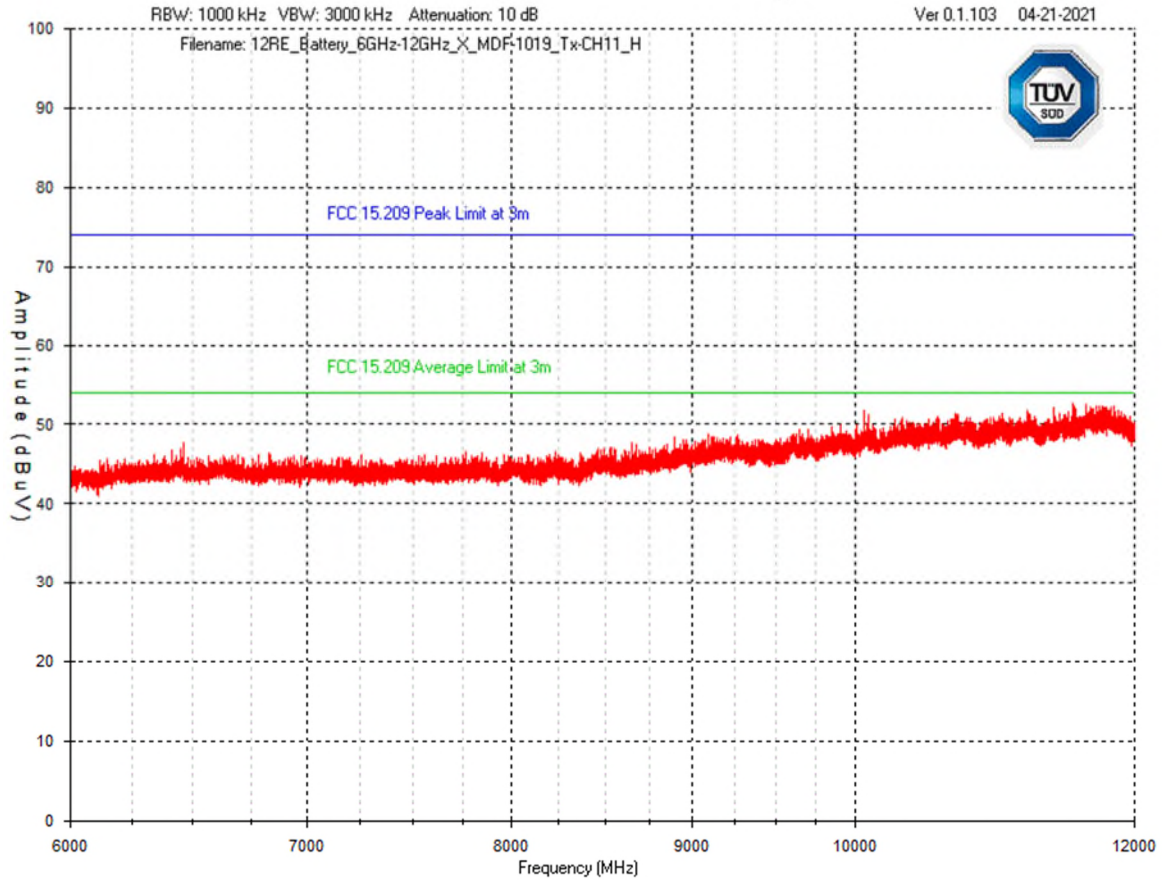
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Low Channel – 1 GHz – 6 GHz
Horizontal - Peak Emission Graph



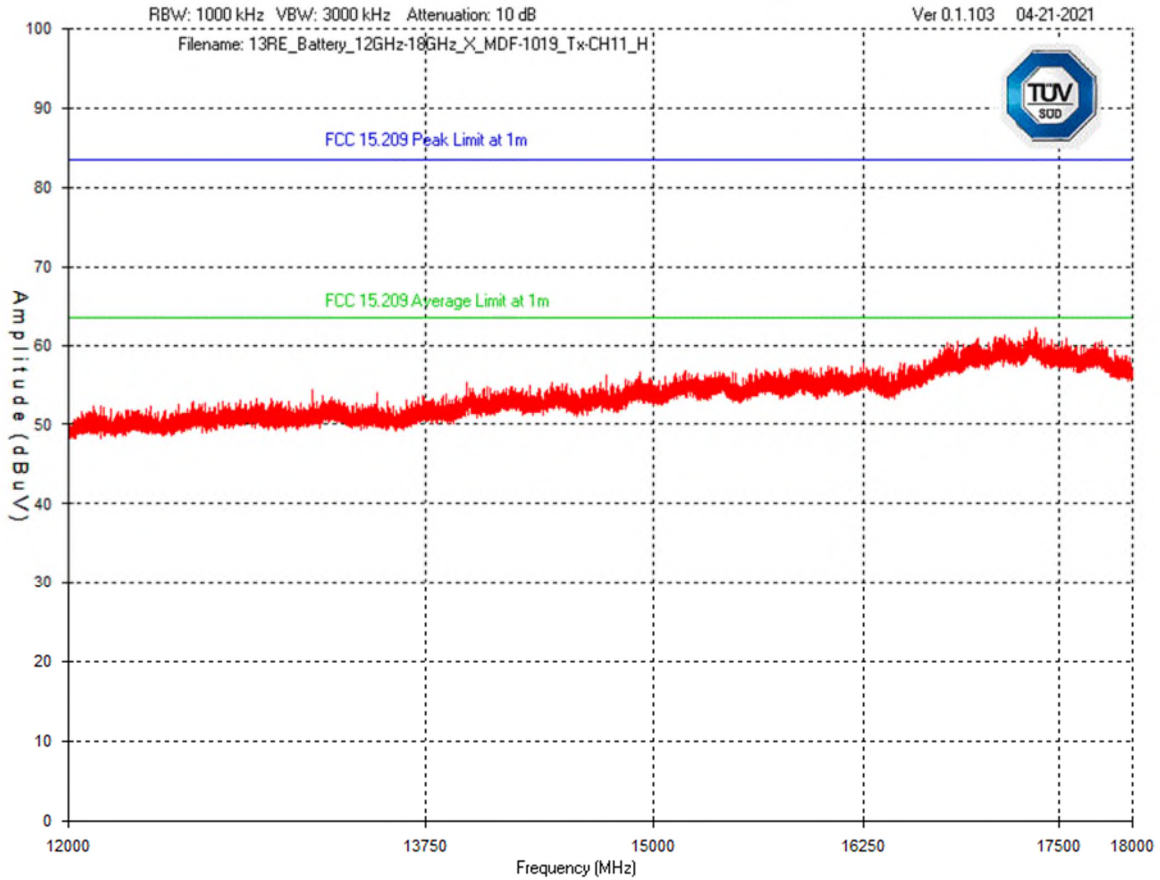
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Low Channel – 6 GHz – 12 GHz
Horizontal - Peak Emission Graph




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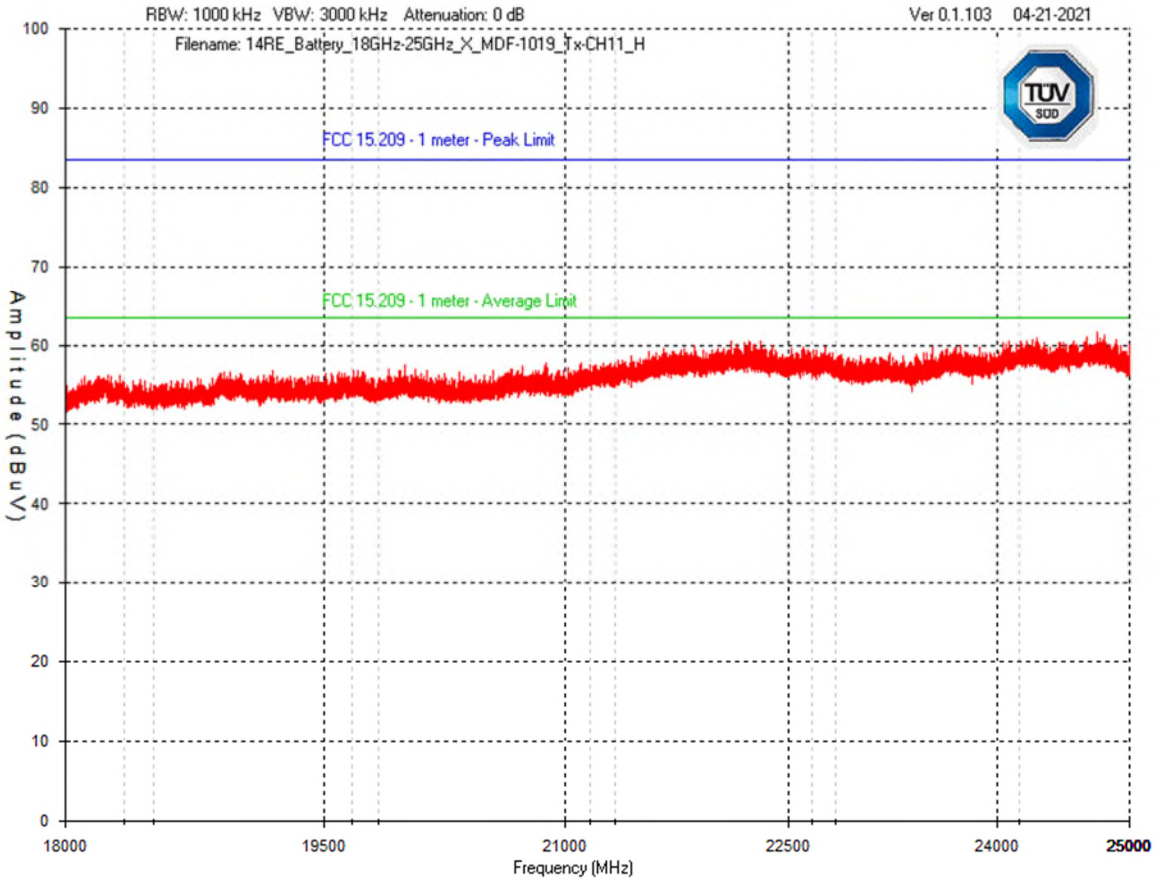
Low Channel – 12 GHz – 18 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

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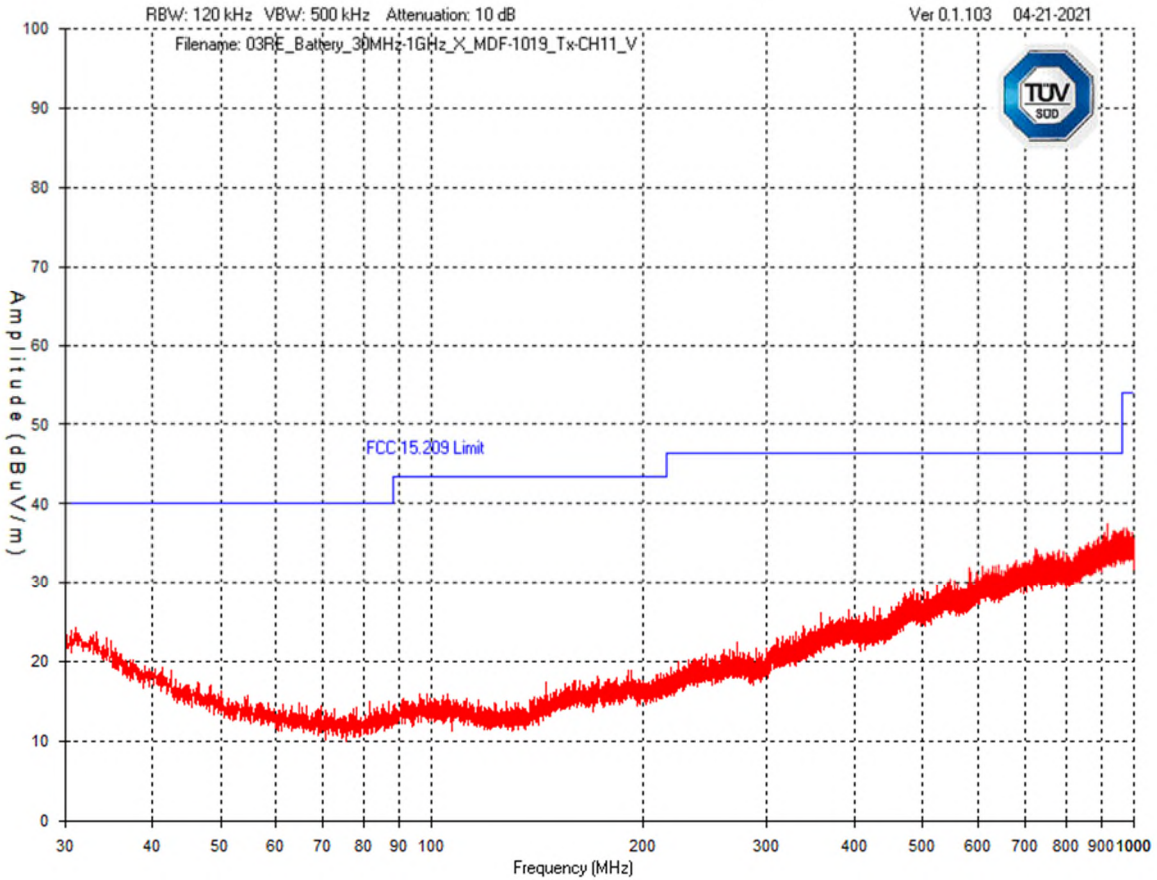
Low Channel – 18 GHz – 25 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

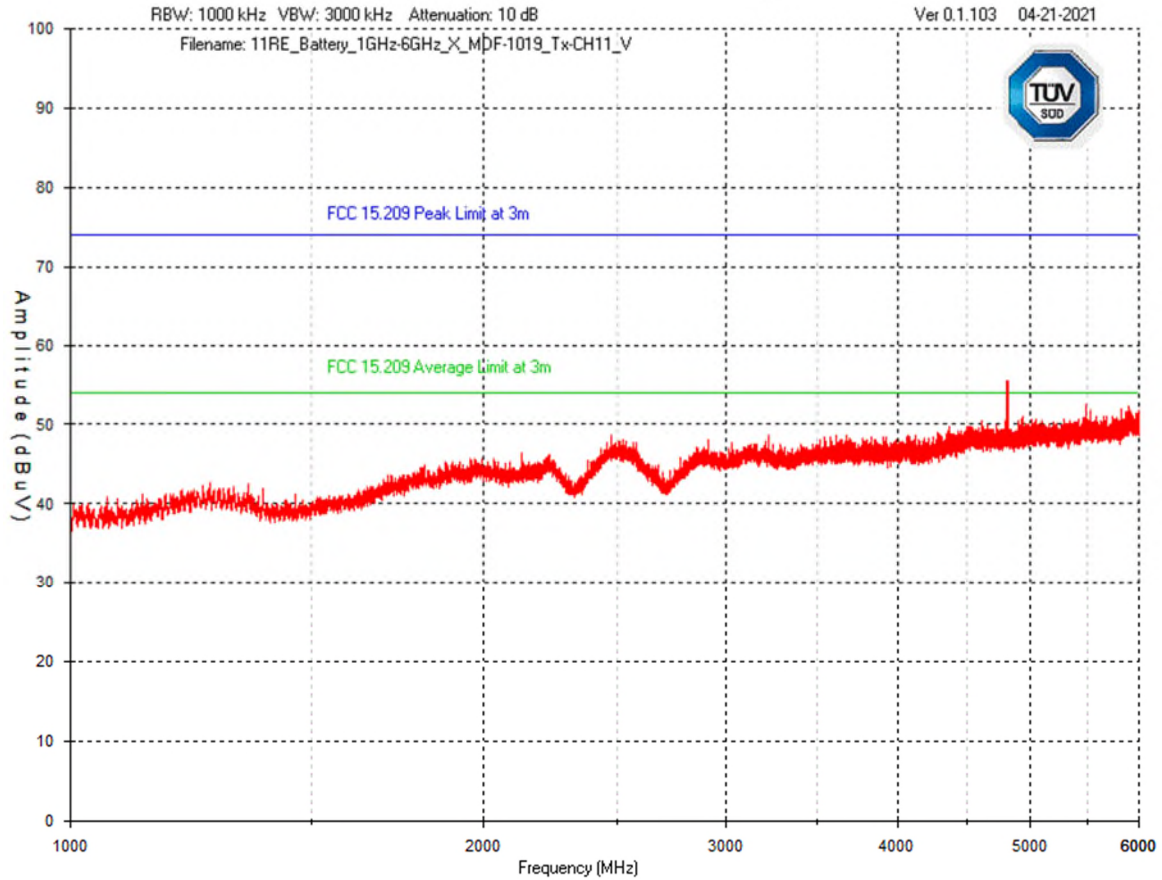
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Low Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



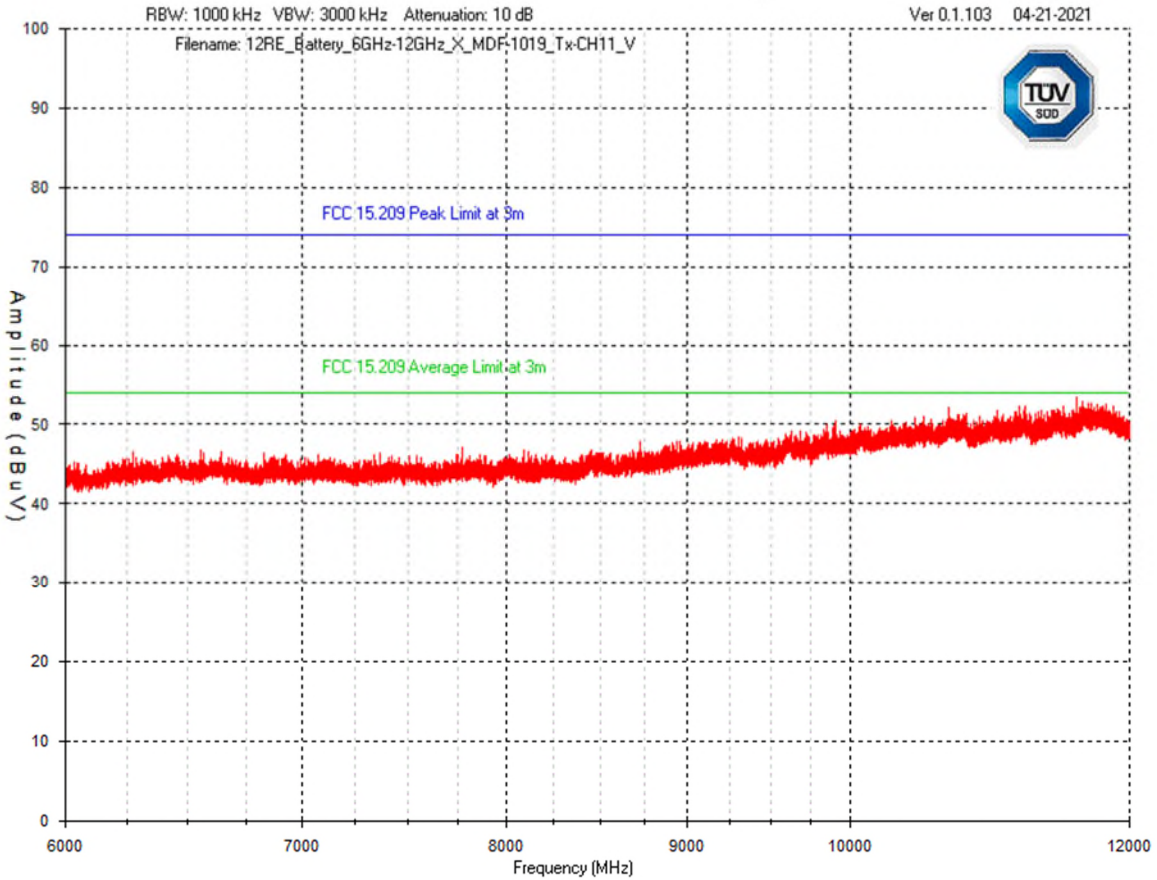
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Product	MDF-1019	
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Low Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph



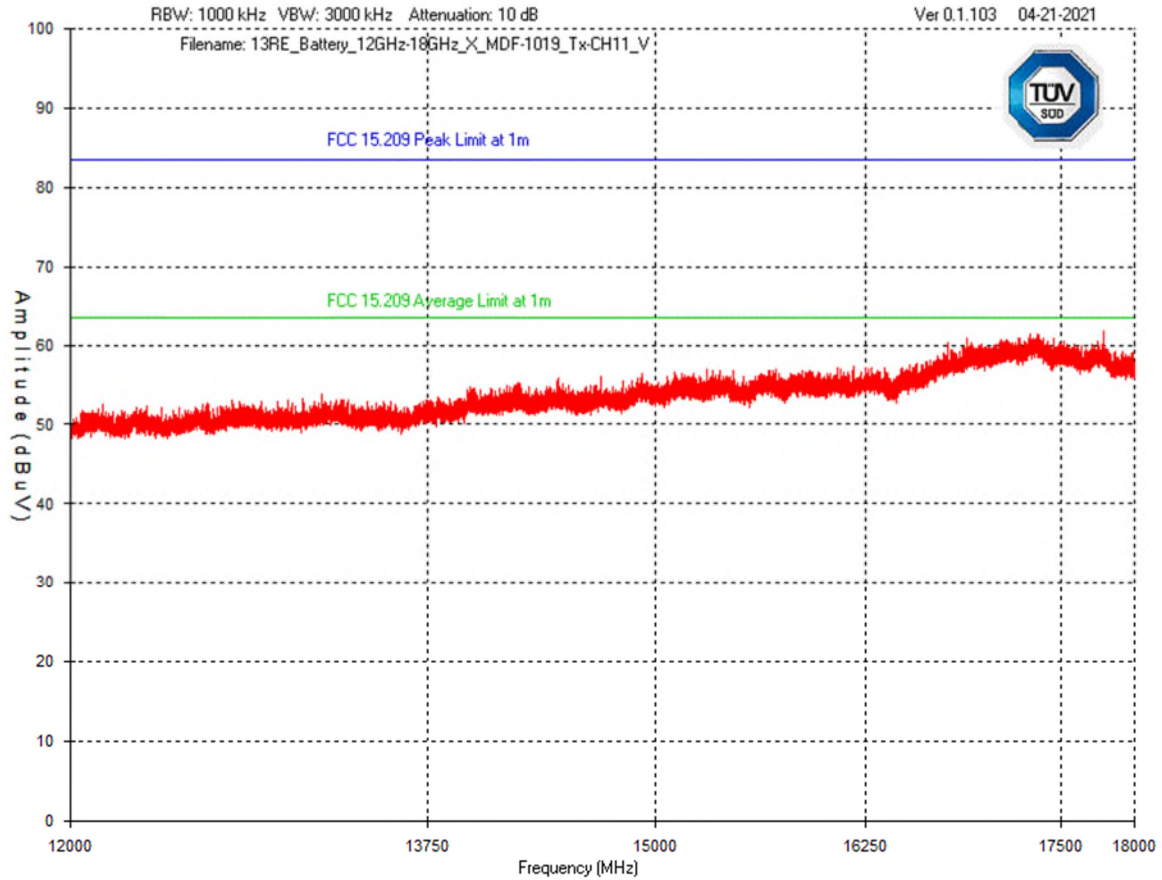
Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

**Low Channel – 6 GHz – 12 GHz
Vertical - Peak Emission Graph**




Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

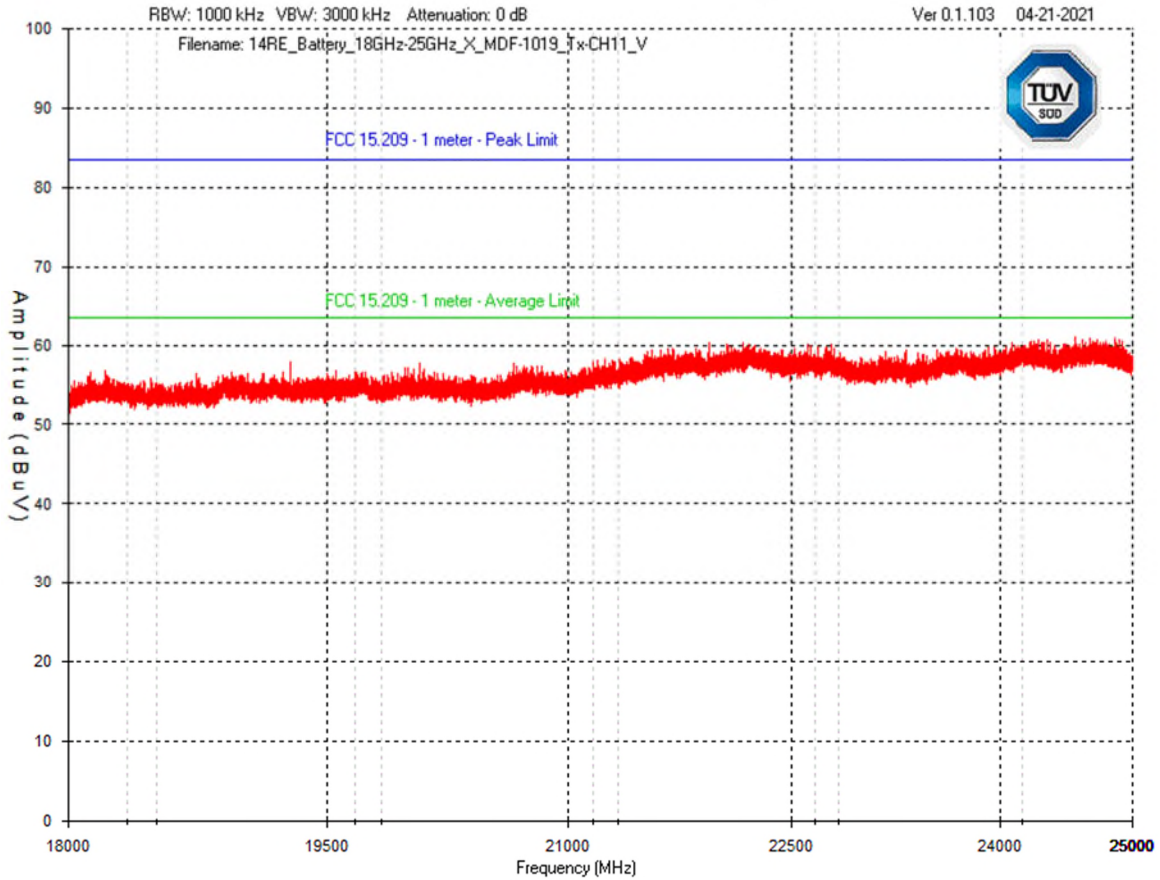
Low Channel – 12 GHz – 18 GHz
Vertical - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Low Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph

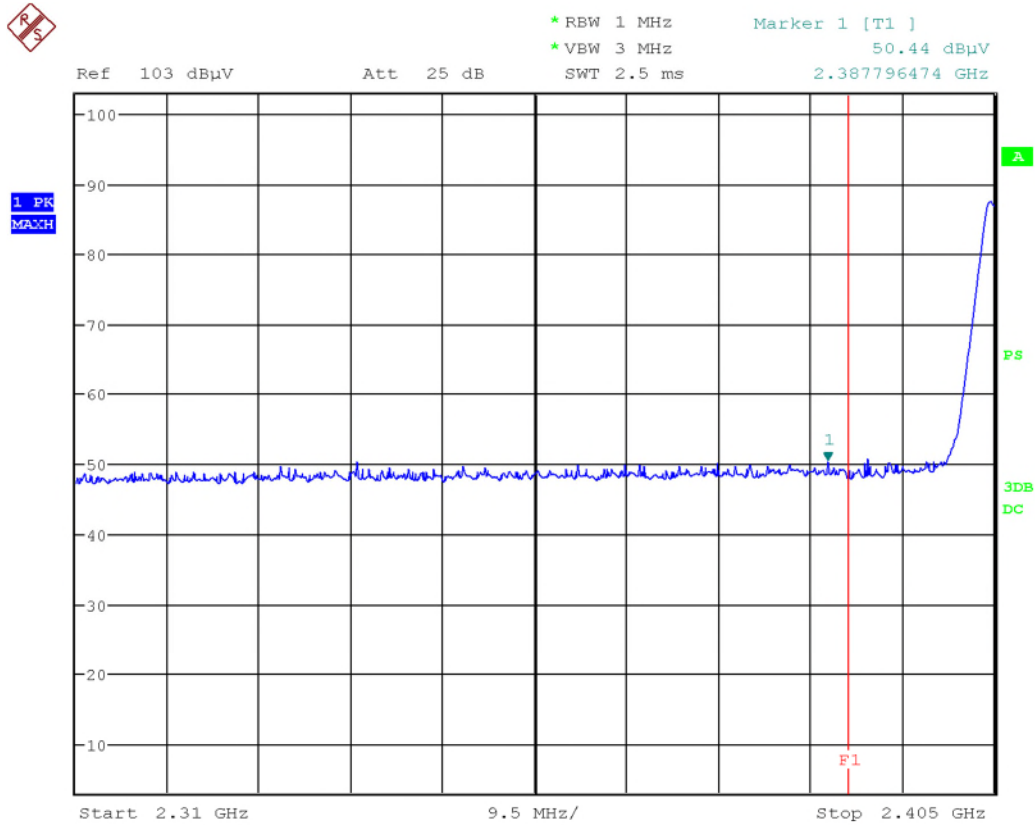


Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Band Edges

Band Edge – Low Channel, X-axis Horizontal - Peak Emission

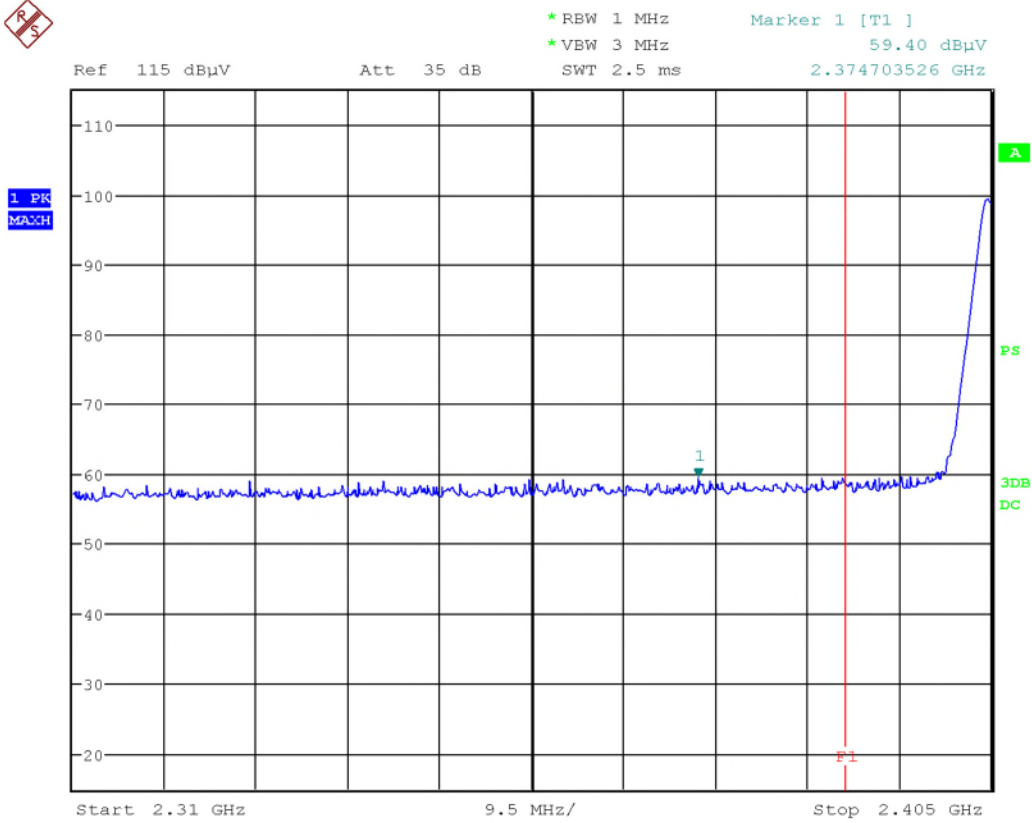


Date: 21.APR.2021 16:06:42

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.


Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Band Edge – Low Channel, X-axis
Vertical - Peak Emission

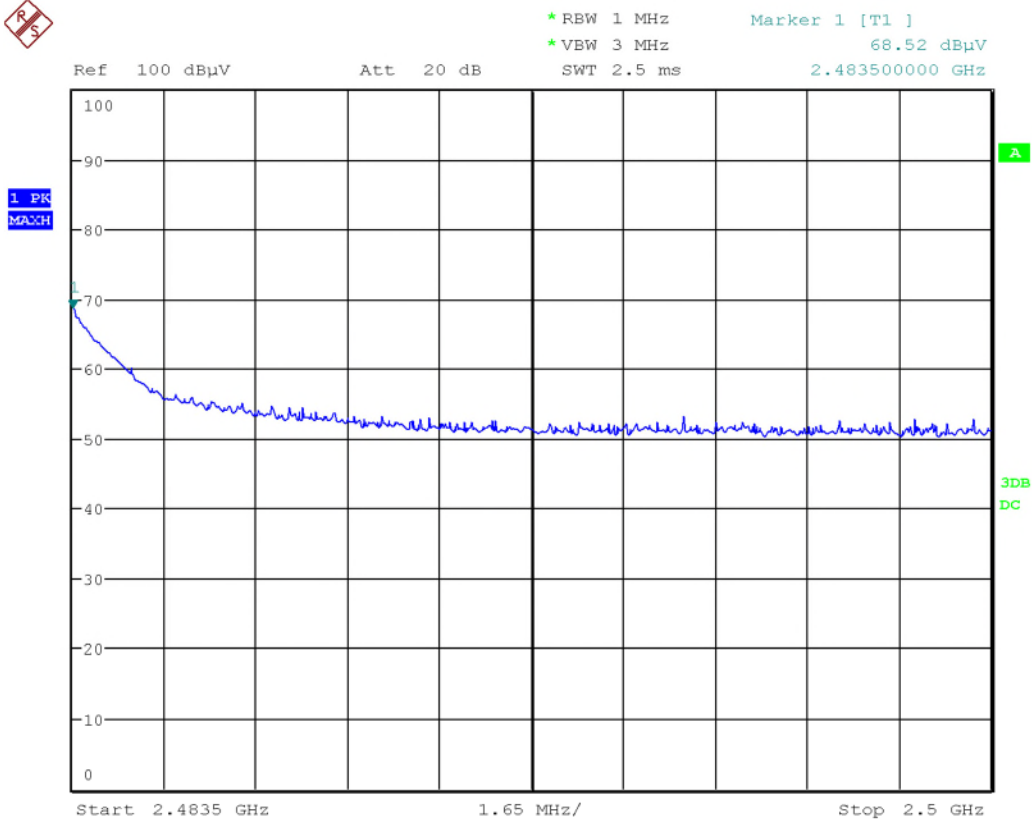


Date: 21.APR.2021 16:01:45

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.


Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Band Edge – High Channel, X-axis
Vertical - Peak Emission



Date: 21.APR.2021 15:06:46

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Final Measurements and Results

The EUT passed. Low, middle, and high bands were measured.


In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205 need to be verified with a final detector.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

The EUT has a fixed (source based) duty cycle of 13% (13ms on time/100ms) which cannot be changed or modified by either the device or the end user. As per KDB 558074 section 12.2.5.2, for the average radiated emission measurements of the band edges and of the spurious emissions in the restricted bands, a duty cycle correction factor of 13% [$20\log(13\%) = -17.72$] was applied to the peak measurement to obtain the average measurement.


Client	Mircom Technologies Ltd.	 Canada
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel										
X axis (vertically positioned, antenna up)										
2405	Peak	Horz	87.7	32.0	4.7	-34.0	90.4			PASS
2405	Avg	Horz	85.4	32.0	4.7	-34.0	88.1			PASS
2405	Peak	Vert	99.4	32.0	4.7	-34.0	102.0			PASS
2405	Avg	Vert	97.1	32.0	4.7	-34.0	99.7			PASS
2387.8	Peak	Horz	50.4	32.0	4.7	-34.1	53.0	74.0	21.0	PASS
2387.8	Avg	Horz	32.7	32.0	4.7	-34.1	35.3	54.0	18.7	PASS
2374.7	Peak	Vert	59.4	32.0	4.6	-34.1	61.9	74.0	12.1	PASS
2374.7	Avg	Vert	41.7	32.0	4.6	-34.1	44.2	54.0	9.8	PASS
2496.7	Peak	Horz	44.7	32.2	4.7	-33.7	47.9	74.0	26.1	PASS
2496.7	Avg	Horz	27.0	32.2	4.7	-33.7	30.2	54.0	23.8	PASS
2495.4	Peak	Vert	45.6	32.2	4.7	-33.7	48.8	74.0	25.2	PASS
2495.4	Avg	Vert	27.8	32.2	4.7	-33.7	31.0	54.0	23.0	PASS
4810	Peak	Horz	44.1	34.2	7.0	-32.5	52.8	74.0	21.2	PASS
4810	Avg	Horz	26.4	34.2	7.0	-32.5	35.1	54.0	18.9	PASS
4810	Peak	Vert	47.7	34.2	7.0	-32.5	56.4	74.0	17.6	PASS
4810	Avg	Vert	30.0	34.2	7.0	-32.5	38.7	54.0	15.3	PASS
7215	Peak	Horz	40.8	35.7	8.7	-32.9	52.2	74.0	21.8	PASS
7215	Avg	Horz	23.0	35.7	8.7	-32.9	34.5	54.0	19.5	PASS
7215	Peak	Vert	40.4	35.7	8.7	-32.9	51.9	74.0	22.1	PASS
7215	Avg	Vert	22.7	35.7	8.7	-32.9	34.2	54.0	19.8	PASS
Mid Channel										
X axis (vertically positioned, antenna up)										
2440	Peak	Horz	86.9	32.2	4.7	-33.9	89.9			PASS
2440	Avg	Horz	84.5	32.2	4.7	-33.9	87.5			PASS
2440	Peak	Vert	98.0	32.2	4.7	-33.9	101.0			PASS
2440	Avg	Vert	95.7	32.2	4.7	-33.9	98.7			PASS
High Channel										
X axis (vertically positioned, antenna up)										
2480	Peak	Horz	86.6	32.2	4.7	-33.8	89.8			PASS
2480	Avg	Horz	84.2	32.2	4.7	-33.8	87.4			PASS
2480	Peak	Vert	98.1	32.2	4.7	-33.8	101.2			PASS
2480	Avg	Vert	95.7	32.2	4.7	-33.8	98.8			PASS
2388.6	Peak	Horz	46.5	32.0	4.7	-34.1	49.1	74.0	24.9	PASS
2388.6	Avg	Horz	28.8	32.0	4.7	-34.1	31.3	54.0	22.7	PASS
2386	Peak	Vert	51.8	32.0	4.7	-34.1	54.3	74.0	19.7	PASS
2386	Avg	Vert	34.1	32.0	4.7	-34.1	36.6	54.0	17.4	PASS
2483.5	Peak	Horz	57.0	32.2	4.7	-33.8	60.1	74.0	13.9	PASS
2483.5	Avg	Horz	39.2	32.2	4.7	-33.8	42.4	54.0	11.6	PASS
2483.5	Peak	Vert	68.5	32.2	4.7	-33.8	71.7	74.0	2.3	PASS
2483.5	Avg	Vert	50.8	32.2	4.7	-33.8	54.0	54.0	0.0	PASS

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Loop Antenna	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna	3142-C	ETS-Lindgren	Nov. 25, 2020	Nov. 25, 2022	GEMC 8
Horn Antenna 1 – 6 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 6 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Oct. 23, 2018	Oct. 23, 2020	GEMC 6371
Attenuator 6 dB	6N5W-06	Inmet	NCR	NCR	GEMC 345
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Dec. 20, 2019	Dec. 20, 2021	GEMC 189
2.4GHz-2.5GHz Notch Filter	BRM50702	Micro-Tronics	NCR	NCR	GEMC 230
RF Cable 10m	LMR-400-10M- 50Ω-MN-MN	LexTec	NCR	NCR	GEMC 274
RF Cable 2m	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
RF Cable	TM18	MegaPhase	NCR	NCR	GEMC 366
RF Cable	Micro-Coax	Utiflex	NCR	NCR	GEMC 344
Emissions Software	0.1.103	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Power Spectral Density

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits and Method

The limits are defined in 15.247(e) and RSS-247 5.2(b).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The method is given in FCC KDB 558074 Section 10.2.


Results

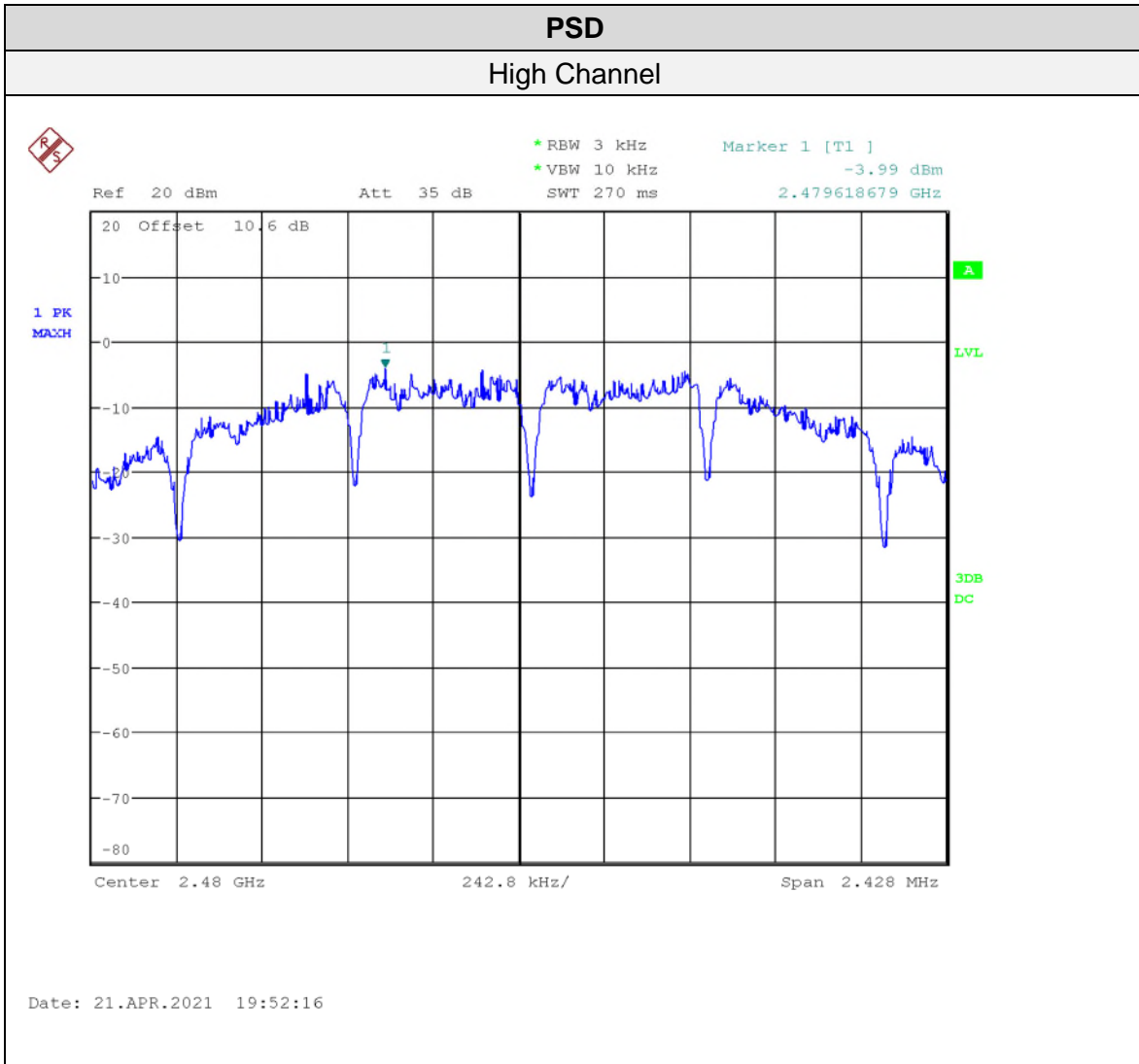
The EUT passed. Low, middle and high bands were measured.

Channel	Frequency (MHz)	PSD (dBm)
Low	2405	-1.64
Mid	2440	-1.74
High	2480	-3.99


Graphs

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer.

Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.


Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Mircom Technologies Ltd.	 Canada
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary


Client	Mircom Technologies Ltd.	
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

For further details for filing purposes, refer to filing package.

General EUT Description

Client	
Organization / Address	Mircom Technologies Ltd. 25 Interchange Way Vaughan, Ontario, L4K 5W3 Canada
Contact	Haim Liberman
Email	hliberman@mircomgroup.com
EUT Details	
EUT Name	Zigbee Module
Model	MDF-1019
FCC ID	2ABFD-MDF1019
IC ID	1156A-MDF1019
Equipment Category	ITE
Basic EUT Functionality	Zigbee Module used for communication between fire alarm panel and notification appliances
Input Voltage	3.3V DC
Rated Input Current	0.1A
Peripherals Required for Test	Laptop to configure the test firmware on the EUT via UART
Intentional Radiator Frequency	2400 – 2483.5 MHz for Zigbee applications as described above.
EUT Configuration	Wireless configured to transmit continuously with the following settings using TI's Smart RF Studio: <ul style="list-style-type: none"> - IEEE 802.15.4 O-QPSK DSSS PHY (250 kbps) - DC/DC enable - Continues Tx - Modulated - Tx Power: 15dBm

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT and Test Setup Photos'.

Client	Mircom Technologies Ltd.	 Canada
Product	MDF-1019	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report