



Canada

EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

Nymi Band 2.0

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for



See Appendix A for full client &
EUT details.



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



R-4023, G-506
C-4498, T-1246



Registration #
CA6844

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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Client	Nymi™	
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Report Scope

This report addresses the EMC verification testing and test results of the **Nymi Band 2.0**, 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 15.247:2017

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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Summary

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

EUT:	Nymi Band 2.0
FCC Certification #, FCC ID:	2ADLKNEE20
Industry Canada Certification #, IC:	12505A-NEE20
EUT passed all tests performed	Yes
Tests conducted by	Amir Emami

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 ceramic chip antenna (1.5 dBi peak gain - Johanson 2450AT18D0100E) 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 axis. Worst case results were obtained with the EUT in the Z-axis. Worst case results are presented. See Appendix B for axis details.

SAR assessment is applicable to the EUT. The separation distance between radiating structure of the EUT and human body is 7.5 mm. According to FCC KDB 447498 Section 4.3.1 5), an assessment distance of 7.5 mm is applied. The maximum conducted power of the EUT is 0.80 mW which is less than the SAR Test Exclusion Power Threshold for 5 mm given in FCC KDB 447498 Appendix A. Therefore the device meets the SAR Test Exclusion criteria and no test is required.

The EUT is not sold with any AC/DC power adaptor and the internal battery is charged via USB. Conducted emissions was evaluated on a laptop to which the EUT was connected and charging from.

Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)

Margin = 50.5dBµV/m – (50dBµV + 10dB + 2.5dB – 20dB)

Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

Margin = Limit – (Received Signal + Attenuation Factor + Cable Loss + LISN Factor)

Margin = 73.0dBµV – (50dBµV + 10dB + 2.5dB + 0.5dB)

Margin = 10.0 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:2017	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
CISPR 32:2012	Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements
FCC KDB 558074: 2017	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 2017	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5 2018	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 2:2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories

Client	Nymi™	 Canada
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Document Revision Status

Revision 0 - August 24, 2018
Initial Release

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 labs near Toronto, Ontario. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is 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. 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), Industry Canada (IC, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-4023, G-506, C-4498, and T-1246). 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 #2555.01. 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 bi-annual 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)
July 24 – 25, 2018	Radiated Emissions	AE	24 – 25	58 – 62	101 – 102
August 1 – 8, 2018	Antenna Conducted Emissions	AE	23 – 25	48 – 59	101 – 102
August 1, 2018	Power Line Conducted Emissions	AE	23.7	56.7	101.8

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Detailed Test Results Section

Client	Nymi™	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 Section 8.1 of FCC KDB 558074 and ANSI C63.10.

Results

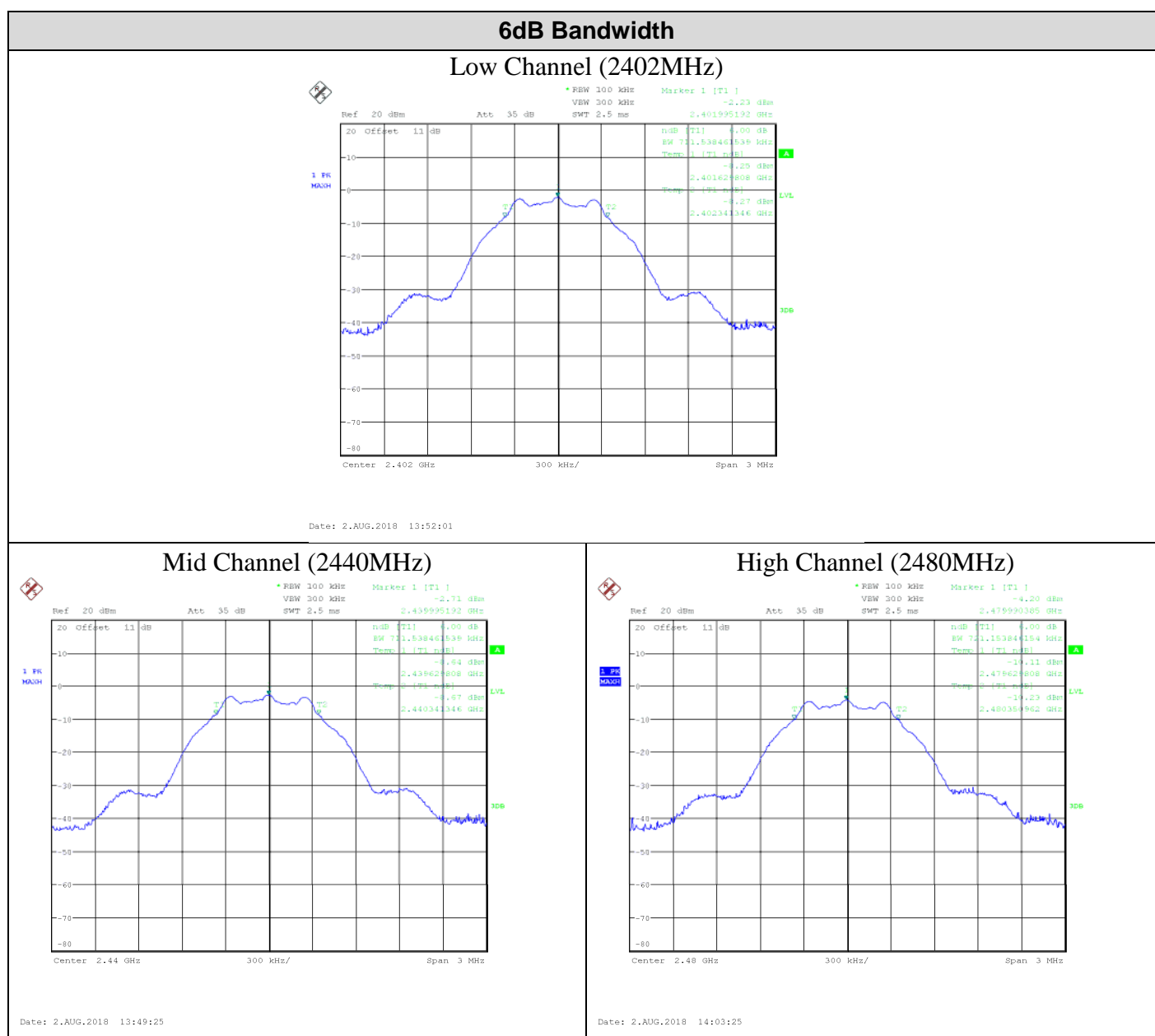
The EUT passed. The minimum 6 dB BW measured was 712 kHz and the maximum 99% Occupied Bandwidth at full power setting was 1058 kHz.

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.712	1.043
Mid	2440	0.712	1.051
High	2480	0.721	1.058

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Graphs

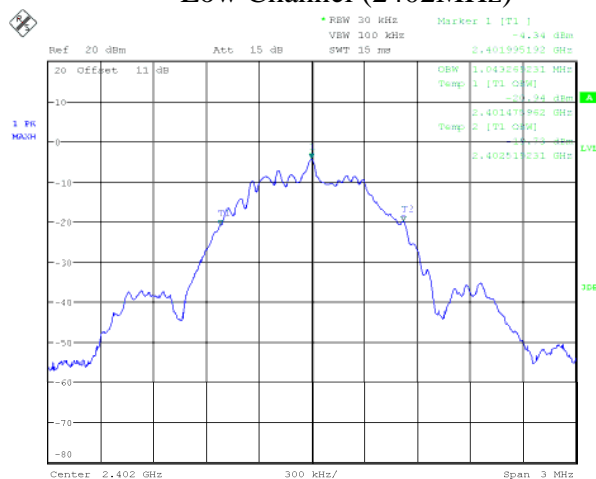
The graphs showed below show the OBW during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of not less than 1 minute.



Client	Nymi™	
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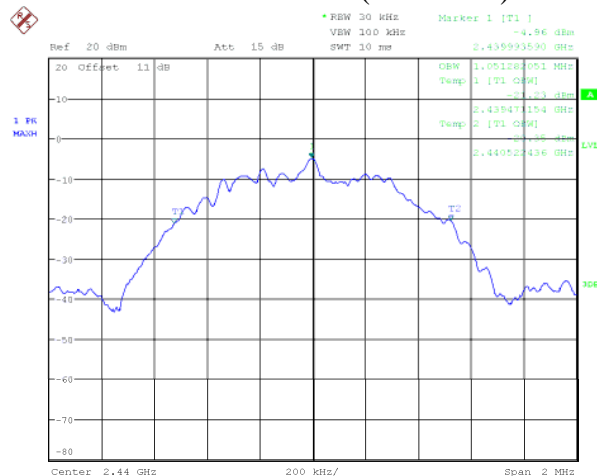
99% Bandwidth

Low Channel (2402MHz)



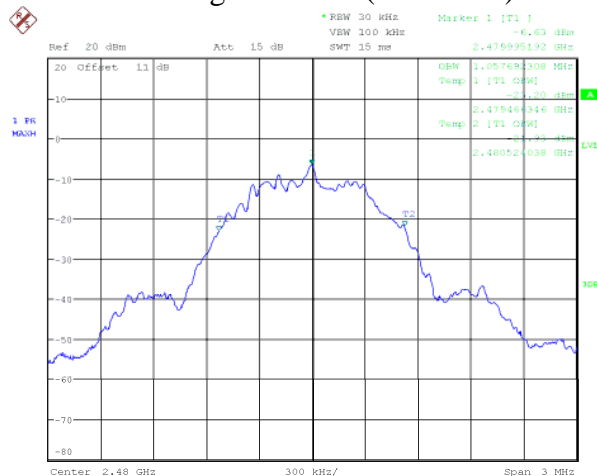
Date: 2.AUG.2018 13:53:01

Mid Channel (2440MHz)



Date: 2.AUG.2018 13:47:25

High Channel (2480MHz)



Date: 2.AUG.2018 14:00:56

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

Client	Nymi™	 Canada
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Feb 28, 2017	Feb 28, 2019	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Nymi™	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 Section 9.1.2 of FCC KDB 558074 and ANSI C63.10.

Results

The EUT passed. The EUT was set to transmit at maximum power (PWR=4dBm). Three channels were measured. The following table shows the peak power:

Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	-0.97	0.80
Mid	2440	-1.01	0.79
High	2480	-1.07	0.78

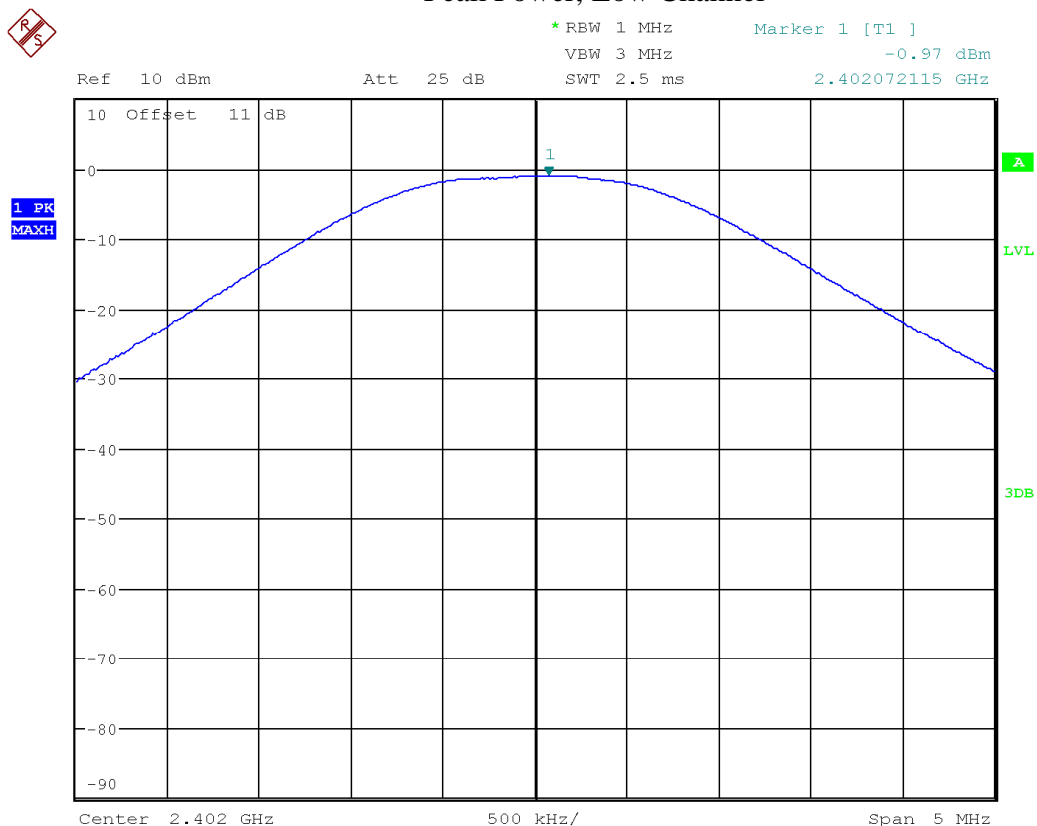
Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer

Graphs

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

Client	Nymi™	 Canada
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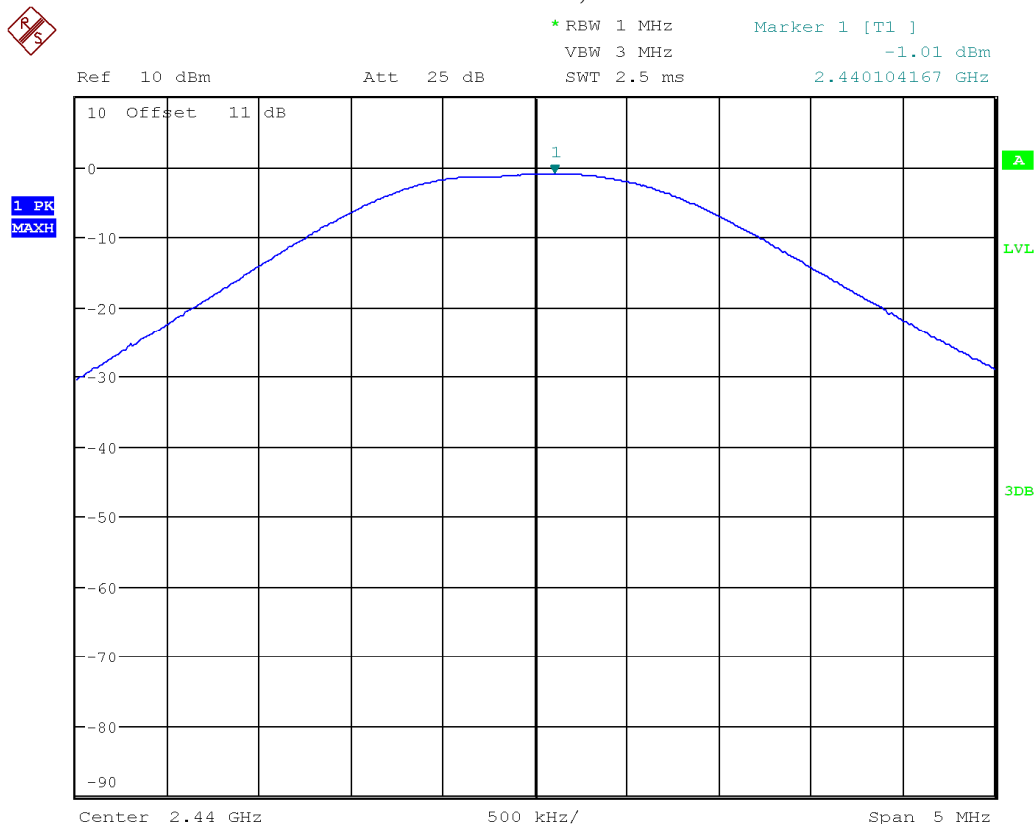
Peak Power, Low Channel



Date: 8.AUG.2018 13:37:39

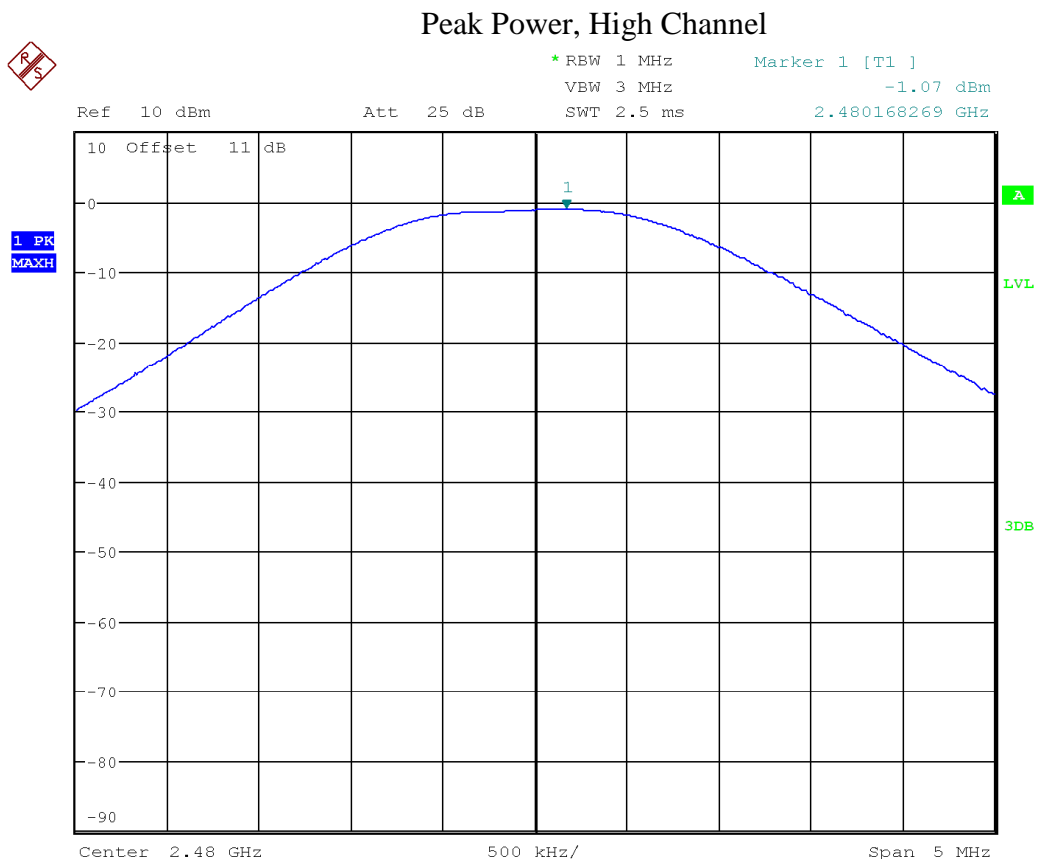
Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Peak Power, Mid Channel



Date: 8.AUG.2018 13:56:12

Client	Nymi™	 Canada
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Date: 8.AUG.2018 13:34:31

See 'Appendix B – EUT and 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	FSQ 26	Rohde & Schwarz	Feb 28, 2017	Feb 28, 2019	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Nymi™	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 Section 11 of FCC KDB 558074 and ANSI C63.10

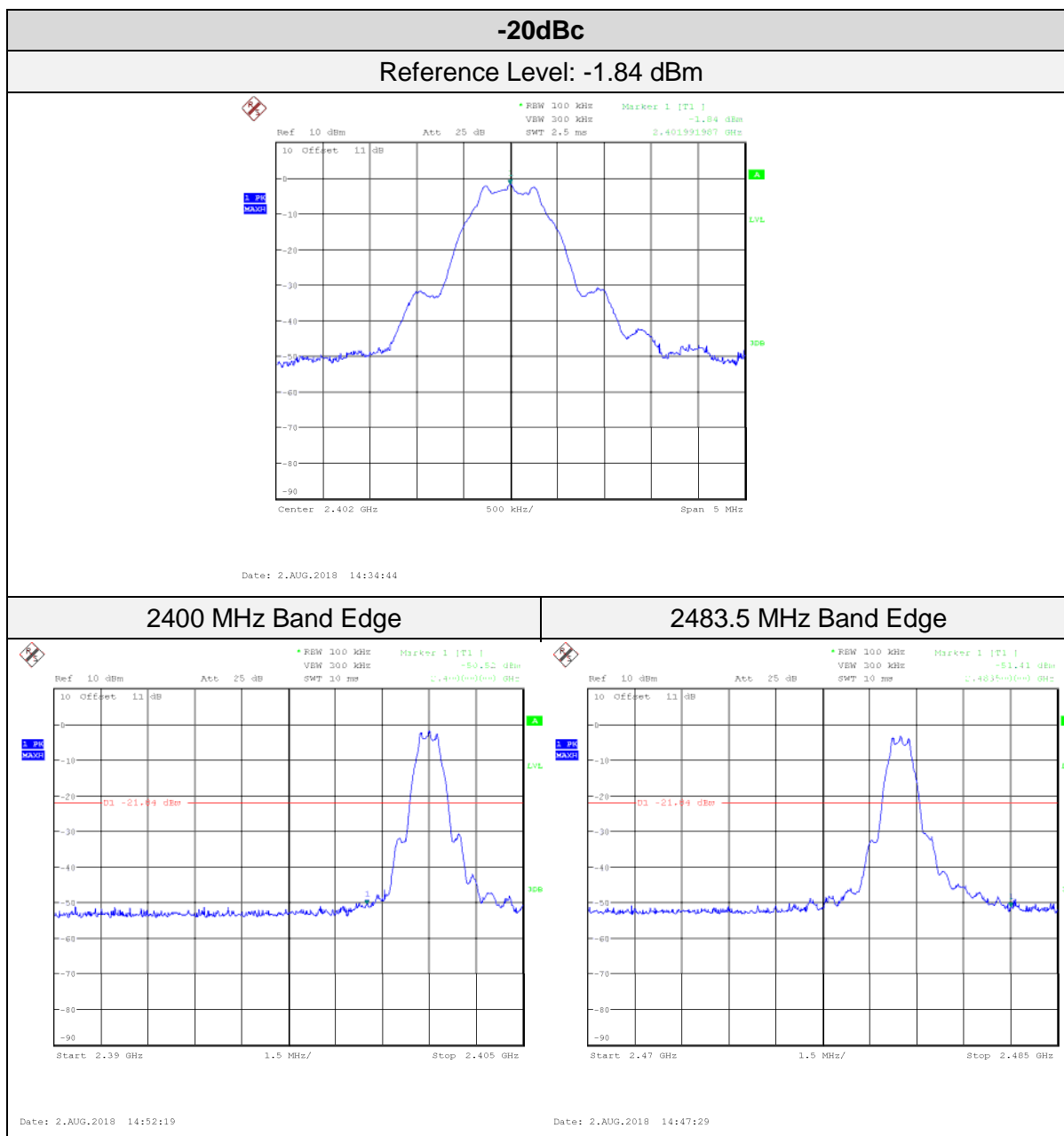
Results

The EUT passed. Low, middle and high bands were measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and also for the higher band edge at 2.4835 GHz in the high band.

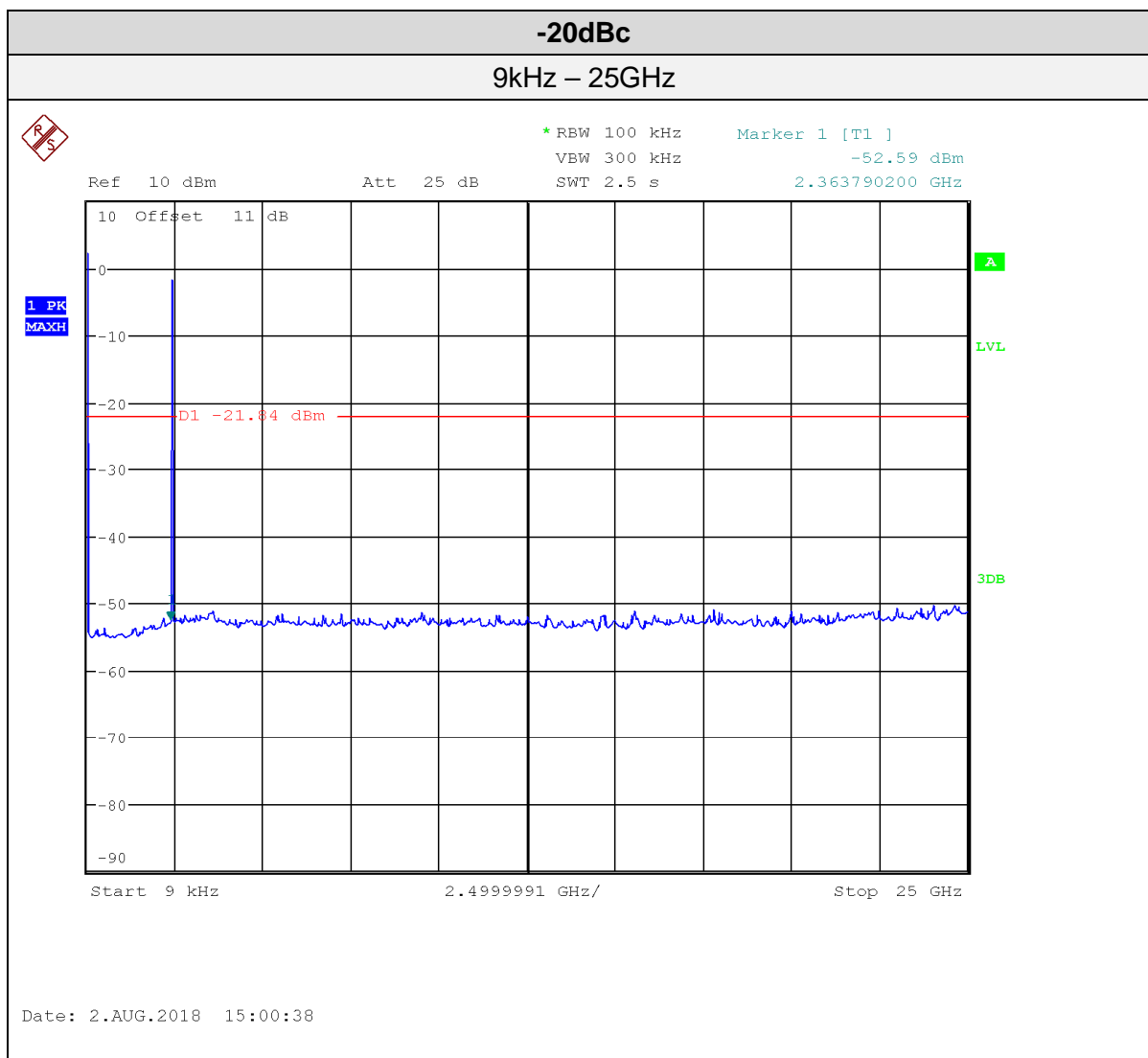
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Graphs

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



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Client	Nymi™	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Feb 28, 2017	Feb 28, 2019	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Nymi™	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 Section 12.2 of FCC KDB 558074 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	Limit
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m ¹
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m ¹
1.705 MHz – 30 MHz	30 uV/m at 30m ¹
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m ¹) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m ¹) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m ¹) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m ¹) at 3m
Above 1000 MHz	500 uV/m (54 dBuV/m ²) at 3m
Above 1000 MHz	500 uV/m (74 dBuV/m ³) at 3m

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

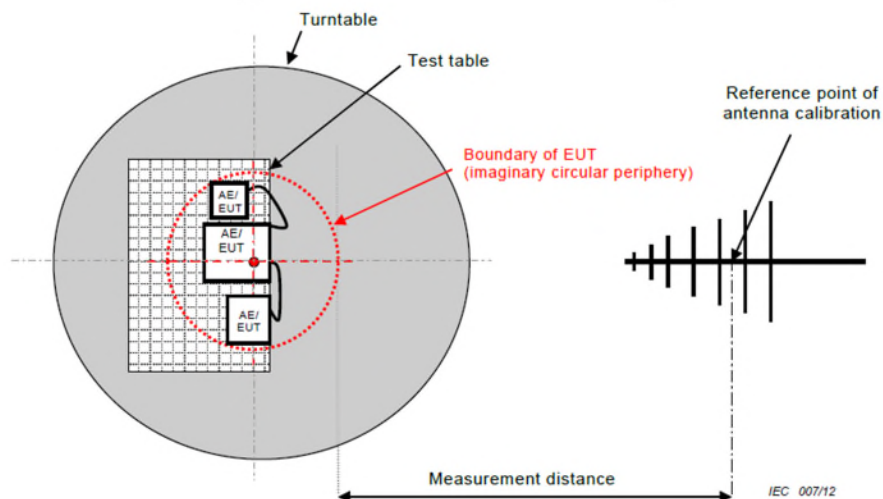
²Limit is with 1 MHz measurement bandwidth and using an Average detector

³Limit 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 $\pm 4.25\text{dB}$ for 30MHz – 1GHz and $\pm 4.93\text{dB}$ 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).

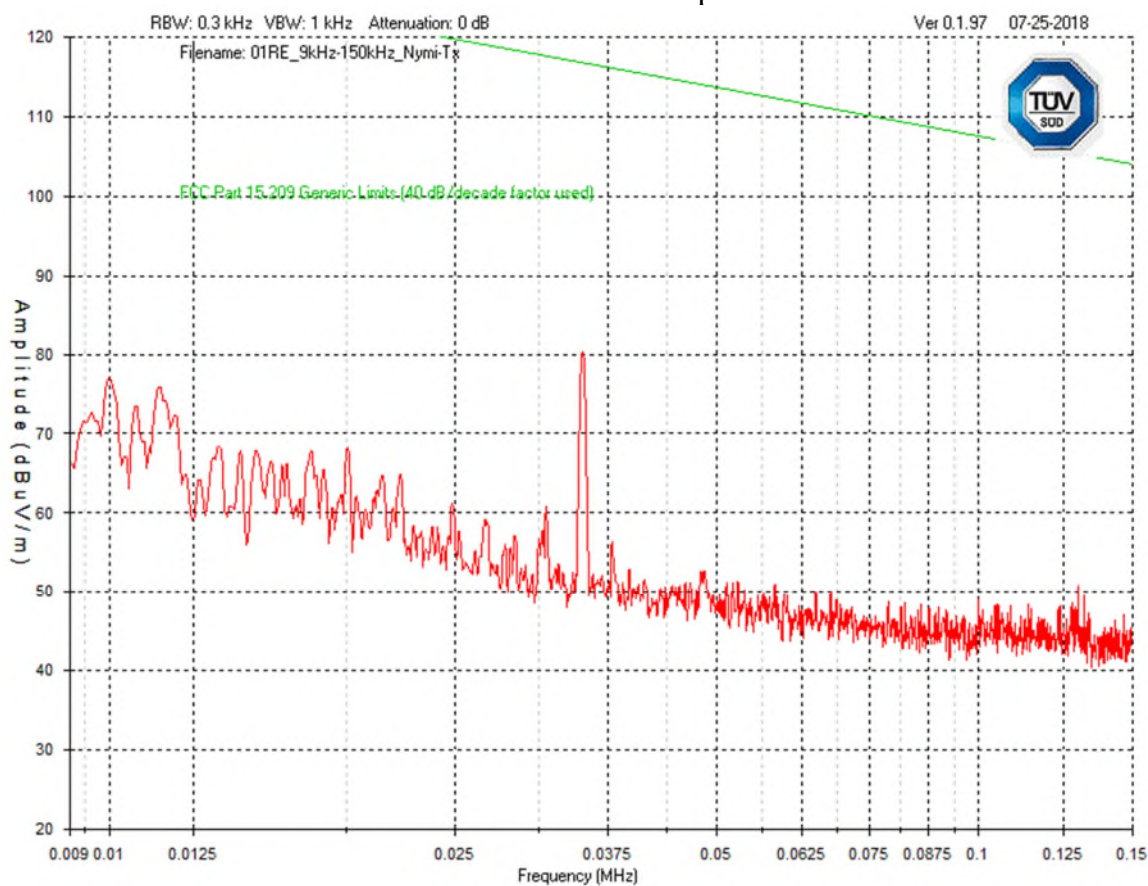
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m /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


Low, middle and high channels, each in three orthogonal axis were checked. However, the worst case graphs are presented from the Z-axis.

Client	Nymi™	
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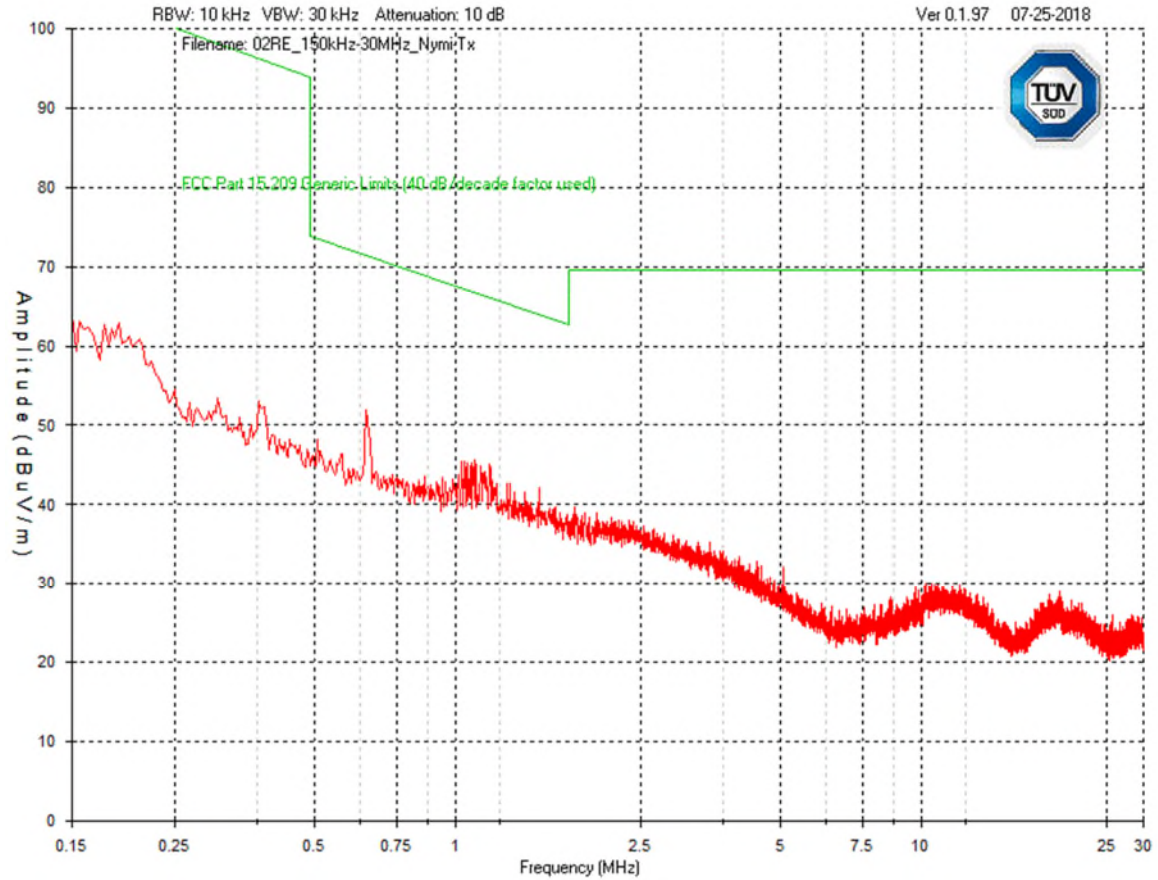
Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements.


Low Channel
9 kHz – 150 kHz
Peak Emission Graph



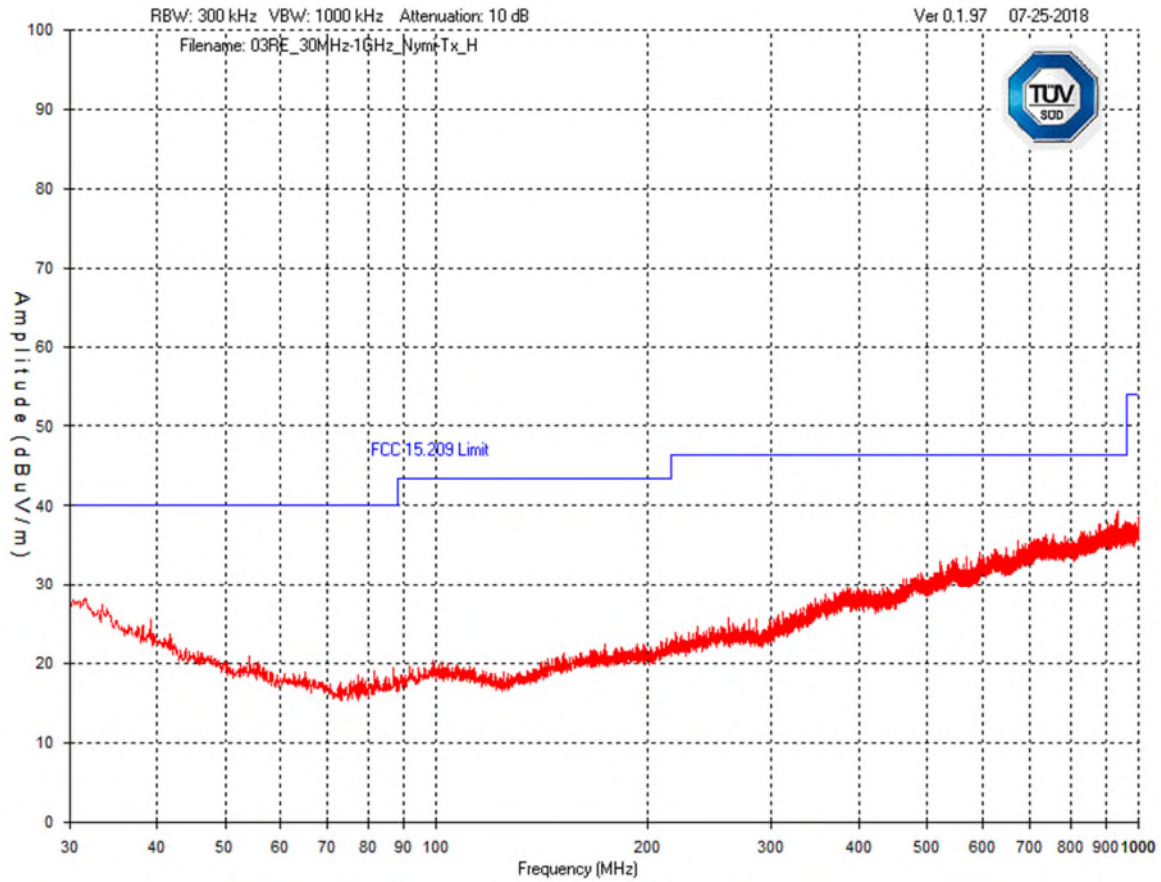
Client	Nymi™	
Product	Nymi Band 2.0	
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Low Channel
150 kHz – 30 MHz
Peak Emission Graph



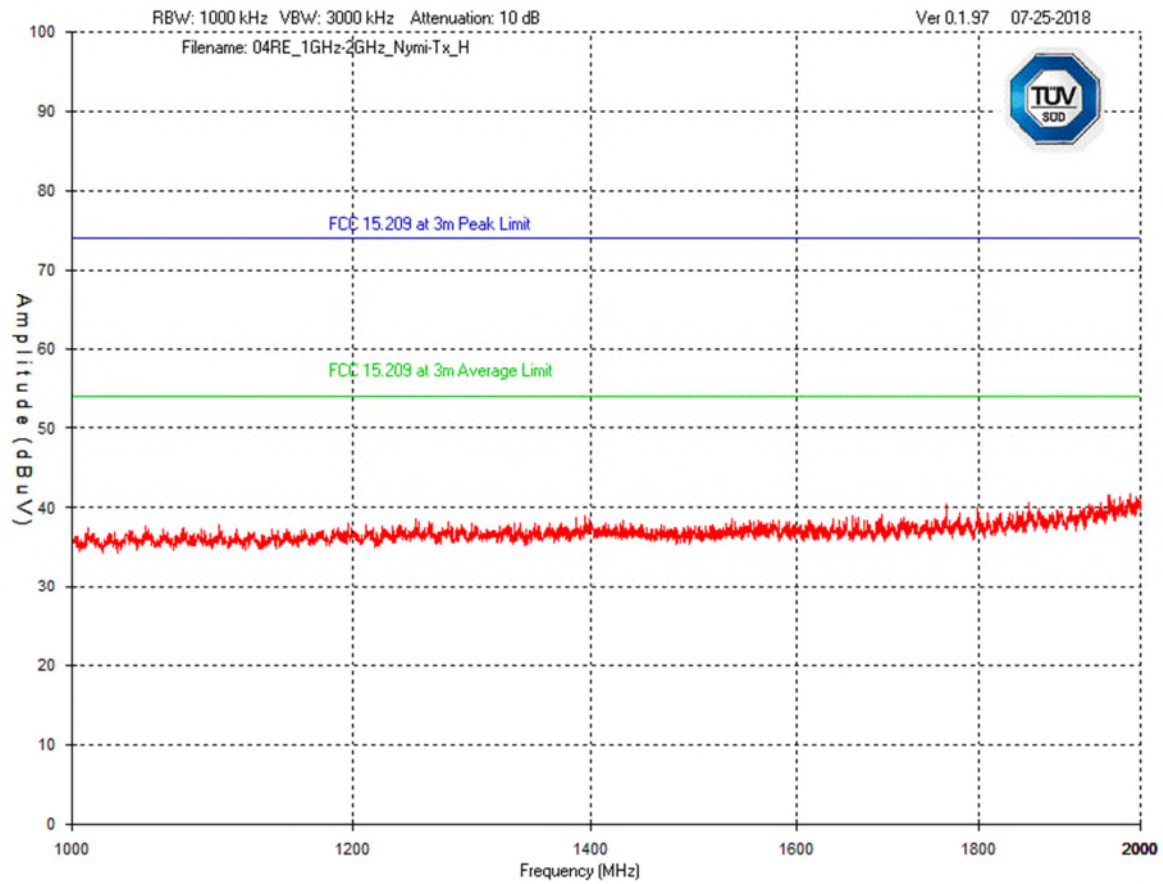
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


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



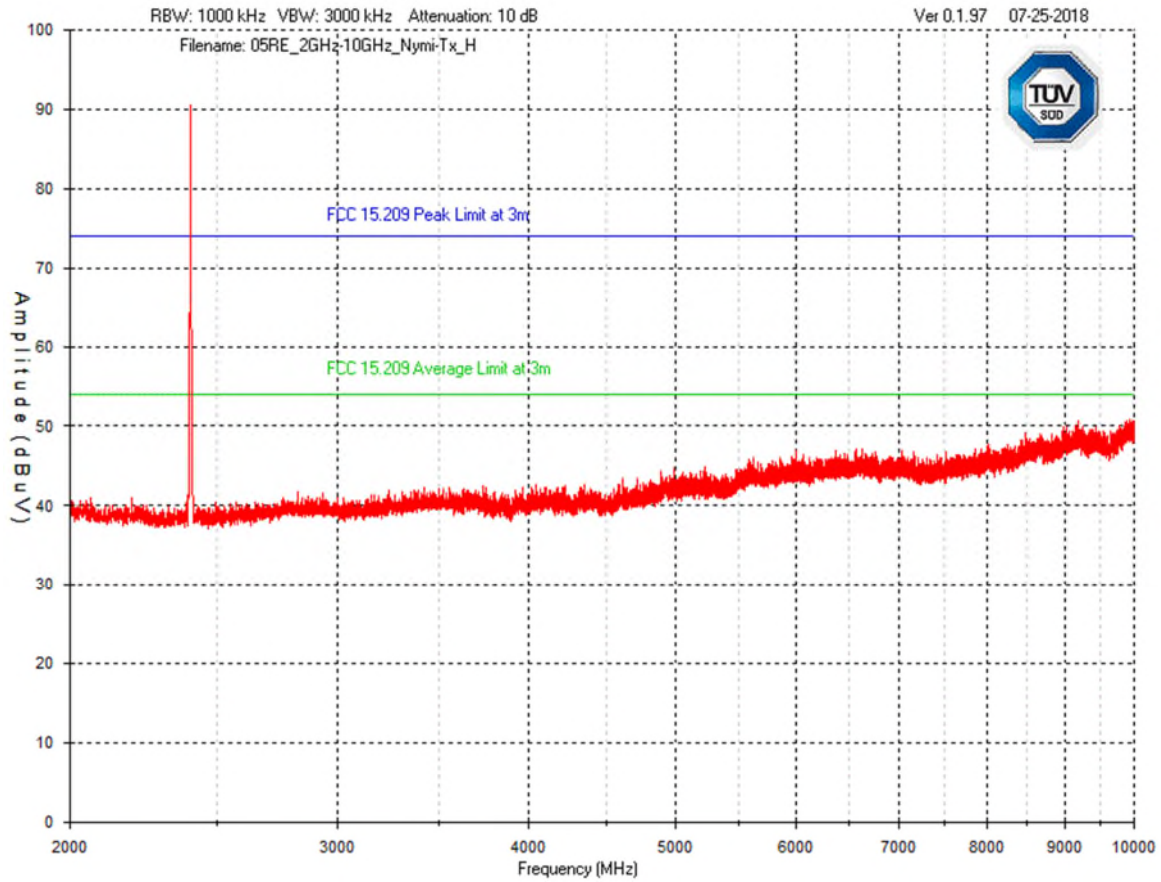
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 1 GHz – 2 GHz
Horizontal - Peak Emission Graph



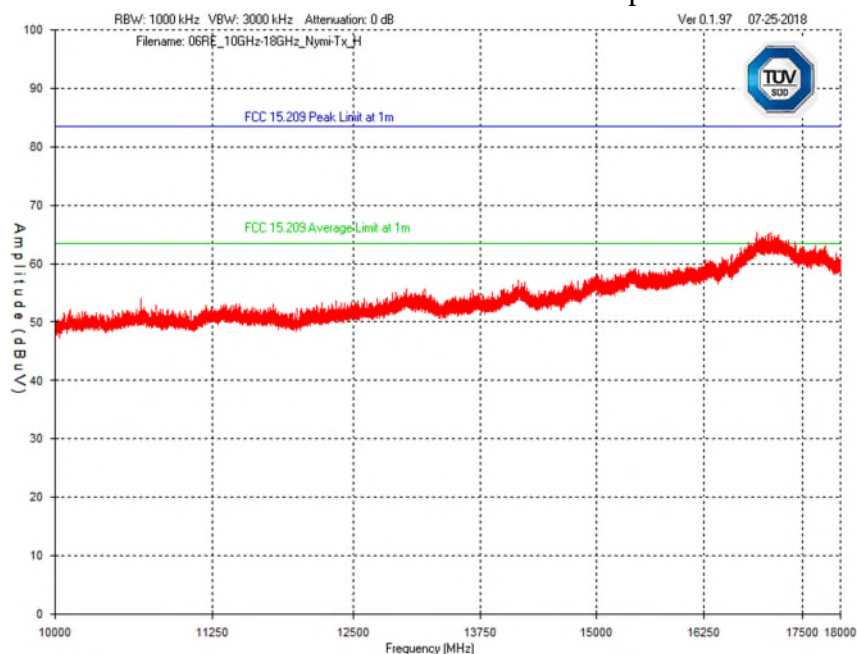
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 2 GHz – 10 GHz
Horizontal - Peak Emission Graph

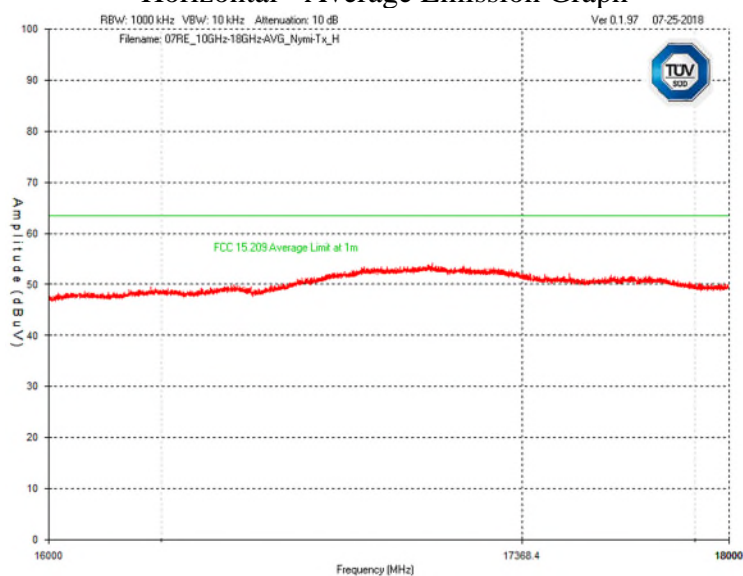


Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 10 GHz – 18 GHz Horizontal - Peak Emission Graph



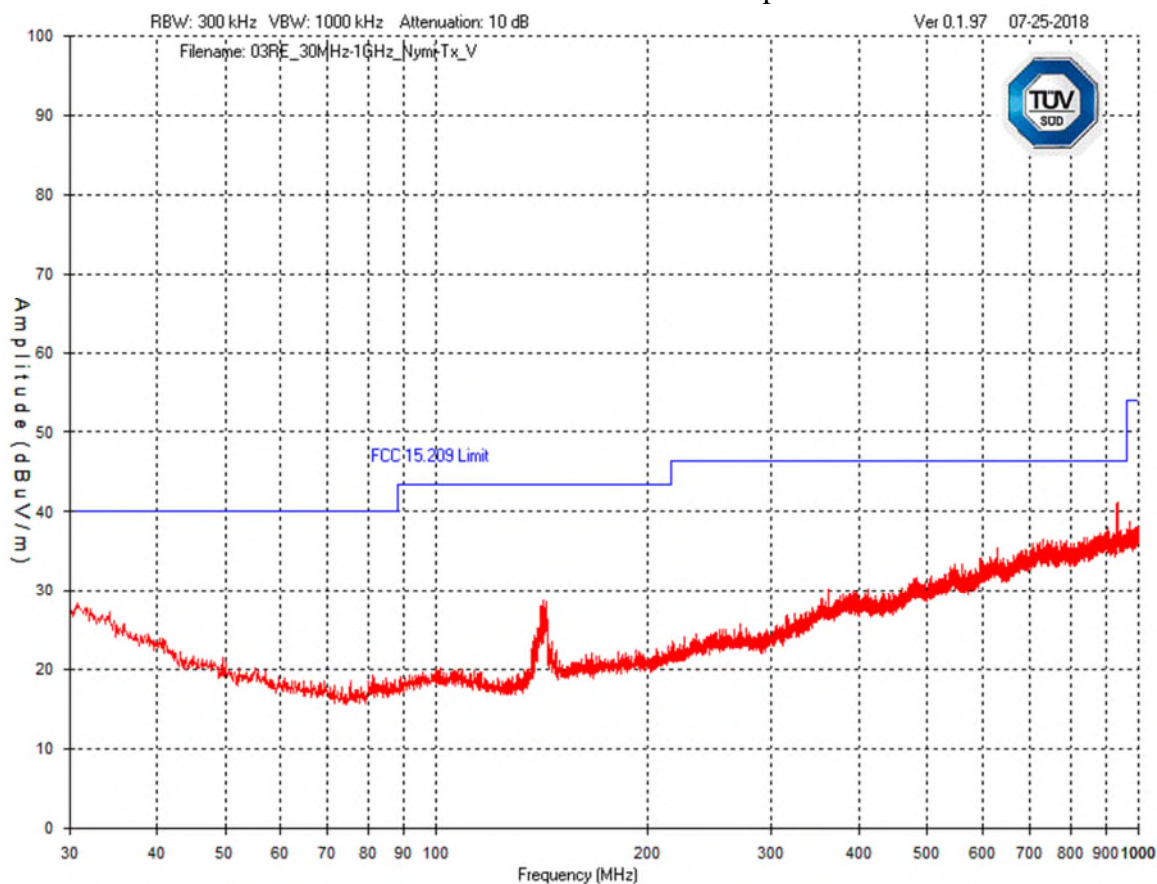
Low Channel – 16 GHz – 18 GHz Horizontal - Average Emission Graph



Plots were taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.
Frequency range was scanned to 25 GHz, with no emissions detected above 18 GHz.

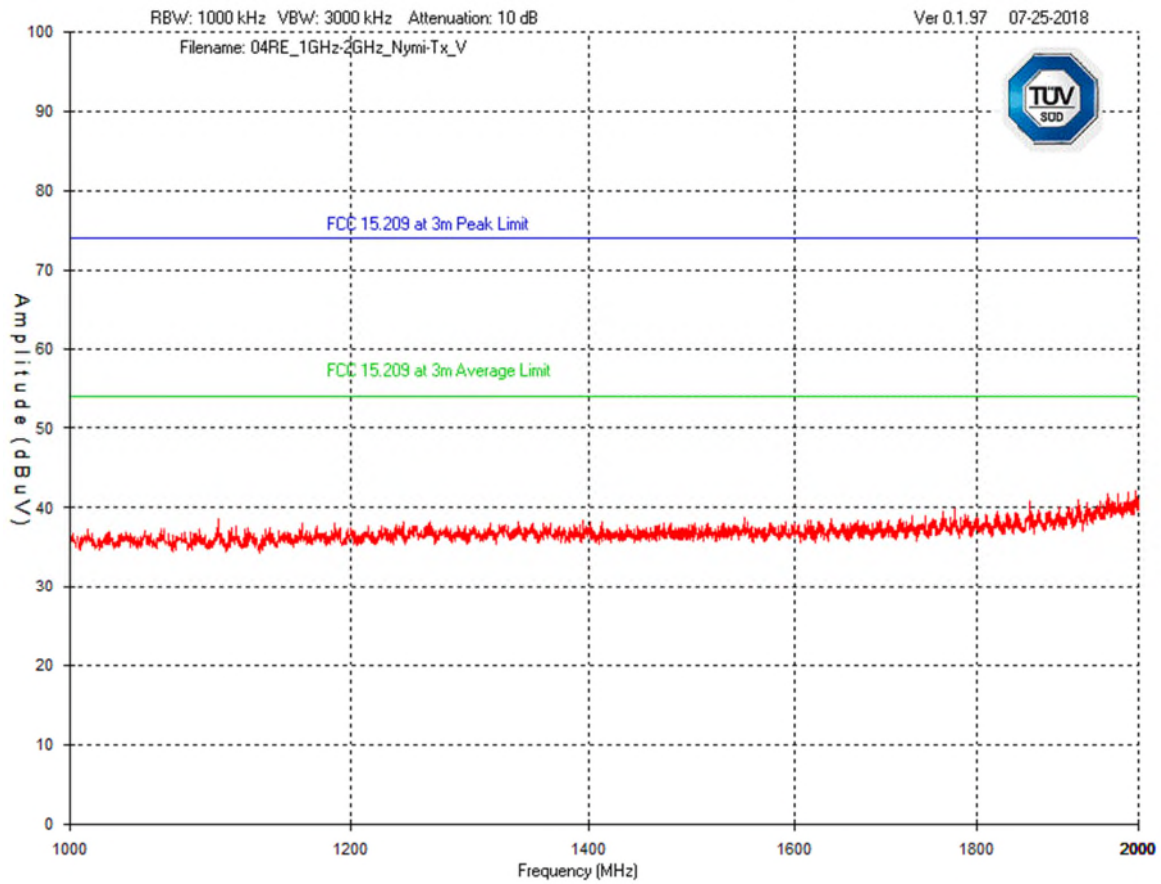
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	


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



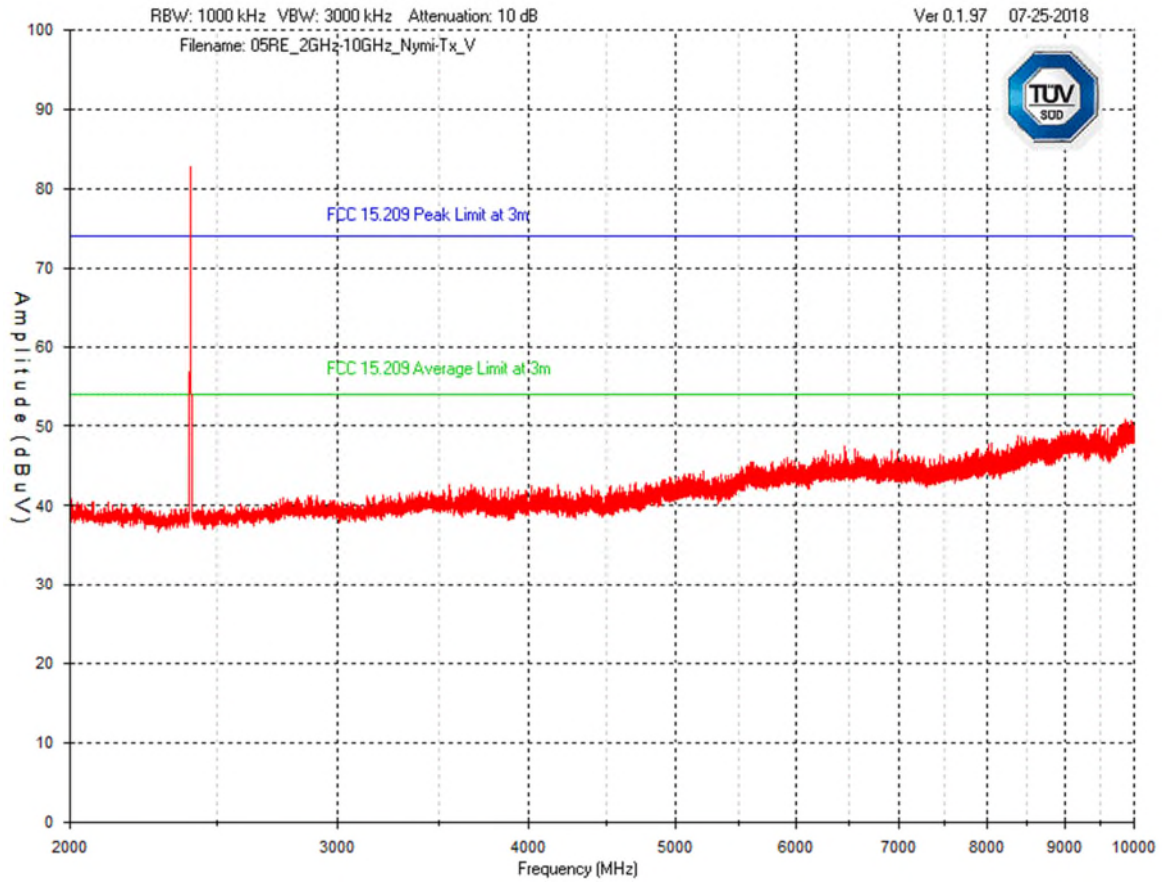
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



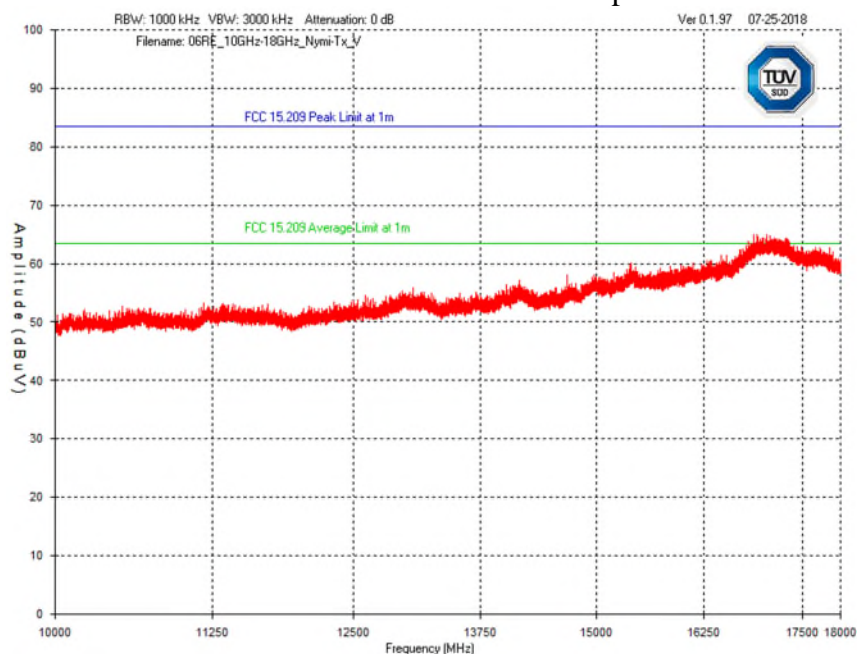
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 2 GHz – 10 GHz
Vertical - Peak Emission Graph

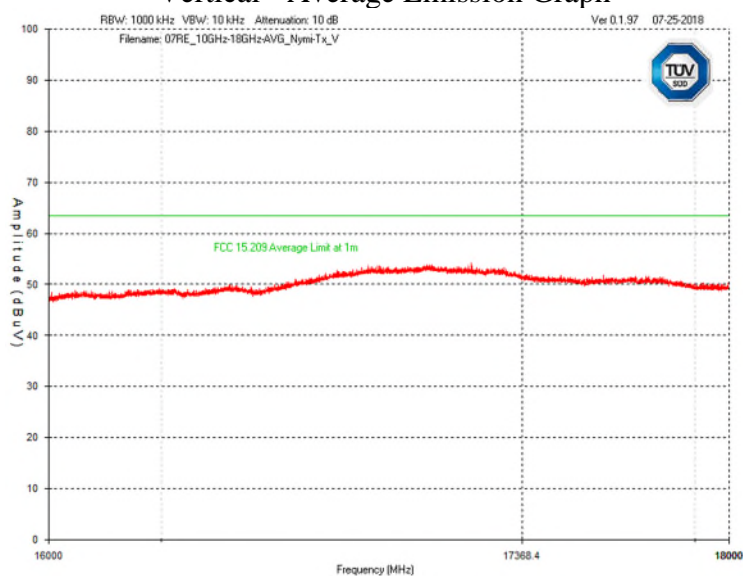


Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Low Channel – 10 GHz – 18 GHz Vertical - Peak Emission Graph



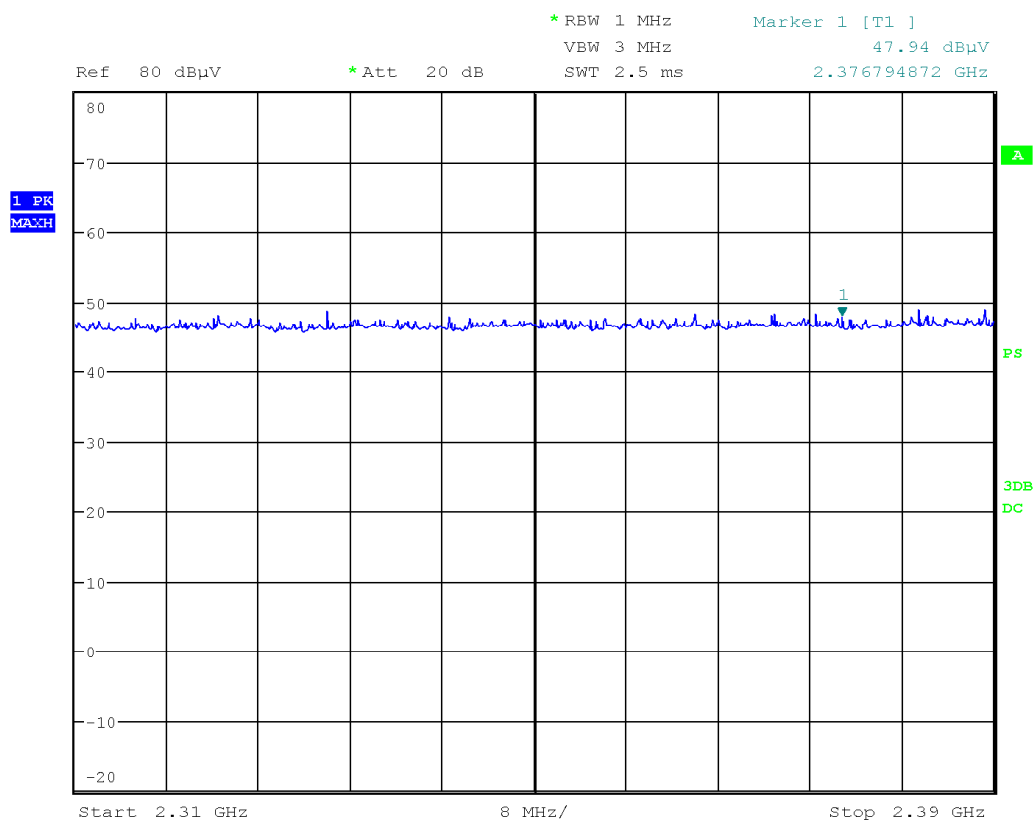
Low Channel – 16 GHz – 18 GHz Vertical - Average Emission Graph



Plots were taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.
Frequency range was scanned to 25 GHz, with no emissions detected above 18 GHz.

Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – Low Channel Horizontal - Peak Emission

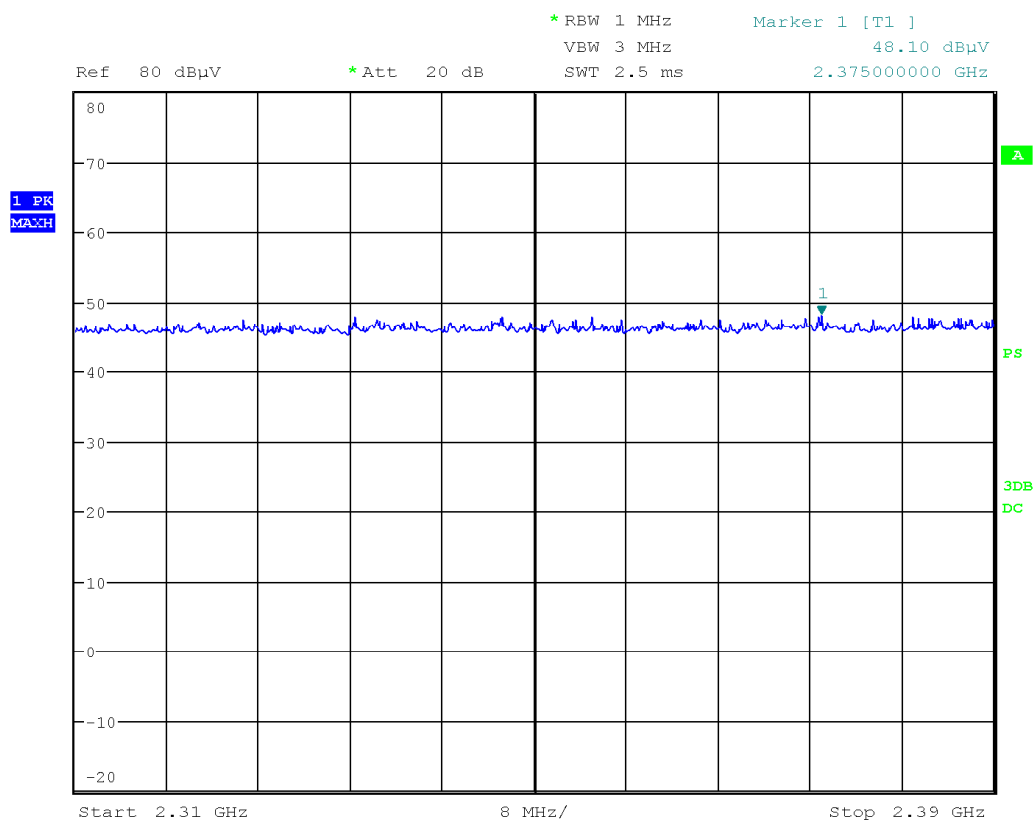


Date: 24.JUL.2018 13:07:57

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – Low Channel Vertical - Peak Emission

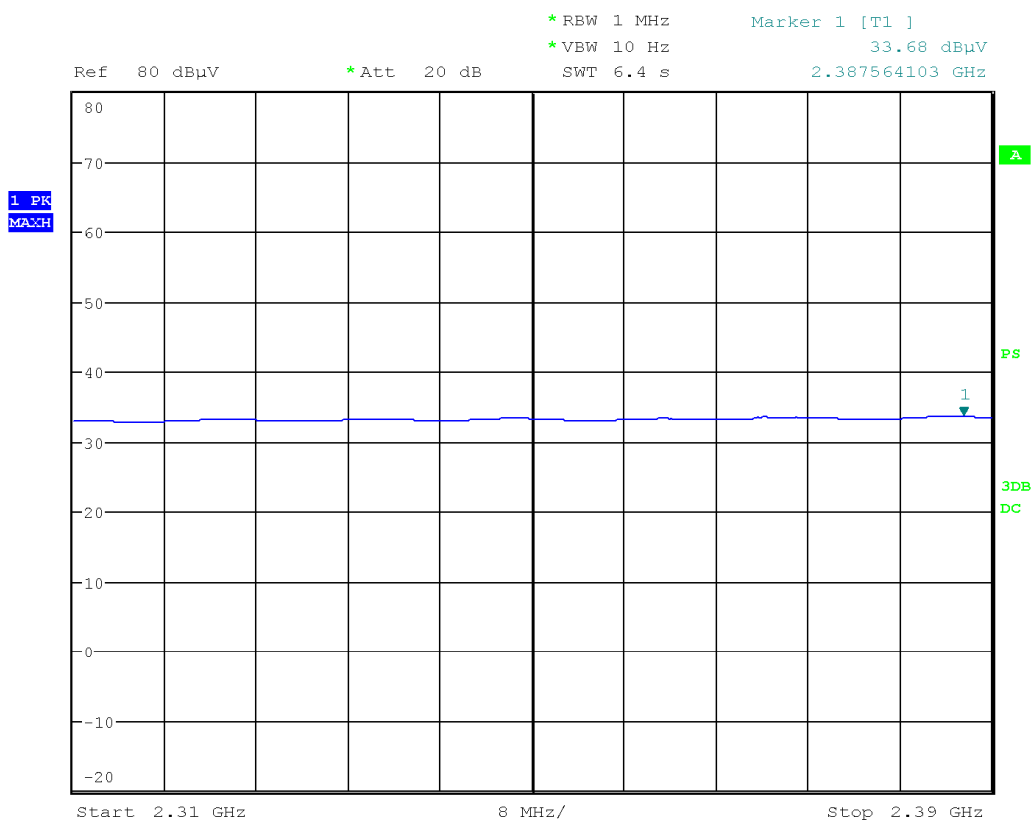


Date: 24.JUL.2018 13:15:32

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – Low Channel Horizontal - Average Emission

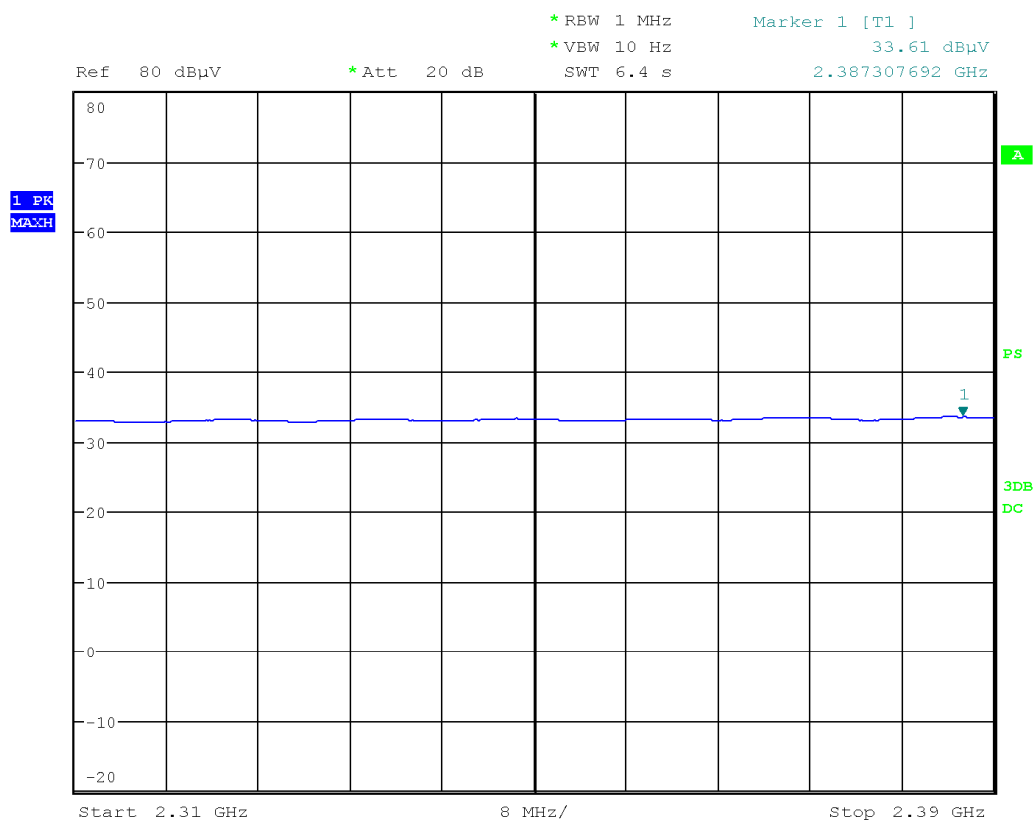


Date: 24.JUL.2018 13:08:49

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – Low Channel Vertical – Average Emission

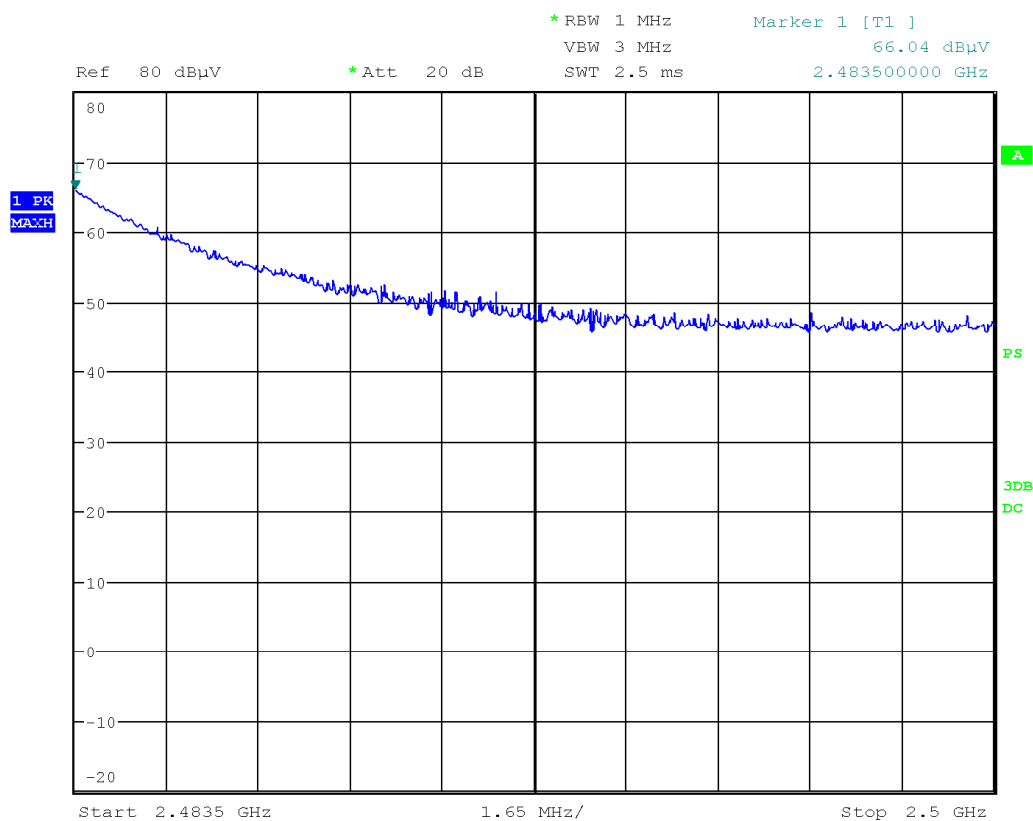


Date: 24.JUL.2018 13:16:14

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – High Channel Horizontal - Peak Emission

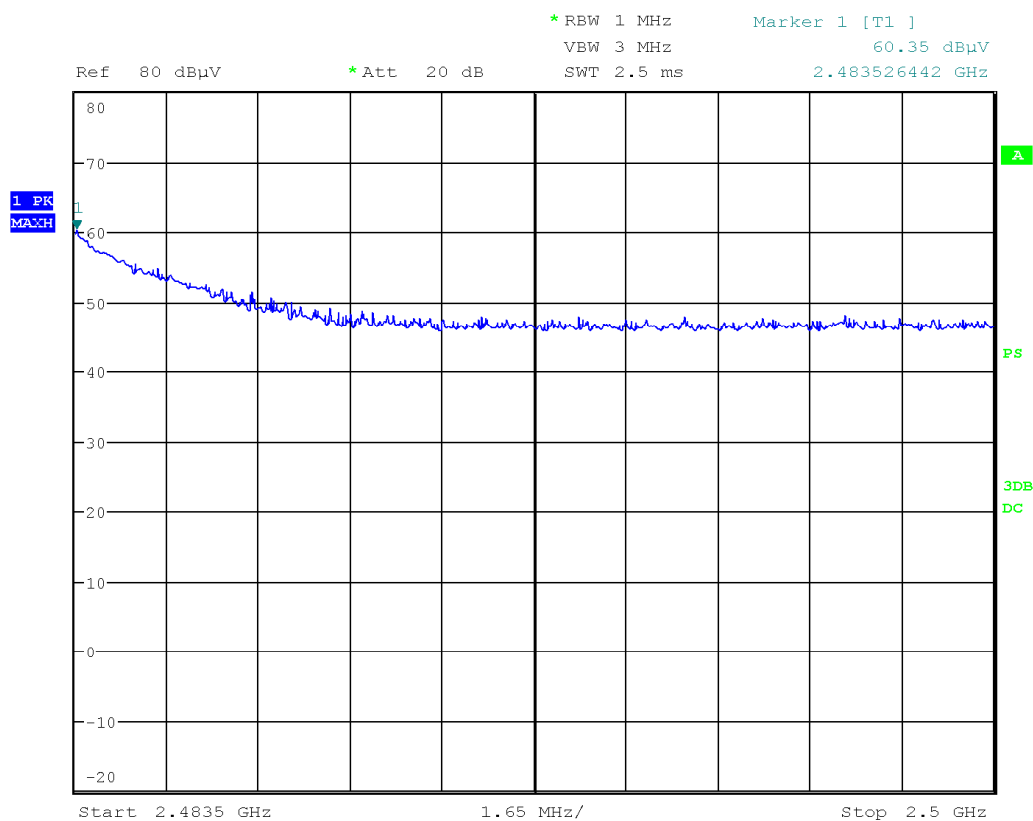


Date: 24.JUL.2018 14:50:14

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – High Channel Vertical - Peak Emission

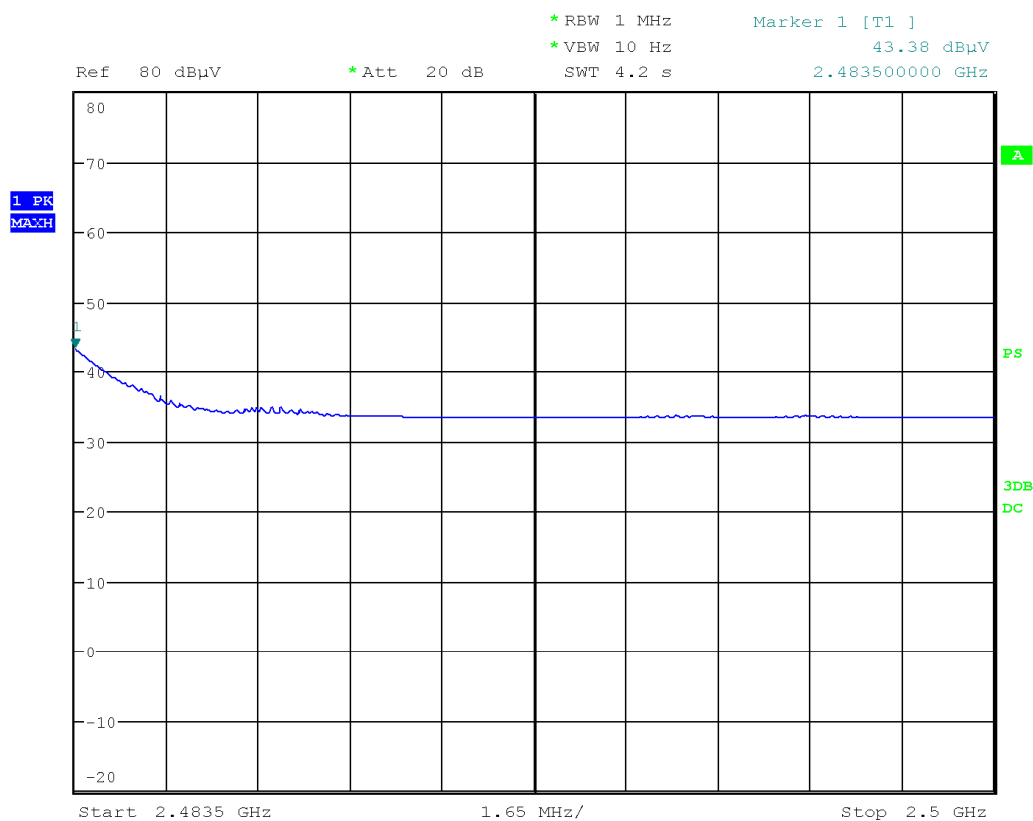


Date: 24.JUL.2018 14:42:55

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – High Channel Horizontal - Average Emission

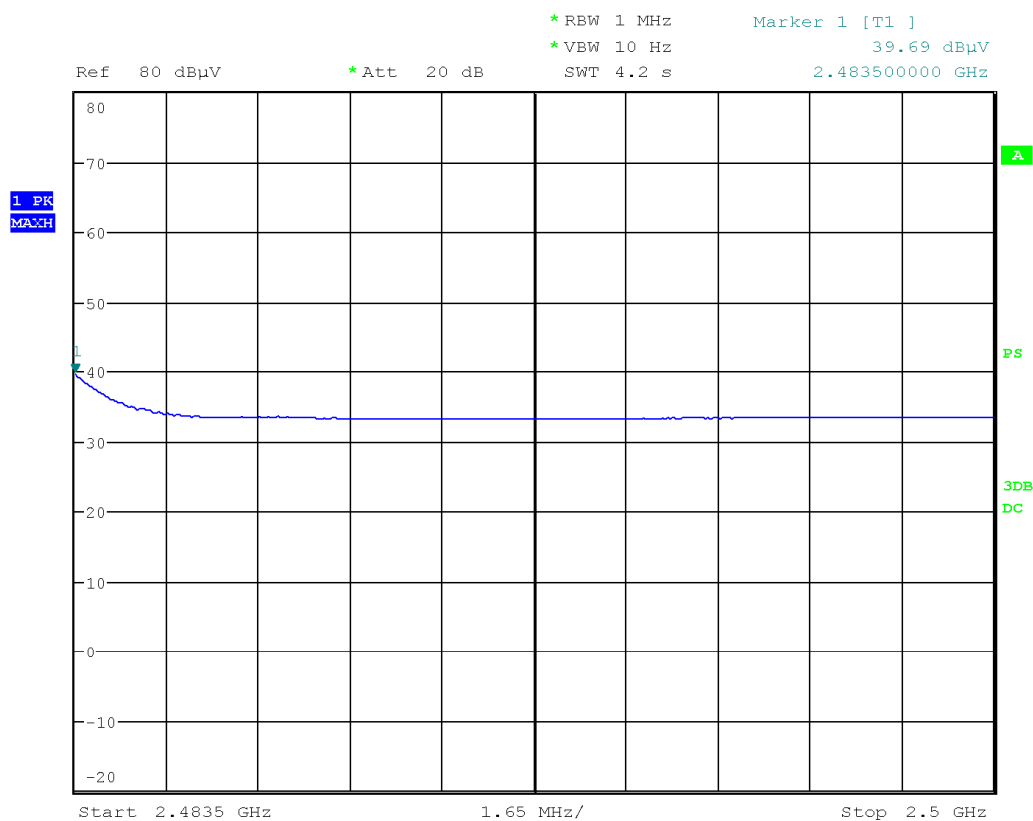


Date: 24.JUL.2018 14:51:00

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Band Edge – High Channel Vertical – Average Emission



Date: 24.JUL.2018 14:43:40

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	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Final Measurements and Results

The EUT passed. Low, middle, and high bands were measured in three orthogonal axis.

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. Emissions outside the restricted bands were measured for informational purposes.

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.

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Low Channel - Z axis (Display Facing Up)											
2402	Peak	Horz	96.6	26.6	3.6	0.0	-35.9	90.9			PASS
2402	Avg	Horz	67.0	26.6	3.6	0.0	-35.9	61.4			PASS
2402	Peak	Vert	88.8	26.6	3.6	0.0	-35.9	83.2			PASS
2402	Avg	Vert	62.8	26.6	3.6	0.0	-35.9	57.2			PASS
2376.8	Peak	Horz	47.9	26.6	3.5	0.0	-35.9	42.2	74.0	31.8	PASS
2387.6	Avg	Horz	33.7	26.6	3.6	0.0	-35.9	28.0	54.0	26.0	PASS
2375	Peak	Vert	48.1	26.6	3.5	0.0	-35.9	42.3	74.0	31.7	PASS
2375	Avg	Vert	33.6	26.6	3.5	0.0	-35.9	27.8	54.0	26.2	PASS
Low Channel - X axis (Side Facing Up/Down)											
2402	Peak	Horz	91.4	26.6	3.6	0.0	-35.9	85.7			PASS
2402	Avg	Horz	64.2	26.6	3.6	0.0	-35.9	58.5			PASS
2402	Peak	Vert	91.7	26.6	3.6	0.0	-35.9	86.0			PASS
2402	Avg	Vert	64.4	26.6	3.6	0.0	-35.9	58.8			PASS
2387.7	Peak	Horz	48.0	26.6	3.6	0.0	-35.9	42.3	74.0	31.7	PASS
2385.6	Avg	Horz	33.7	26.6	3.6	0.0	-35.9	28.0	54.0	26.0	PASS
2383.2	Peak	Vert	48.3	26.6	3.6	0.0	-35.9	42.5	74.0	31.5	PASS
2385.3	Avg	Vert	33.4	26.6	3.6	0.0	-35.9	27.7	54.0	26.3	PASS
Low Channel - Y axis (Strap facing up/down)											
2402	Peak	Horz	92.3	26.6	3.6	0.0	-35.9	86.6			PASS
2402	Avg	Horz	64.7	26.6	3.6	0.0	-35.9	59.1			PASS
2402	Peak	Vert	93.4	26.6	3.6	0.0	-35.9	87.8			PASS
2402	Avg	Vert	65.4	26.6	3.6	0.0	-35.9	59.7			PASS
2384	Peak	Horz	47.9	26.6	3.6	0.0	-35.9	42.1	74.0	31.9	PASS
2384	Avg	Horz	33.6	26.6	3.6	0.0	-35.9	27.9	54.0	26.1	PASS
2372.2	Peak	Vert	48.2	26.6	3.5	0.0	-35.9	42.4	74.0	31.6	PASS
2372.2	Avg	Vert	33.5	26.6	3.5	0.0	-35.9	27.7	54.0	26.3	PASS

Low Channel

Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
Mid Channel - Z axis (Display Facing Up)											
2440	Peak	Horz	97.7	26.5	3.6	0.0	-35.8	91.9			PASS
2440	Avg	Horz	67.6	26.5	3.6	0.0	-35.8	61.9			PASS
2440	Peak	Vert	92.2	26.5	3.6	0.0	-35.8	86.4			PASS
2440	Avg	Vert	64.7	26.5	3.6	0.0	-35.8	58.9			PASS
Mid Channel - X axis (Side Facing Up/Down)											
2440	Peak	Horz	89.4	26.5	3.6	0.0	-35.8	83.6			PASS
2440	Avg	Horz	63.2	26.5	3.6	0.0	-35.8	57.4			PASS
2440	Peak	Vert	92.4	26.5	3.6	0.0	-35.8	86.6			PASS
2440	Avg	Vert	64.8	26.5	3.6	0.0	-35.8	59.1			PASS
Mid Channel - Y axis (Strap Facing Up/Down)											
2440	Peak	Horz	93.5	26.5	3.6	0.0	-35.8	87.7			PASS
2440	Avg	Horz	65.4	26.5	3.6	0.0	-35.8	59.6			PASS
2440	Peak	Vert	94.2	26.5	3.6	0.0	-35.8	88.5			PASS
2440	Avg	Vert	65.8	26.5	3.6	0.0	-35.8	60.0			PASS

Mid Channel

Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBµV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBµV/m)	Emission Limit (dBµV/m)	Margin (dB)	Result
High Channel - Z axis (Display Facing Up)											
2480	Peak	Horz	98.8	26.3	3.6	0.0	-35.8	92.9			PASS
2480	Avg	Horz	68.2	26.3	3.6	0.0	-35.8	62.3			PASS
2480	Peak	Vert	91.9	26.3	3.6	0.0	-35.8	86.0			PASS
2480	Avg	Vert	64.5	26.3	3.6	0.0	-35.8	58.6			PASS
2483.5	Peak	Horz	66.0	26.3	3.6	0.0	-35.8	60.1	74.0	13.9	PASS
2483.5	Avg	Horz	43.4	26.3	3.6	0.0	-35.8	37.5	54.0	16.5	PASS
2483.5	Peak	Vert	60.4	26.3	3.6	0.0	-35.8	54.5	74.0	19.5	PASS
2483.5	Avg	Vert	39.7	26.3	3.6	0.0	-35.8	33.8	54.0	20.2	PASS
High Channel - X axis (Side Facing Up/Down)											
2480	Peak	Horz	90.3	26.3	3.6	0.0	-35.8	84.4			PASS
2480	Avg	Horz	63.6	26.3	3.6	0.0	-35.8	57.7			PASS
2480	Peak	Vert	91.9	26.3	3.6	0.0	-35.8	86.0			PASS
2480	Avg	Vert	64.5	26.3	3.6	0.0	-35.8	58.6			PASS
2483.5	Peak	Horz	58.5	26.3	3.6	0.0	-35.8	52.6	74.0	21.4	PASS
2483.5	Avg	Horz	38.9	26.3	3.6	0.0	-35.8	33.0	54.0	21.0	PASS
2483.5	Peak	Vert	59.5	26.3	3.6	0.0	-35.8	53.6	74.0	20.4	PASS
2483.5	Avg	Vert	39.6	26.3	3.6	0.0	-35.8	33.7	54.0	20.3	PASS
High Channel - Y axis (Strap Facing Up/Down)											
2480	Peak	Horz	94.7	26.3	3.6	0.0	-35.8	88.8			PASS
2480	Avg	Horz	66.0	26.3	3.6	0.0	-35.8	60.1			PASS
2480	Peak	Vert	94.9	26.3	3.6	0.0	-35.8	89.0			PASS
2480	Avg	Vert	66.1	26.3	3.6	0.0	-35.8	60.2			PASS
2483.5	Peak	Horz	62.1	26.3	3.6	0.0	-35.8	56.2	74.0	17.8	PASS
2483.5	Avg	Horz	41.2	26.3	3.6	0.0	-35.8	35.3	54.0	18.7	PASS
2483.5	Peak	Vert	62.3	26.3	3.6	0.0	-35.8	56.4	74.0	17.6	PASS
2483.5	Avg	Vert	41.3	26.3	3.6	0.0	-35.8	35.4	54.0	18.6	PASS

High Channel

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 12, 2018	Jan. 12, 2020	GEMC 233
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Feb. 27, 2018	Feb. 27, 2020	GEMC 6375
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Jun. 12, 2018	Jun. 12, 2020	GEMC 312
Horn Antenna 18 – 26.5 GHz	SAS-572	A.H. Systems	Oct 11, 2016	Oct 11, 2018	GEMC 6371
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 2, 2017	Feb. 2, 2019	GEMC 168
Loop Antenna	EM 6871	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 13, 2017	Feb 13, 2019	GEMC 71
BiLog Antenna	3142-C	ETS	Oct. 5, 2016	Oct. 5, 2018	GEMC 8
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
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
Emissions Software	0.1.97	Global EMC	NCR	NCR	GEMC 58

FCC - 15.209 - Radiated Emissions_Rev1

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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 Section 10.2 of FCC KDB 558074.

Results

The EUT passed. Low, medium, and high bands were tested. The worst case value is -17.65 dBm as measured with a 3 kHz resolution bandwidth (peak power).

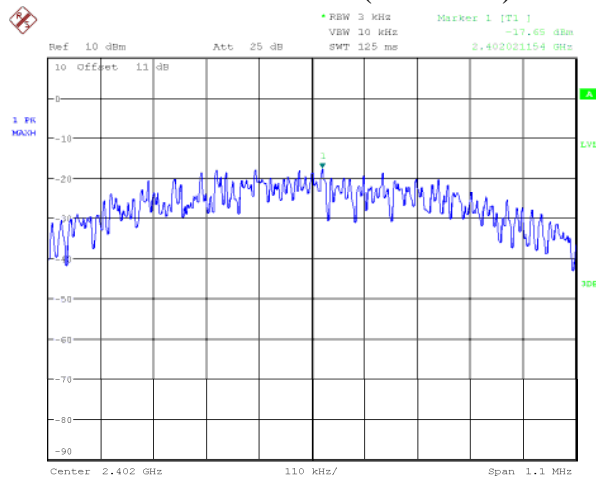
Graphs

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channels were investigated in each mode, with the worst case being presented. The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer.

Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

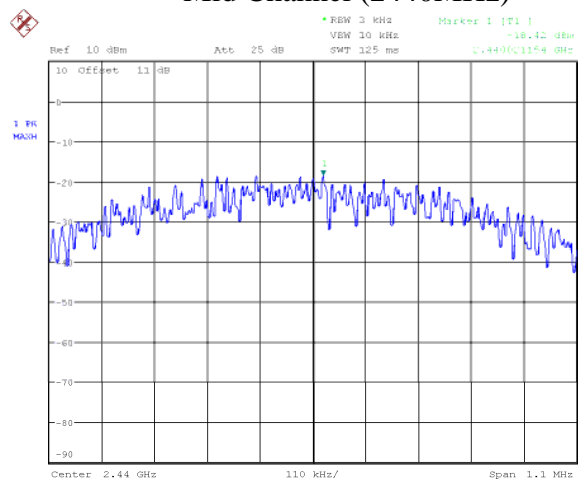
PSD

Low Channel (2402MHz)



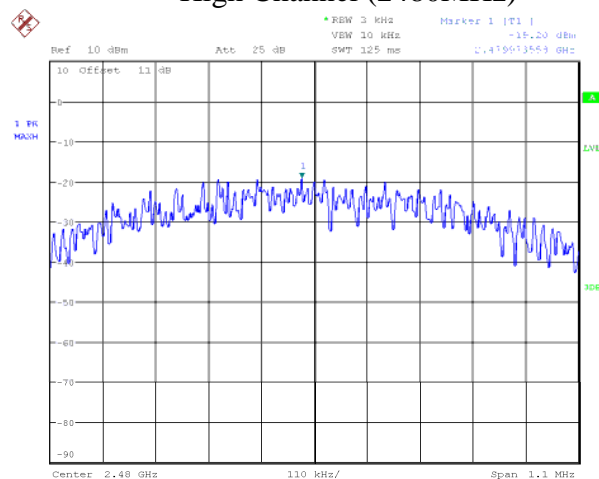
Date: 2.AUG.2018 15:07:12

Mid Channel (2440MHz)



Date: 2.AUG.2018 15:10:26

High Channel (2480MHz)



Date: 2.AUG.2018 15:19:22

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

Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	FSQ 26	Rohde & Schwarz	Feb 28, 2017	Feb 28, 2019	GEMC 234
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits and Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207

Method is as defined in ANSI C63.4

Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dBμV	150 kHz – 500 kHz	66 to 56* dBμV
500 kHz – 5 MHz	46 dBμV	500 kHz – 5 MHz	56 dBμV
5 MHz – 30 MHz	50 dBμV	5 MHz – 30 MHz	60 dBμV

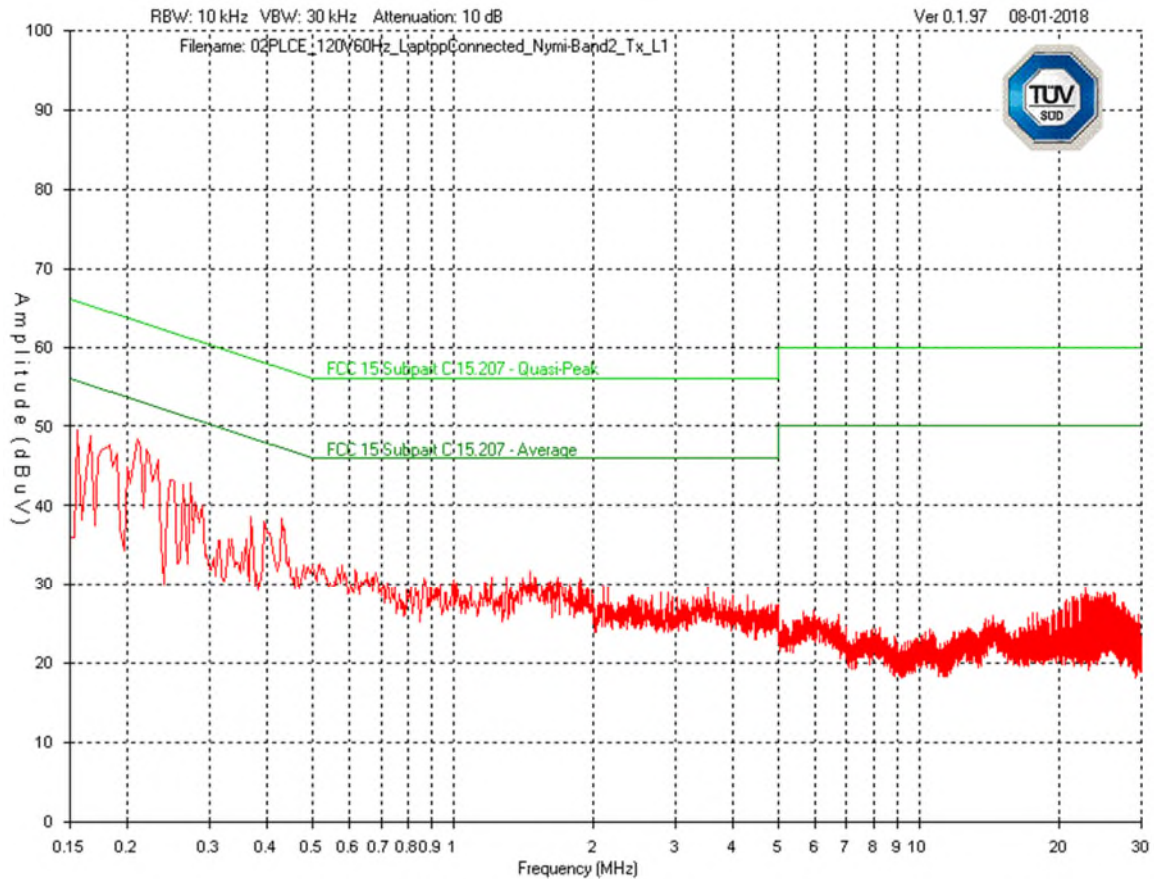
* Decreases linearly with the logarithm of the frequency

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

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

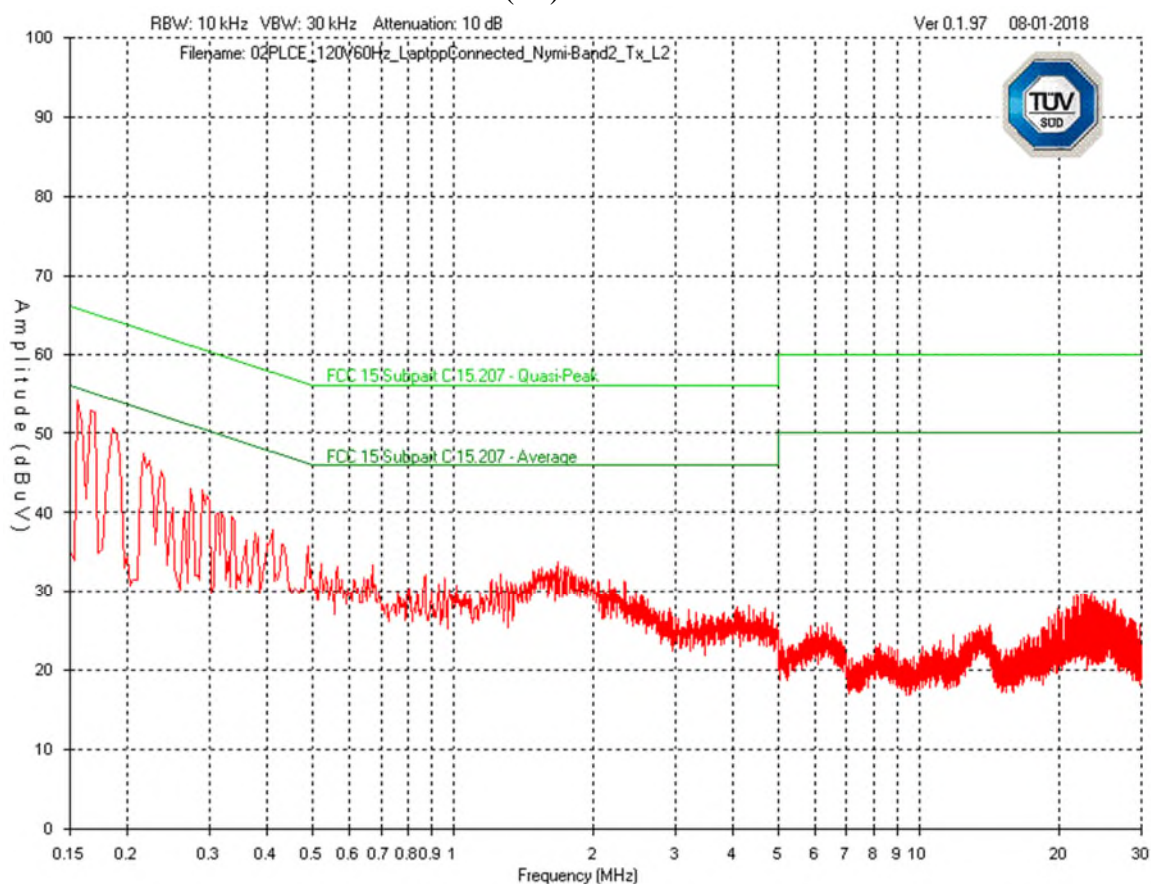
Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Line 1 (L1) – 120Vac 60Hz



Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Line 2 (L2) – 120Vac 60Hz



Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Final Measurements

Product Category			Class B								
Supply			Laptop powered at 120Vac 60Hz								
Frequency (MHz)	Detector	Received Signal (dBμV)	Atten Factor (dB)	Cable Factor (dB)	LISN Factor (dB)	Level (dBμV)	QP Limit (dBμV)	AVG Limit (dBμV)	QP Margin (dB)	AVG Margin (dB)	Pass/Fail
Line 1											
0.152	AVG	17.9	10	0.0	0.0	27.9	--	53.2	--	25.3	Pass
0.210	AVG	12.6	10	0.0	0.0	22.6	--	53.2	--	30.7	Pass
0.157	PEAK	39.4	10	0.0	0.1	49.5	65.6	--	16.1	--	Pass
0.210	PEAK	38.3	10	0.0	0.0	48.3	63.2	--	14.9	--	Pass
Line 2											
0.157	AVG	16.5	10	0.0	0.0	26.5	--	55.6	--	29.2	Pass
0.167	AVG	14.5	10	0.0	0.0	24.5	--	55.1	--	30.6	Pass
0.187	AVG	13.9	10	0.0	0.0	23.9	--	54.2	--	30.3	Pass
0.157	PEAK	44.0	10	0.0	0.0	54.0	65.6	--	11.6	--	Pass
0.167	PEAK	42.8	10	0.0	0.0	52.8	65.1	--	12.3	--	Pass
0.187	PEAK	40.6	10	0.0	0.0	50.6	64.2	--	13.6	--	Pass

Average and Quasi-Peak Emissions Table

Note:

Peak = Peak measurement

AVG = Average measurement

QP = Quasi-Peak measurement

See 'Appendix B – EUT, Peripherals and Test Setup Photos' for photos showing the test set-up for the highest line conducted emission

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Dec. 27, 2017	Dec. 27, 2019	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 10, 2018	Jan. 10, 2020	GEMC 302
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	612-10-1	Meca Electronics, Inc.	NCR	NCR	GEMC 223
Emissions Software	0.1.97	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

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Client	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Appendix A – EUT Summary

Client	Nymi™	
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

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

General EUT Description

Client	
Organization / Address	Nymi Inc. 82 Peter Street, Suite 500, Toronto, ON, M5V2G5 Canada
Phone	416-977-3042
EUT Details	
EUT Name	Nymi Band 2.0
FCC ID	2ADLKNEE20
IC:	12505A-NEE20
Equipment Category	Enterprise Wearable
Basic EUT Functionality	Wearable device for biometric user identification
EUT is powered using	Internal Rechargeable Battery
Input Voltage	Battery: 3.0 – 4.2
Rated Input Current	0.15A max, 1mA nominal
Connectors available on EUT	MicroUSB for charging
Peripherals Required for Test	None. EUT has test menu
Release type	Final
Intentional Radiator Frequency	2400 – 2483.5 MHz for BLE applications as described above.
EUT Configuration	Wireless configured to transmit continuously at 100% duty cycle

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	Nymi™	 Canada
Product	Nymi Band 2.0	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247:2017	

Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report