



Canada

RF Test Report

As per

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

Unlicensed Intentional Radiators

on the

Precision 3 Powermeter
PML300 and PMR300
(BLE Transmitter)

Issued by:

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Prepared by:

Jadon Bull,
Project Engineer

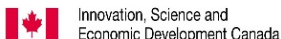
Reviewed by:

Min Xie,
Sr. Project Engineer

Testing produced for



See Appendix A for full client &
EUT details.



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



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



Registration #
CA6844



Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Report Scope

This report addresses the EMC verification testing and test results of the **Precision 3 Powermeter** Models: **PML300 and PMR300**, and are 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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Summary

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

EUT:	Precision 3 Powermeter PML300 & PMR300
FCC Certification #, FCC ID:	ZZNPM301
ISED Certification #, IC:	9896A-PM300
EUT passed all tests performed	Yes
Tests conducted by	Jadon Bull
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	N/A See Justification
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:

The Maximum Peak Envelope Conducted Power, Antenna Spurious Conducted Emissions, and Transmitter Spurious Radiated Emissions tests were performed on both the PML300 and PMR300 models. All other tests were performed on the PML300 as representative of both EUT models.

For the Antenna requirement specified in LP0002 Clause 3.2, the unit uses a custom antenna (-7.0 dBi max peak gain) 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 axis details.

Power line conducted emissions was not applicable since the EUT is a coin cell battery operated device. All tests were performed with a new battery.

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 7 2020	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 (DTSS), 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 24 th , 2023	Initial Release	JB

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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)
03/30/2023	Radiated Emissions	JB	23.4	10.3	102.6
04/10/2023			22.1	16.9	103
04/14/2023			22.5	35.3	101.2
03/22/2023	Antenna Conducted Emissions	JB	22.7	17.4	102.4
4/21/2023			23	22.6	101.3

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Detailed Test Results Section

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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 538.4 kHz

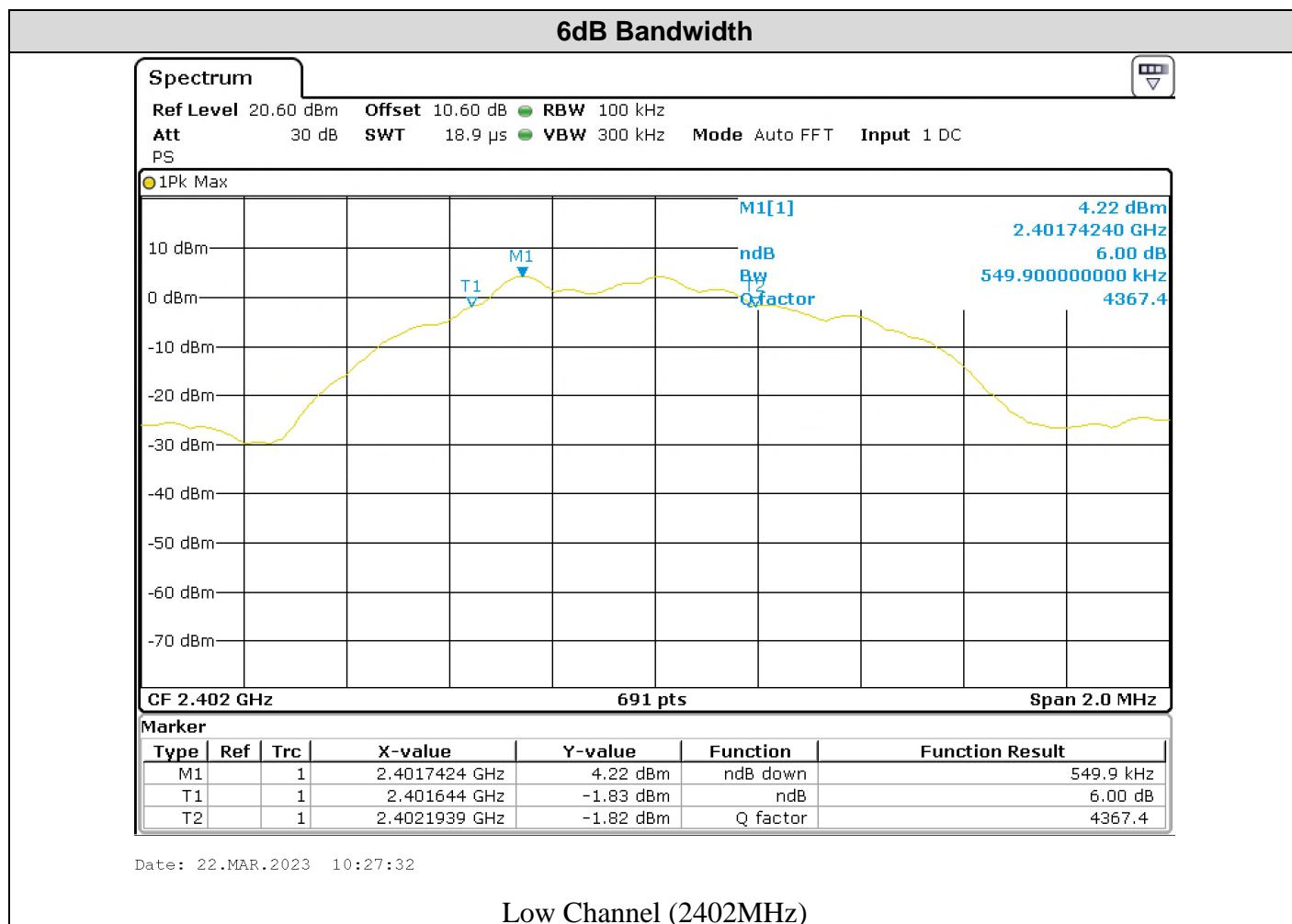
The maximum 99% Occupied Bandwidth was 1051 kHz.


Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	549.9	1042
Mid	2440	538.4	1048
High	2480	538.4	1051

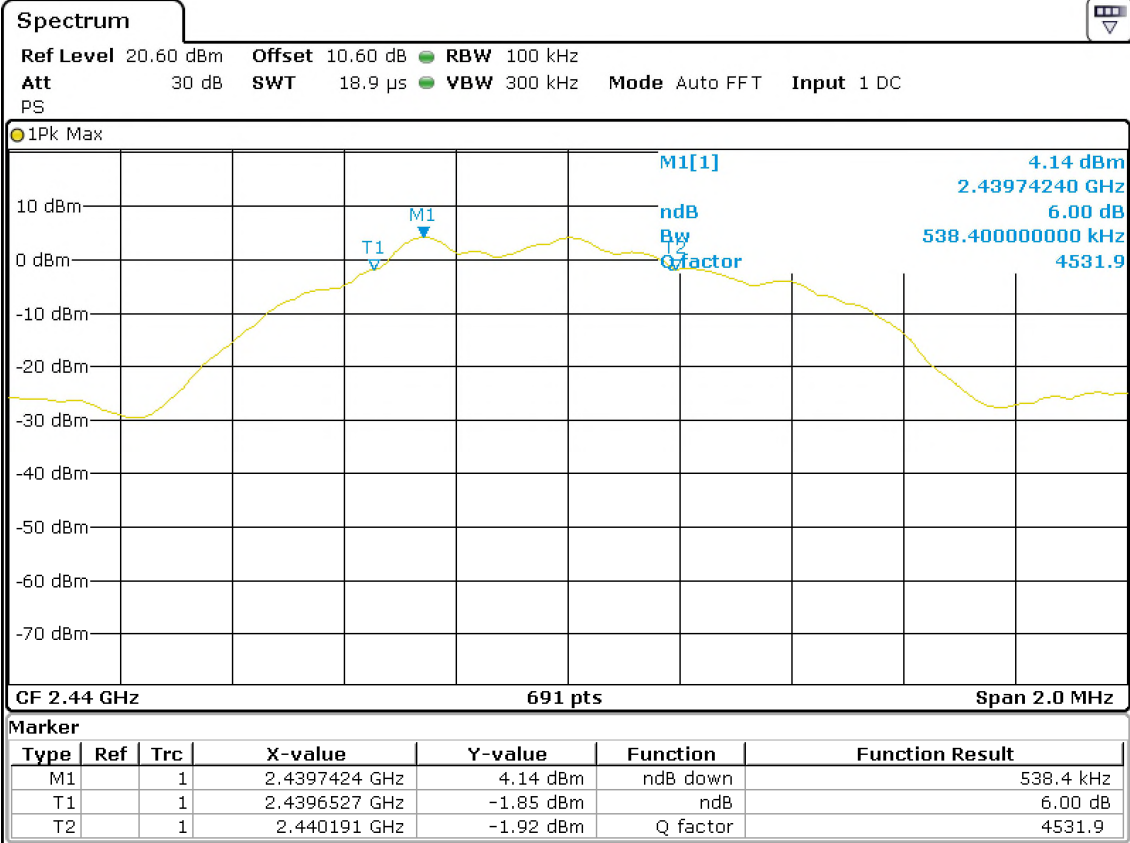
Client	4iiii Innovations	
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Graphs

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.




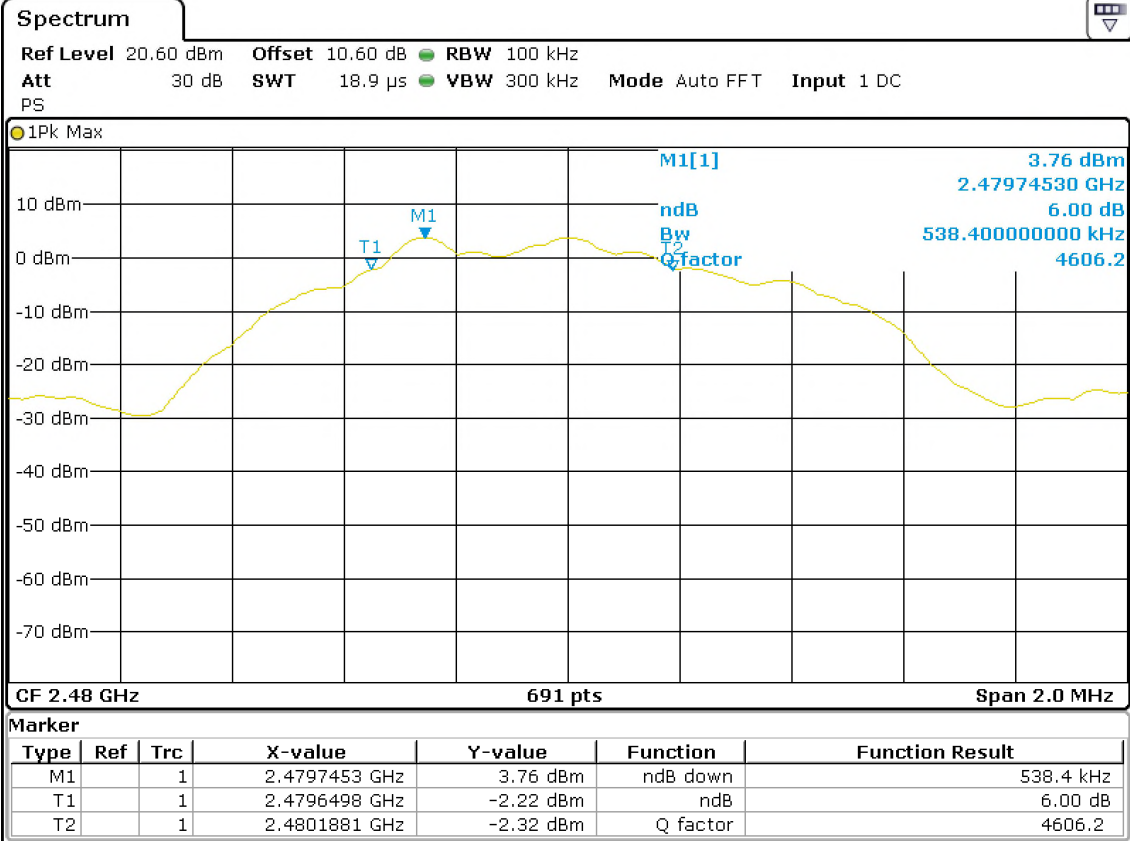
Client	4iiii Innovations	
Product	PML300 and PMR300	
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Date: 22.MAR.2023 12:19:21


Mid Channel (2440MHz)

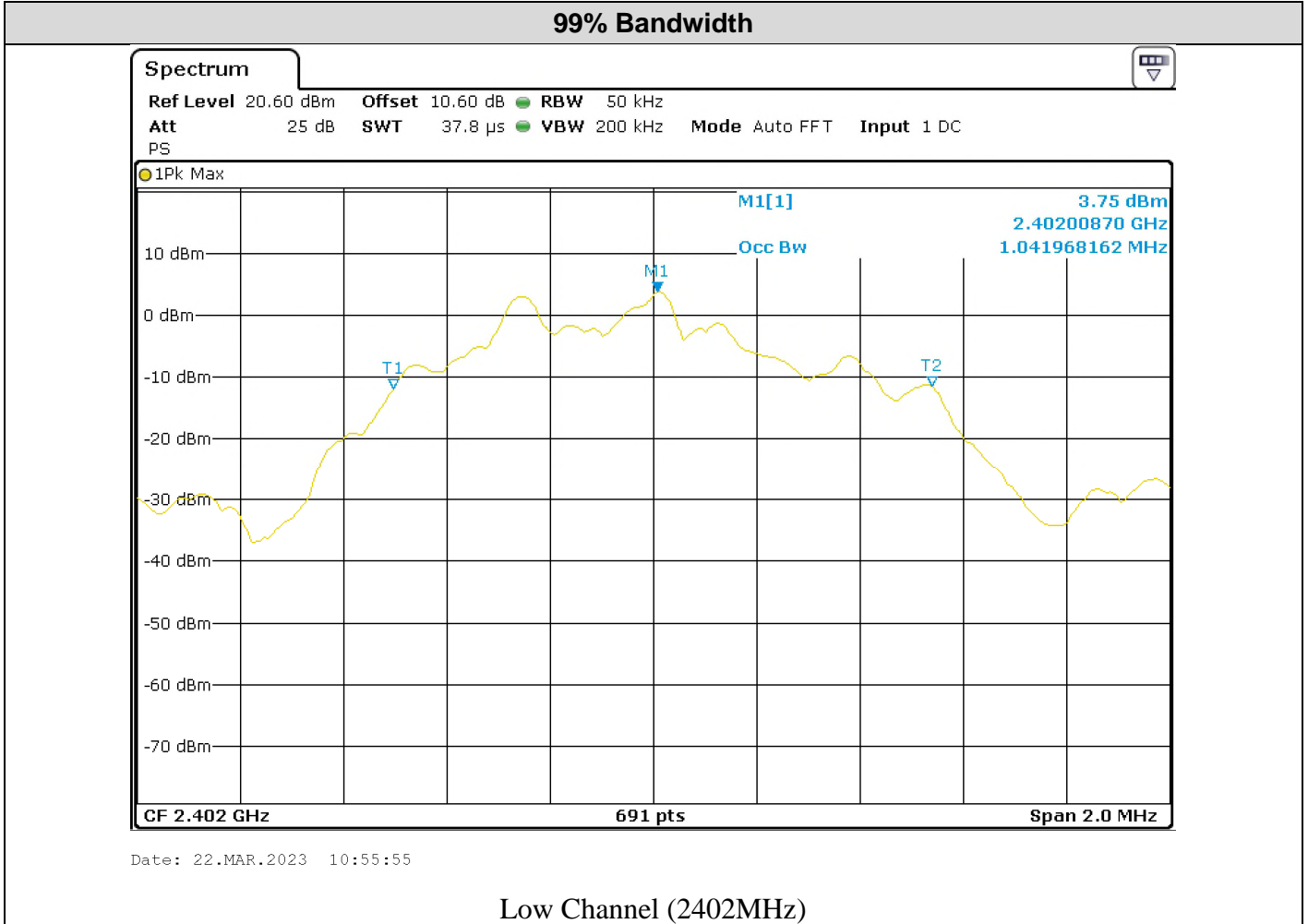
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
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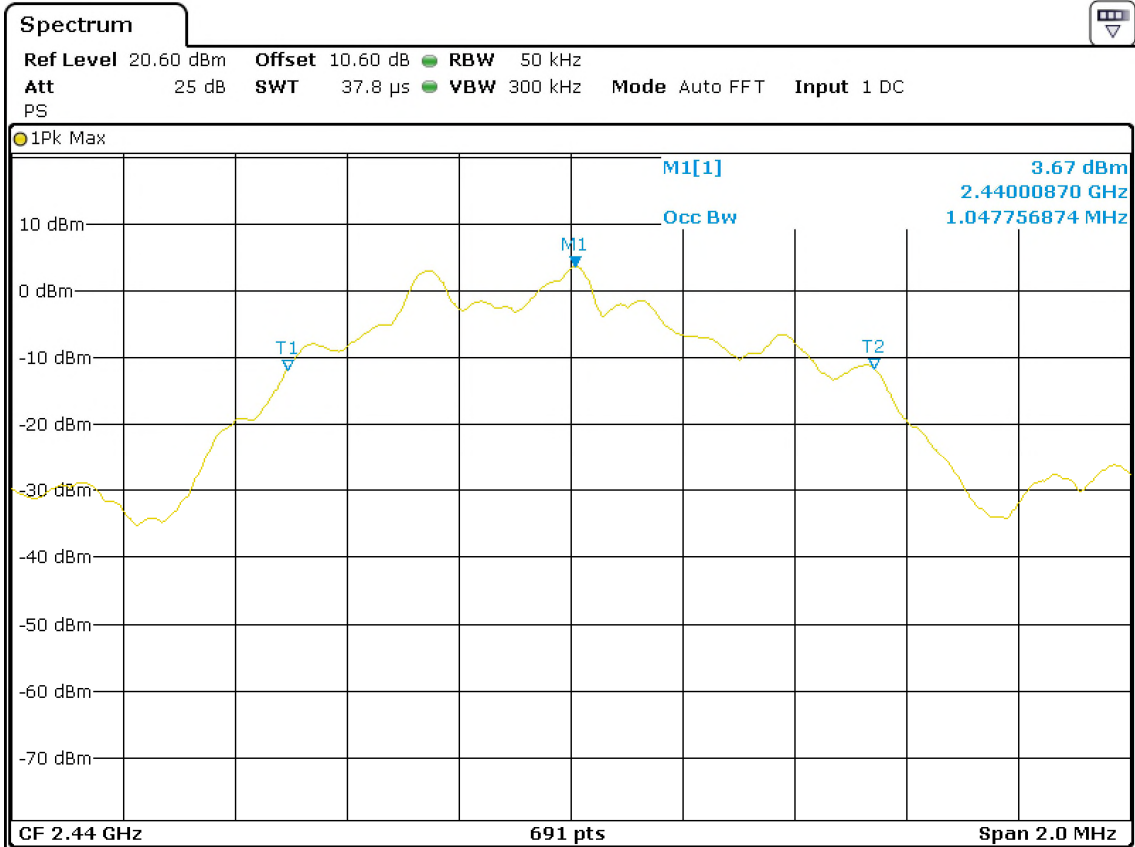
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High Channel (2480MHz)

Client	4iiii Innovations	 TÜV SÜD Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




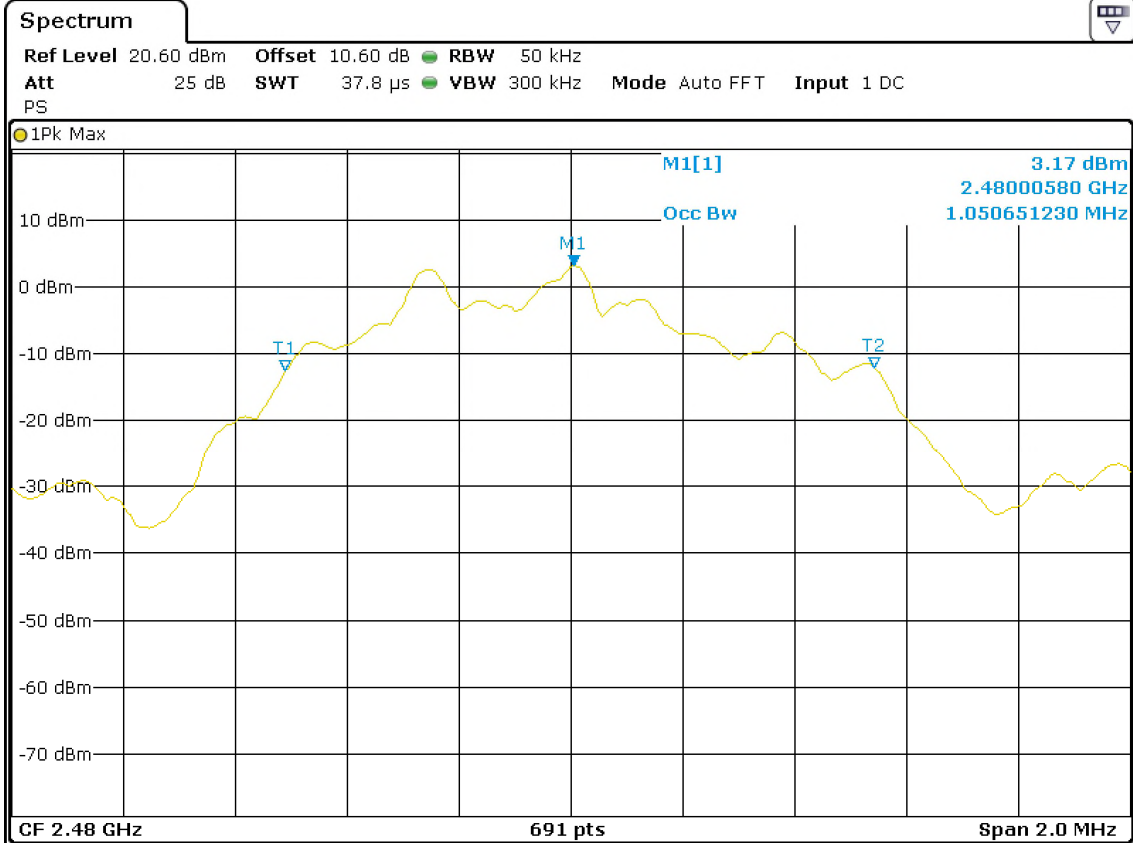
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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Mid Channel (2440MHz)

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



Date: 22.MAR.2023 12:26:34


High Channel (2480MHz)

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Note: See 'Appendix B – EUT & 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	ESR 26	Rohde & Schwarz	Mar. 31, 2022	Mar. 31, 2024	GEMC 341
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Results

The EUT passed.

PML300


Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	4.15	2.60
Mid	2440	4.06	2.55
High	2480	3.85	2.43

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

PMR300

Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	2402	2.67	1.85
Mid	2440	2.36	1.72
High	2480	1.90	1.55

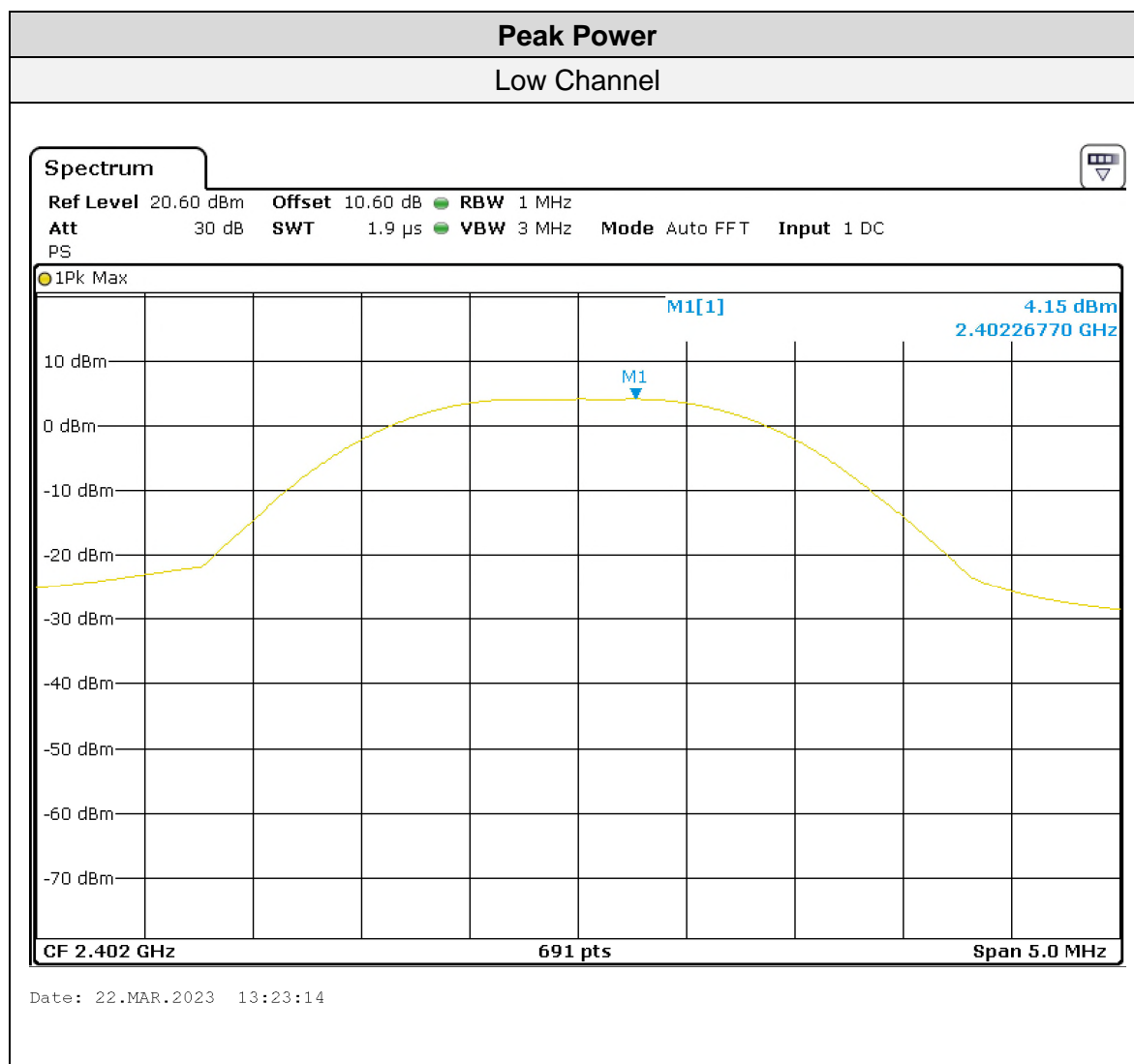
Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer


Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

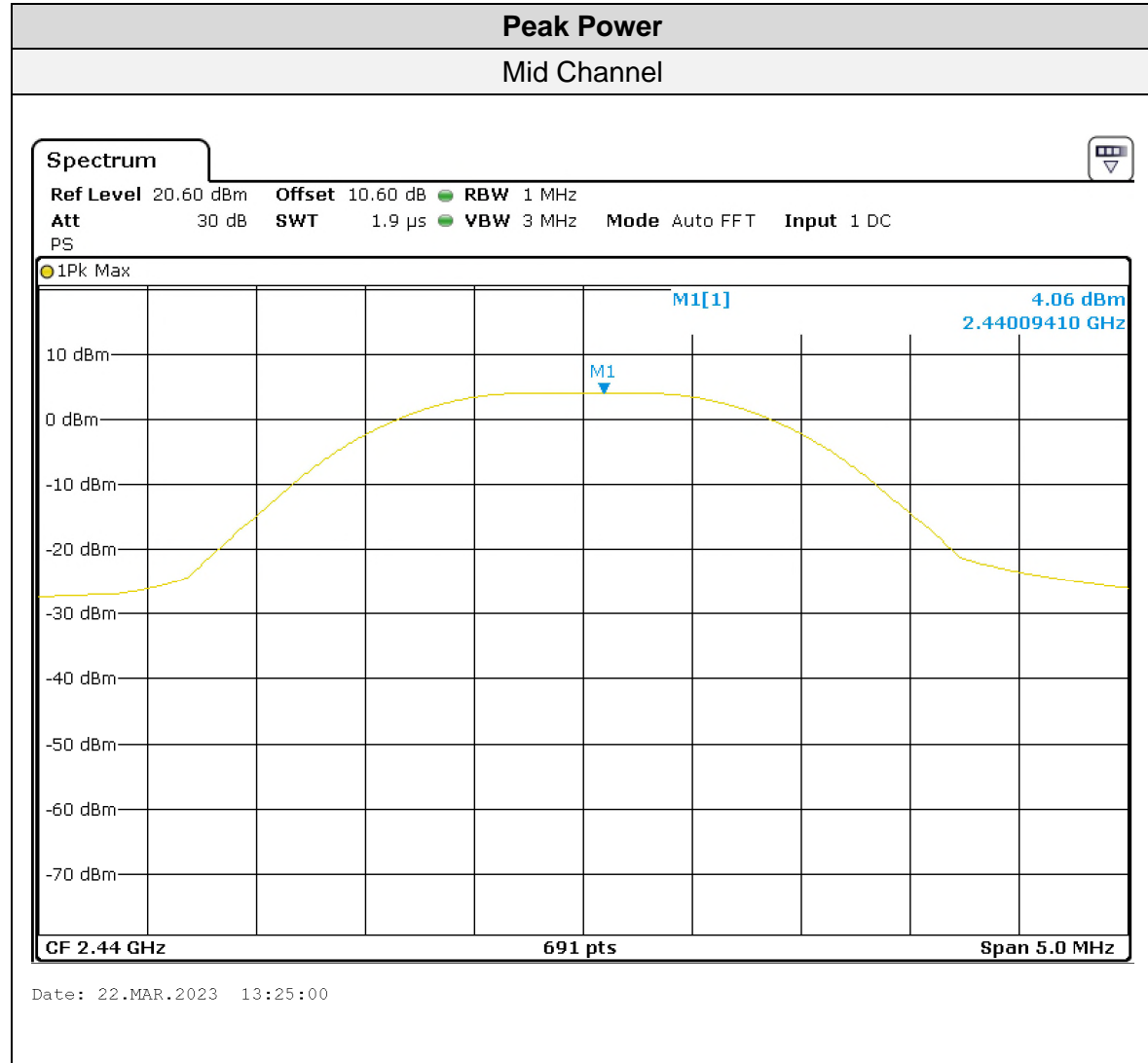
Graphs


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.

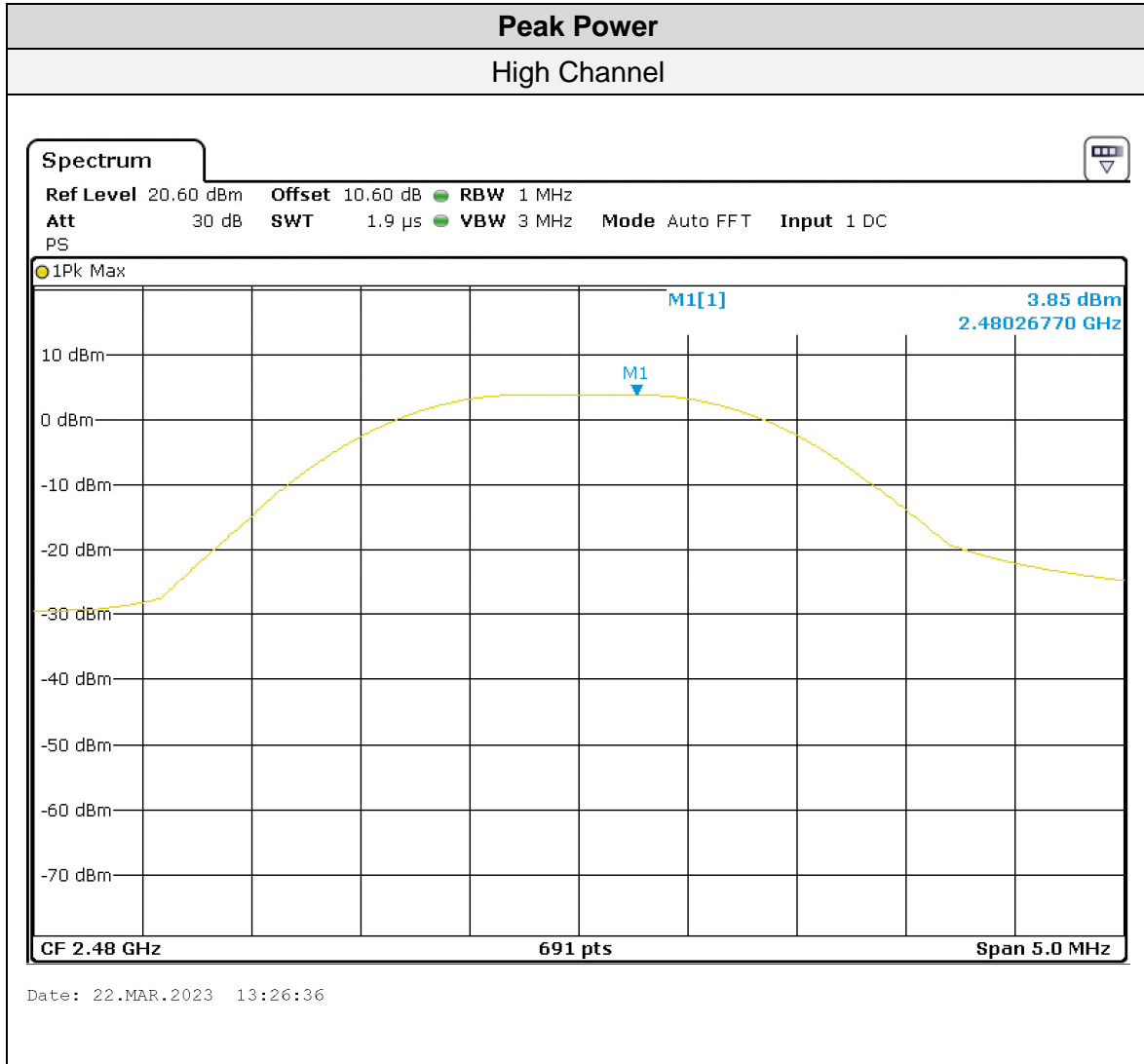
PML300




Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

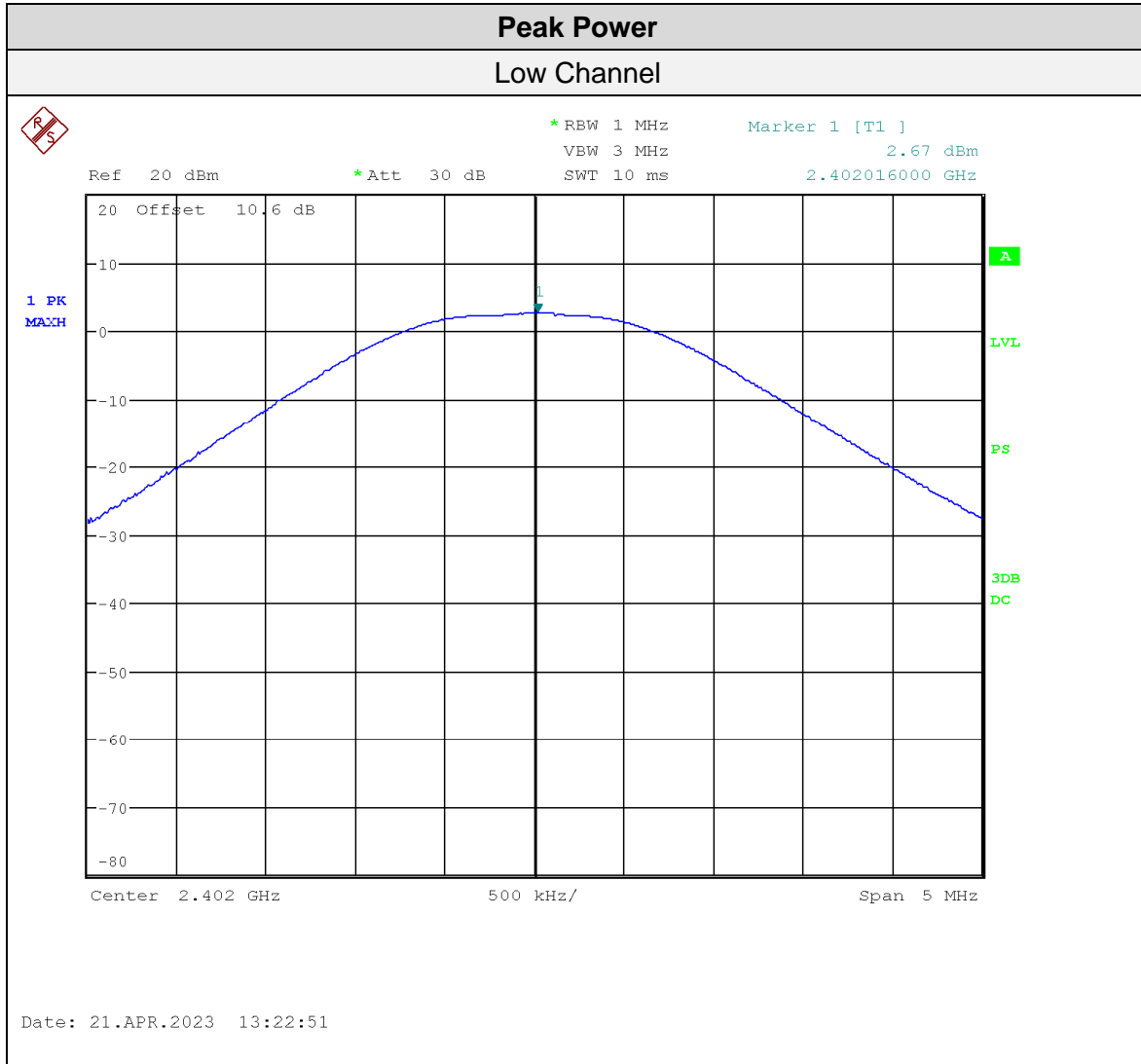



Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
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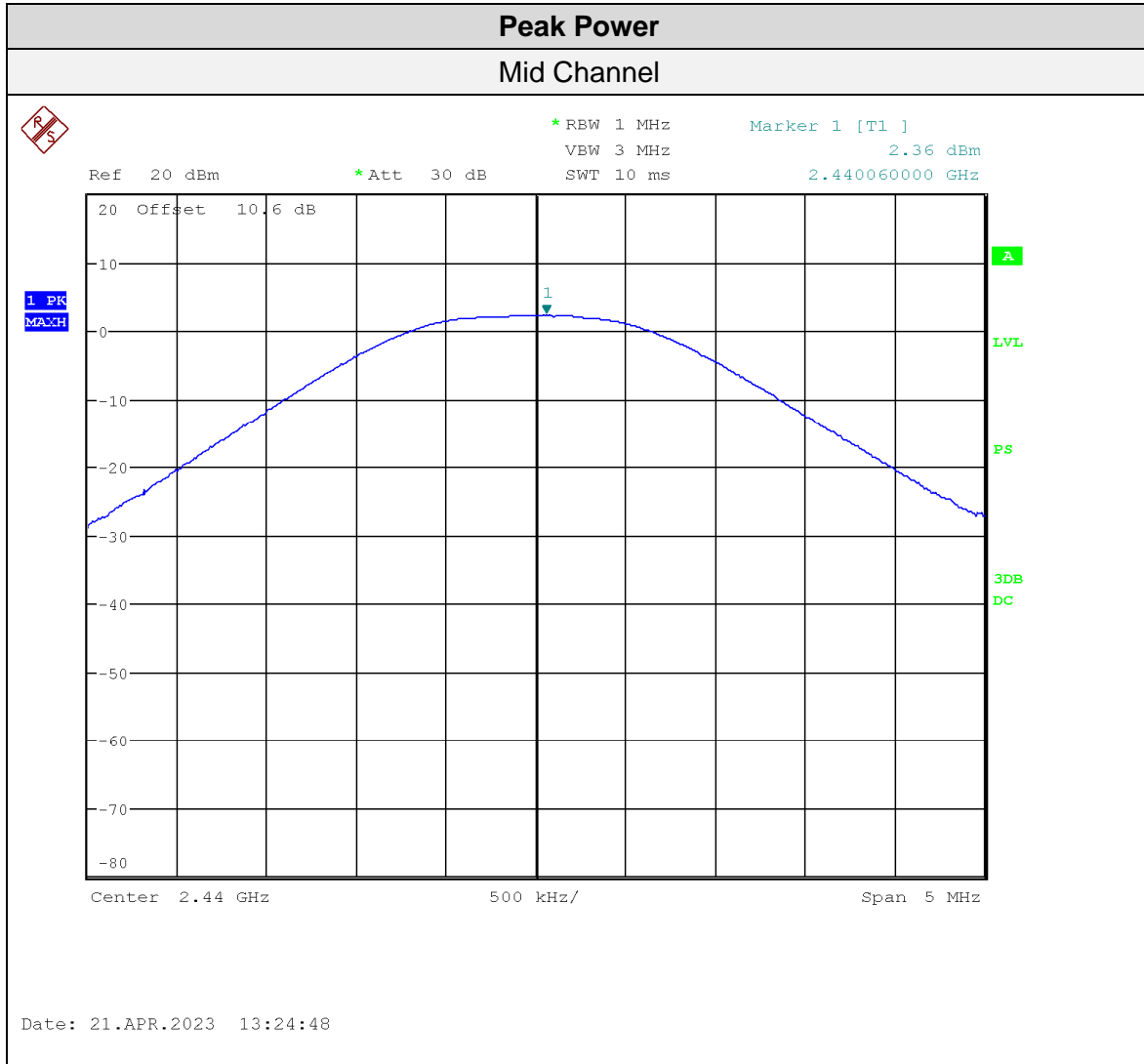



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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

PMR300




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

Test Equipment List

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Spectrum Analyzer	ESR 26	Rohde & Schwarz	Mar. 31, 2022	Mar. 31, 2024	GEMC 341
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	4iiii Innovations	
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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

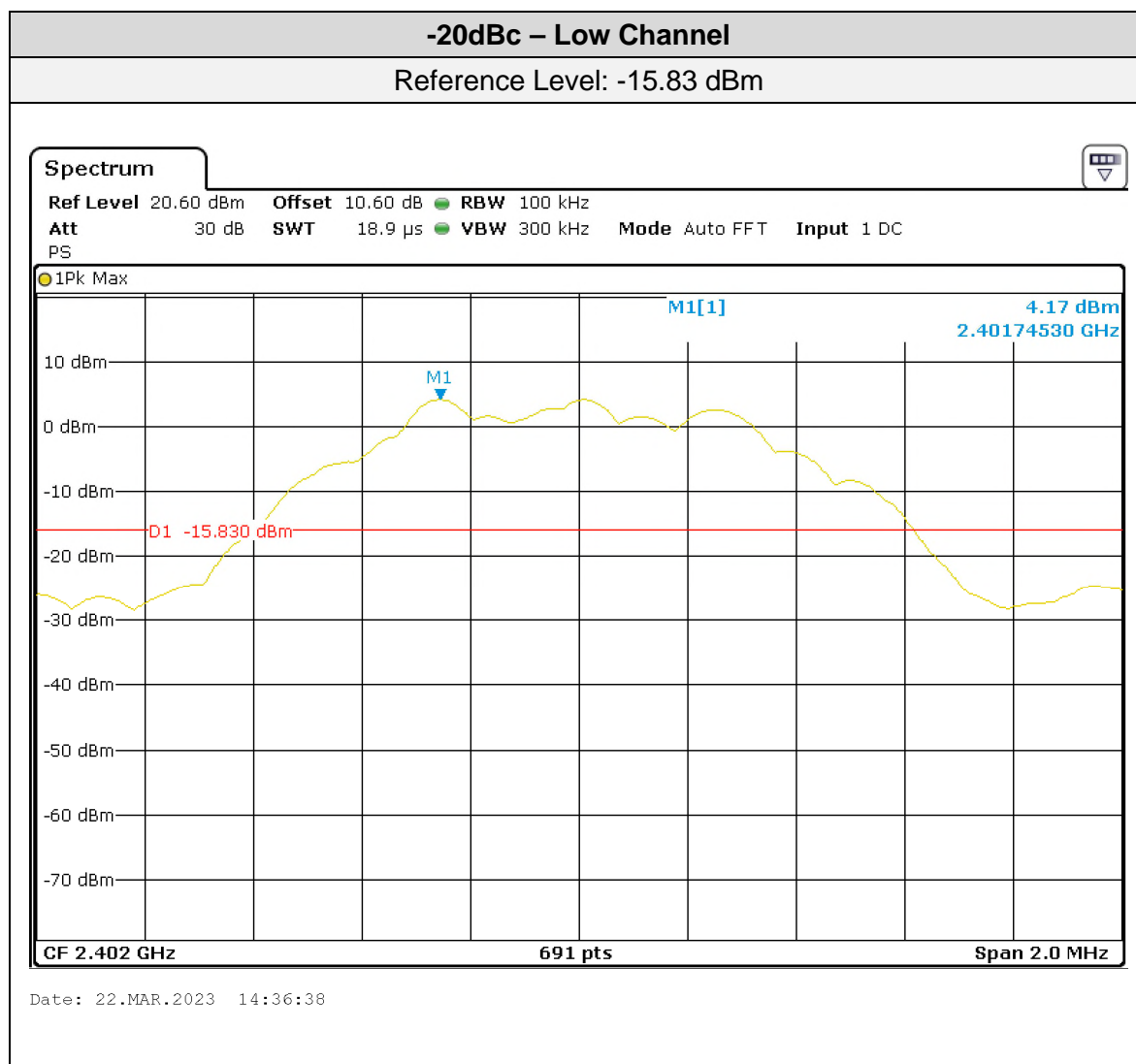
The EUT passed. Low, middle and high bands were measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Graphs

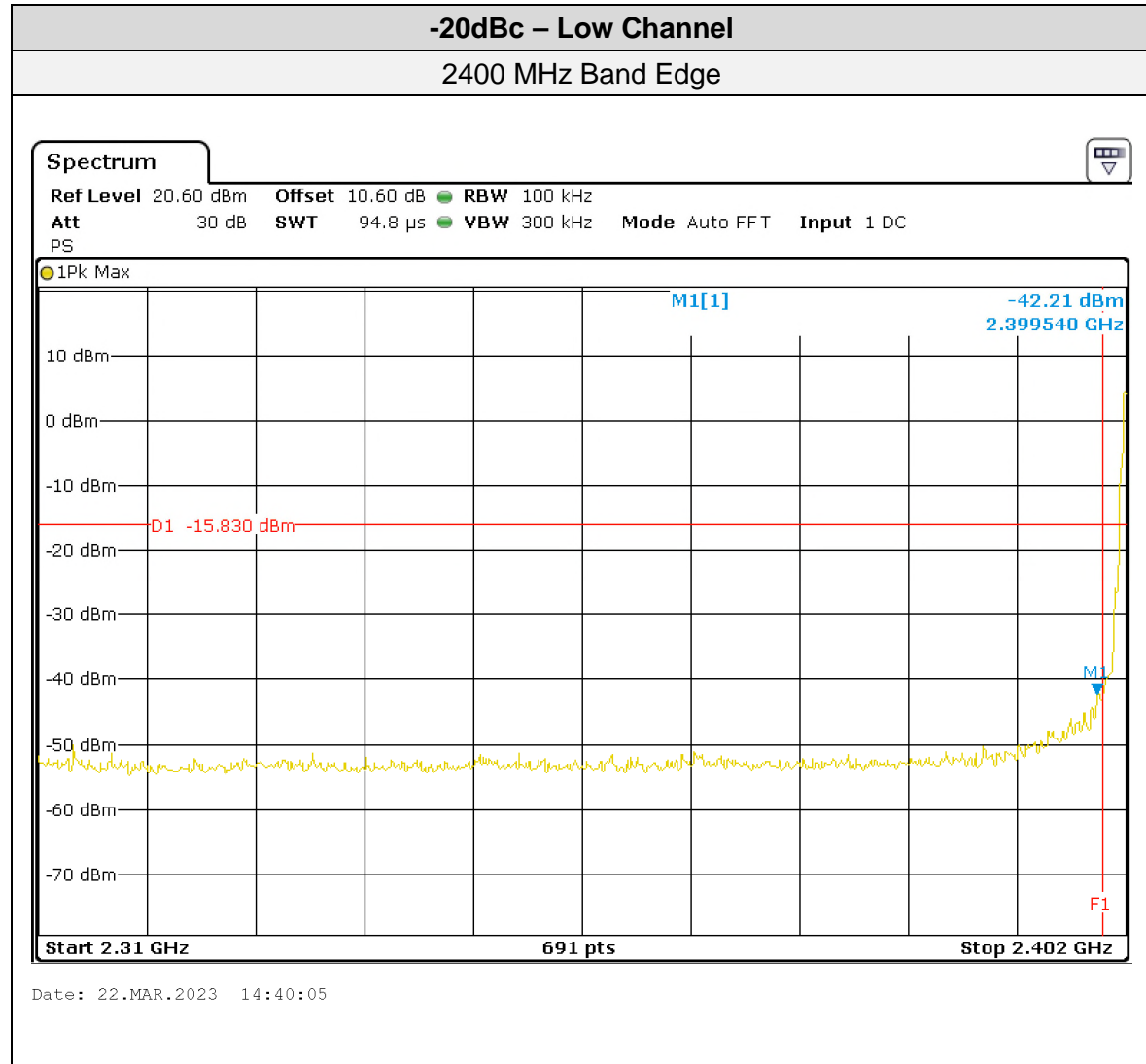
PML300


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

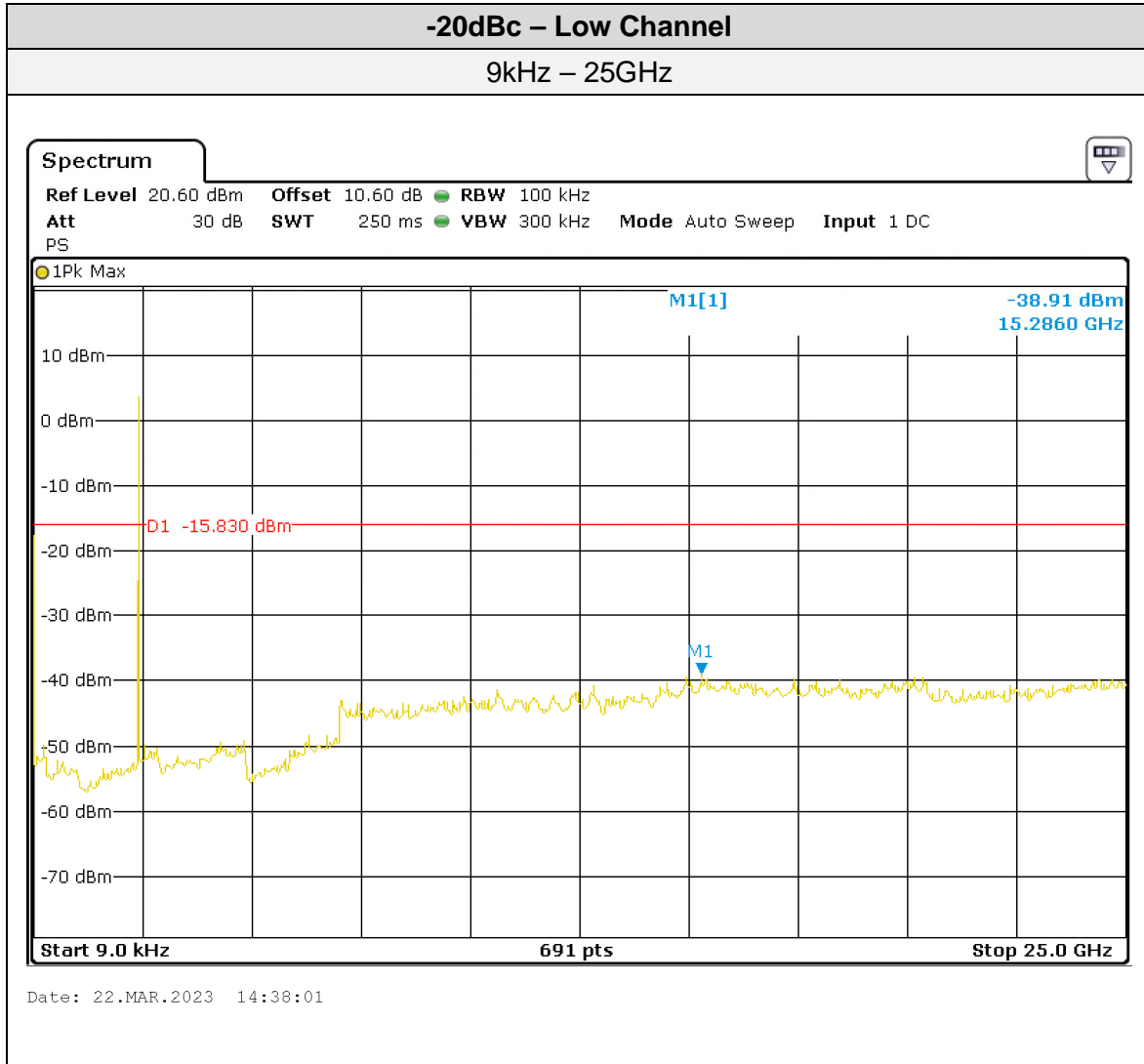



Note: Low channels has the highest power of the three tested channels.

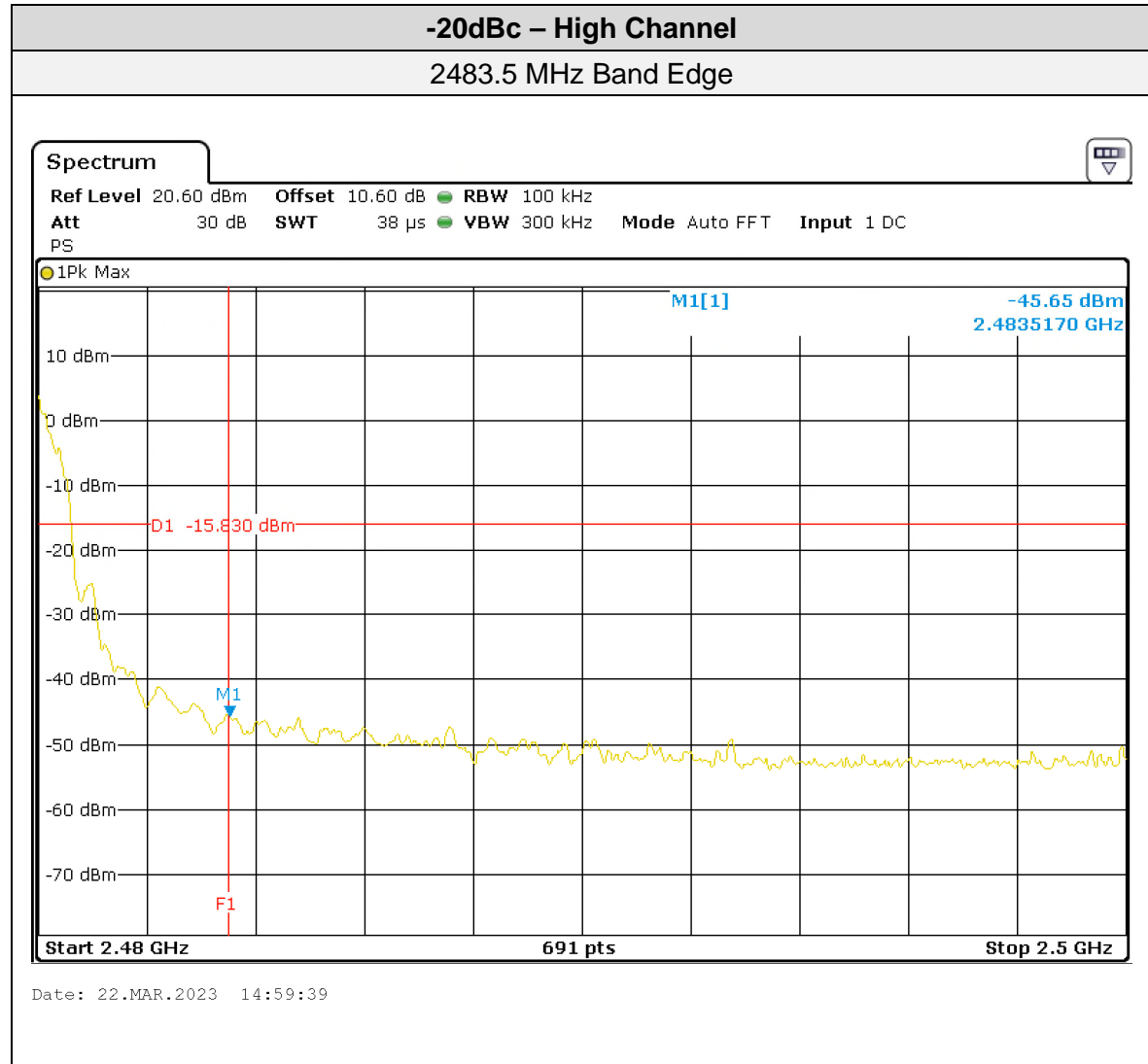
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	4iiii Innovations	
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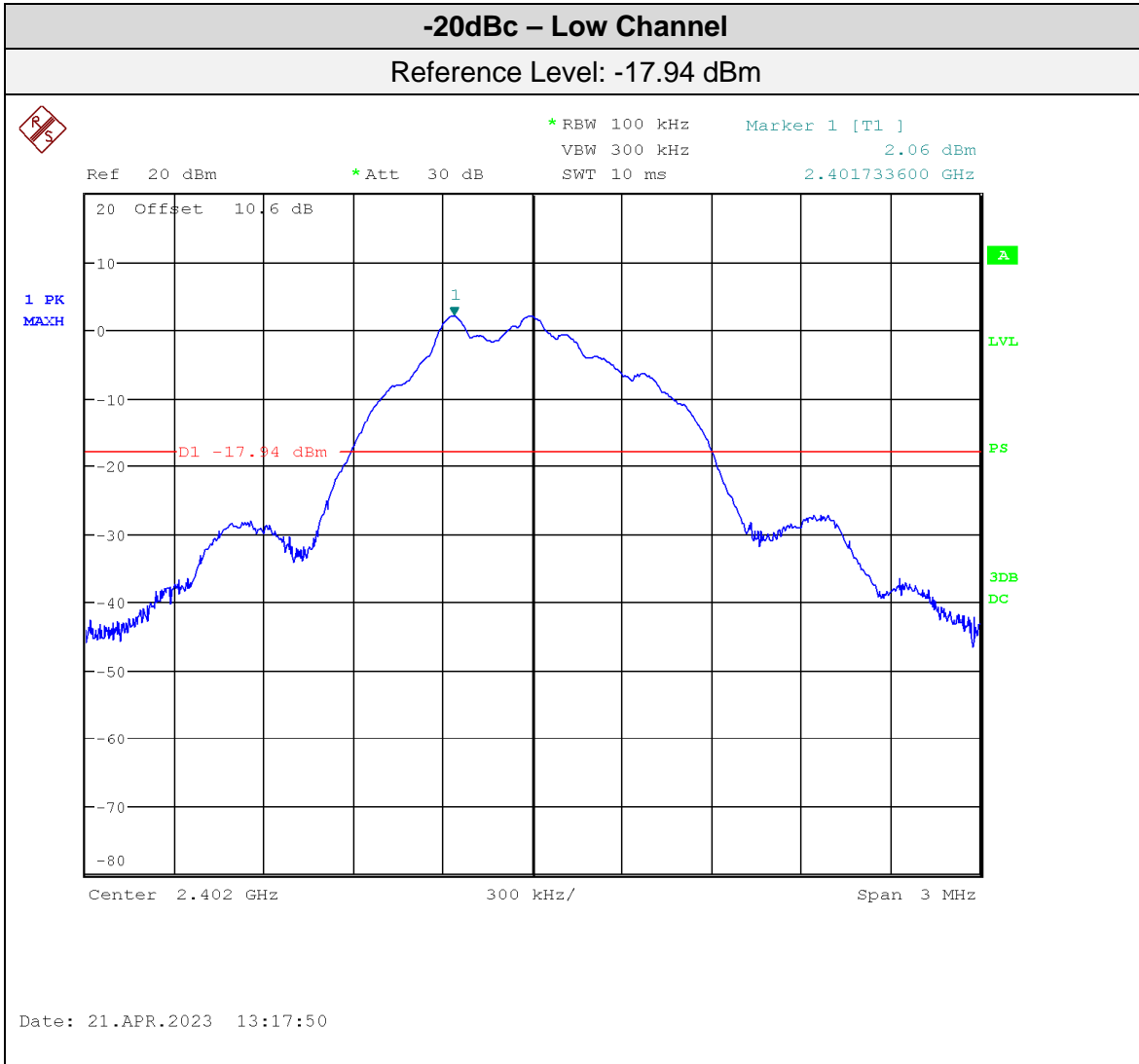
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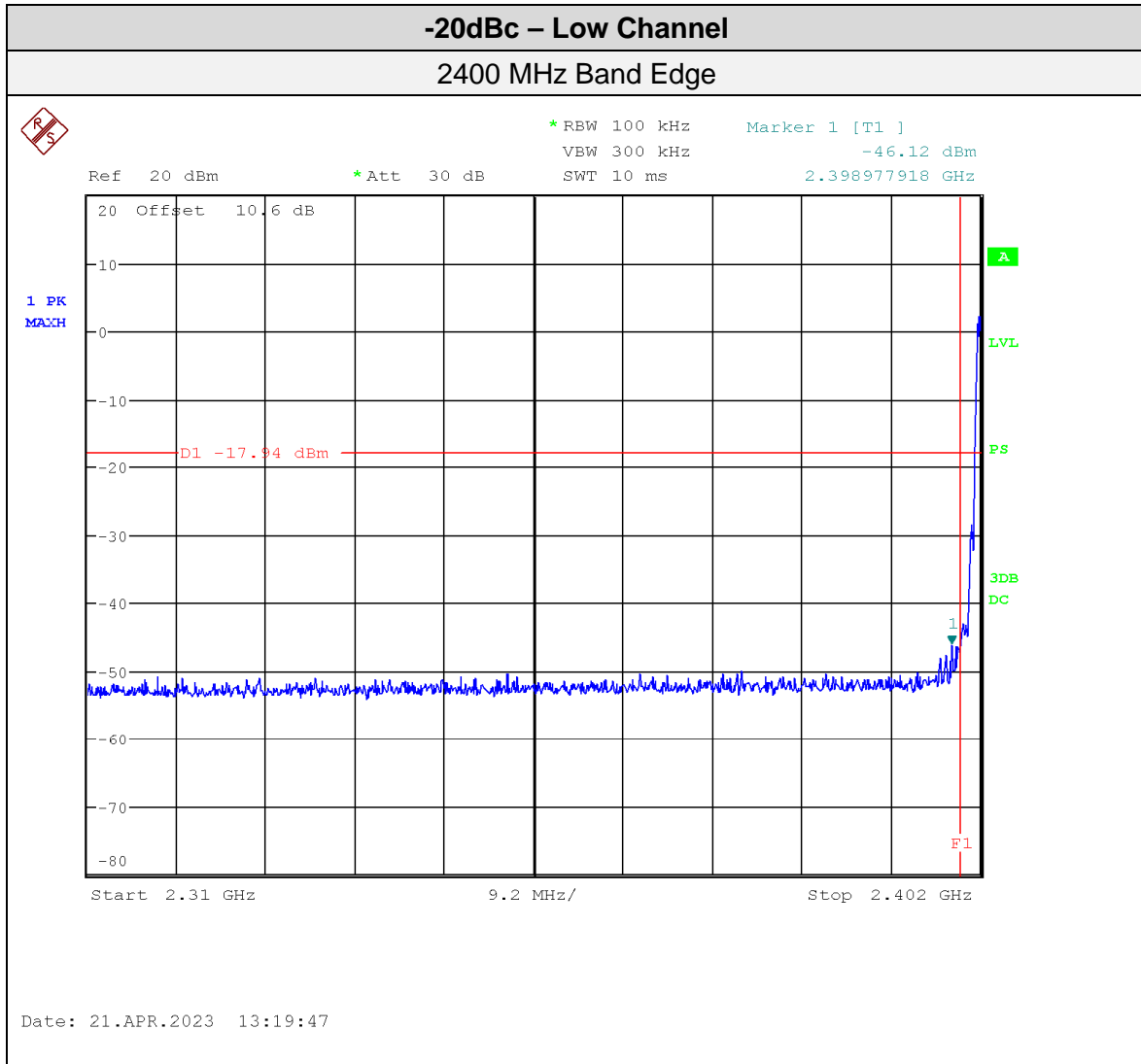
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PMR300

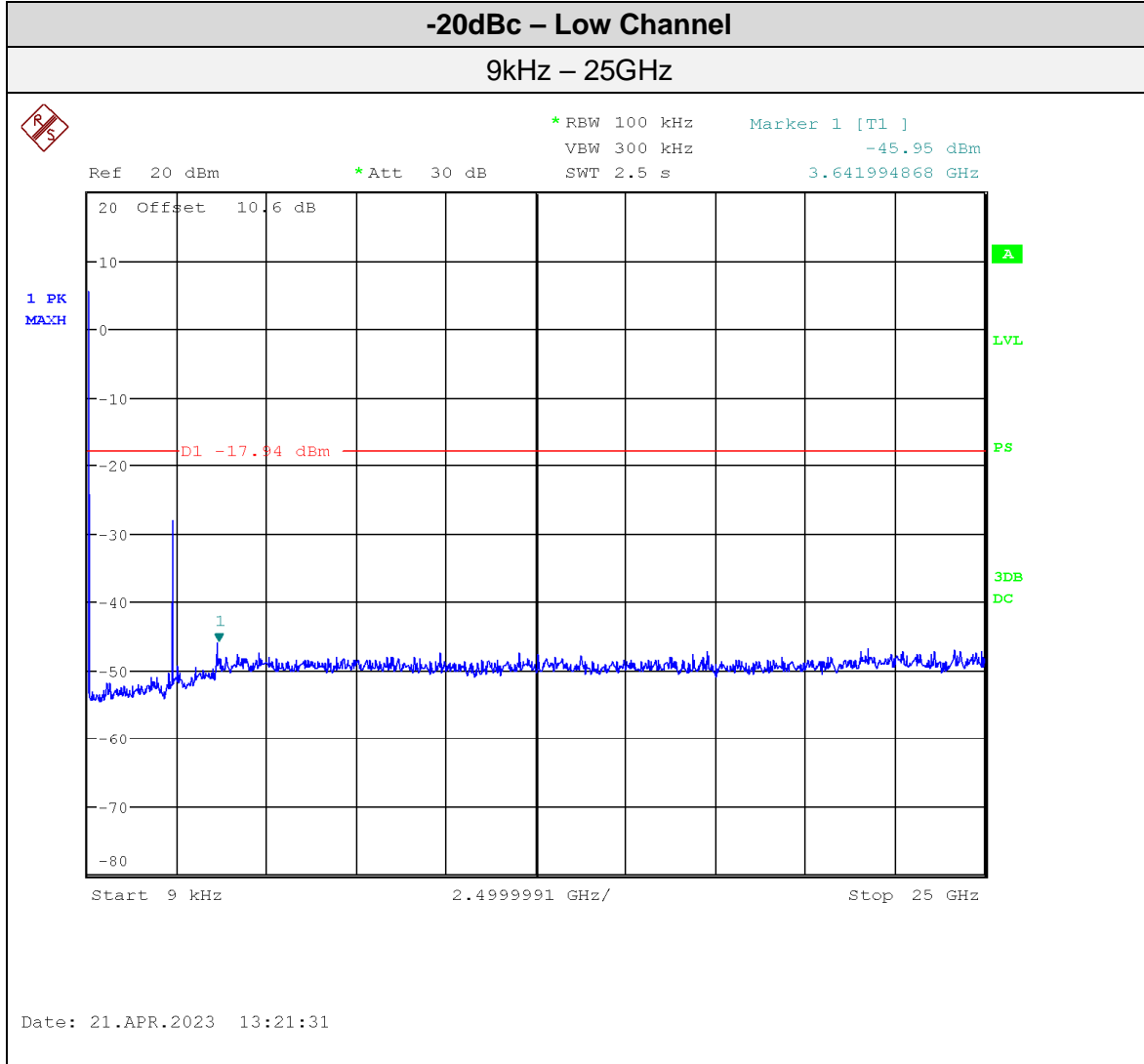
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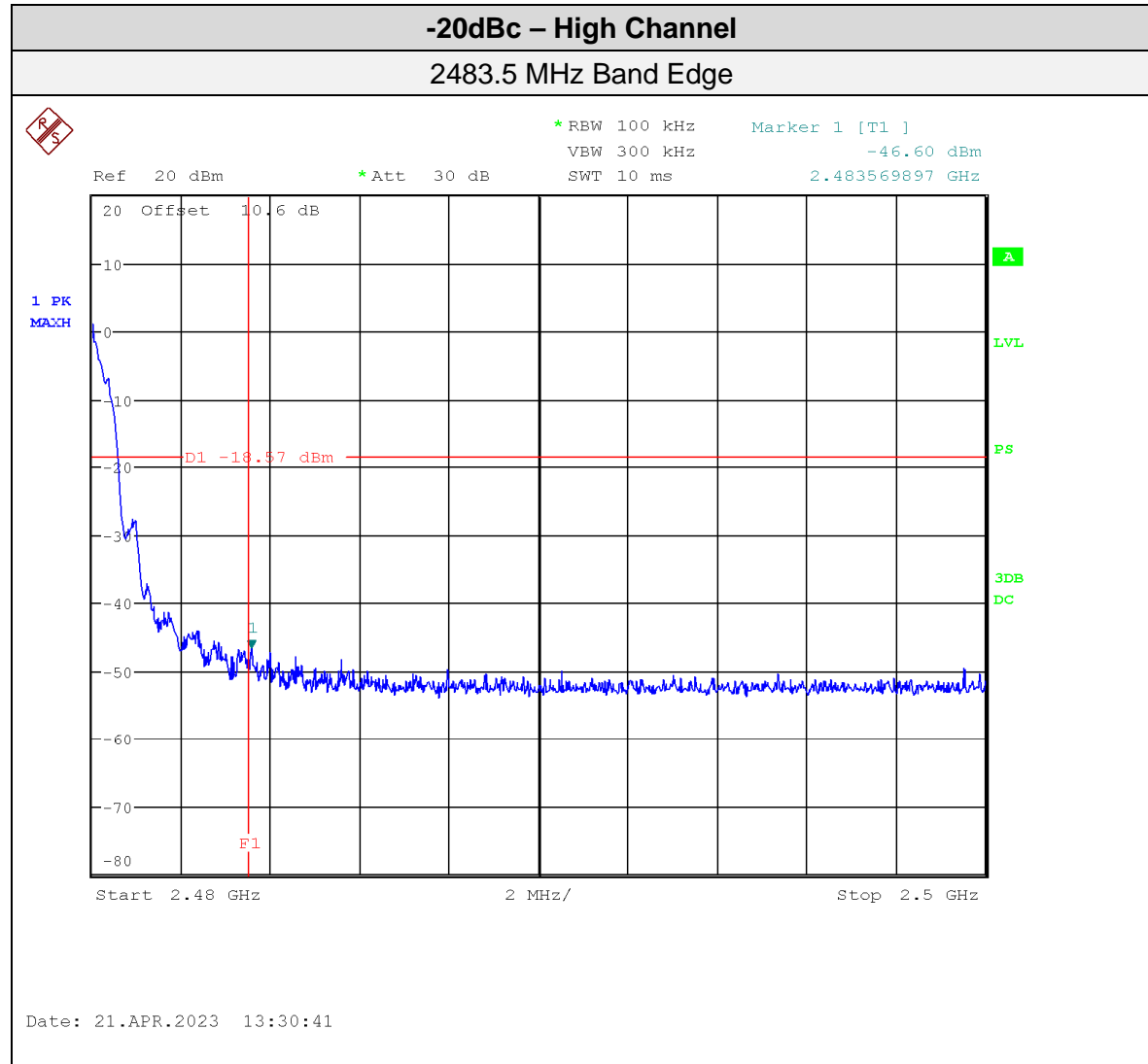
Client	4iiii Innovations	
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Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

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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 8.5 and ANSI C63.10 Section 6.10 and 11.11.

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 (dB $\mu\text{V/m}$)
0.009 MHz – 0.490 MHz	2400/F(kHz) ^a (at 300m)	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

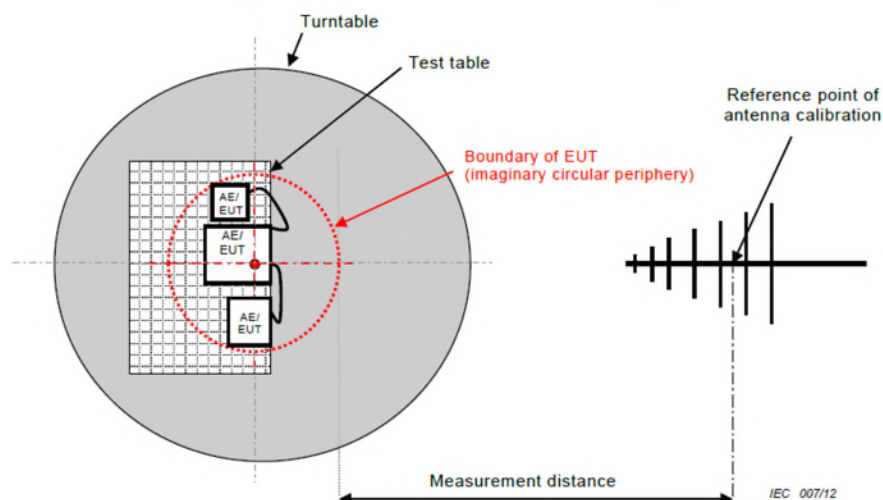
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^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.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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).

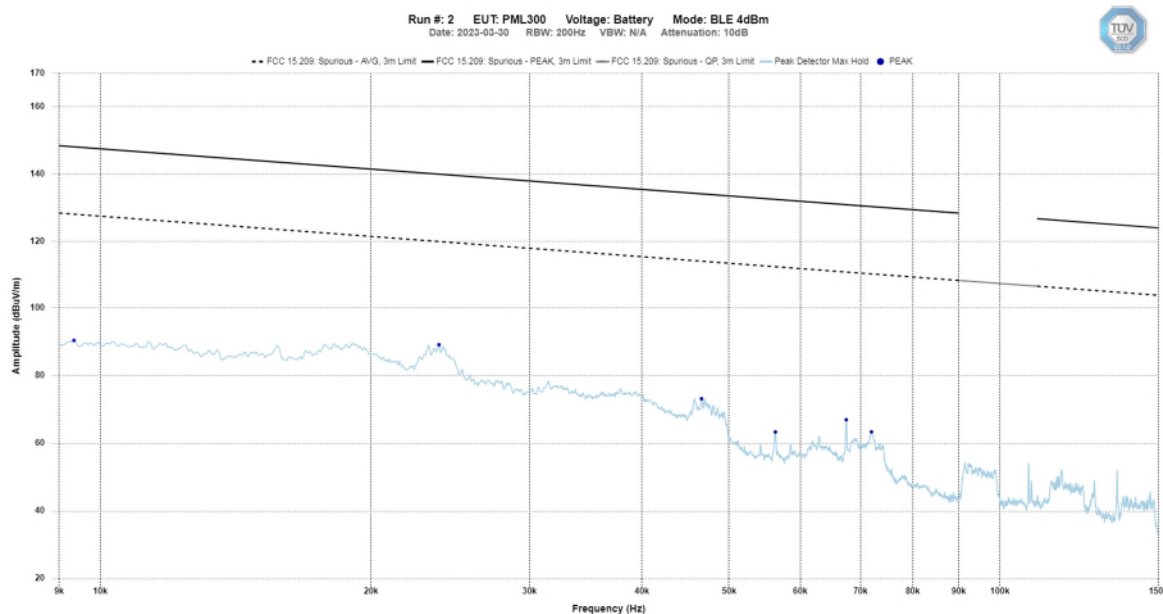
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m /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

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Radiated peak output power for low, middle and high channels in each of the three orthogonal axes were checked. The worst case was used for the EUT configuration during Transmitter Spurious Radiated Emissions which was high channel in the X-axis orientation.

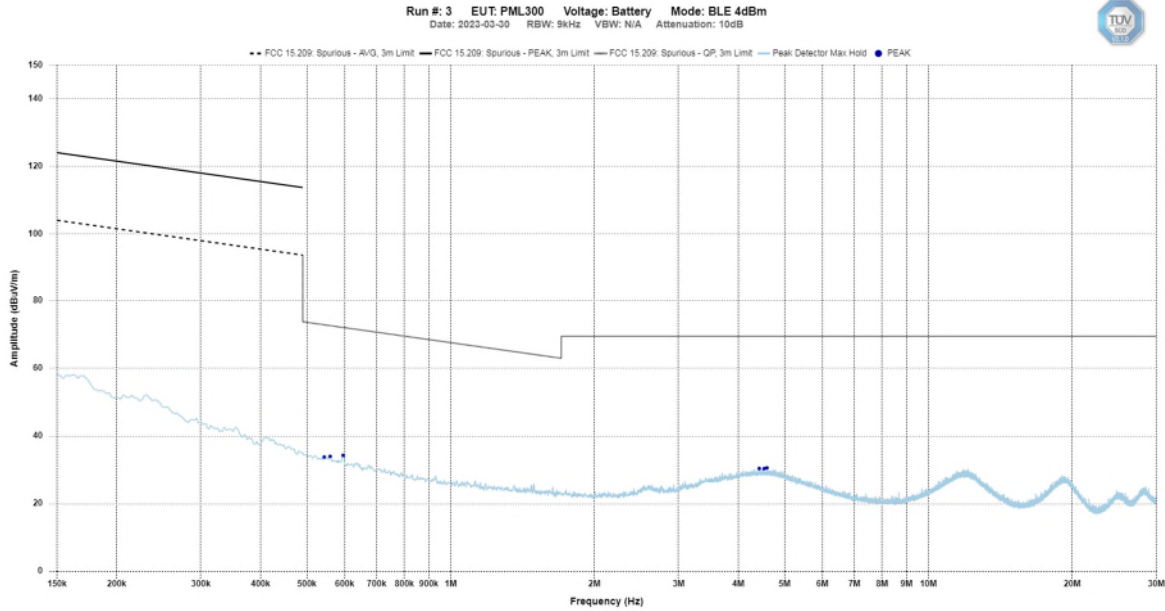
Band-edge measurement graphs are shown for illustration purposes. For Band Edge measurements, the external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer. See final measurement section for all measurements. Graphs for the worst-case, X-axis, are presented.

Spurious Emissions – PML300

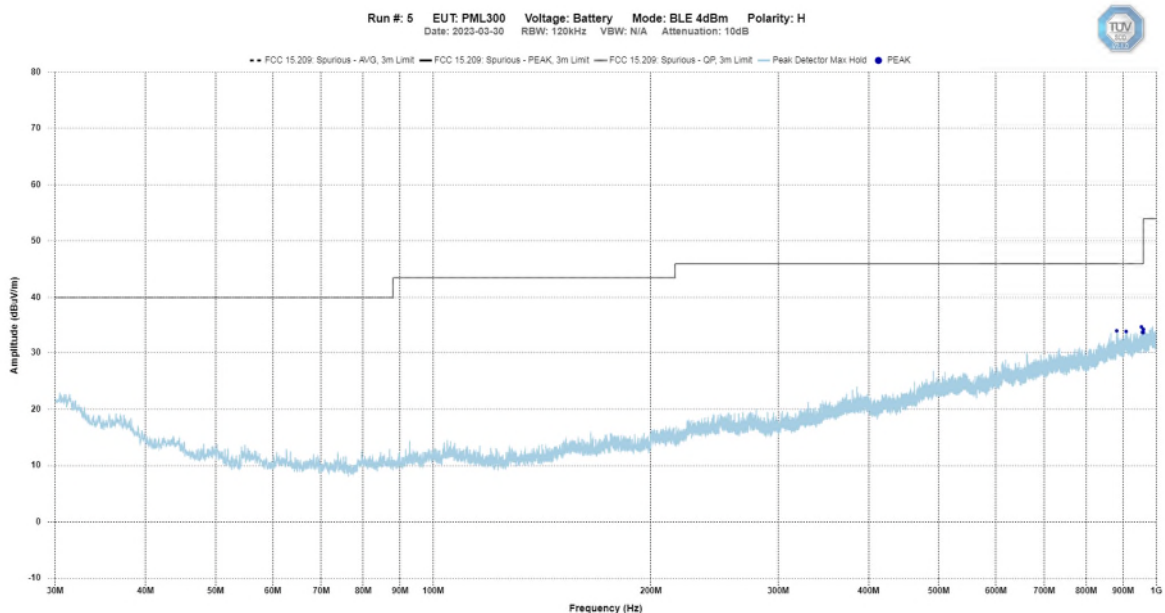


High Channel
9 kHz – 150 kHz - Peak Emission Graph


Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

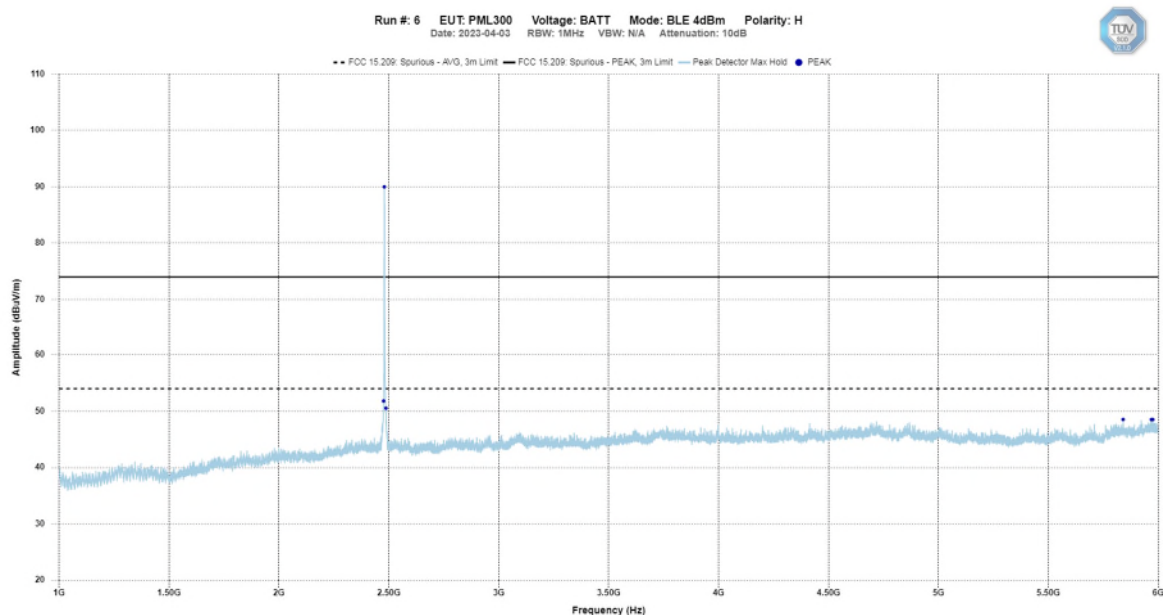


High Channel - 150 kHz – 30 MHz
Peak Emission Graph




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

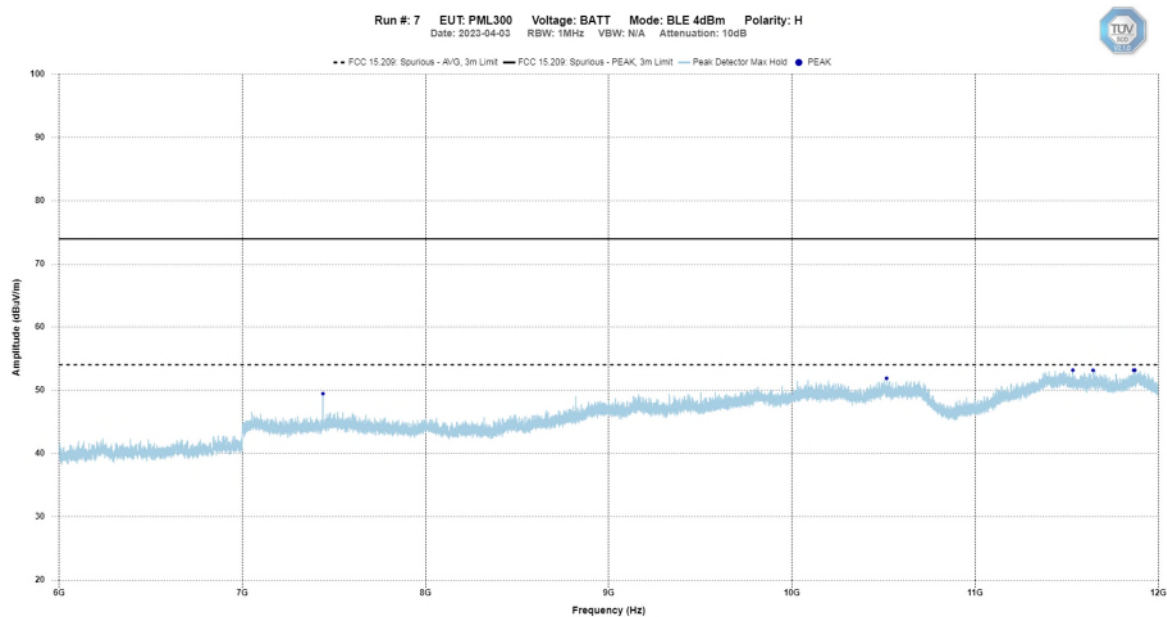
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

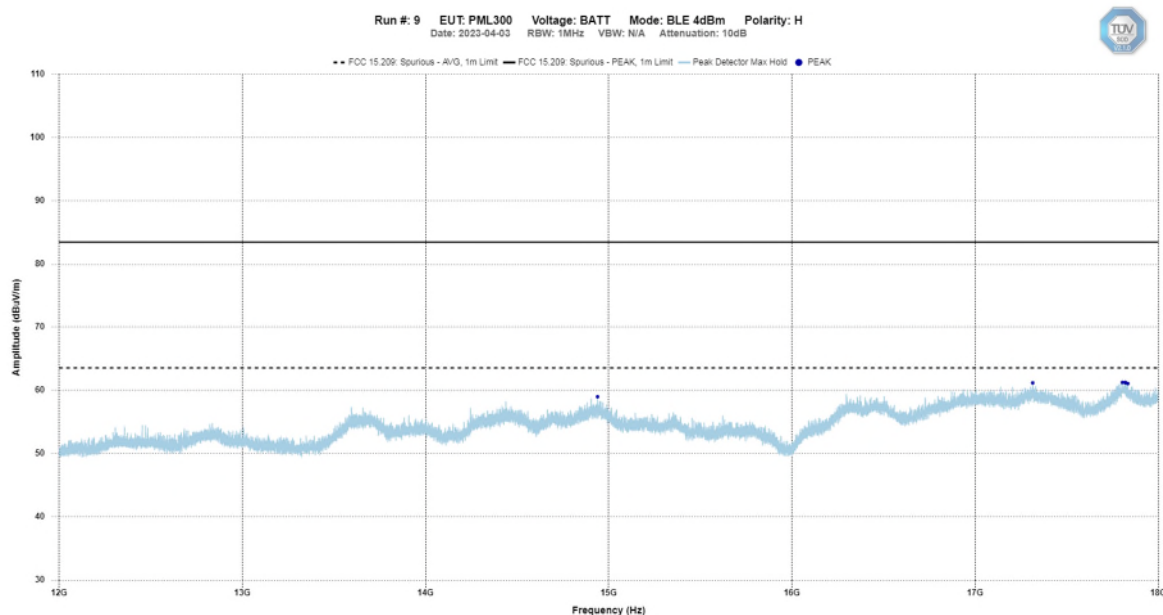
Note: The emissions at 2.48MHz are from the BLE intentional transmitter and therefore were not considered for final measurements of radiated spurious emissions.

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

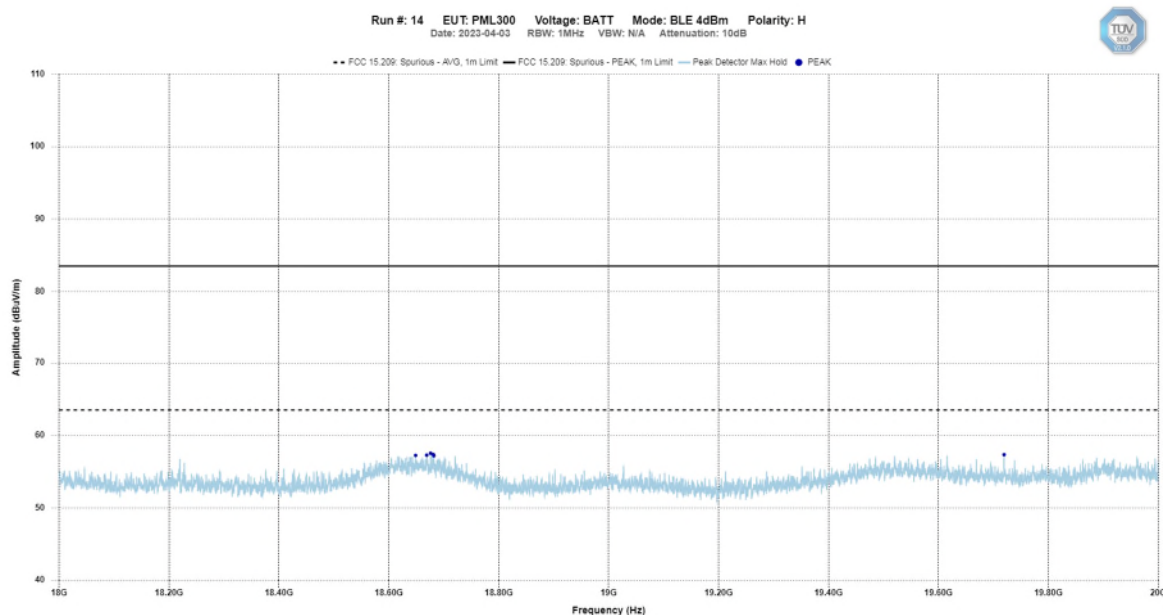
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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


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

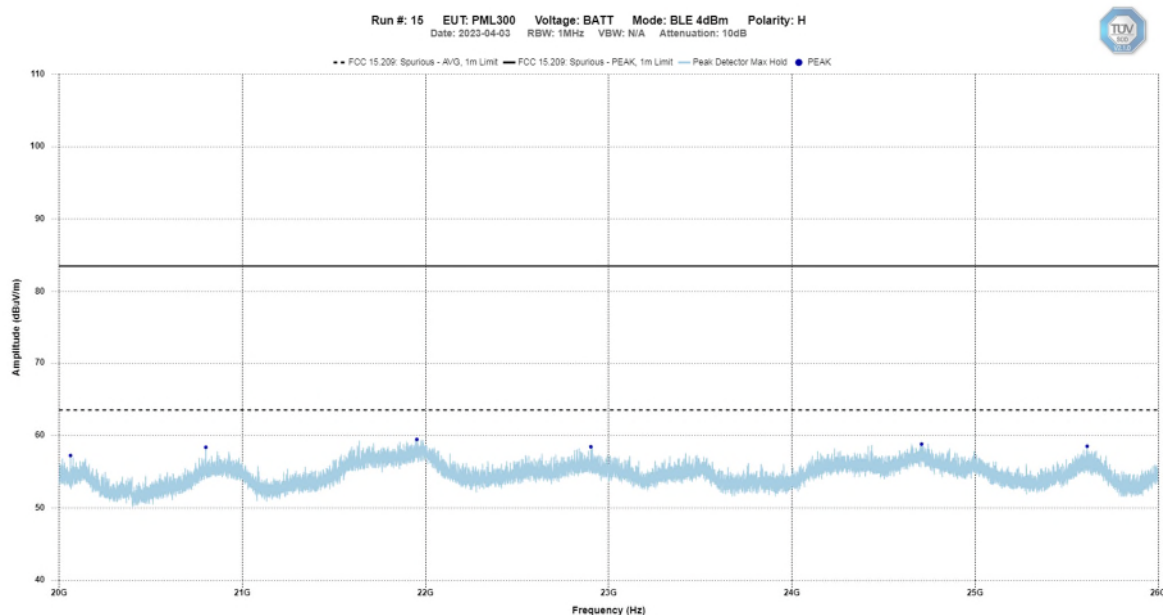
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



High Channel – 18 GHz – 20 GHz
Horizontal - Peak Emission Graph


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

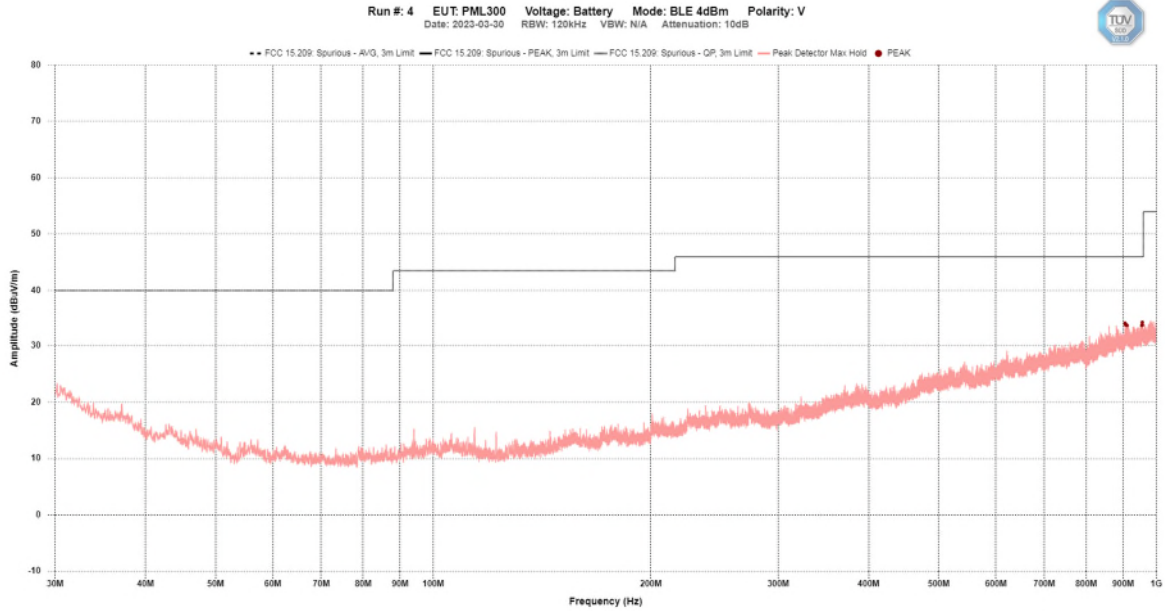
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 20 GHz – 26 GHz
Horizontal - Peak Emission Graph

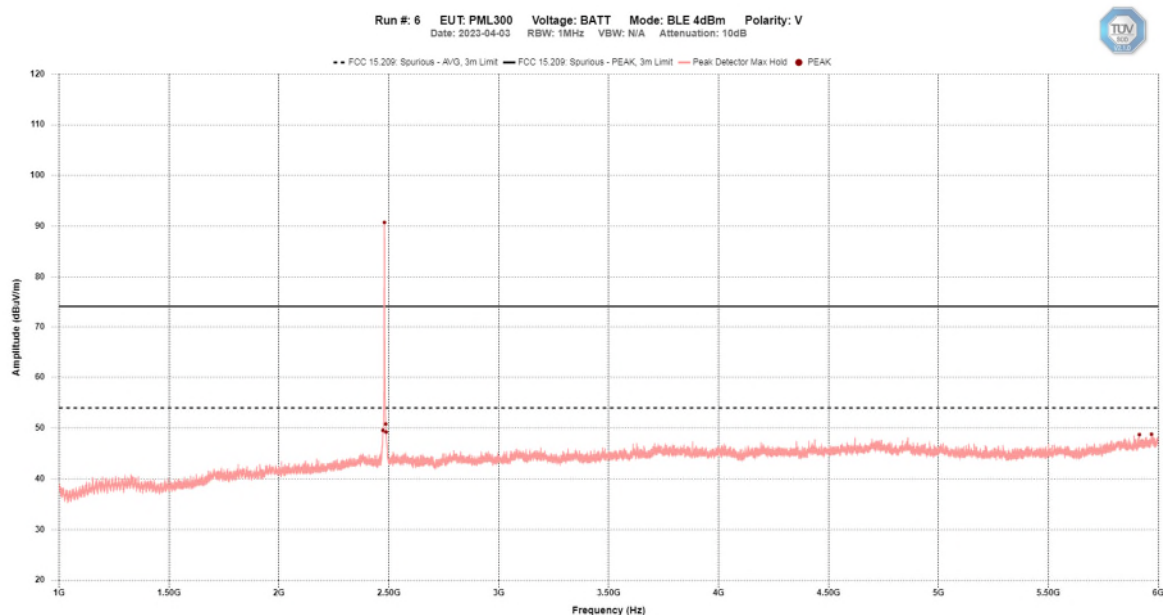
Note: Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

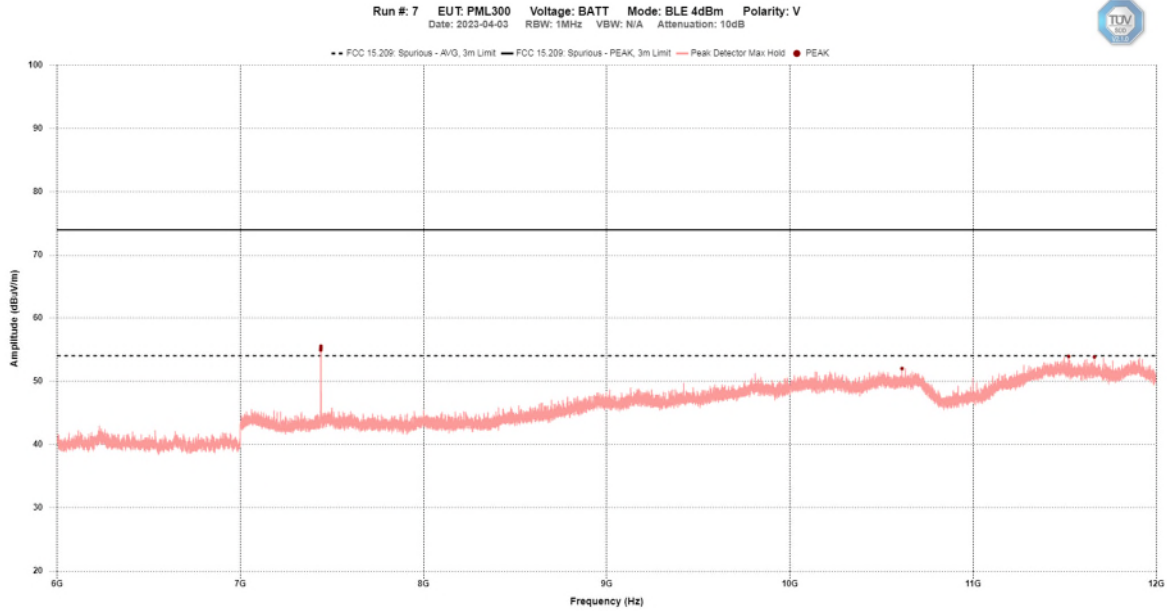
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph

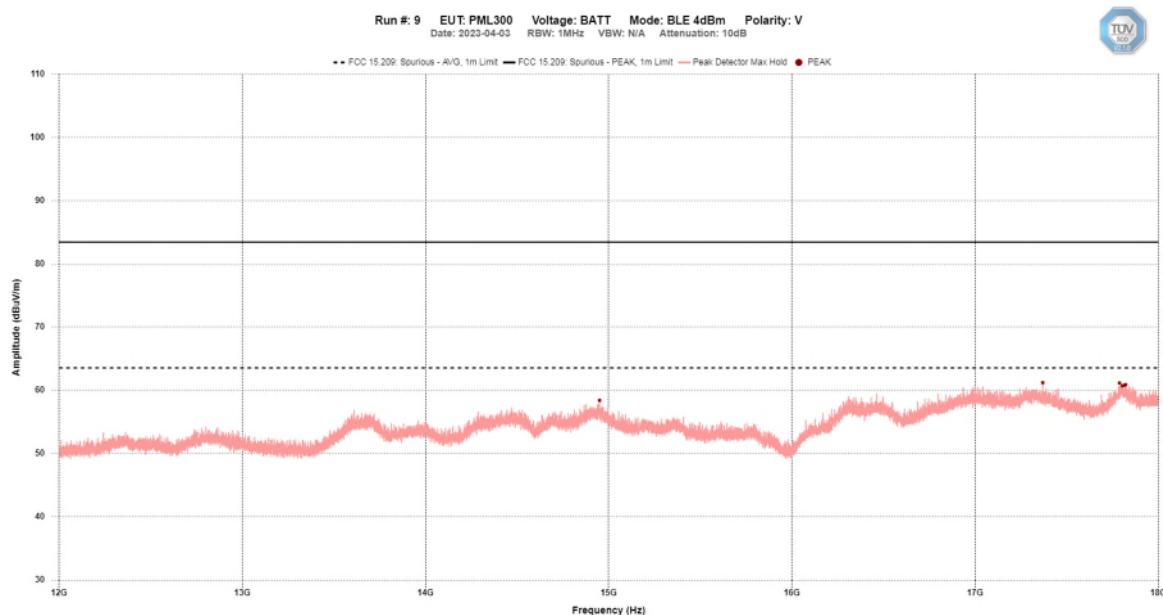
Note: The emissions at 2.48MHz are from the BLE intentional transmitter and therefore were not considered for final measurements of radiated spurious emissions.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 6 GHz – 12 GHz
Vertical - Peak Emission Graph

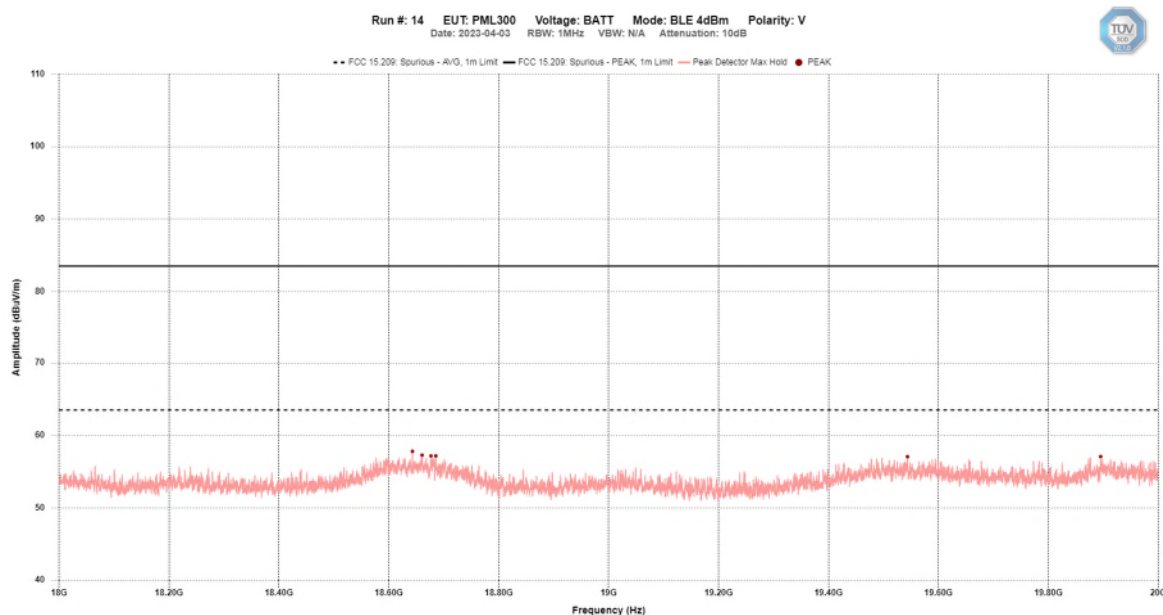
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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


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

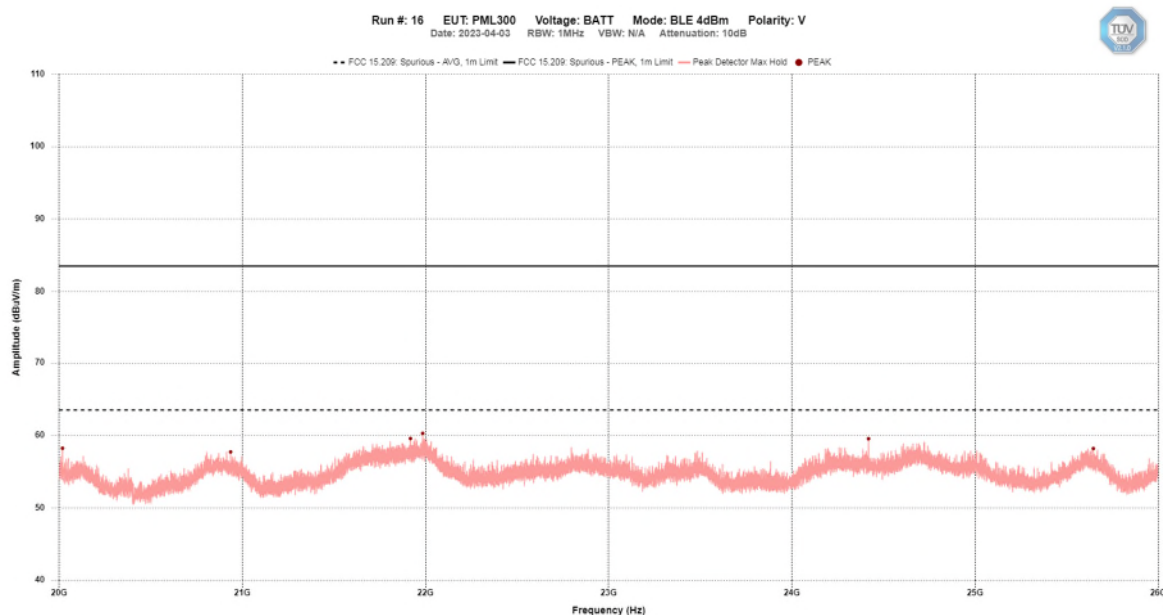
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



High Channel – 18 GHz – 20 GHz
Vertical - Peak Emission Graph


Note: 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	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

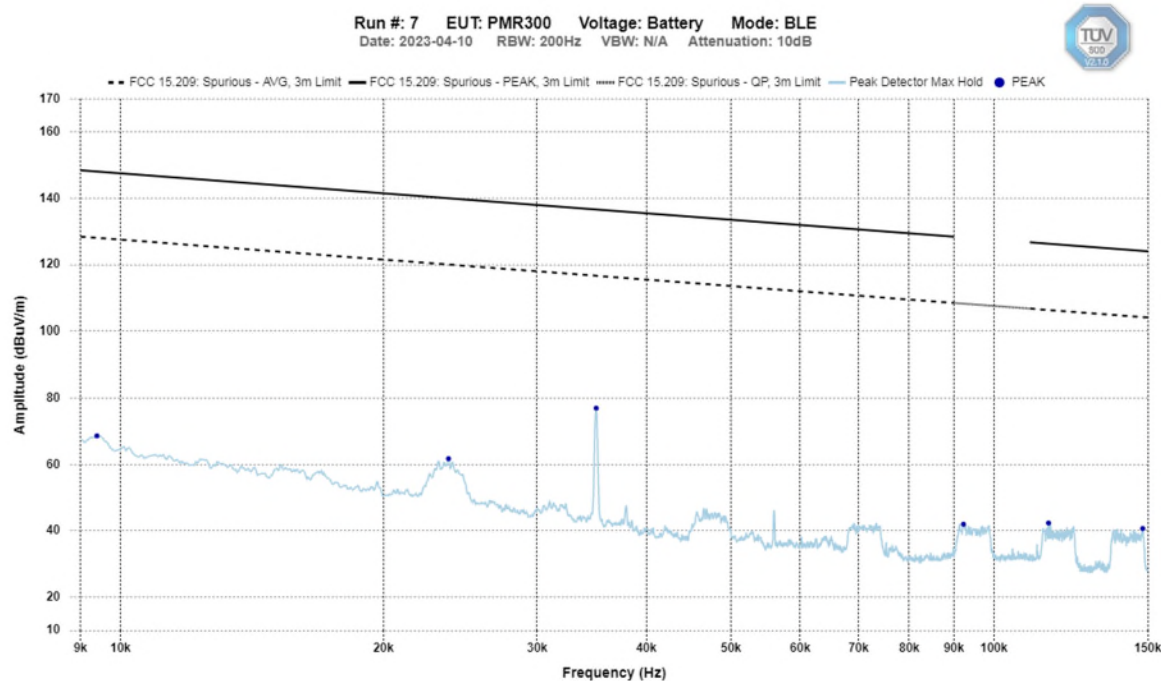


High Channel – 20 GHz – 26 GHz
Vertical - Peak Emission Graph


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

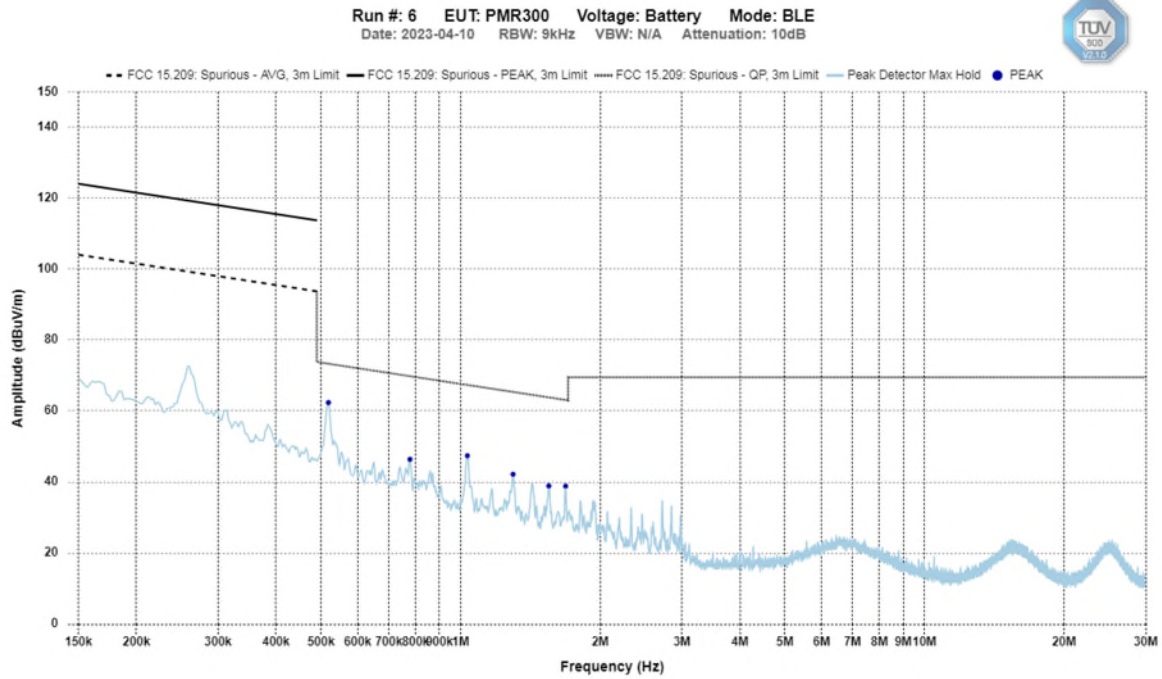
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Spurious Emissions – PMR300




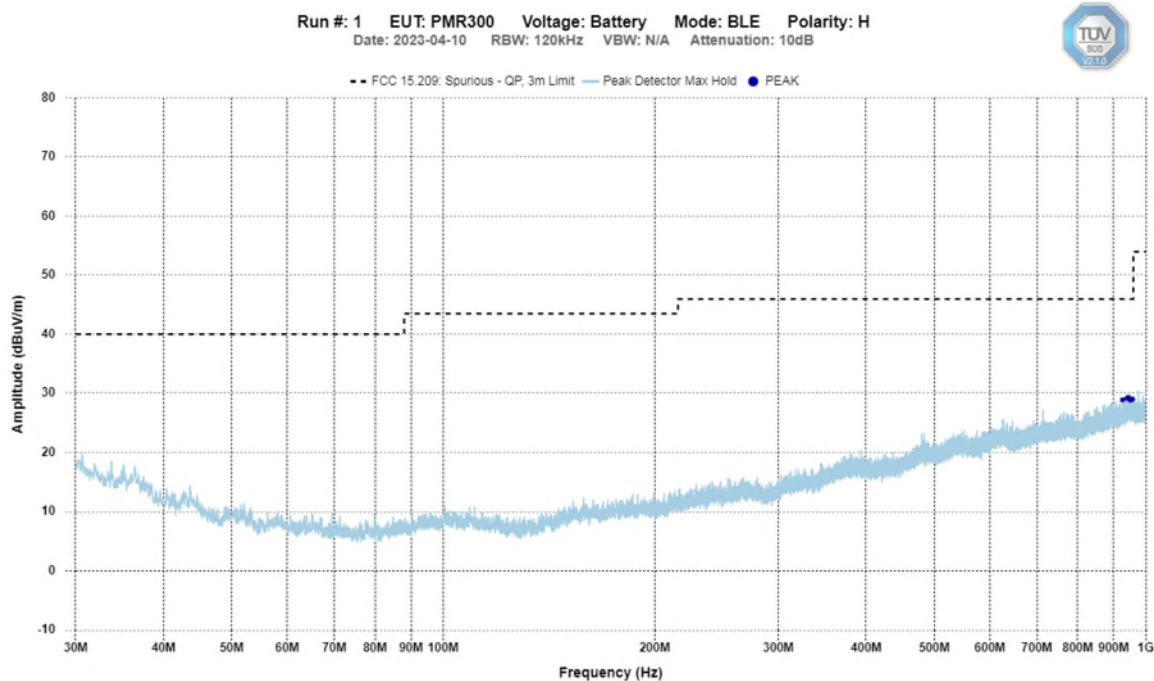
High Channel - 9 kHz – 150 kHz
Peak Emission Graph

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




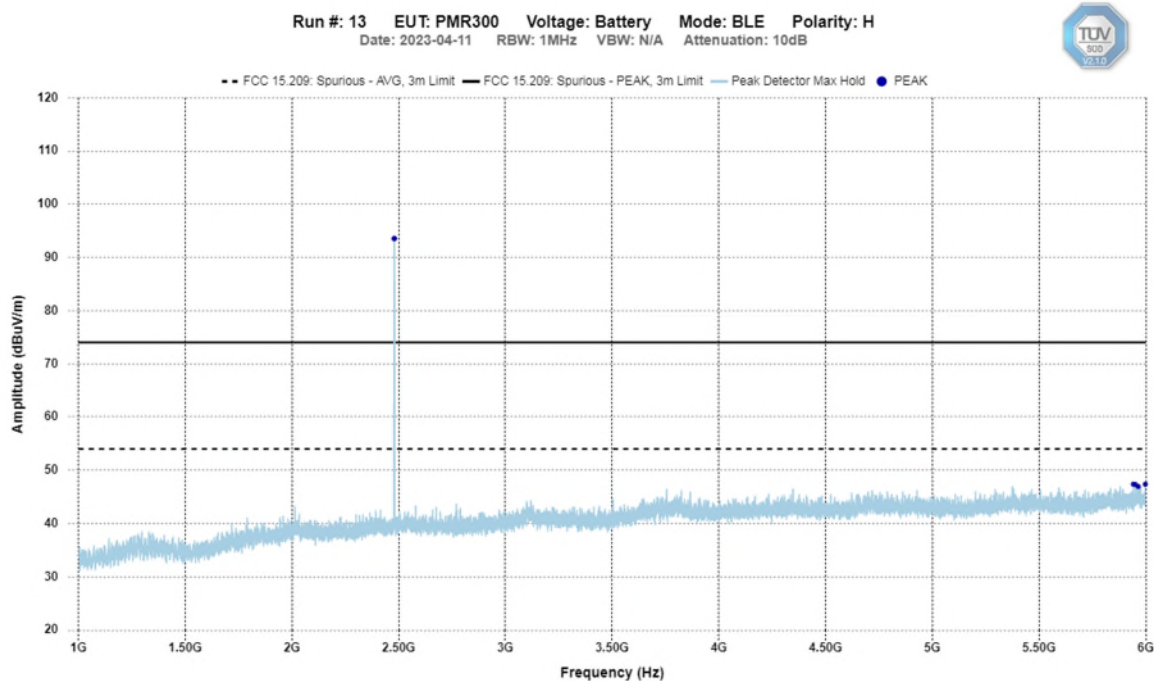
High Channel - 150 kHz – 30 MHz
Peak Emission Graph

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

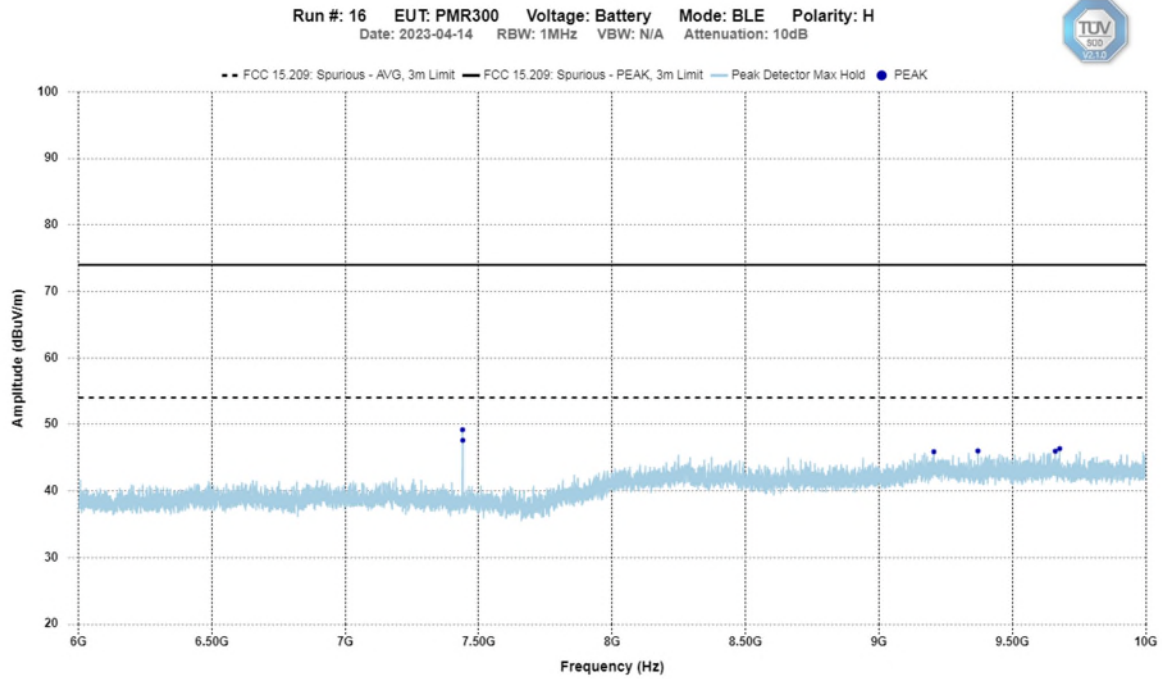
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

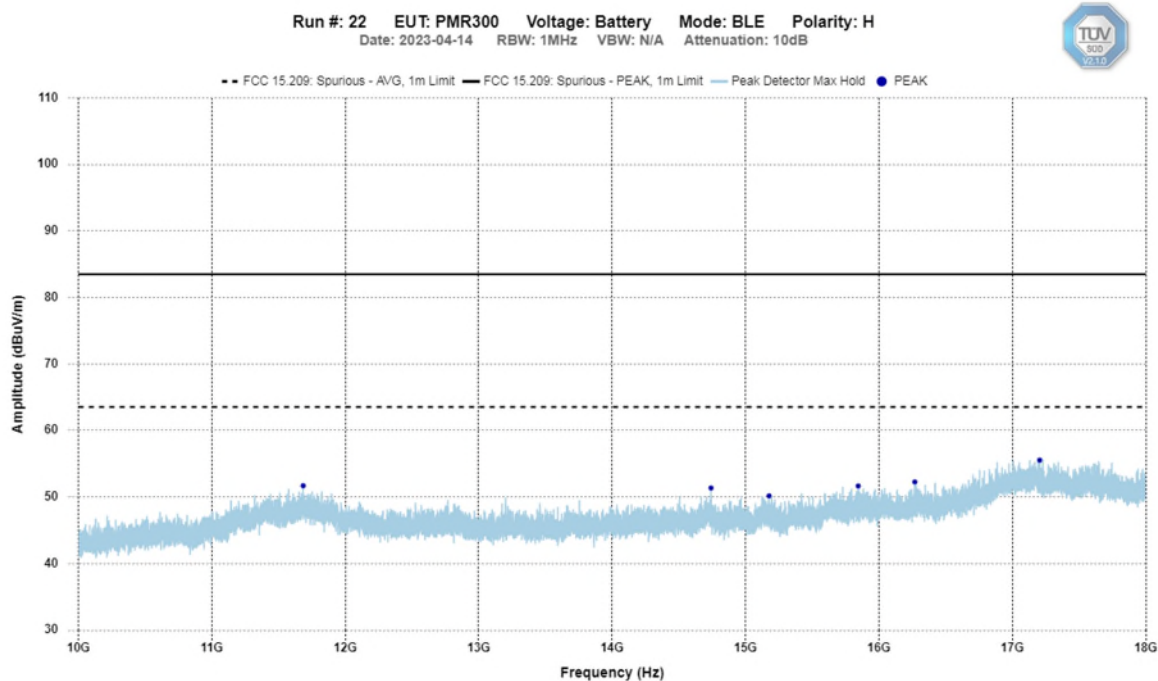
Note: The emissions at 2.48MHz are from the BLE intentional transmitter and therefore were not considered for final measurements of radiated spurious emissions.

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 6 GHz – 10 GHz
Horizontal - Peak Emission Graph

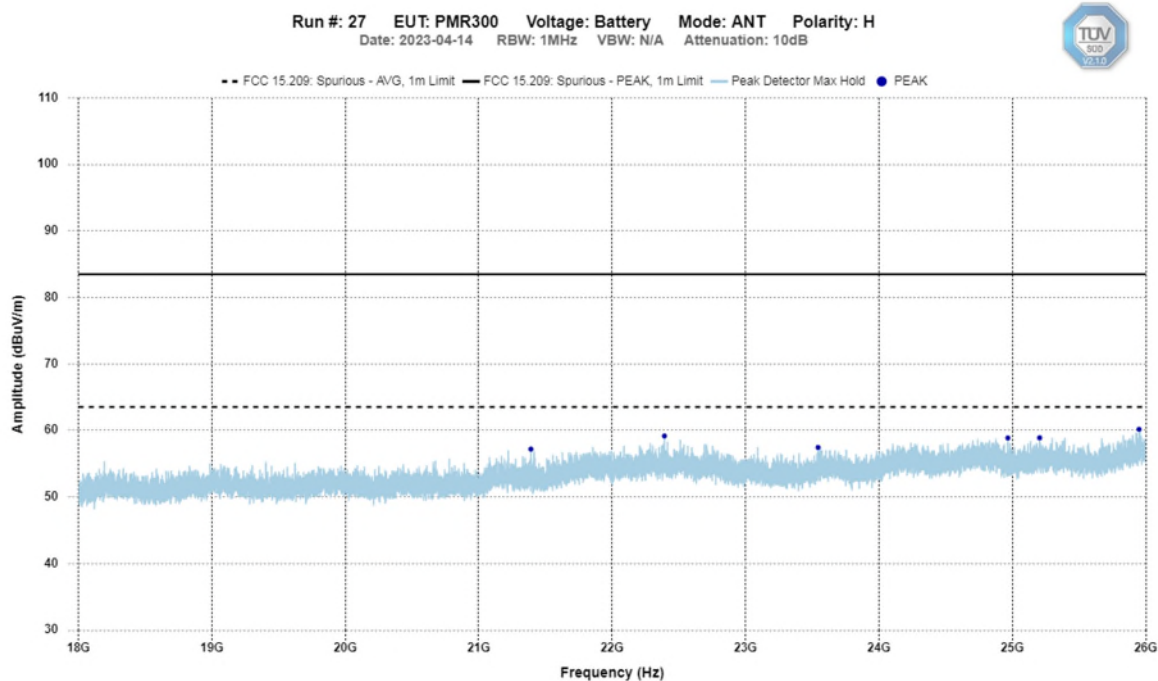
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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


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

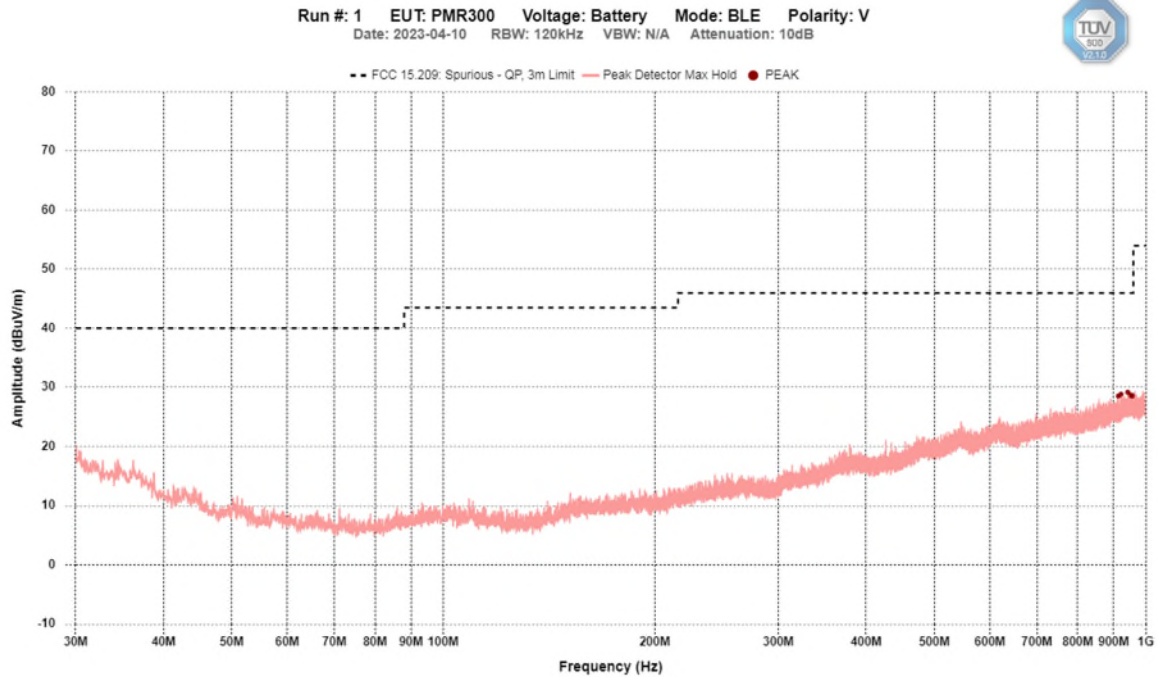
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 18 GHz – 26 GHz
Horizontal - Peak Emission Graph

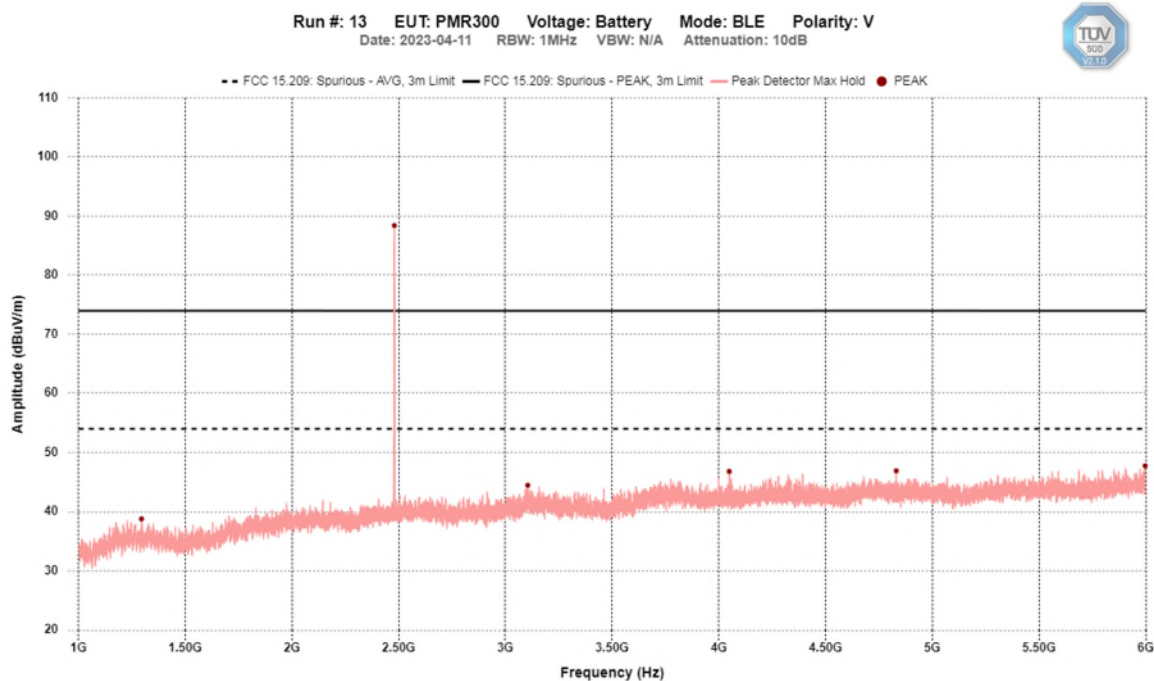
Note: Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




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

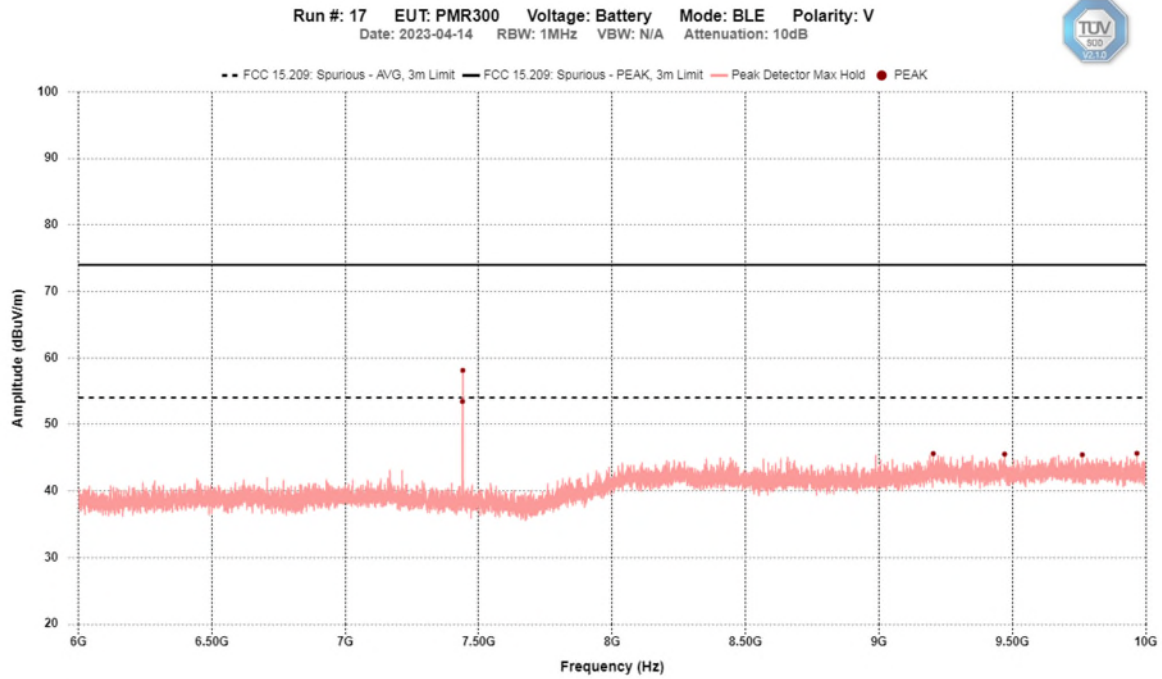
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph

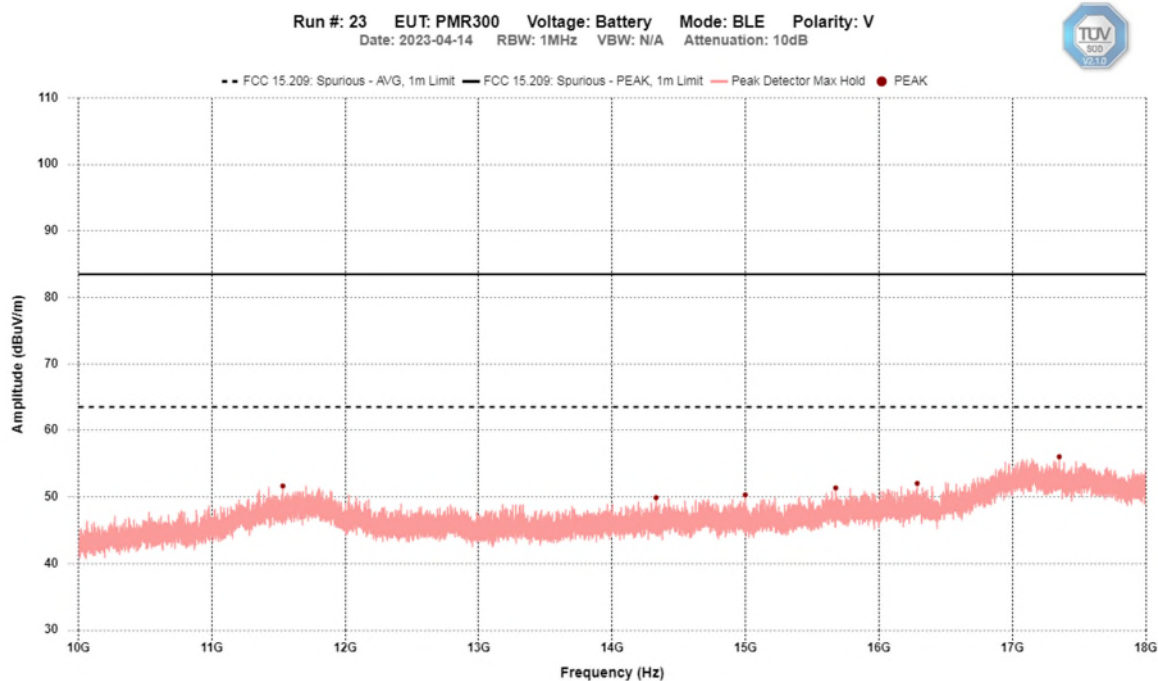
Note: The emissions at 2.48MHz are from the BLE intentional transmitter and therefore were not considered for final measurements of radiated spurious emissions.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




High Channel – 6 GHz – 10 GHz
Vertical - Peak Emission Graph

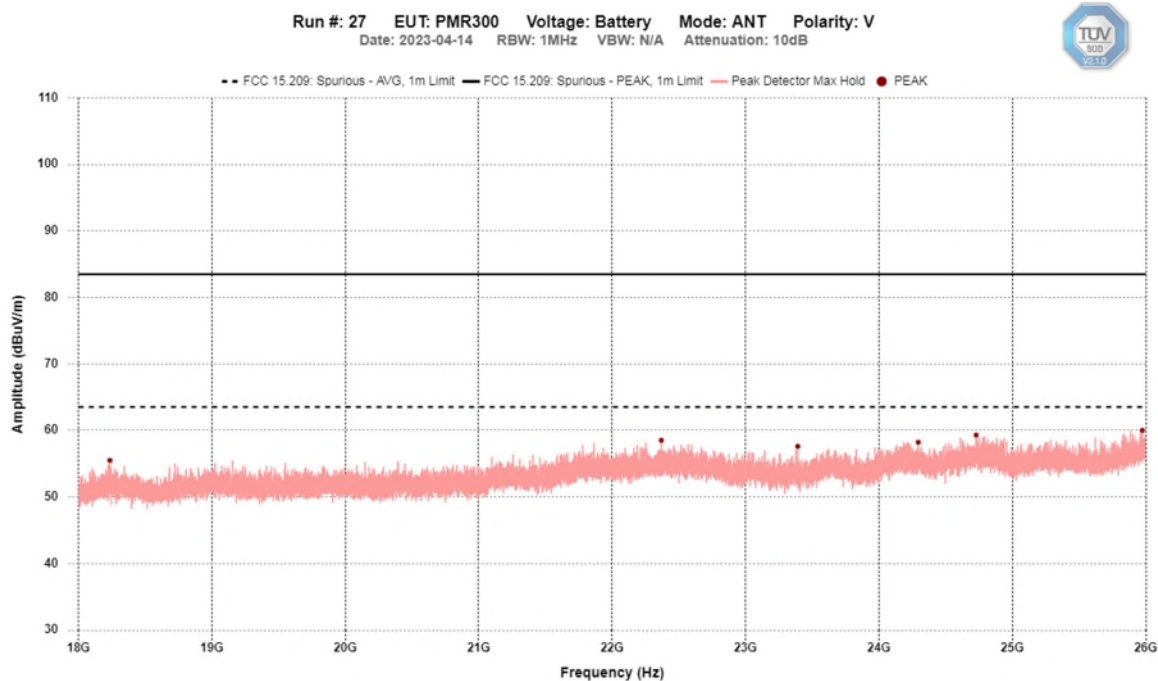
Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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


Note: 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	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

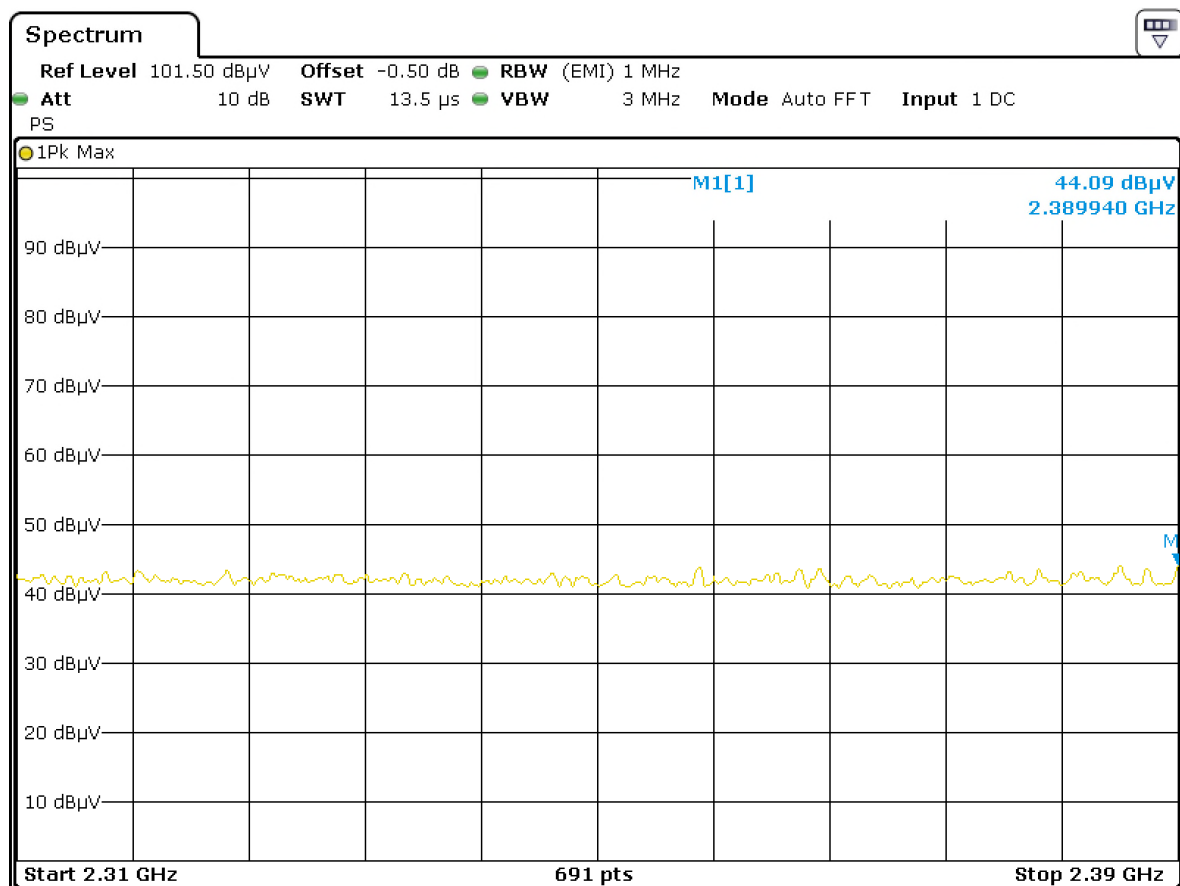


High Channel – 18 GHz – 26 GHz
Vertical - Peak Emission Graph

Note: 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	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Band Edges – PML300

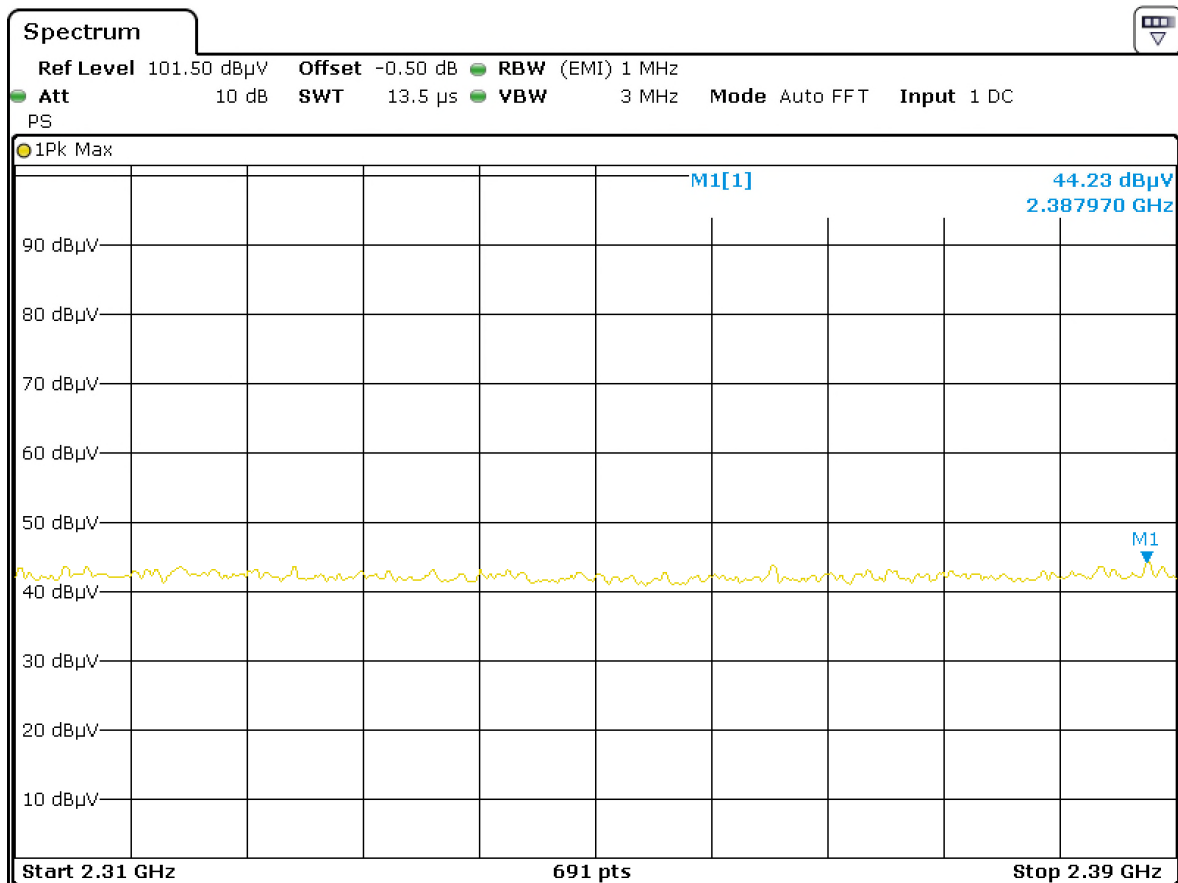


Date: 23.MAR.2023 10:38:18

Band Edge – Low Channel
Horizontal - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

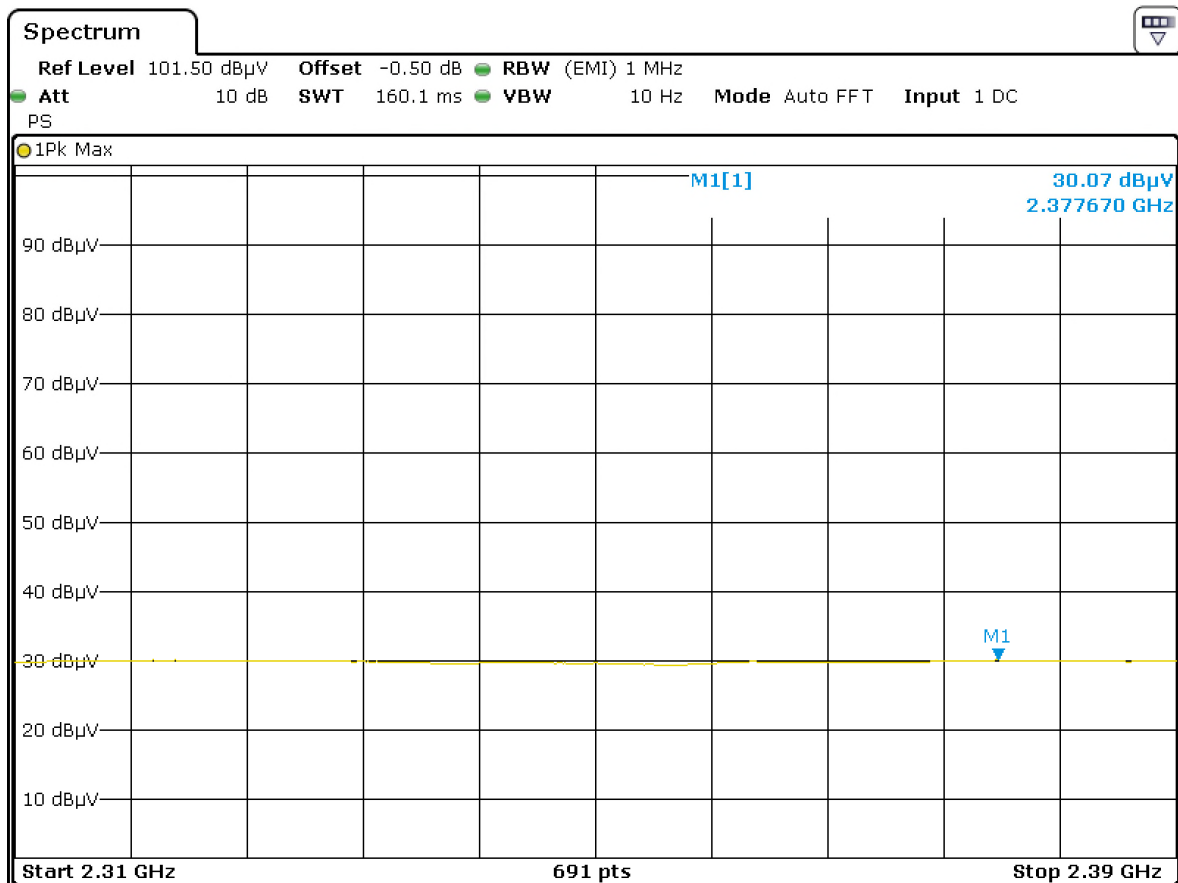


Date: 23.MAR.2023 10:40:08

Band Edge – Low Channel
Vertical - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 TÜV SÜD Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

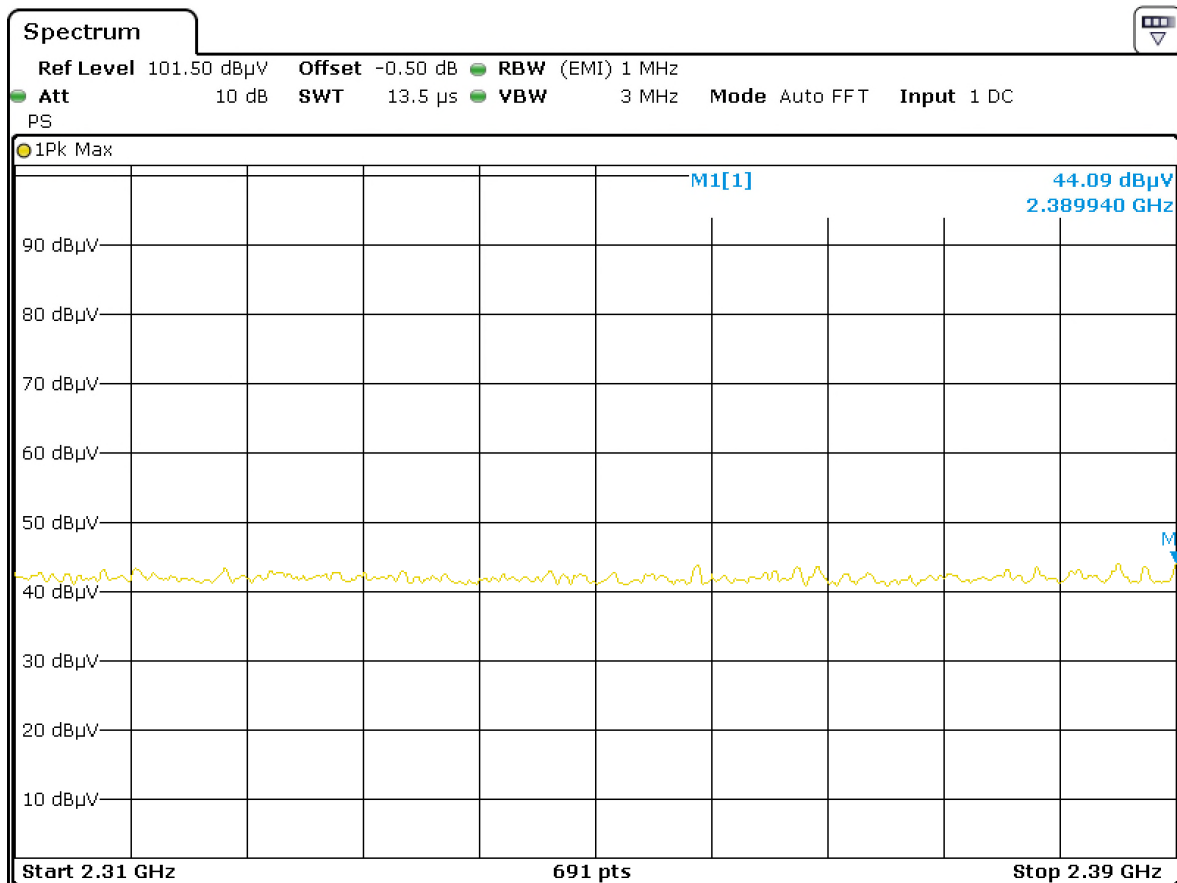


Date: 23.MAR.2023 10:42:00

Band Edge – Low Channel
 Horizontal - Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

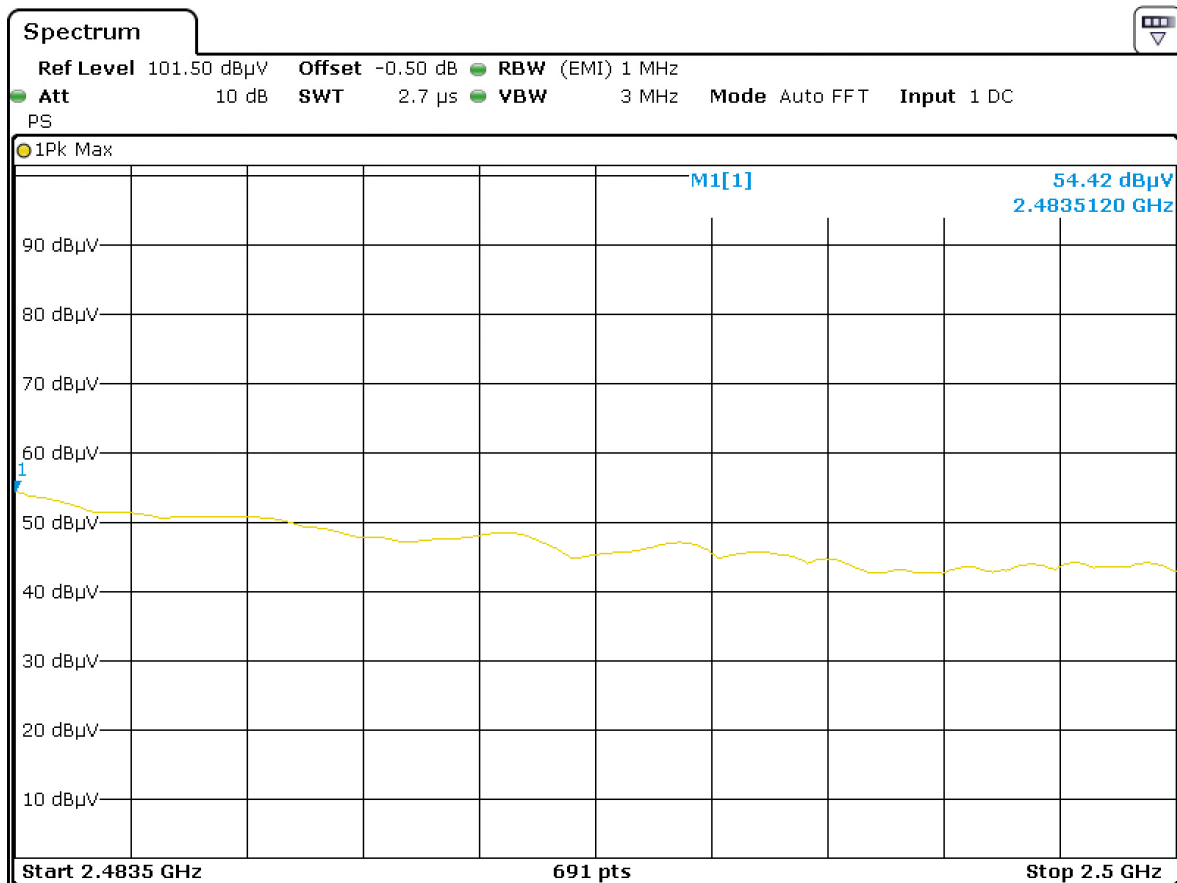


Date: 23.MAR.2023 10:38:18

Band Edge – Low Channel
Vertical – Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

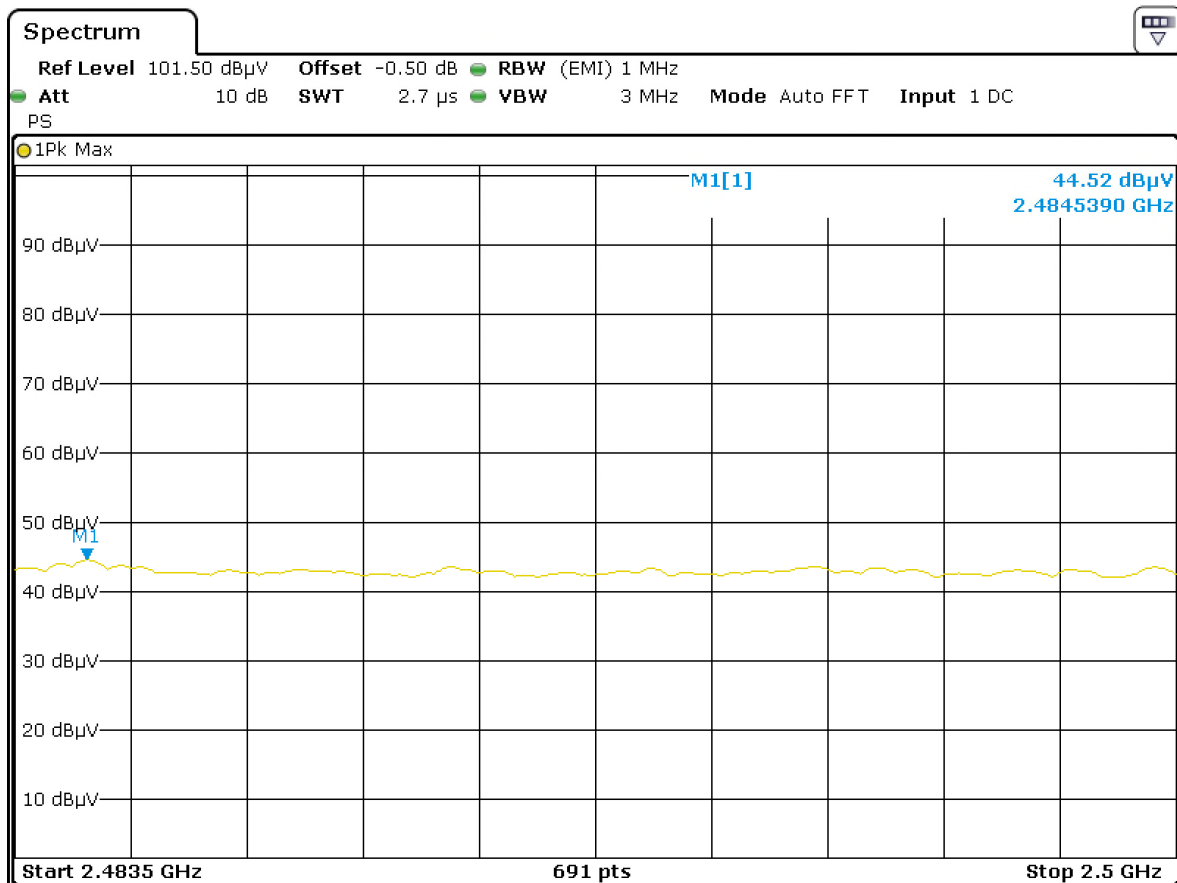


Date: 23.MAR.2023 13:34:03

Band Edge – High Channel
Horizontal - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 TÜV SÜD Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

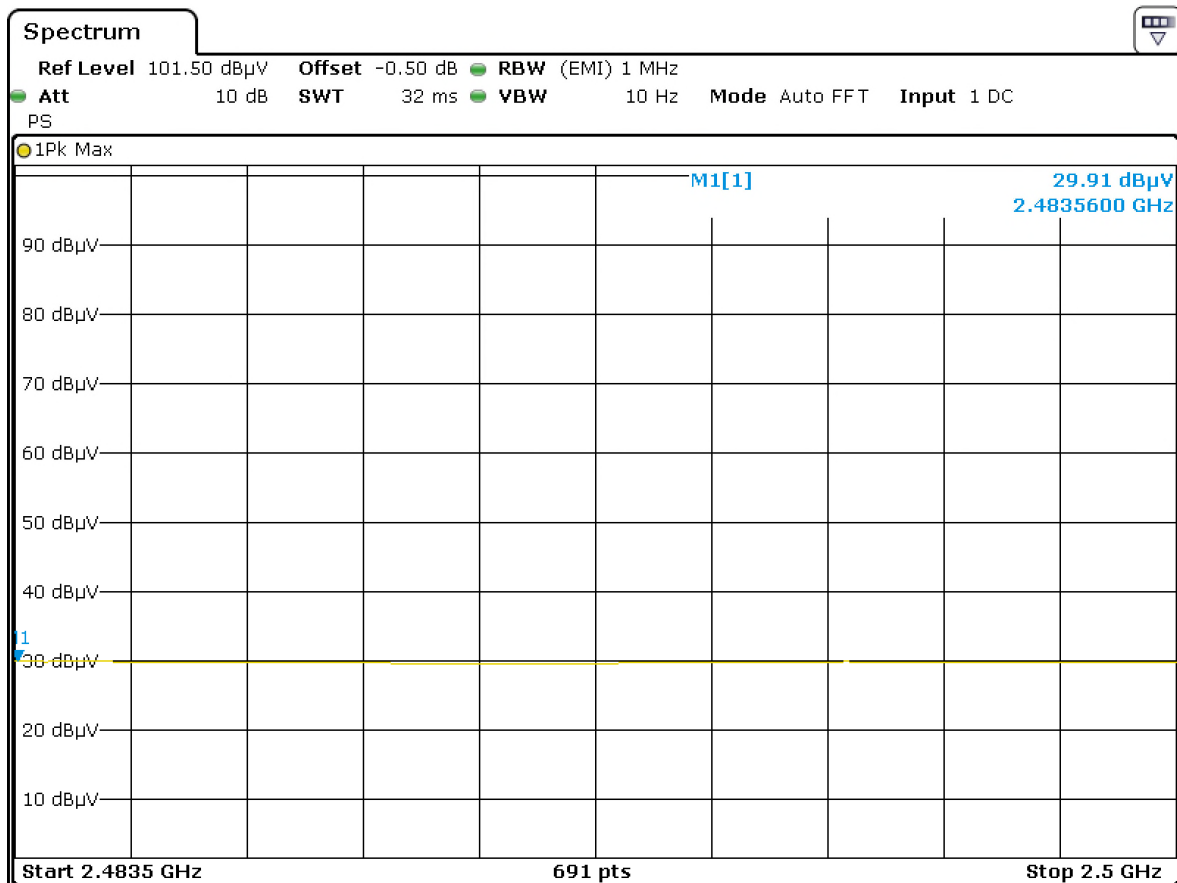


Date: 23.MAR.2023 13:35:05

Band Edge – High Channel
Vertical - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 TÜV SÜD Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



Date: 23.MAR.2023 13:40:09

Band Edge – High Channel
 Horizontal - Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



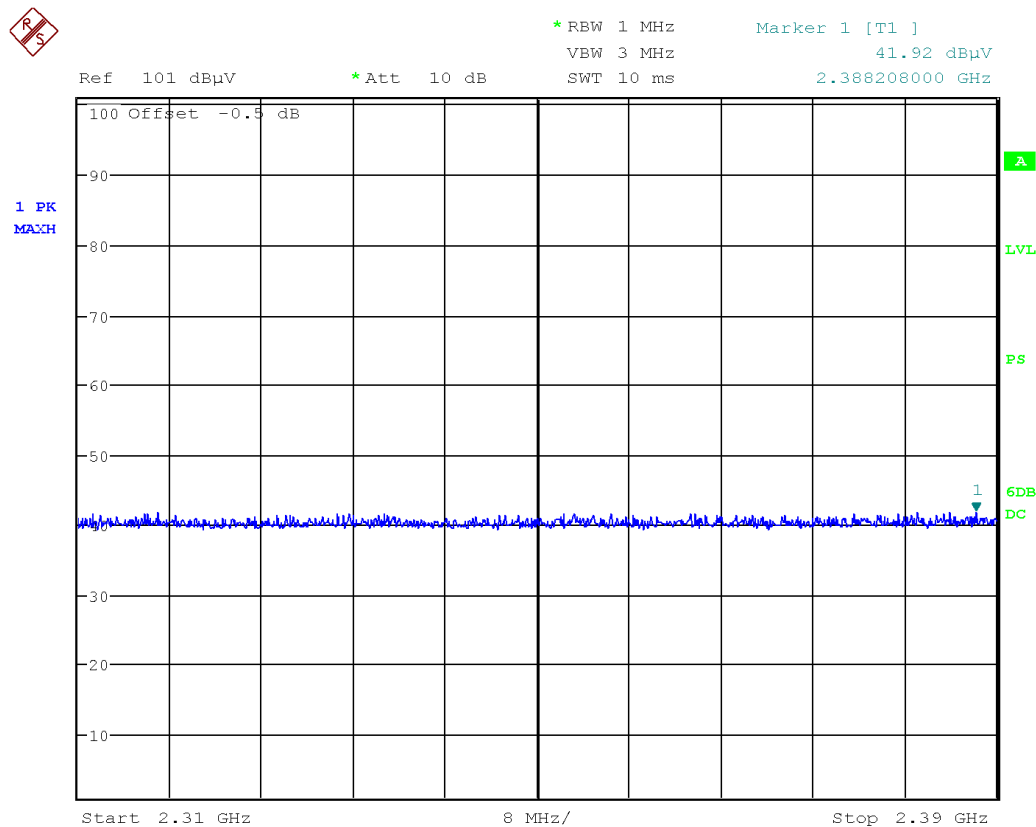
Date: 23.MAR.2023 13:35:57

Band Edge – High Channel
 Vertical – Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Band Edges – PMR300

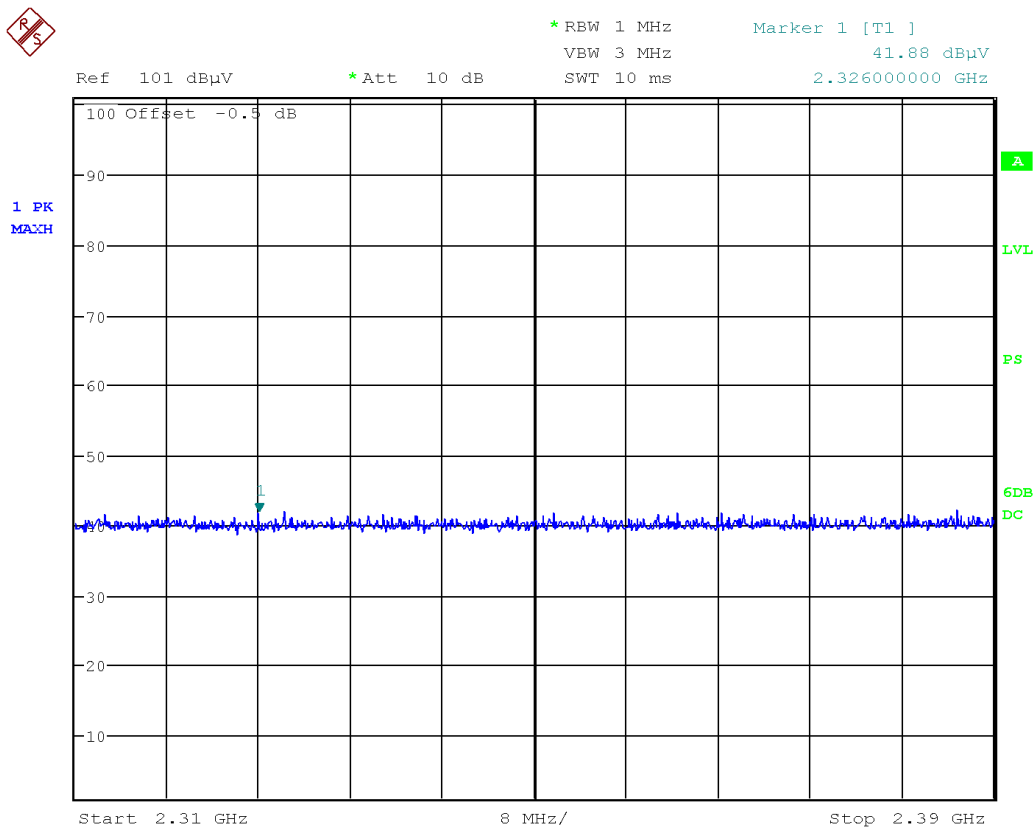


Date: 14.APR.2023 11:18:12

Band Edge – Low Channel
Horizontal - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

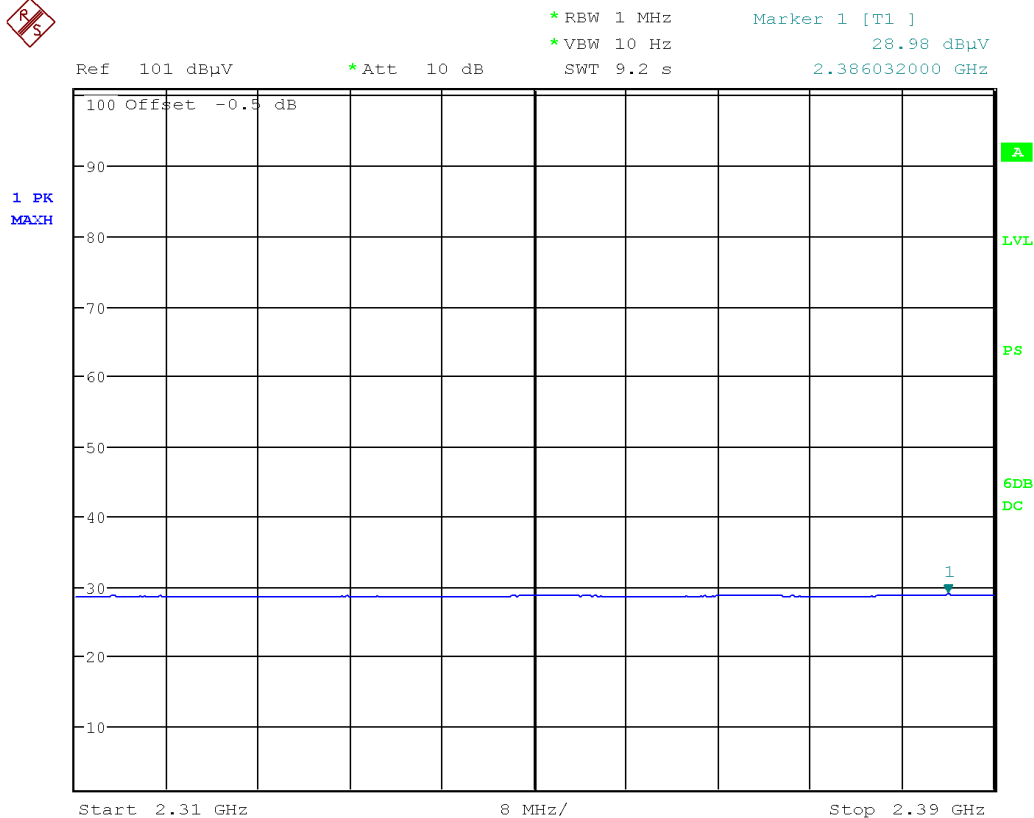


Date: 14.APR.2023 11:14:18

Band Edge – Low Channel Vertical - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

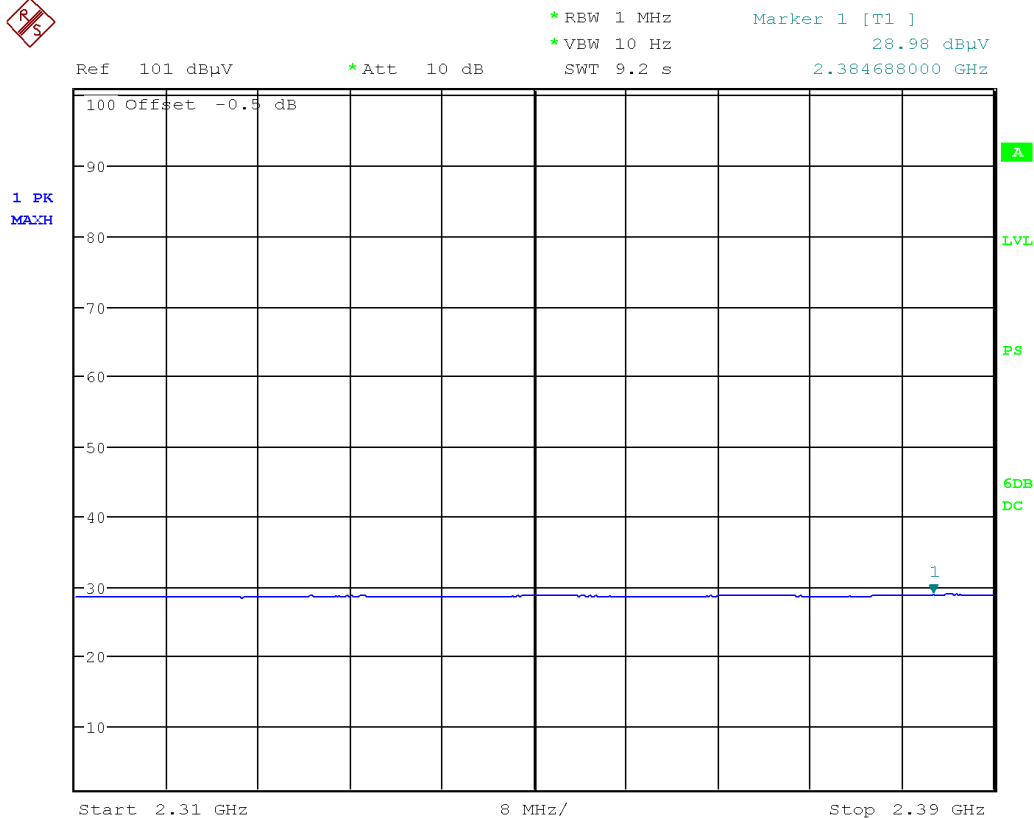


Date: 14.APR.2023 11:19:07

Band Edge – Low Channel Horizontal - Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

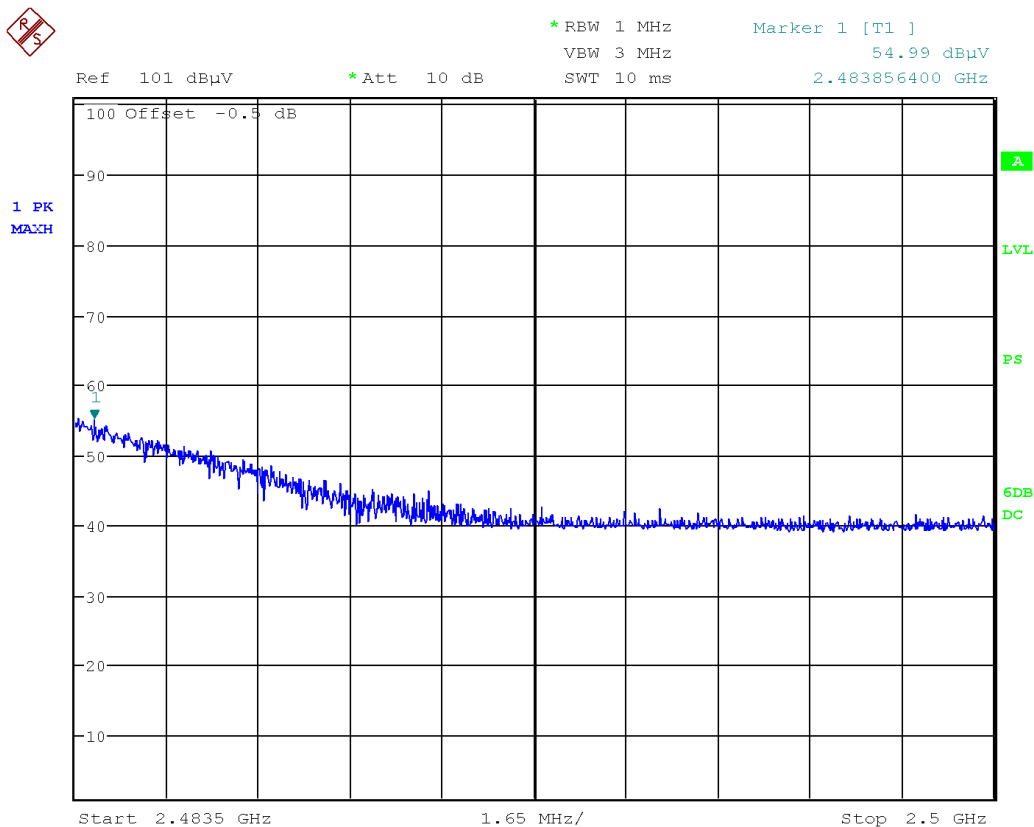


Date: 14.APR.2023 11:15:20

Band Edge – Low Channel Vertical – Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

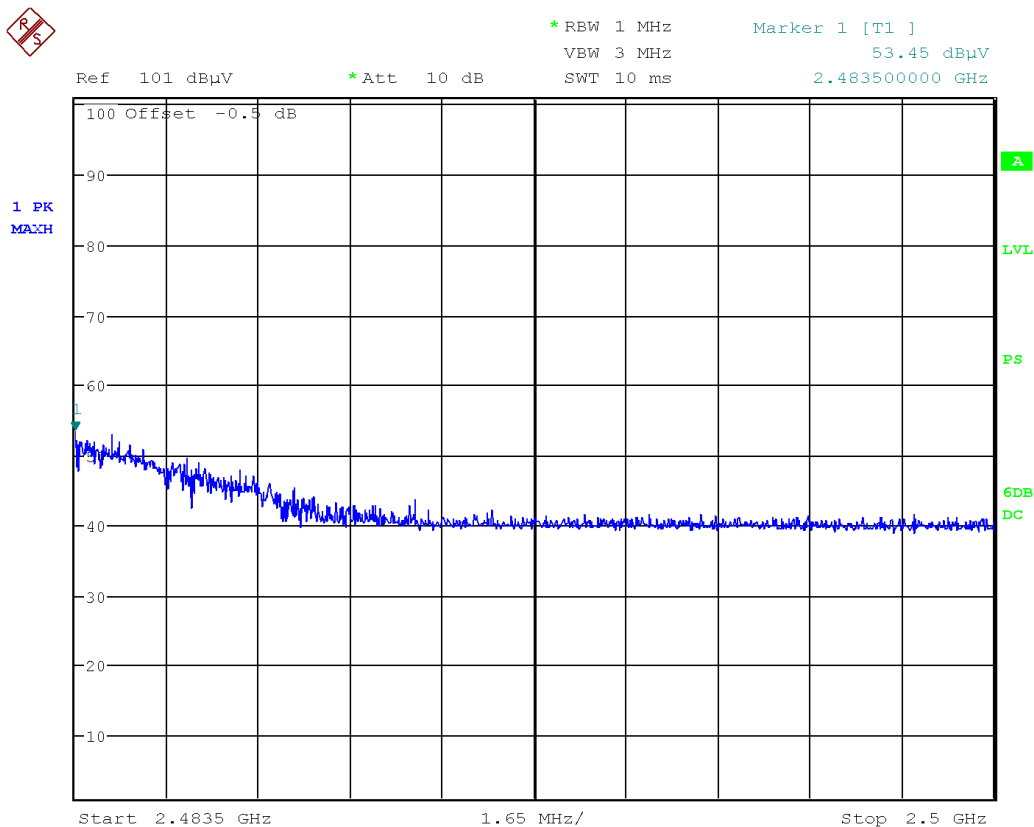


Date: 14.APR.2023 11:24:56

Band Edge – High Channel
Horizontal - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

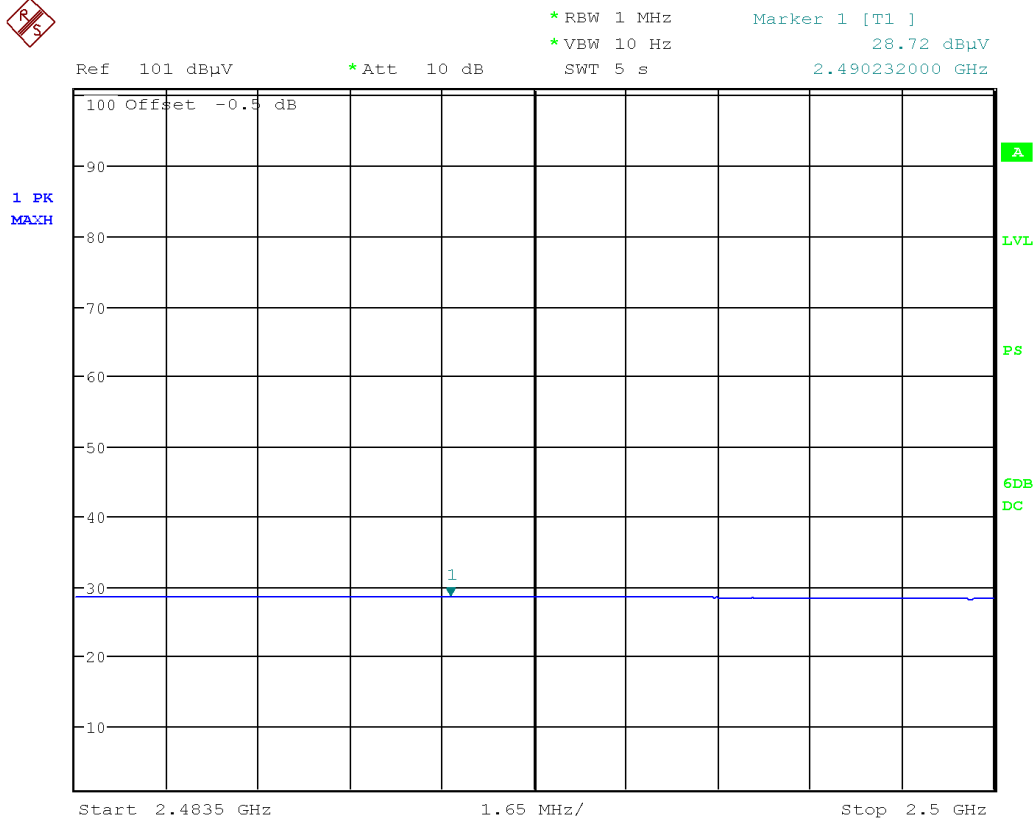


Date: 14.APR.2023 11:27:47

Band Edge – High Channel Vertical - Peak Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

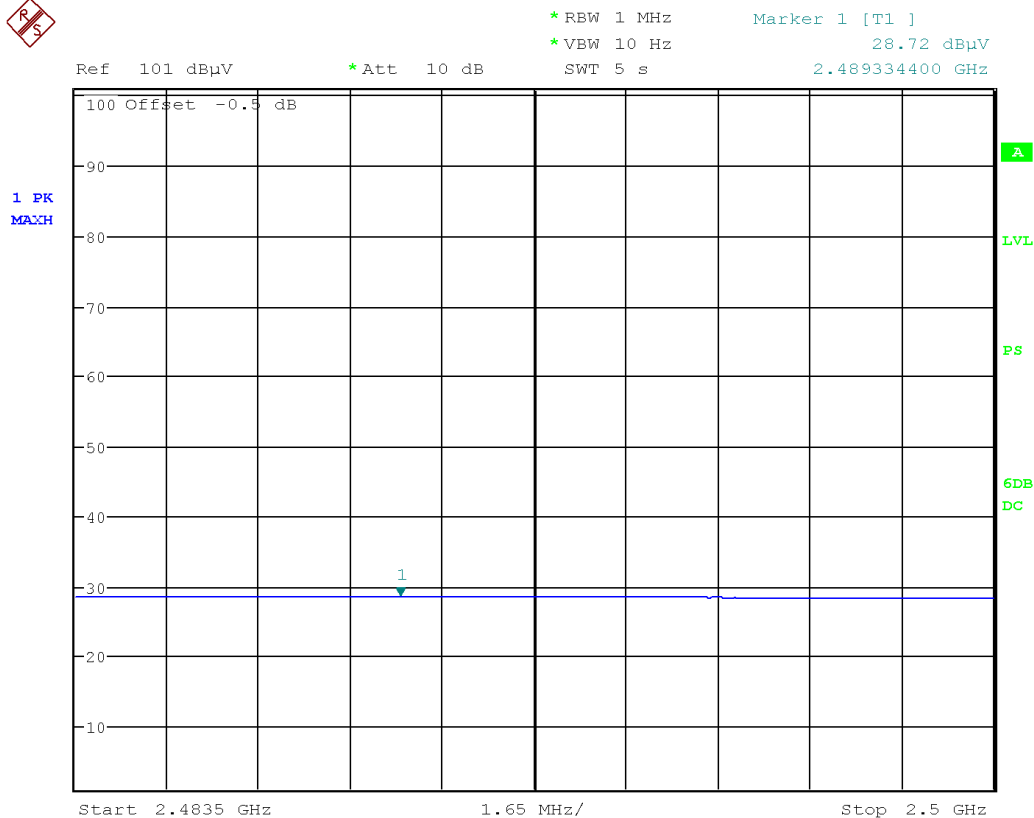


Date: 14.APR.2023 11:25:45

Band Edge – High Channel Horizontal - Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.


Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



Date: 14.APR.2023 11:30:24

Band Edge – High Channel
Vertical – Average Emission

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Final Measurements and Results

The EUT passed. All measurements of Spurious Emissions were taken in the X-axis orientation and the high channel, as these were the worst-case determined orientation and channel. Additionally, the band edges of the low and high channel 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. 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.

PML300

EUT Name		PML300								
Limit		FCC 15.209, Spurious								
Power Supply		BATT								
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	PEAK Limit (dBuV/m)	AVG Limit (dBuV/m)	PEAK Margin (dB)	AVG Margin (dB)	Table Azimuth (Degrees)	Mast Height (cm)	Test Result
Horizontal										
11.534G	PEAK	7.5	53.1	74.0	--	20.9	--	360.0	110.0	Pass
11.534G	AVG	7.5	39.1	--	54.0	--	14.9	360.0	110.0	Pass
10.517G	PEAK	6.4	51.9	74.0	--	22.1	--	360.0	110.0	Pass
10.517G	AVG	6.4	38.2	--	54.0	--	15.8	360.0	110.0	Pass
7.441G	PEAK	1.4	49.4	74.0	--	24.6	--	360.0	110.0	Pass
7.441G	AVG	1.4	32.7	--	54.0	--	21.3	360.0	110.0	Pass
11.866G	PEAK	7.5	53.1	74.0	--	20.9	--	360.0	110.0	Pass
11.866G	AVG	7.5	39.6	--	54.0	--	14.4	360.0	110.0	Pass
11.873G	PEAK	7.4	53.1	74.0	--	20.9	--	360.0	110.0	Pass
11.873G	AVG	7.4	39.6	--	54.0	--	14.4	360.0	110.0	Pass
11.644G	PEAK	8.2	53.1	74.0	--	20.9	--	360.0	110.0	Pass
11.644G	AVG	8.2	39.5	--	54.0	--	14.5	360.0	110.0	Pass
Vertical										
7.441G	PEAK	1.4	55.5	74.0	--	18.5	--	35.0	110.0	Pass
7.441G	AVG	1.4	32.4	--	54.0	--	21.6	35.0	110.0	Pass
11.522G	PEAK	7.8	53.9	74.0	--	20.1	--	360.0	110.0	Pass
11.522G	AVG	7.8	39.4	--	54.0	--	14.6	360.0	110.0	Pass
10.612G	PEAK	5.4	52.0	74.0	--	22.0	--	360.0	110.0	Pass
10.612G	AVG	5.4	37.9	--	54.0	--	16.1	360.0	110.0	Pass
7.44G	PEAK	1.4	55.2	74.0	--	18.8	--	360.0	110.0	Pass
7.44G	AVG	1.4	33.4	--	54.0	--	20.6	360.0	110.0	Pass
7.439G	PEAK	1.4	54.9	74.0	--	19.1	--	30.0	110.0	Pass
7.439G	AVG	1.4	33.1	--	54.0	--	20.9	30.0	110.0	Pass
11.662G	PEAK	8.5	53.8	74.0	--	20.2	--	360.0	110.0	Pass
11.662G	AVG	8.5	39.8	--	54.0	--	14.2	360.0	110.0	Pass


Average and Peak Emissions Table

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

PMR300

EUT Name		PMR300								
Limit		FCC 15.209, Spurious								
Power Supply		Battery								
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	PEAK Limit (dBuV/m)	AVG Limit (dBuV/m)	PEAK Margin (dB)	AVG Margin (dB)	Table Azimuth (Degrees)	Mast Height (cm)	Test Result
Horizontal										
7.44G	AVG	1.5	34.9	--	54.0	--	19.1	105.0	180.0	Pass
7.44G	PEAK	1.5	62.5	74.0	--	11.5	--	105.0	180.0	Pass
7.441G	AVG	1.5	32.9	--	54.0	--	21.1	110.0	180.0	Pass
7.441G	PEAK	1.5	61.8	74.0	--	12.2	--	110.0	180.0	Pass
Vertical										
7.441G	AVG	1.5	32.3	--	54.0	--	21.7	186.0	150.0	Pass
7.441G	PEAK	1.5	58.1	74.0	--	15.9	--			Pass
7.439G	AVG	1.5	33.2	--	54.0	--	20.8	188.0	150.0	Pass
7.439G	PEAK	1.5	59.0	74.0	--	15.0	--			Pass


Average and Peak Emissions Table

Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Note: See 'Appendix B – EUT & 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	ESR 26	Rohde & Schwarz	Mar. 31, 2022	Mar. 31, 2024	GEMC 341
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Feb. 11, 2022	Feb. 11, 2024	GEMC 233
Loop Antenna	EM 6871	Electro-Metrics	Mar 13, 2023	Mar 13, 2025	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Mar 13, 2023	Mar 13, 2025	GEMC 71
BiLog Antenna	3142-C	ETS-Lindgren	Dec. 7, 2022	Dec. 7, 2024	GEMC 8
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Mar. 11, 2022	Mar. 11, 2024	GEMC 340
Attenuator 6 dB	6N5W-06	Inmet	NCR	NCR	GEMC 345
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	Sep. 16, 2022	Sep. 16, 2024	GEMC 301
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Mar. 11, 2022	Mar. 11, 2024	GEMC 189
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Sep. 20, 2022	Sep. 20, 2024	GEMC 312
RF Cable <1GHz	LMR-400	LexTec	NCR	NCR	GEMC 27
RF Cable <1GHz	HP305S	Semflex	NCR	NCR	GEMC 310
RF Cable >1GHz	EMC2	MegaPhase	NCR	NCR	GEMC 370
RF Cable <1GHz	LMR-400	LexTec	NCR	NCR	GEMC 274
RF Cable <1GHz	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
RF Cable >1GHz	EMC2	MegaPhase	NCR	NCR	GEMC 369
Emissions Software	V2.1.0	TUV SUD Canada, Inc.	NCR	NCR	GEMC 361

Client	4iiii Innovations	
Product	PML300 and PMR300	
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

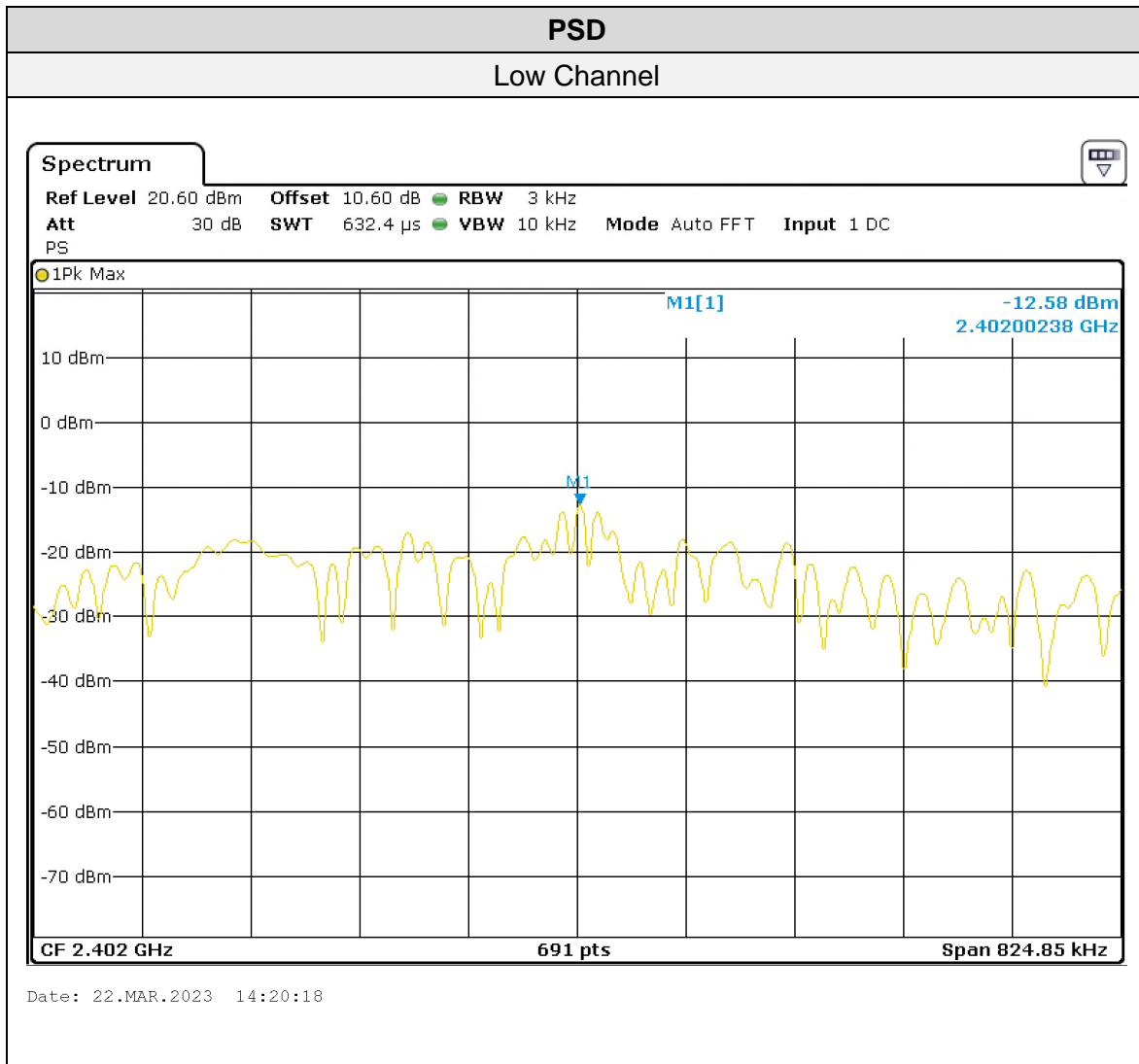
The EUT passed. Low, middle and high bands were measured.


Channel	Frequency (MHz)	PSD (dBm)
Low	2402	-12.58
Mid	2442	-12.72
High	2480	-13.13

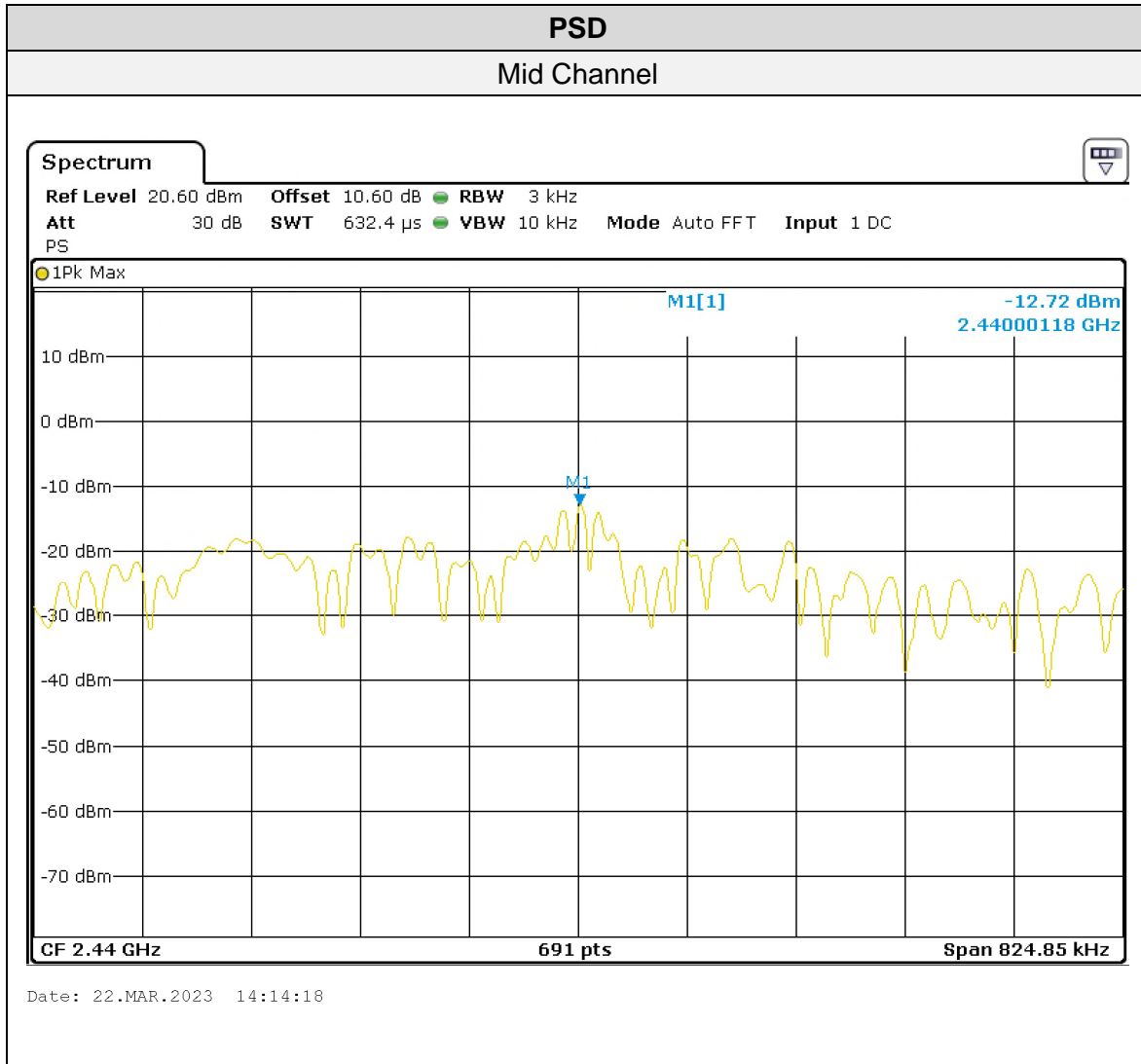
Graphs


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.

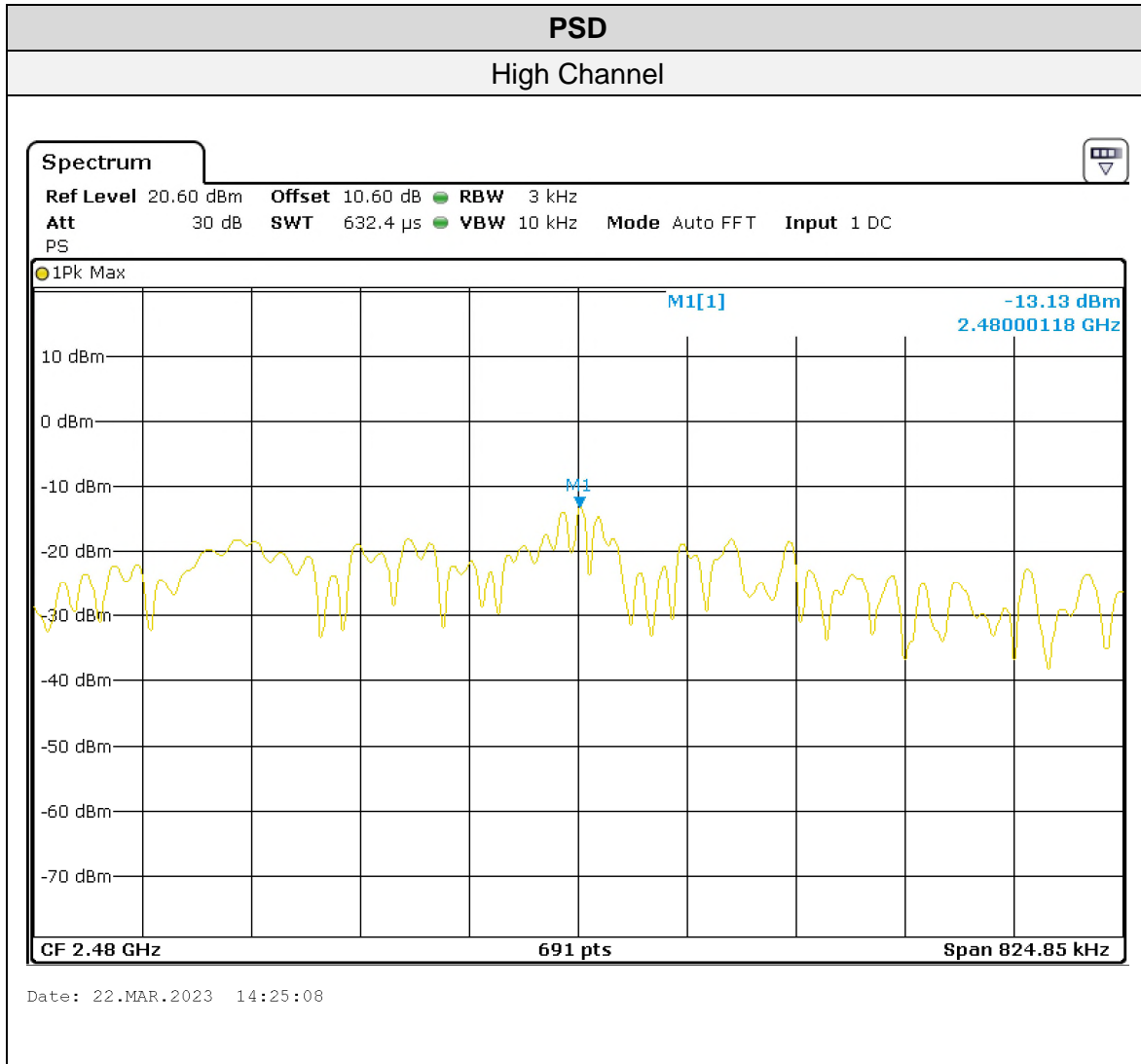
Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	4iiii Innovations	
Product	PML300 and PMR300	
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Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




Client	4iiii Innovations	
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Note: See 'Appendix B – EUT & 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	ESR 26	Rohde & Schwarz	Mar. 31, 2022	Mar. 31, 2024	GEMC 341
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC 133

Client	4iiii Innovations	 Canada
Product	PML300 and PMR300	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary


Client	4iiii Innovations	
Product	PML300 and PMR300	
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	4iiii Innovations Inc. 141 2nd Ave East, Cochrane, AB, Canada, T4C 2B9
Contact	Michael Mercer
Phone	403-800-3095
Email	mike@4iiii.com
EUT Details	
EUT Name	PRECISION3 POWERMETER
EUT Model	PML300 and PMR300
FCC ID	ZZNPM301
IC	9896A-PM300
Equipment Category	ITE
Basic EUT Functionality	The PML300/PMR300 power meter is an electronic device that is permanently attached to a bicycle crank and measures the amount of energy a rider imparts to the drive train. The device connects wirelessly to any BLE equipped smart phone as well as most ANT+® bicycle computer head units.
Input Voltage and Frequency	2.6 – 3.3 VDC
Rated Input Current	10mA
Connectors available on EUT	None
Peripherals Required for Test	Android phone with 4iiii configuration App
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 Power Setting: +4dBm

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	4iiii Innovations	 Canada
Product	PML300 and PMR300	
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