

TUV SUD Canada

RF Test Report

As per

RSS 247 Issue 1:2015

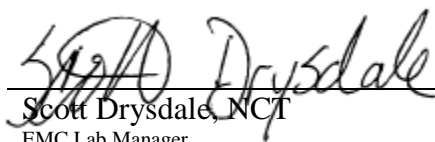
&

FCC Part 15 Subpart C:2015

Unlicensed Intentional Radiators

on the

**Open Smart Device Interface (OSDI)
SecureMesh Module**



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Testing produced for



See Appendix A for full customer & EUT details.





Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Report Scope

This report addresses the EMC verification testing and test results of the Open Smart Device Interface (OSDI) SecureMesh Module Unit, herein referred to as EUT (Equipment Under Test) performed at TUV SUD Canada Labs.

The EUT was tested for compliance against the following standards:


RSS 247 Issue 1:2015 / FCC Part 15 Subpart C 15:2015

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

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

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or TUV SUD Canada


Opinions/interpretations expressed in this report, if any, are outside the scope of TUV SUD Canada Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of TUV SUD Canada Inc, unless otherwise stated.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Summary


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

EUT FCC Certification #, FCC ID:	TMB-OSDI4W1
EUT Industry Canada Certification #, IC:	6028A-OSDI4W1
HVIN	CL-R0353A-6.1
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN	Restricted Bands for intentional operation	N/A	Pass
FCC 15.207 RSS-GEN	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-247 5.5	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2.1	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4.4	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-247 5.4.5	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 5.2.2	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			Pass

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All tests were performed by Scott Drysdale.

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 '*'.

Client	Trilliant Networks Canada Inc.	
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Justifications, Descriptions, or Deviations

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

The module was tested separately at a lower duty cycle and the peak measurements were compared to the host tested module. The results with the OSDI-EVAL host module were equal or worst case compared to the module testing separately, however the results in this test report are worst case or representative of the testing performed with module separately.

This device was additionally tested in a Trilliant OSDI-EVAL board CL-R0350D-2. This host was used as it was the only way to ensure the module could operate at > 98% duty cycle. The results with the OSDI-EVAL were equal or worst case compared to the module testing separately.

The duty cycle of the EUT during measurement was greater than or equal to 98%. Note that this duty cycle is performed in this special mode for test purposes only.


For the Antenna requirement specified in FCC 15.203 (RSS 247), this device can be configured with the following antenna(s), and the antenna connector type(s), and antenna gain.

Manufacturer	Type	Part Number	Gain	Connector
Trilliant	M-Type	CP-0299A	4.8 dBi	trace on board
Linx Planar	Planar	ANT-2.4uSP	3.8 dBi	trace on board
Mobile Mark	Omnidirectional	IMAG5-24000-3K-BLK-120	5.0	RP-TNC
L-Com	Omnidirectional	HG24023RD-RTF	3.0	RP-TNC

For all radiated measurements, all antennas above were investigated, and the worst case results (R02406NM), which is covered under a “Limited module approval” for this same module, are presented in this test report.

For the Restricted Bands of operation, the EUT is designed to only operate between 2.4 GHz and 2.4835 GHz.

For the power line conducted emissions requirements, the EUT is DC powered, however AC power line conducted emissions with powered via an AC-DC power source is included in this test report.


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For the scope of this test report, radiated testing of the EUT host was pre-scanned in three orthogonal axis to maximize emissions. Additionally the antenna was scanned in each axis.

For maximum permissible exposure, this device operates at less than 1 Watt at 2.4GHz to 2.4835 GHz MHz and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance is presented as separate exhibit.


A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used are listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

Note that due to circumstances, the current scope of accreditation for the same location now is A2LA 2955.02, however the testing performed for this report was performed under A2LA 2955.02, which was valid at the time of testing and first issuance of report.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS 247:2015	- Issue 1: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

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


Margin = 8.5 dB

Document Revision Status

Revision 1 - Aug 11, 2016. Modified GEMC-FCC-Q50417 to be initial release of this report.

Revision 2- Aug 24, 2016. Added HVIN and host on justification.

Revision 3- Sept 2, 2016. Reworded justification and deviations section as per TCB request.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
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Definitions and Acronyms

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

AE – Auxiliary Equipment.

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

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity


EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency


Client	Trilliant Networks Canada Inc.	
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Testing Facility

Testing for EMC on the EUT was carried out at TUV SUD Canada labs in Montréal, Québec, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations


The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is 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 semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test. Testing was performed under Global EMC Inc. was performed under accreditation by A2LA with a scope of accreditation listed under certificate number 2555.01, however due to circumstances the scope of accreditation for the same location is currently covered under TUV SUD certificate, certificate #2955.02.

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Testing Environmental Conditions and Dates

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

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
Oct 20-30, 2015	Radiated	SD	20°C	30-45%	98 -103kPa
Oct 20-30, 2015	Antenna Conducted	SD	23°C	30-55%	98 -103kPa
March 11, 2016	Powerline conducted emissions	SD	23°C	30-55%	98 -103kPa

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Detailed Test Results Section

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
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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 & 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		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

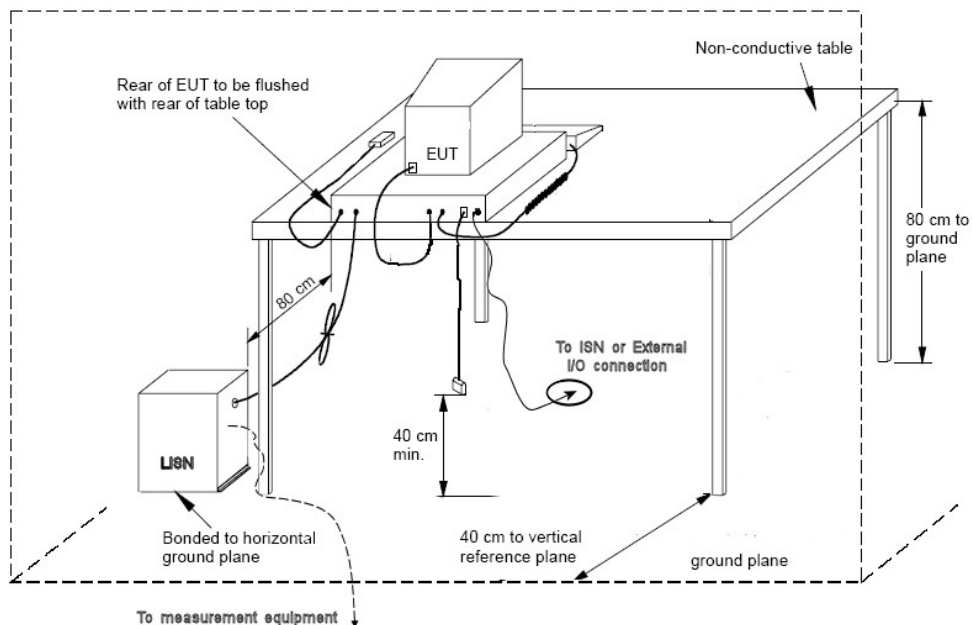
The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.


Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth .

Typical Setup Diagram

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2


Client	Trilliant Networks Canada Inc.	
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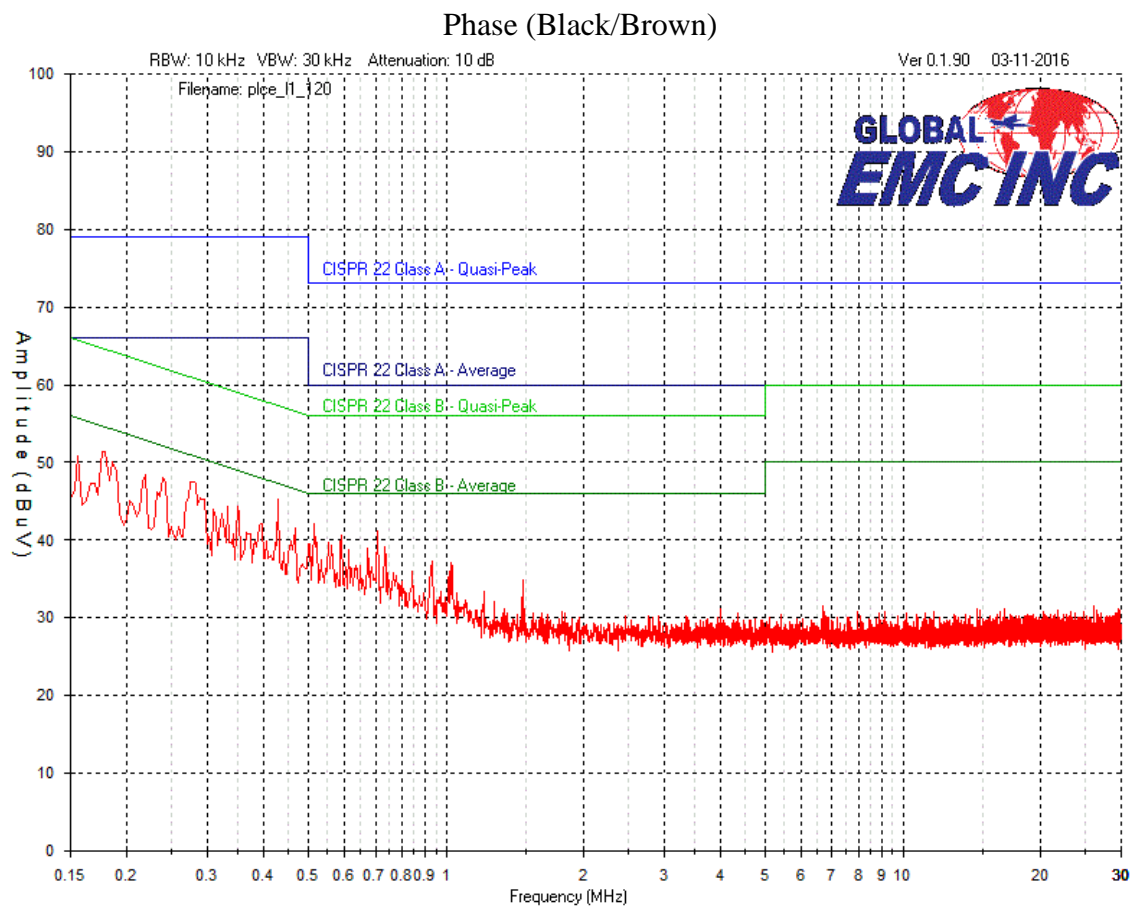
Measurement Uncertainty


The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

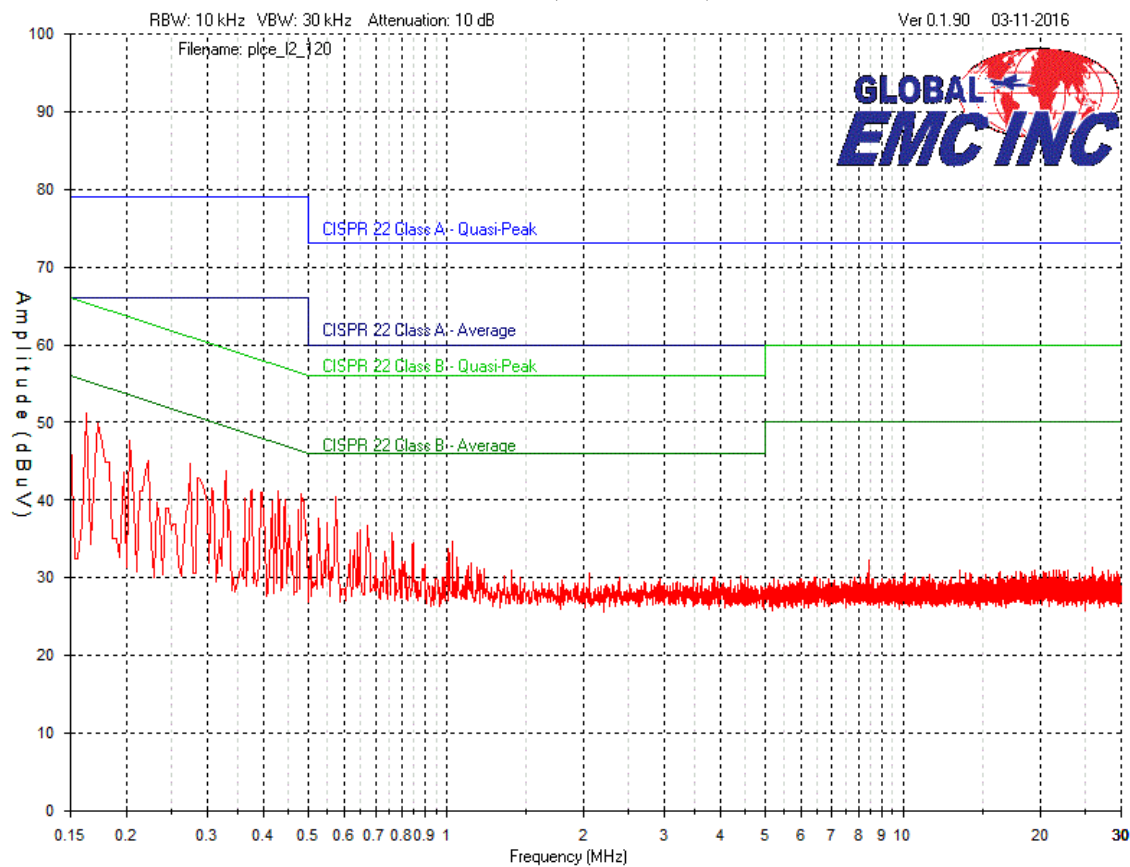
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.


Client	Trilliant Networks Canada Inc.	
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Neutral (White/Blue)



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Final Measurements


Peak readings VS. Average Emissions reading table – Line 1

Frequency (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Cable (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.4286	35.1	10	0	0.2	45.3	47.3	2	Pass
0.1765	40.2	10	0	1.2	51.4	54.6	3.2	Pass
0.276	36.8	10	0	0.6	47.4	50.9	3.5	Pass
0.5148	31.9	10	0	0.2	42.1	46	3.9	Pass
0.2396	37.3	10	0	0.8	48.1	52.1	4	Pass
0.2197	37.6	10	0	0.9	48.5	52.8	4.3	Pass

Peak readings Vs. Average Emissions reading table – Line 2

Frequency (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Cable (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.163	39.8	10	0	1.4	51.2	55.3	4.1	Pass
0.173	38.6	10	0	1.3	49.9	54.8	4.9	Pass
0.482	30.6	10	0	0.2	40.8	46.3	5.5	Pass
0.575	30.3	10	0	0.2	40.5	46	5.5	Pass
0.329	33.4	10	0	0.4	43.8	49.5	5.7	Pass
0.203	36.6	10	0	1	47.6	53.5	5.9	Pass


Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up for the highest line conducted emission

Client	Trilliant Networks Canada Inc.	
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Test Equipment List Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset#
HP Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
LISN	FCC-LISN-50/250-16-2-01	FCC	3-20-15	3-20-17	4005
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Attenuator 10 dB	FP-50-10	Trilithic	1-28-15	1-28-17	4027

1: For cables and attenuators, verification dates apply.

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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.

Limit(s) and Method

The method is as defined in ANSI C63.4.


The limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m¹
 0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m¹
 1.705 MHz – 30 MHz, 30 uV/m at 30 m¹
 30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m¹) at 3 m
 88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m¹) at 3 m
 216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m¹) at 3 m
 Above 960 MHz, 500 uV/m (54.0 dBuV/m¹) at 3 m
 Above 1000 MHz, 500 uV/m (54 dBuV/m²) at 3m
 Above 1000 MHz, 5000 uV/m (74 dBuV/m³) at 3m

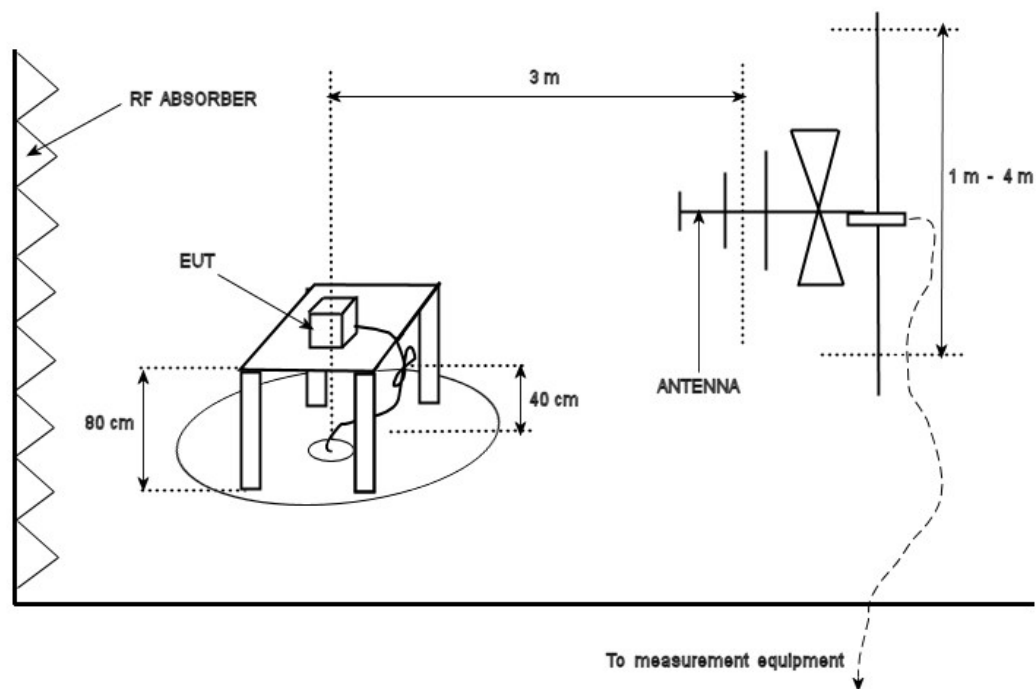
¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1


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

³Limit is with 1 MHz measurement bandwidth and using a Peak detector

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Typical Radiated Emissions Setup



Client	Trilliant Networks Canada Inc.	
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Measurement Uncertainty


The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

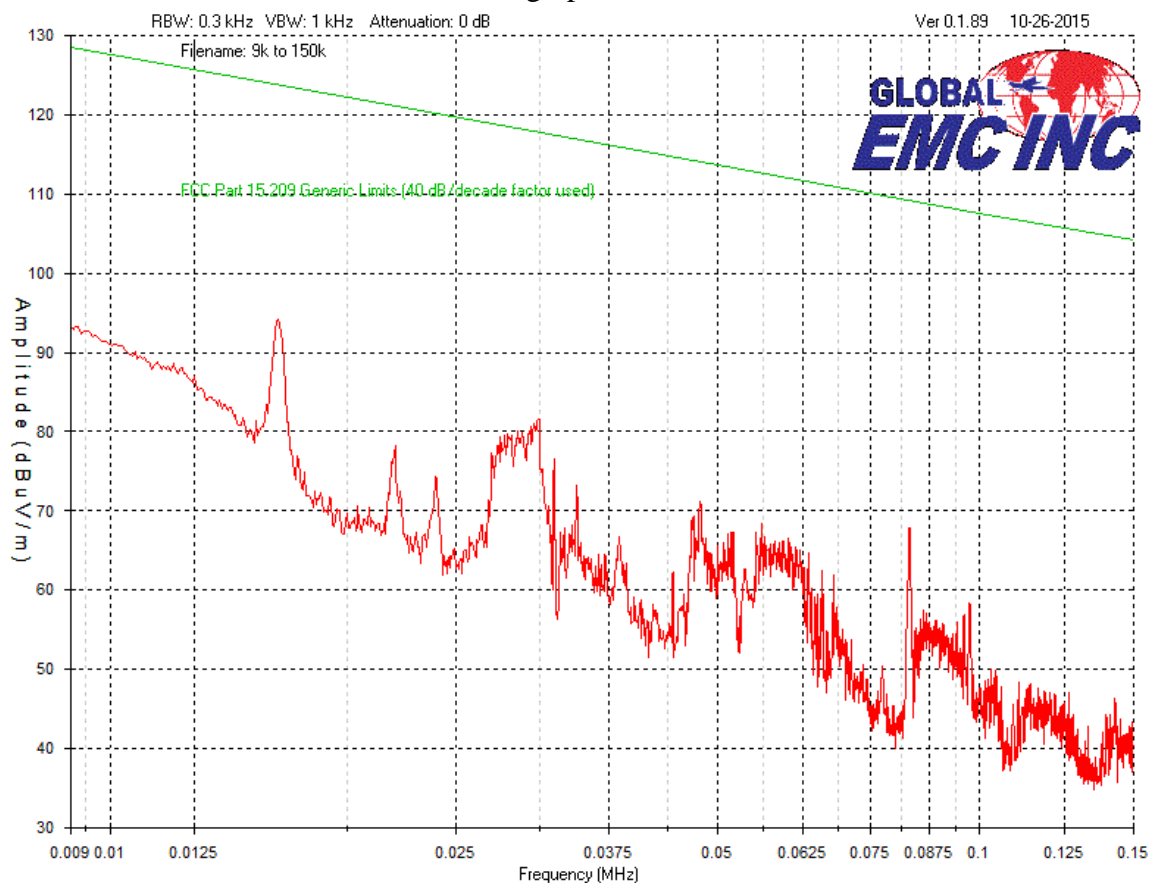
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.


In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of a 25 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.

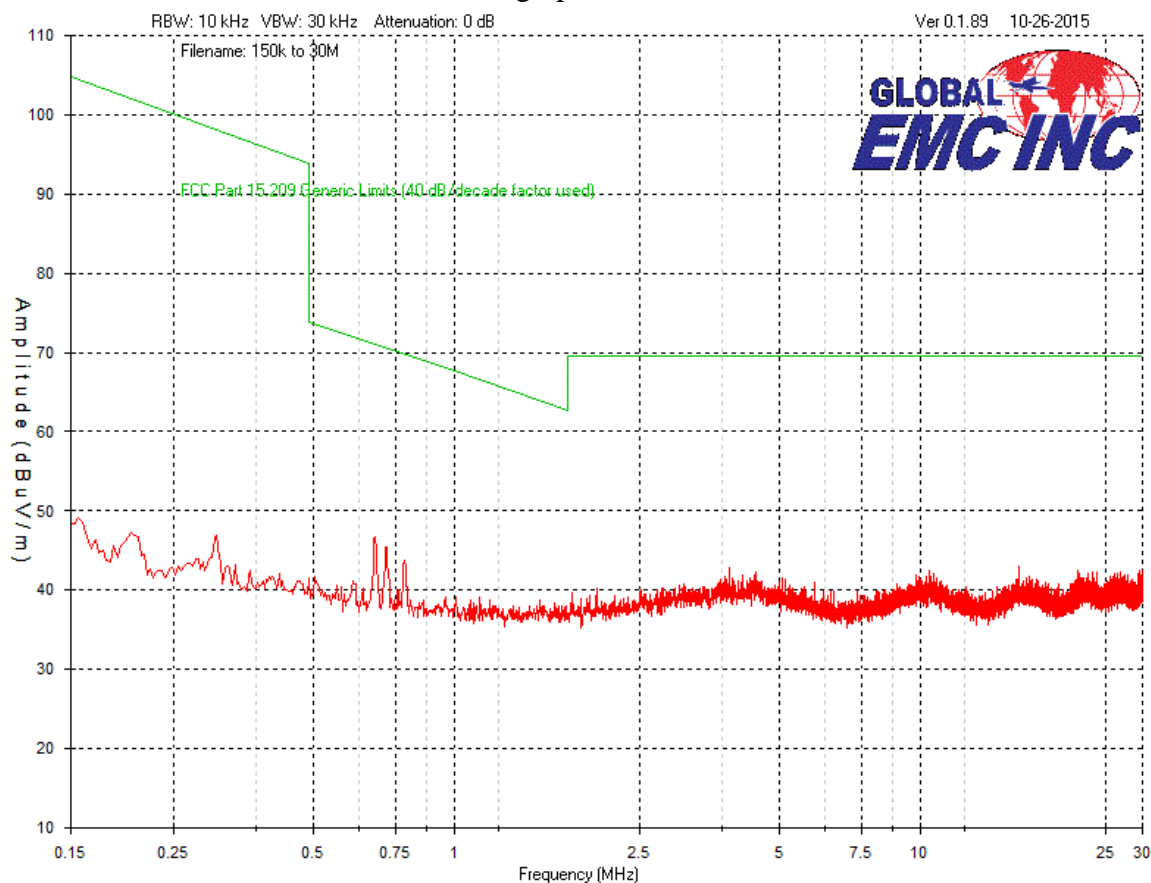
Client	Trilliant Networks Canada Inc.	
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Peak emissions graph - 9 kHz to 150 KHz



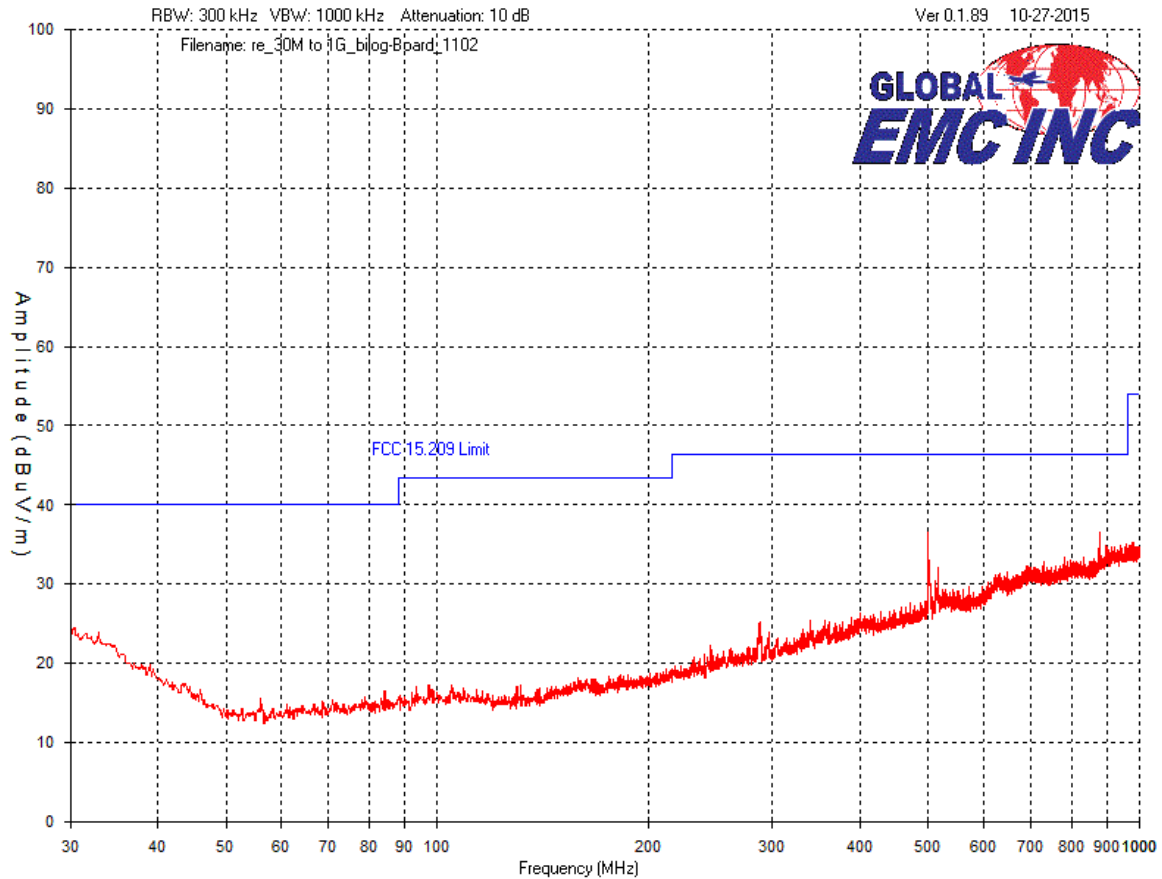
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Peak emissions graph - 150 kHz to 30 MHz




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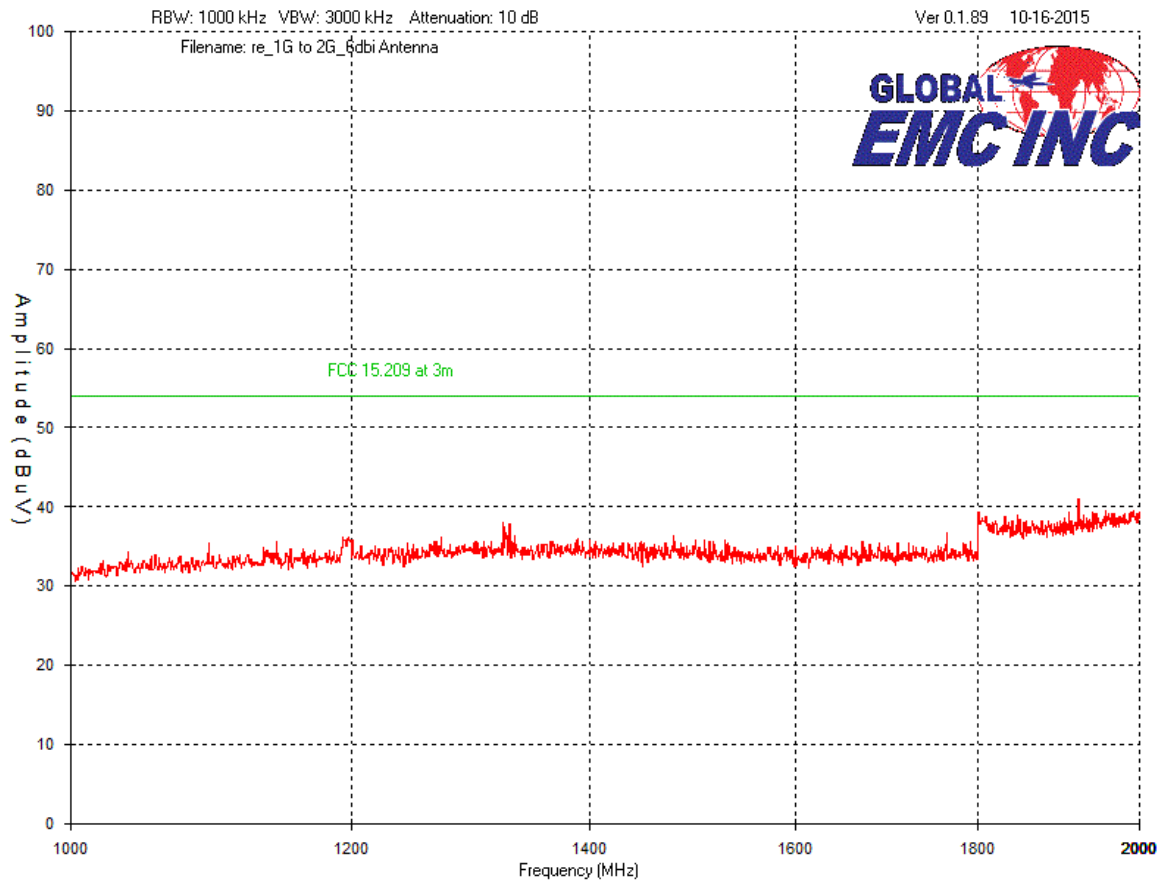
Vertical – Peak Emissions Graph – 30 MHz to 1 GHz




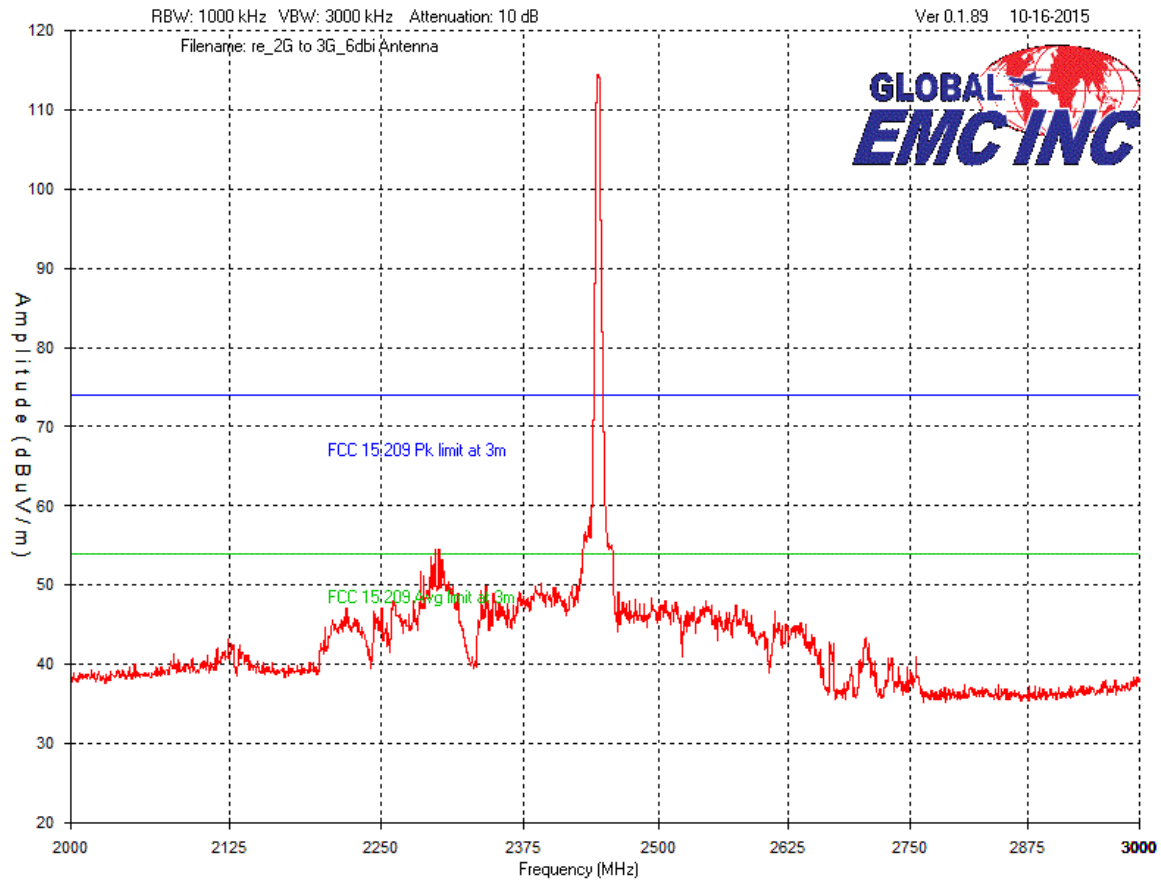
Low, Mid and High scanned, worst case or representative shown above.

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Vertical – Peak emissions Graph – Above 1 GHz

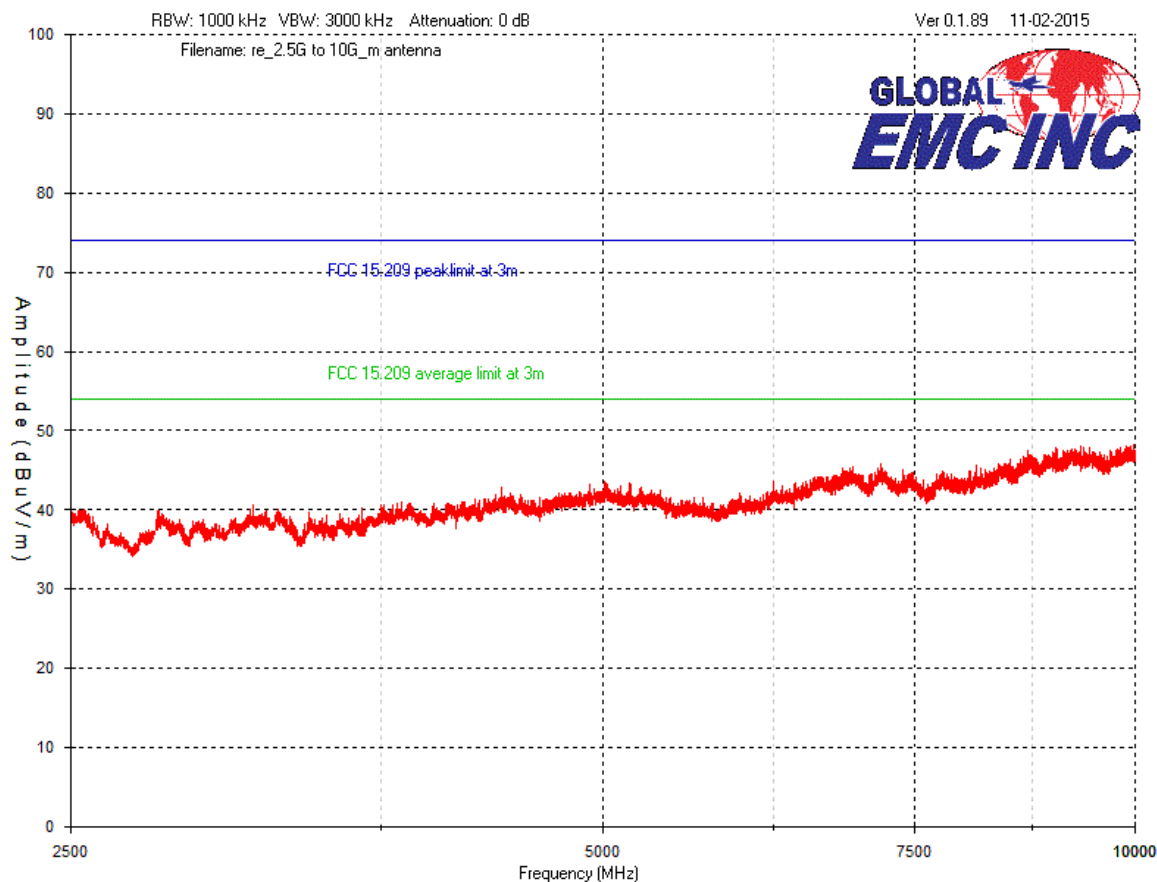


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Mid-channel shown as worst case. See table for details.

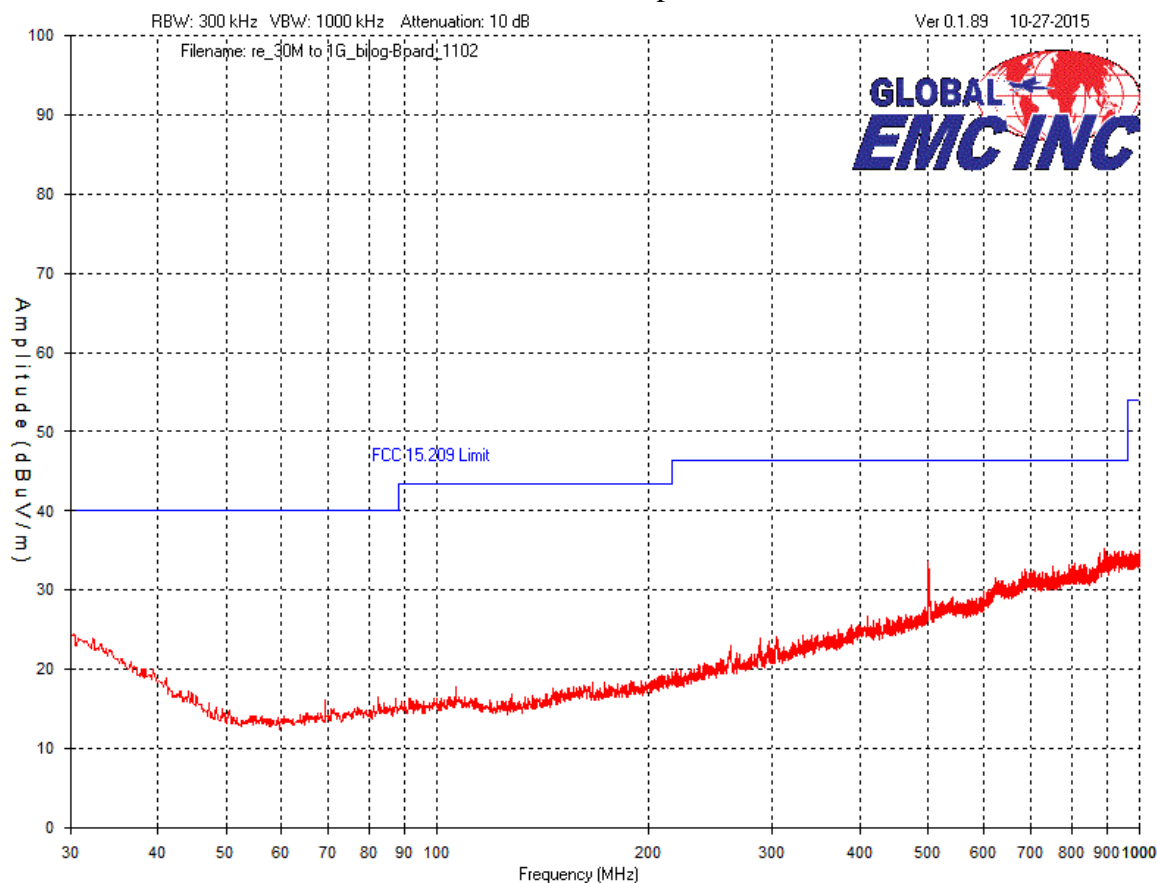
Client	Trilliant Networks Canada Inc.	
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Note: Emissions were scanned to 25 GHz, and no emissions above 10 GHz were detected. The system noise floor was below the average limit.

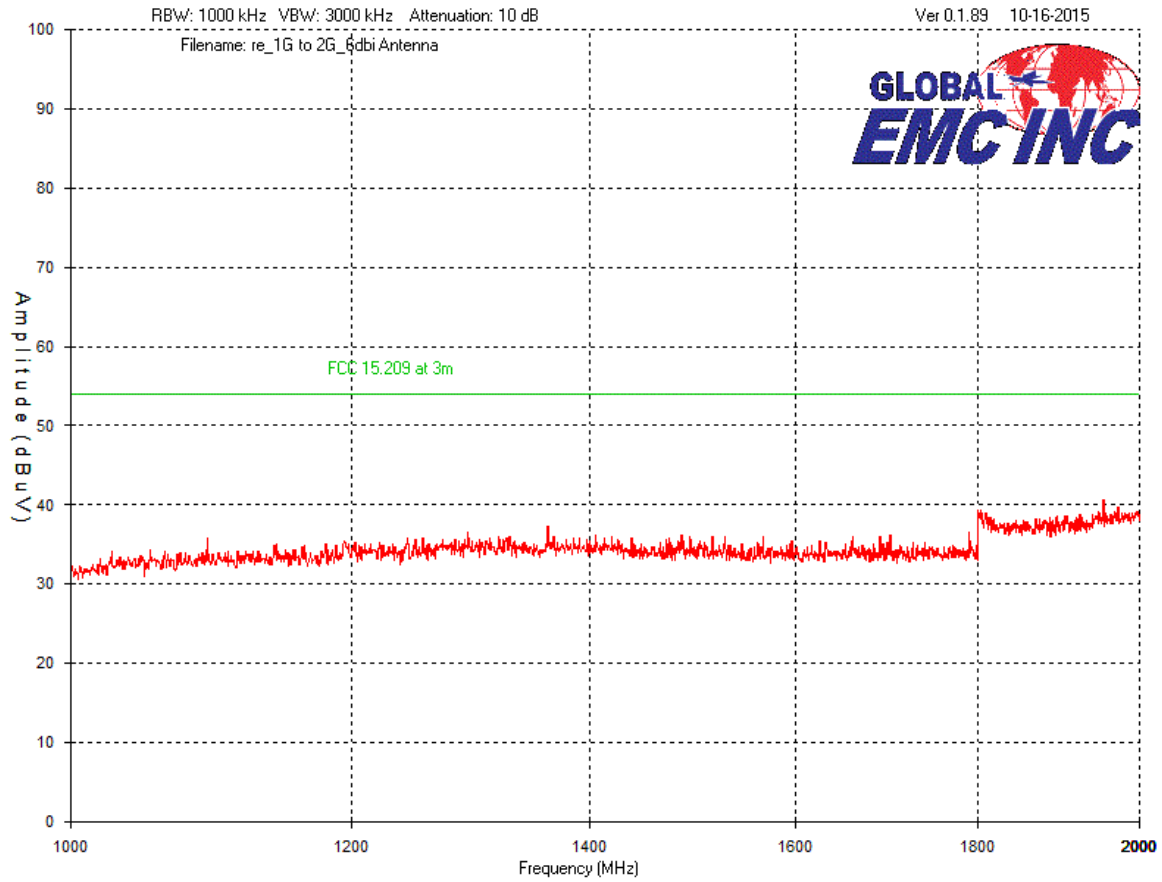
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Horizontal – Peak Emissions Graph – 30 MHz to 1 GHz

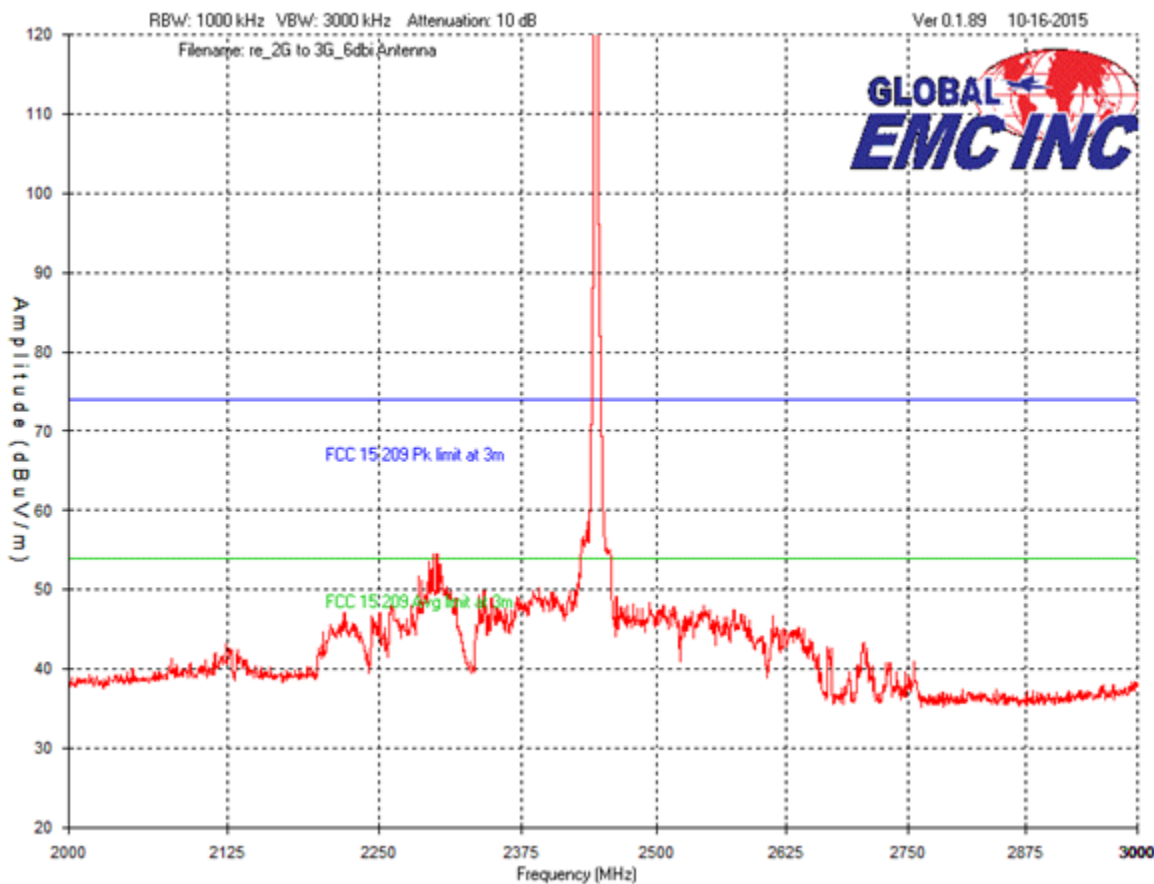


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Horizontal – Peak Emissions Graph – Above 1 GHz



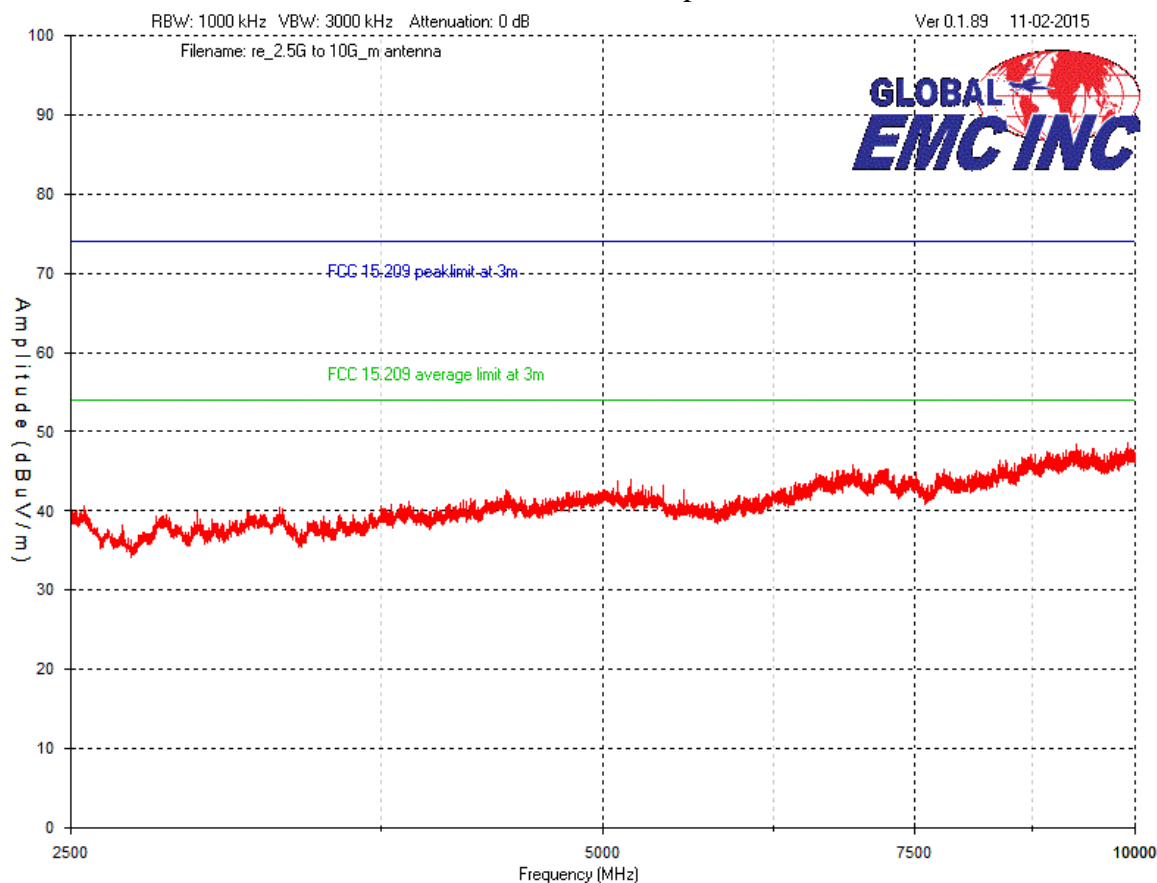
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Note: The emission shown between 2250 MHz and 2375 MHz above occurs at 2305MHz, and is not in a restricted band. Although the peak reading is shown above, this emission has significant modulation and the average measurement is at least 6 dB below the peak shown above. No emissions were detected within the restricted bands at low, mid and high settings.

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Horizontal – Peak Emissions Graph – Above 1 GHz



Note: Emissions were scanned to 26 GHz, and no emissions were detected above 1- GHz and the system noise floor did not exceed the average limit

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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Final Measurements

Note: 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.

No peak emissions were detected within the bands specified in 15.205.

For information purposes, the fundamental was measured at 3 meters.

Peak readings were obtained using a resolution bandwidth of 1 MHz and video bandwidth of 3 MHz.


Harmonic emissions were measured at 3 m. Only the highest harmonic is recorded. A duty cycle correction factor is applied on average emission results.

According to the operation description, the maximum duty cycle is 10%. Therefore, as per FCC 15.35(c), the relaxation factor allowance is calculated as:


$$\begin{aligned}
 \text{Average Factor} &= 20 * \text{Log}(\text{Worst Case EUT On-time over 100 ms time window}) \\
 &= 20 * \text{Log}(10/100) \\
 &= -20\text{dB}
 \end{aligned}$$

Where applicable, an average factor was applied. In each case, where a limit is applicable and the average factor is applied, all the of the below is applies:

- 1) the unwanted emission is temporally related to the fundamental emission (i.e., an intermodulation or harmonic product, or band edge component of the fundamental),
- 2) the unwanted emission falls into a restricted frequency band (e.g., 2390 MHz or 2483.5 MHz)
- 3) the maximum duty cycle used in determining the reduction factor is "hardwired" such that under no condition can it be changed or modified by either the device or the end user.


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(μV)	Antenna factor dB	Cable loss dB + Preselector	Attenuator dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Low Channel											
2405	Peak	Horz	93.9	30.6	5.2	10.0	33.0	106.7			PASS
2405	Peak	Vert	114.8	30.6	5.2	10.0	33.0	127.6			PASS
2390	Peak	Horz	43.0	30.6	5.2	10.0	33.0	55.8	74.0	18.2	PASS
2390	Avg	Horz	23.0	30.6	5.2	10.0	33.0	34.6	54.0	18.2	PASS
2390	Peak	Vert	55.1	30.6	5.2	10.0	33.0	67.9	74.0	6.1	PASS
2390	Avg	Vert	35.1	30.6	5.2	10.0	33.0	46.7	54.0	6.1	PASS
2400	Peak	Horz	47.2	30.6	5.2	10.0	33.0	60.0	74.0	14.0	PASS
2400	Avg	Horz	27.2	30.6	5.2	10.0	33.0	38.8	54.0	14.0	PASS
2400	Peak	Vert	59.6	30.6	5.2	10.0	33.0	72.4	74.0	1.6	PASS
2400	Peak	Vert	39.6	30.6	5.2	10.0	33.0	52.4	54.0	1.6	PASS
Mid channel											
2445	Peak	Horz	94.2	30.6	5.2	10.0	33.0	107.0			PASS
2445	Avg	Horz	73.0	30.6	5.2	10.0	33.0	85.8			PASS
2445	Peak	Vert	115.3	30.6	5.2	10.0	33.0	128.1			PASS
2445	Avg	Vert	94.1	30.6	5.2	10.0	33.0	106.9			PASS
High channel 25											
2475	Peak	Horz	92.5	30.6	5.2	10.0	33.0	105.3			PASS
2475	Peak	Vert	104.9	30.6	5.2	20.0	33.0	127.7			PASS
2483.5	Peak	Horz	34.5	30.6	5.2	20.0	33.0	57.3	74.0	16.7	PASS
2483.5	Avg	Horz	14.5	30.6	5.2	20.0	33.0	36.1	54.0	16.7	PASS
2483.5	Peak	Vert	46.6	30.6	5.2	20.0	33.0	69.4	74.0	4.6	PASS
2483.5	Avg	Vert	26.6	30.6	5.2	20.0	33.0	48.2	54.0	4.6	PASS
2485.5	Peak	Vert	48.6	30.6	5.2	20.0	33.0	71.4	74.0	2.6	PASS
2485.5	Avg	Vert	28.6	30.6	5.2	20.0	33.0	50.2	54.0	2.6	PASS

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date ¹	Next Calibration Date ¹	Asset #
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
BiLog Antenna	3142-C	ETS	2-10-15	2-10-17	137
Horn Antenna	ATH1G18G	AR	4-23-15	4-23-17	4003
Biconical Antenna	EM-6913	Electro-Metrics	4/28/15	4/28/17	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	4/14/15	4/14/17	4087
Attenuator 3 dB	FP-50-3	Trilithic	1-28-15	1-28-17	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	7/22/15	7/22/16	4089
1-26.5GHz preamp	8449B	Agilent	9-9-14	9-9-16	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Emission software	0.1.87	TUV SUD Canada	1-28-15	1-28-17	58

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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

The Limit is as specified in FCC Part 15 and RSS 247.


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.

Method

The DTS bandwidth method is as per FCC KDB 558074 Section 8.1 for the 6 dB BW. For the 20 dB BW, FCC KDB 558074, Section 2.0 references ANSI C63.10 for occupied bandwidth. ANSI C63.10 Section 6.9.1 was used for occupied bandwidth.


Results

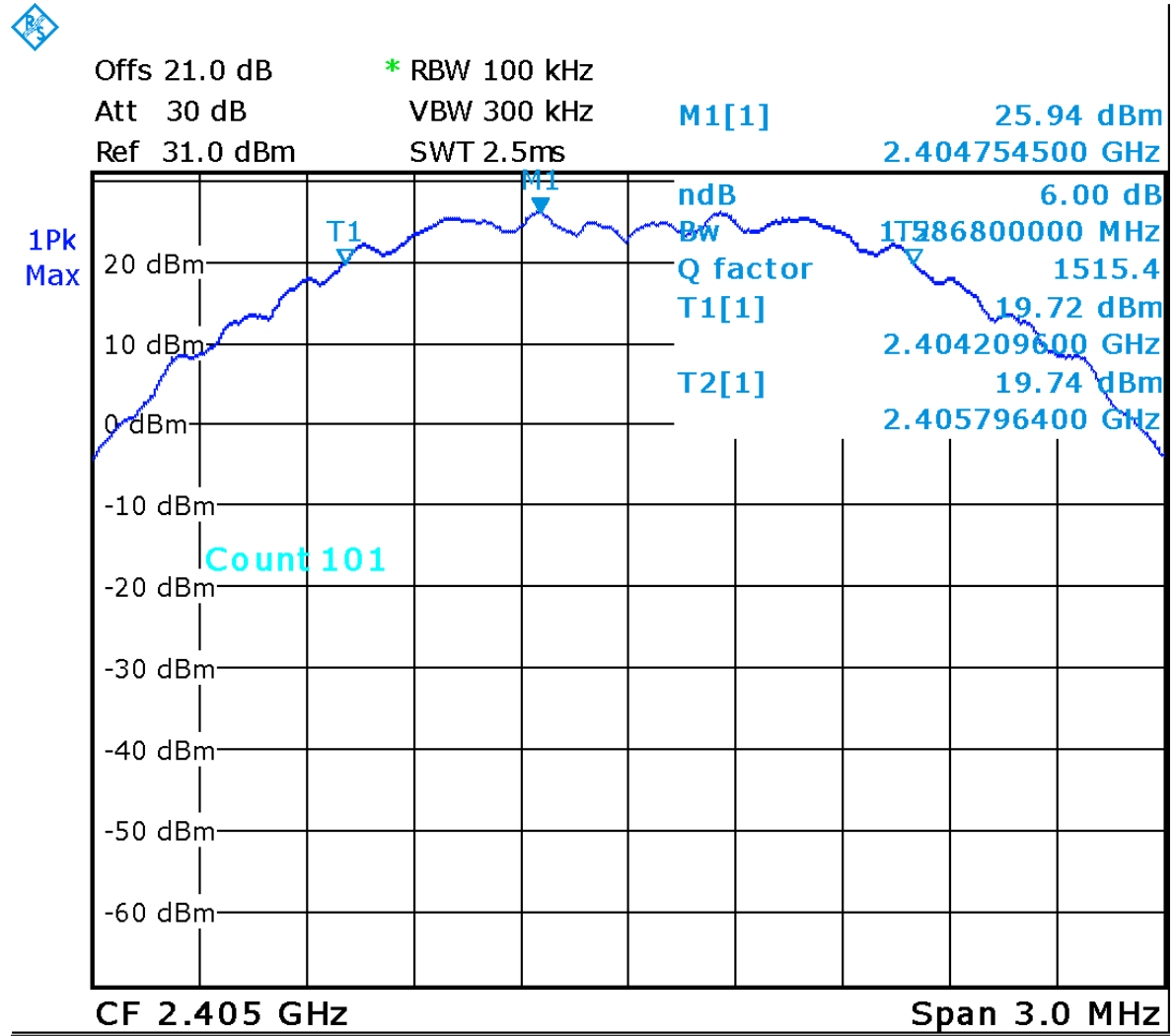
The EUT passed. The minimum 6 dB BW measured was 1.5808 MHz. For information purposes, the 99% occupied BW was measured to be 2.202 MHz


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

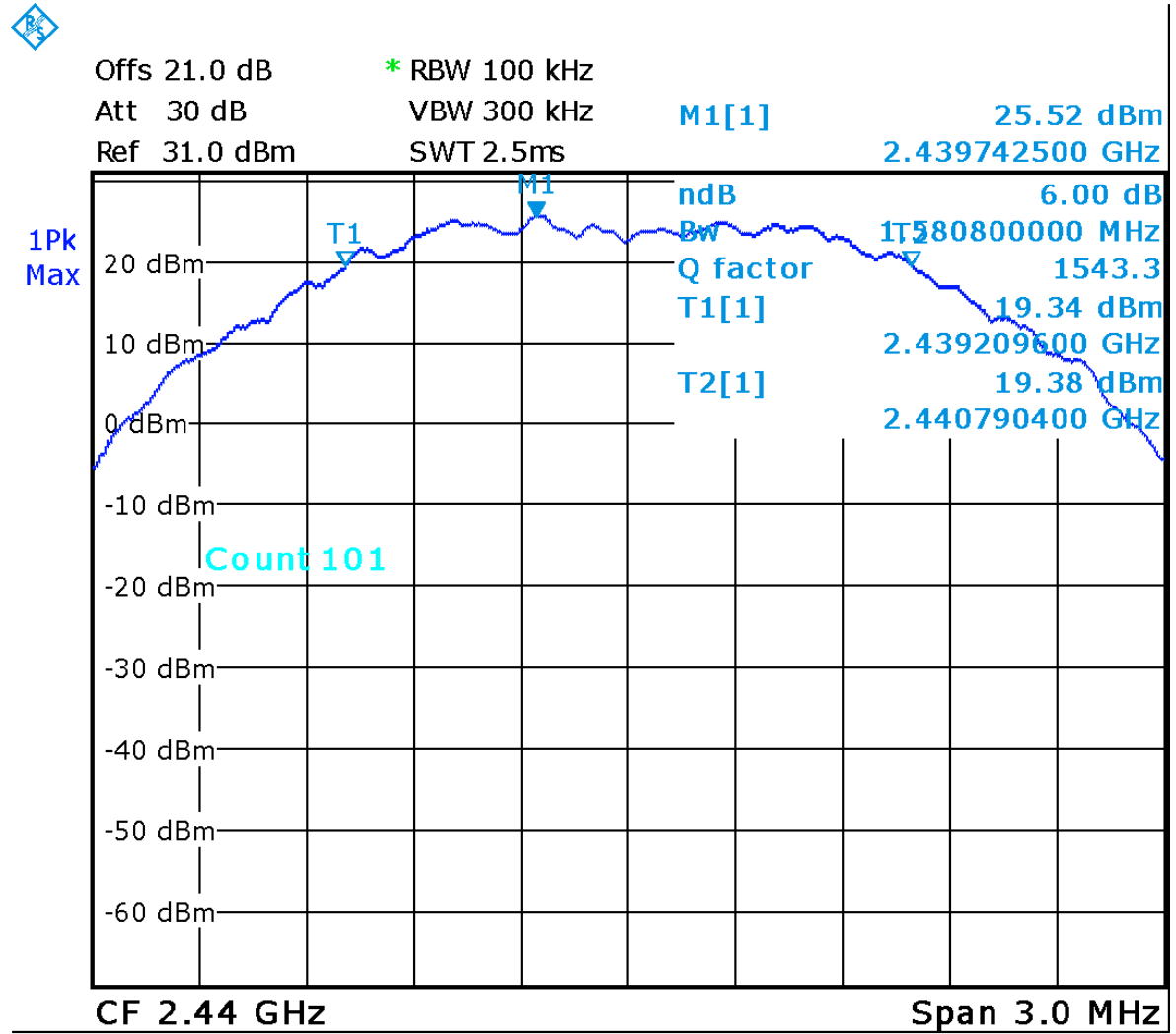
Graph(s)


The graphs shown below shows the channel spacing 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. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.

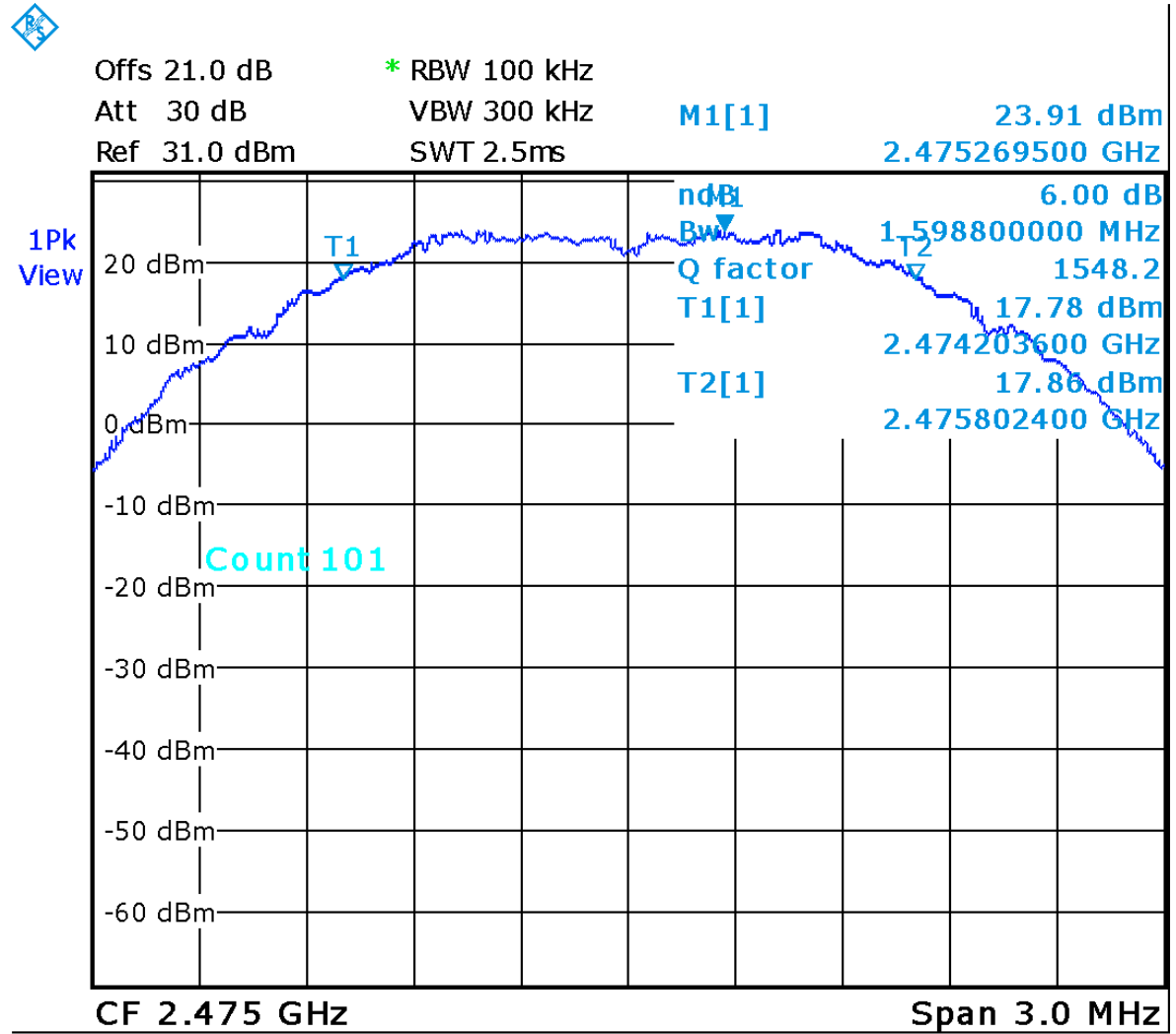
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

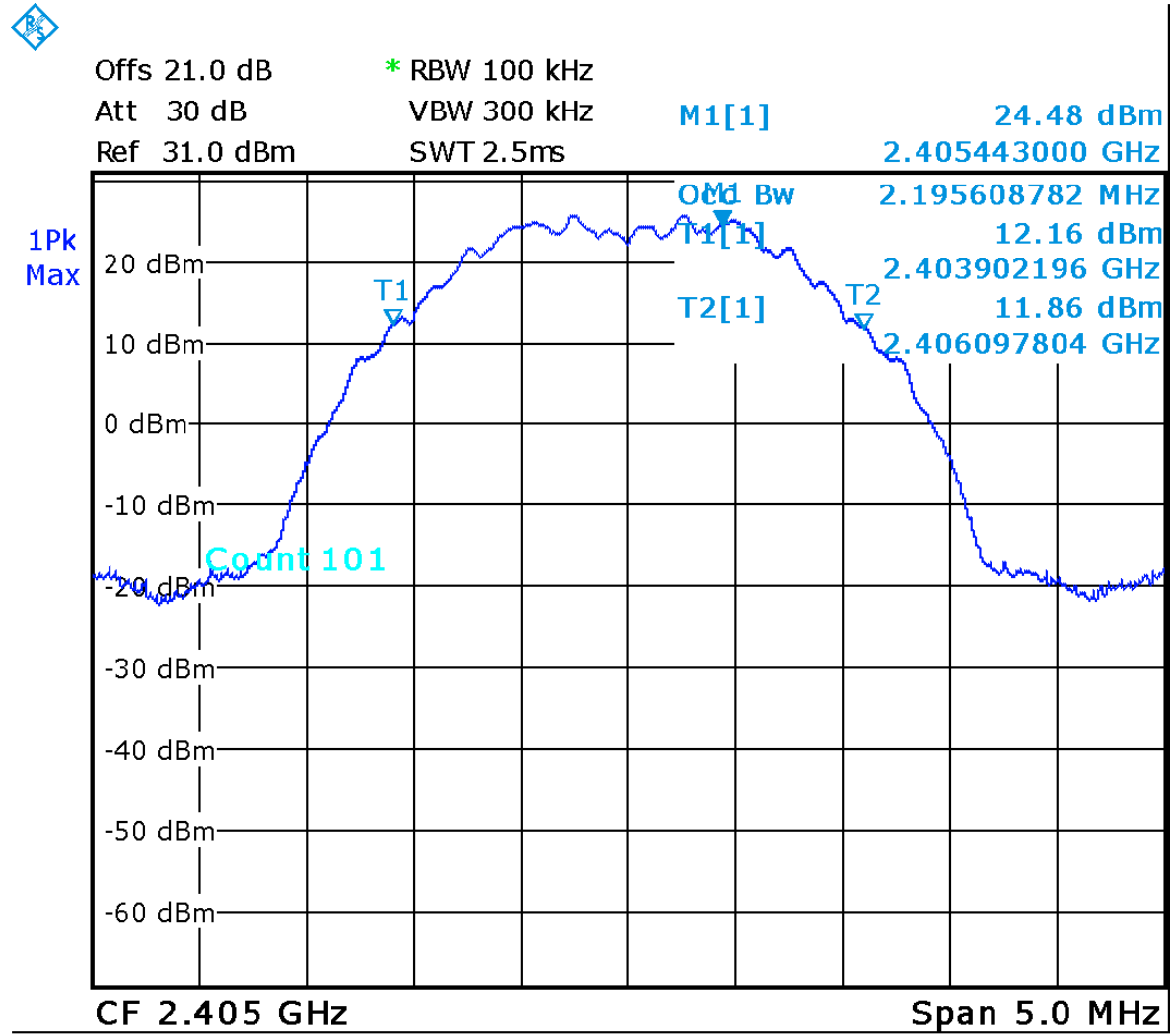



Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

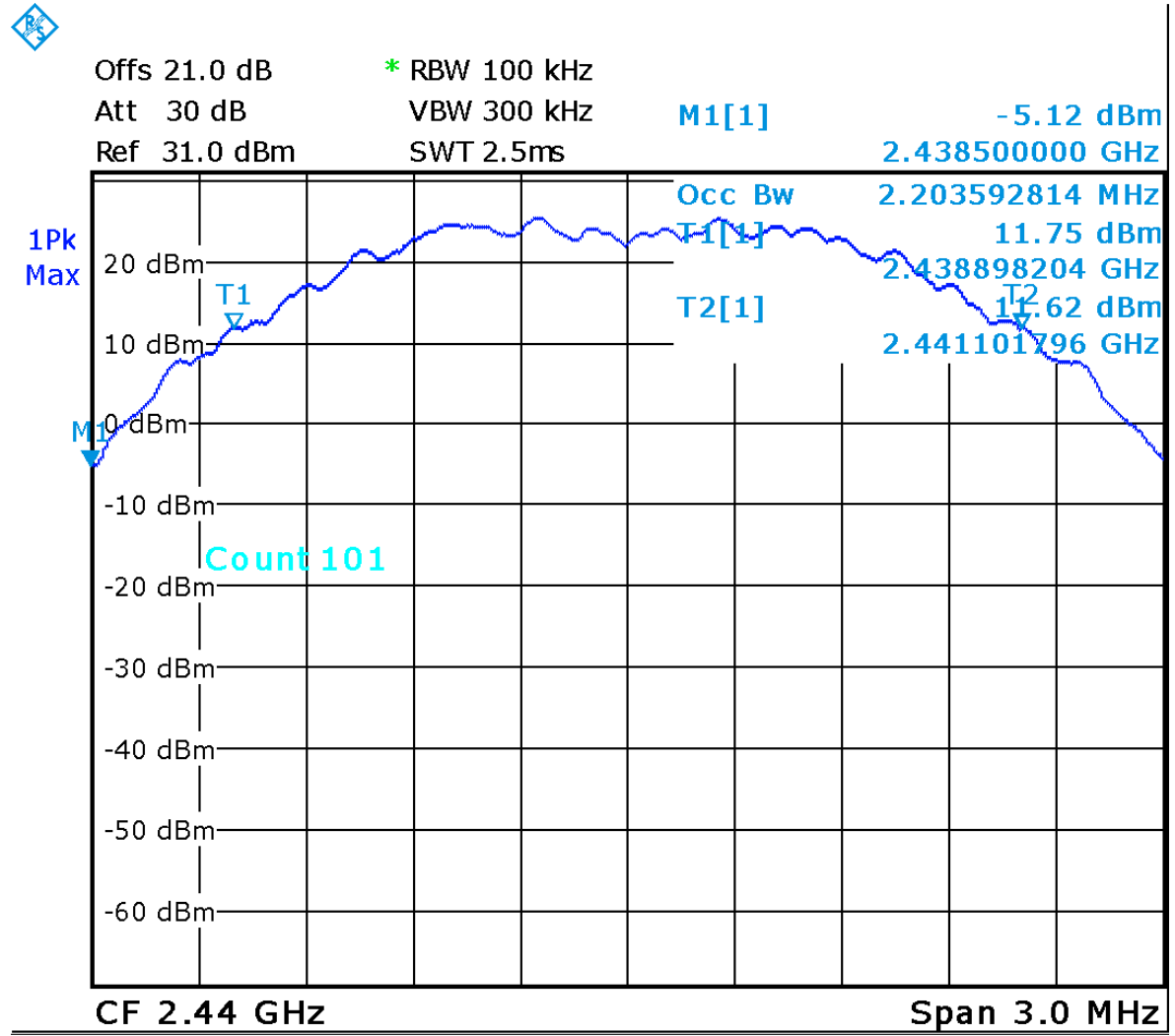



6 dB BW Low = 1.5868 MHz
6 dB BW Mid = 1.5808 MHz
6 dB BW High = 1.5988 MHz

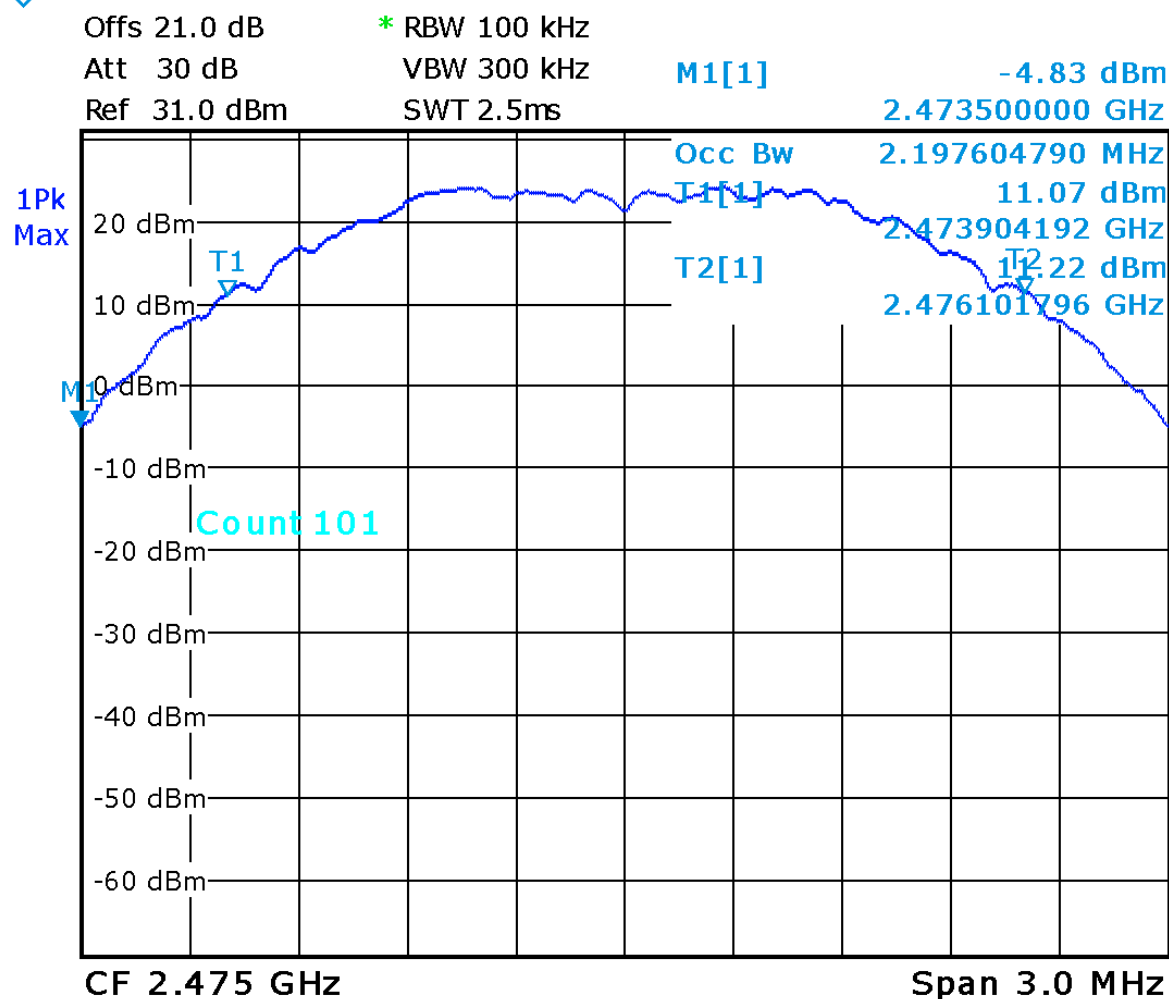
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Occupied BW Low = 2.196 MHz
 Occupied BW Mid = 2.204 MHz
 Occupied BW High = 2.198 MHz


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

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 20 dB	FP-50-20	Trilithic	1-28-15	1-28-17	4038
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 25, 2015	Nov 25, 2017	4169
RF Cable 0.5M	LMR-400- 0.5M- 50OHM- MN-MN	LexTec	1-28-15	1-28-17	4029

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Maximum conducted output 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, that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in FCC Part 15.247(b) and RSS 247.

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.


Method

Method was as per ANSI C63.10.

Results

The EUT passed. The maximum conducted (peak) output power measured was 29.63 dBm (918.3 mW). The maximum conducted (average) output power was 26.6 dBm.


Both values meet the requirement of being less than 30 dBm.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

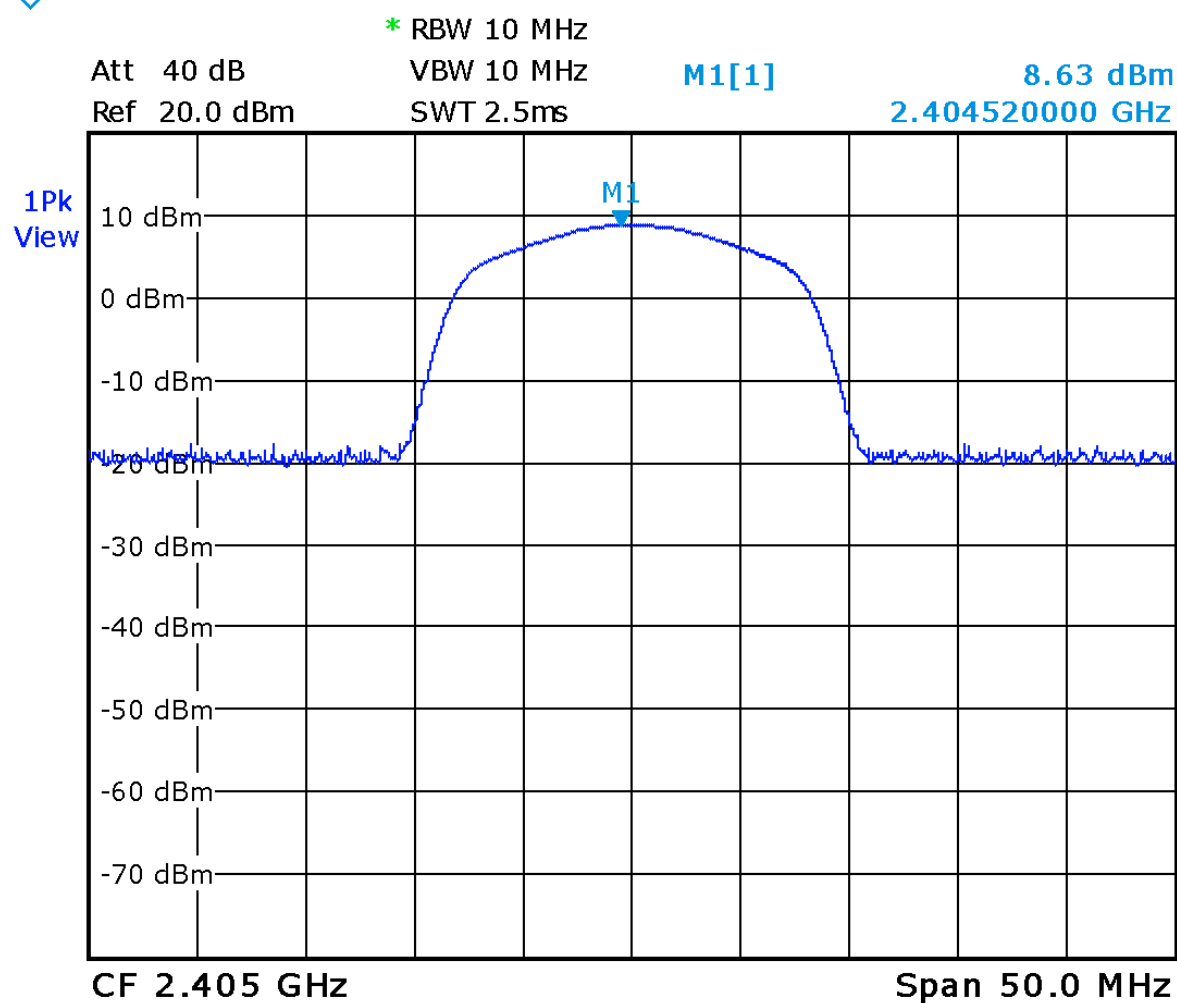
Table(s)

The tables shown below shows the Maximum conducted (peak) output power output of the device during the antenna conducted measurement during transmit operation of the EUT.


Band	Channel	Frequency (GHz)	Maximum conducted (average) output power (dBm)	Raw Peak Reading (dBm)	Atten.+Cable Factor(dB)	Maximum conducted (peak) output power (dBm)
Low	11	2.405	26.4	8.63	21	29.63
Medium	18	2.440	26.6	7.98	21	28.98
High	25	2.475	25.8	7.68	21	28.68

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

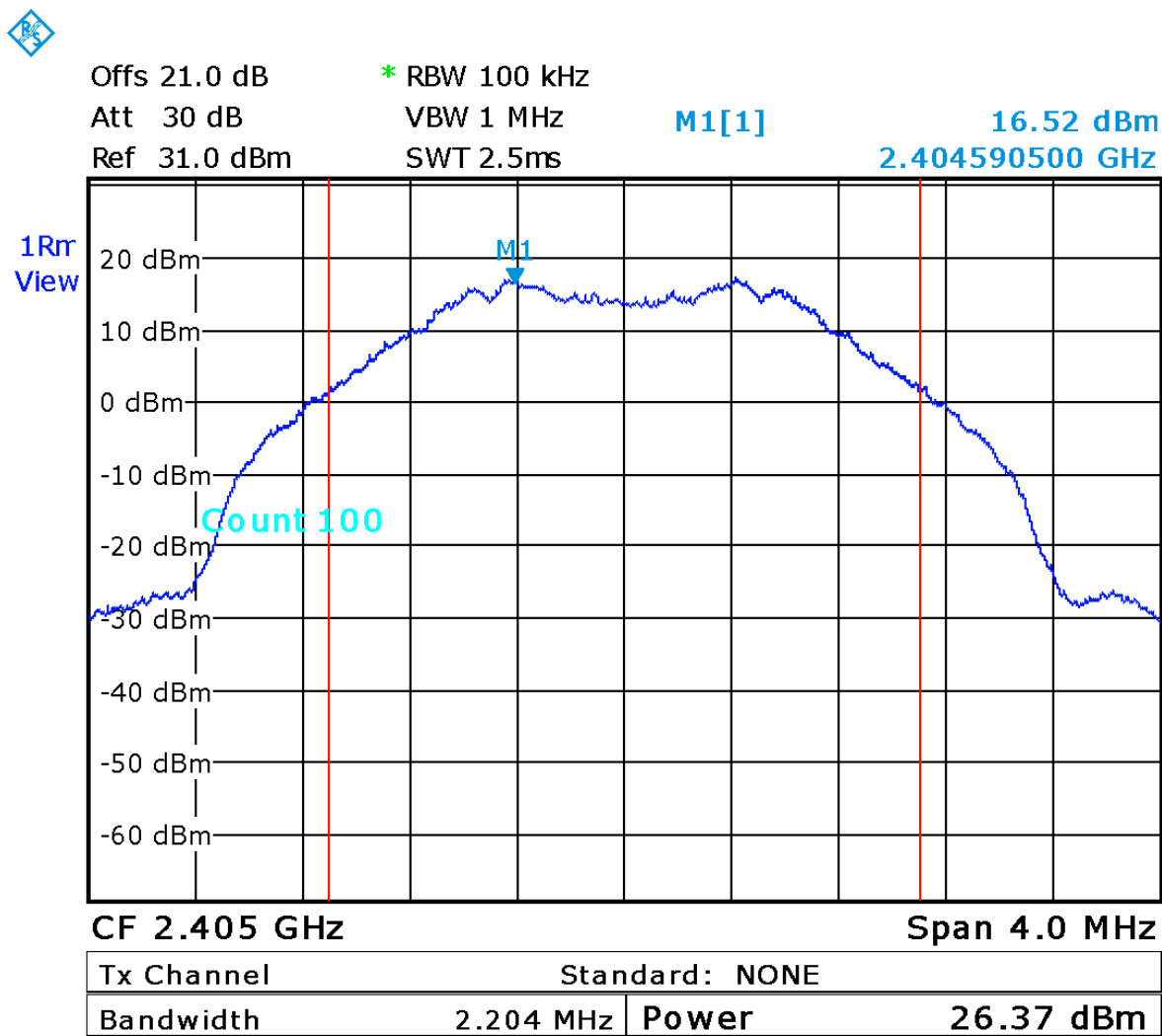
Low Channel 11 – Maximum conducted peak output power




Note: 20 dB external attenuator and 1 dB cable loss.

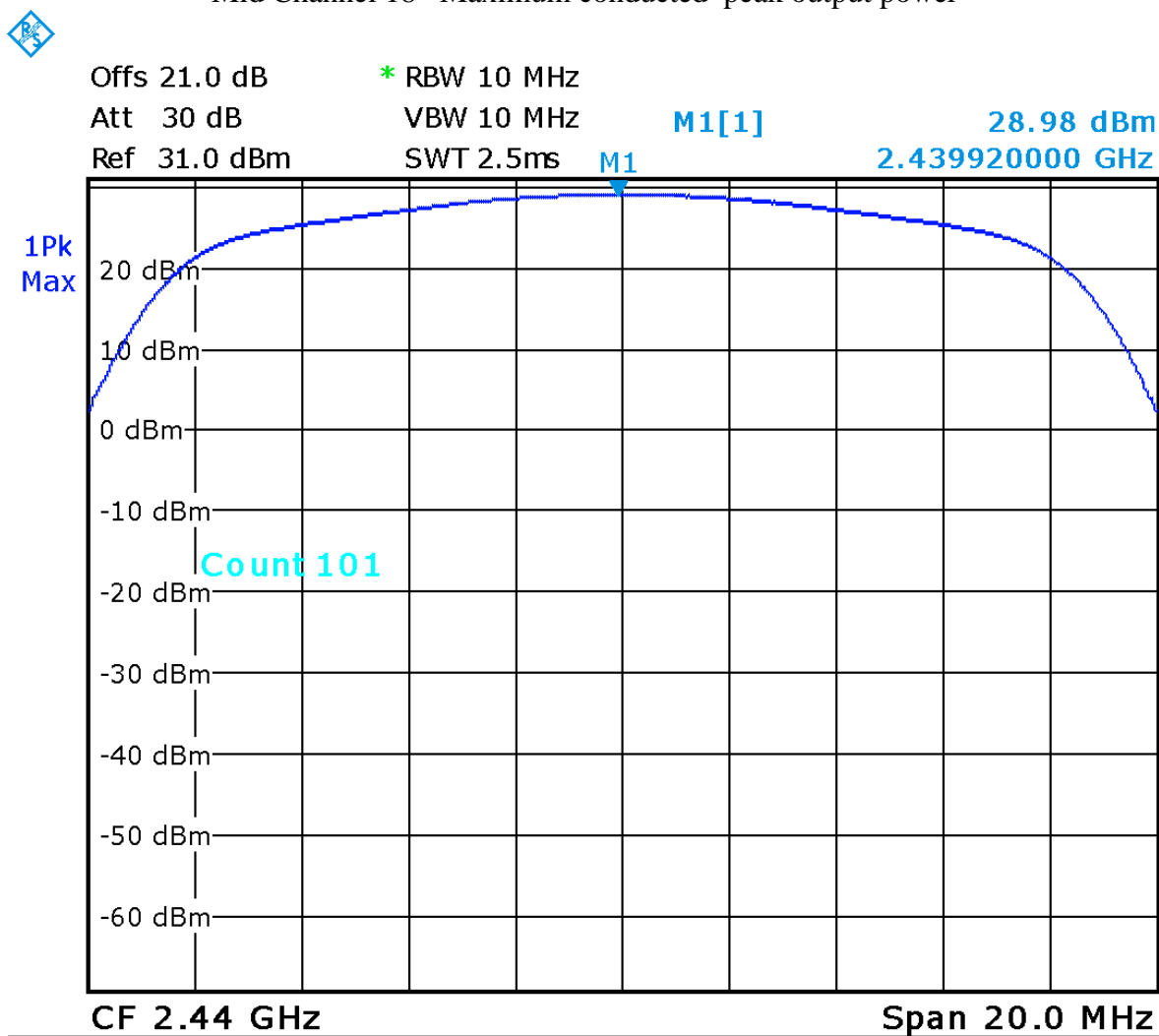
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Low Channel 11 – Maximum conducted average output power



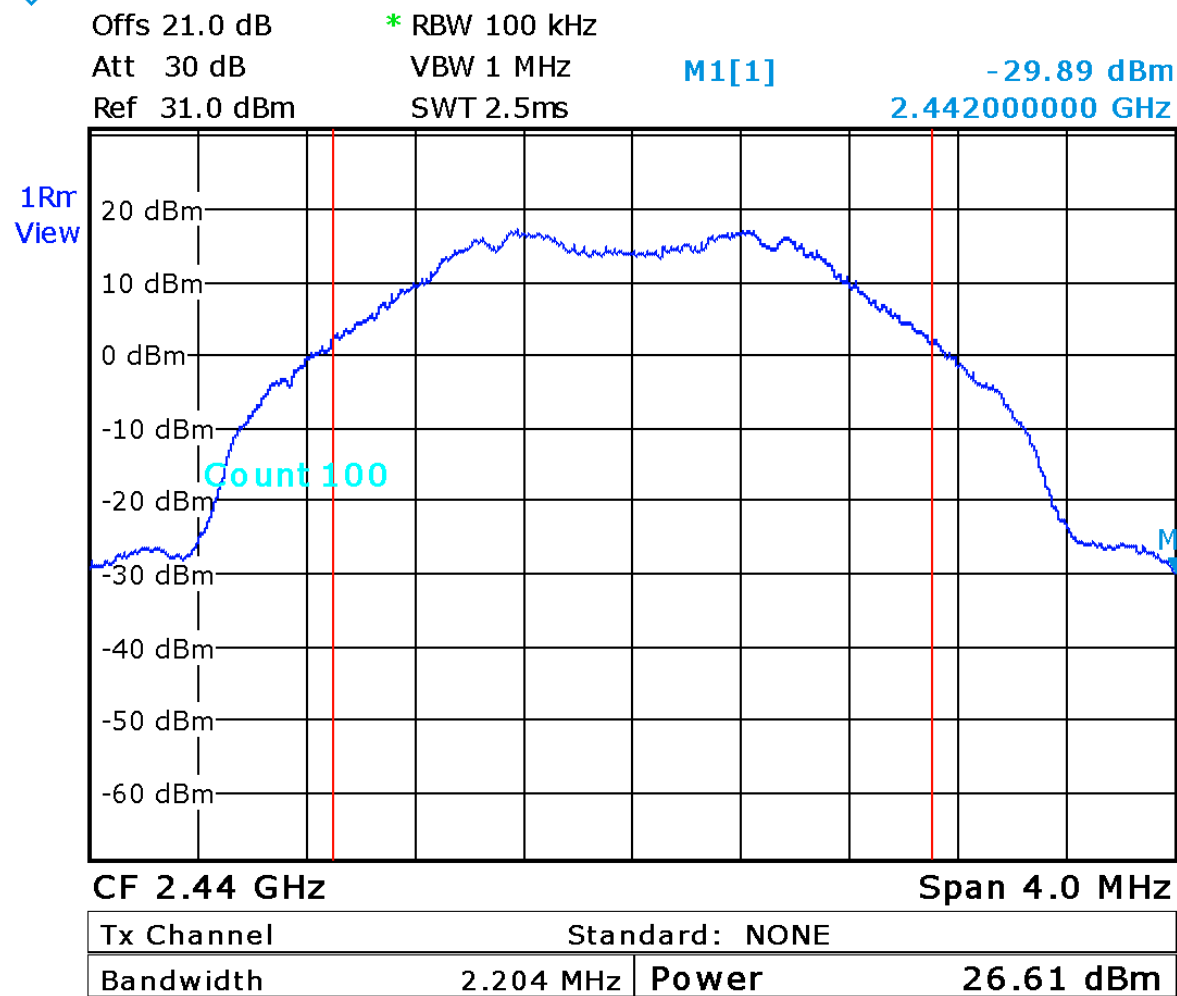
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Mid Channel 18– Maximum conducted peak output power



Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Mid Channel 18– Maximum conducted average output power



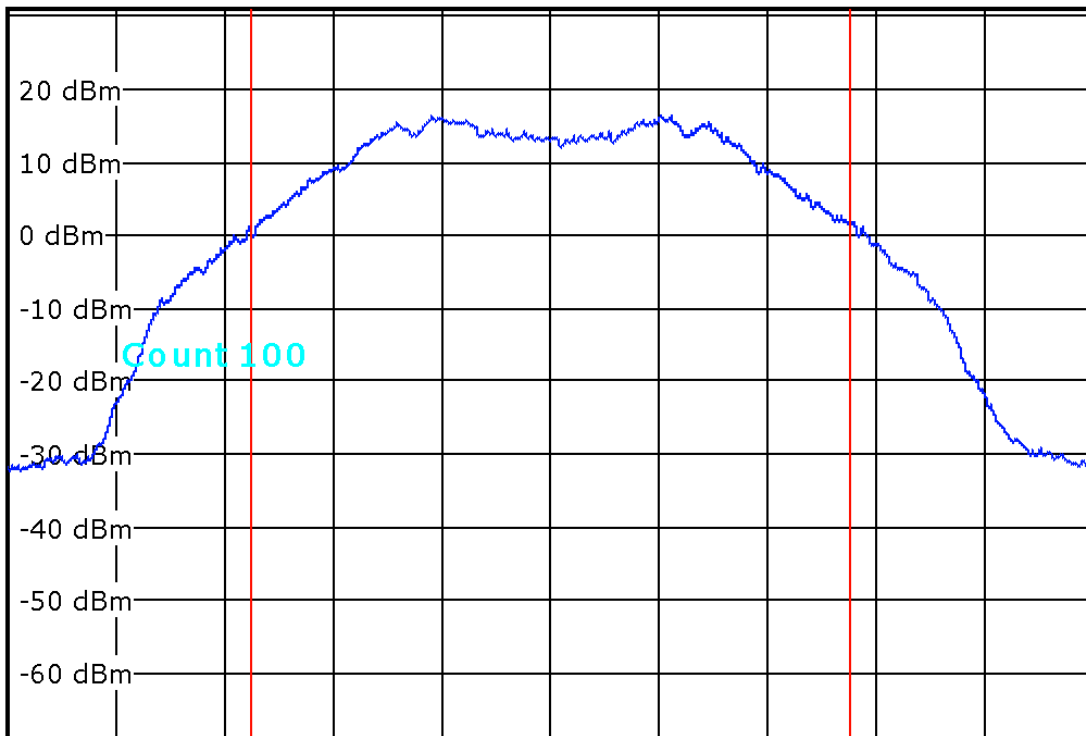
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

High Channel 25– Maximum conducted average output power



Offs 21.0 dB * RBW 100 kHz
 Att 30 dB VBW 1 MHz
 Ref 31.0 dBm SWT 2.5ms

1Rr
Avg




CF 2.475 GHz

Span 4.0 MHz

Tx Channel		Standard: NONE	
Bandwidth	2.204 MHz	Power	25.79 dBm


Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 30 dB	FP-50-30	Trilithic	1-28-15	1-28-17	4041
Spectrum Analyzer	ESL6	Rohde & Schwarz	11-25-15	11-25-17	160
RF Cable 0.5m	LMR-400- 0.5M- 50OHM- MN-MN	LexTec	1-28-15	1-28-17	4029

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Spurious Conducted Emissions

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


The limits are defined in 15.247(d). As peak power was used, 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.

Method

Method was as per Ansi C 63.4.

Results

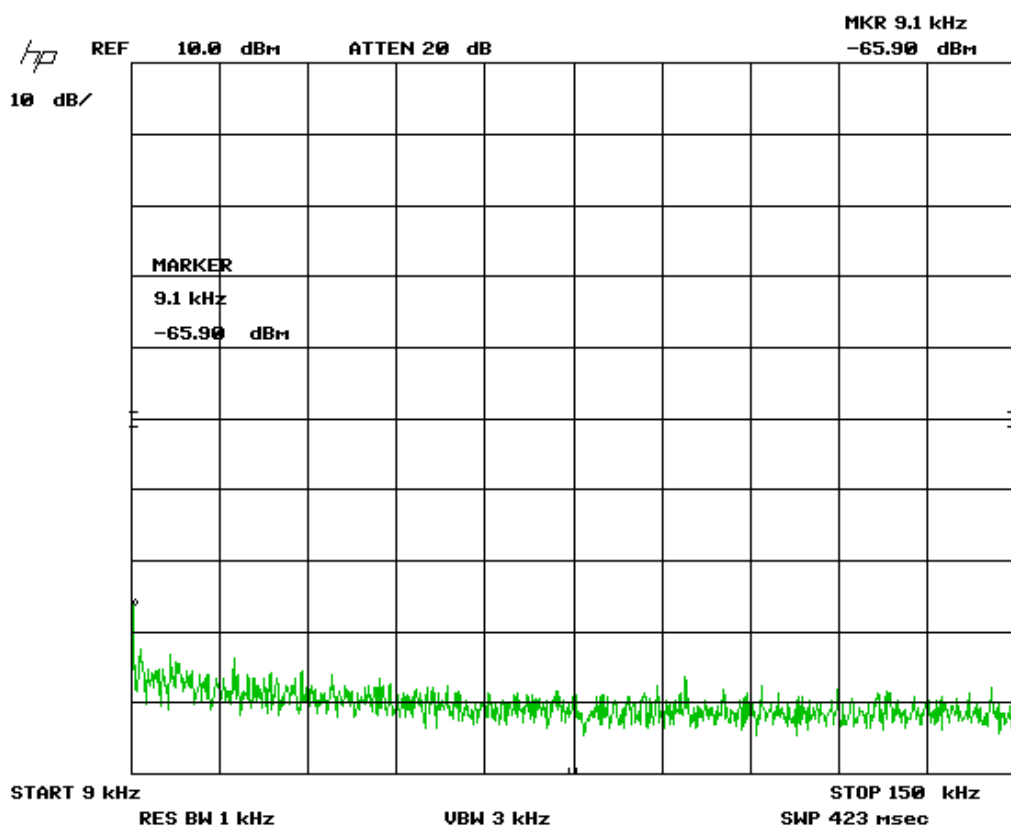
The EUT pass. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band. Note this device also complies with the -30 dBc requirement as shown in the graphs below.


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

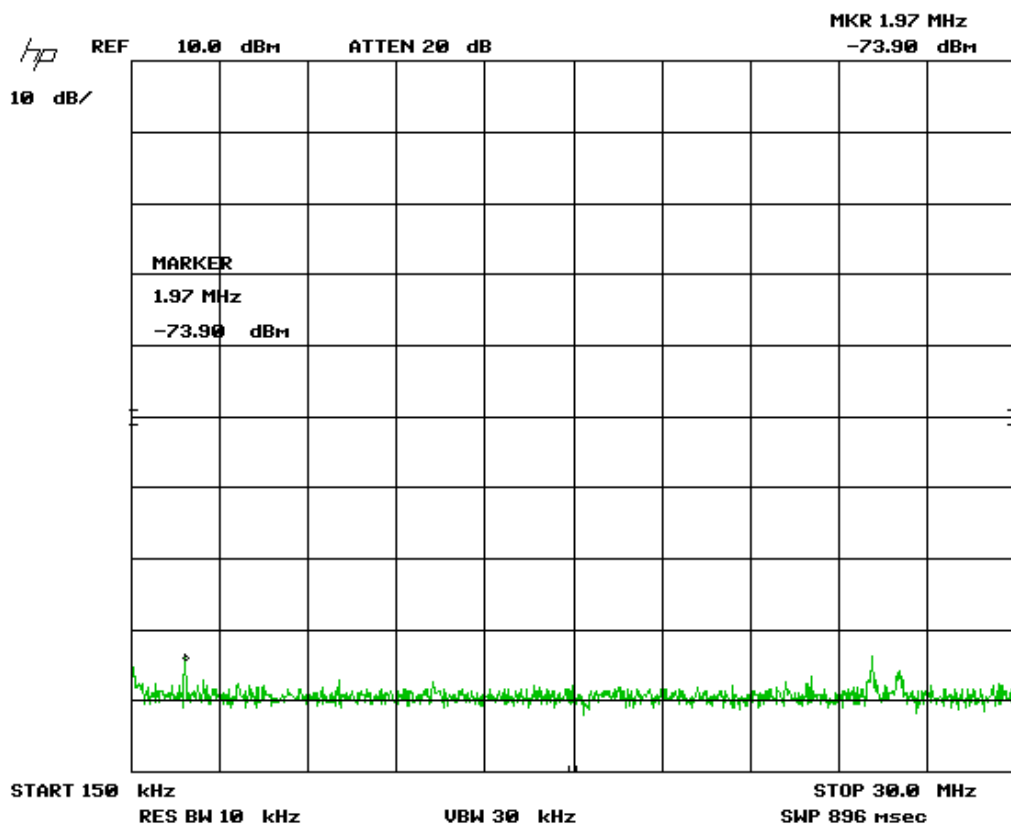
Graph(s)


The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Note there was 20 dB of external attenuation taken during this measurement.

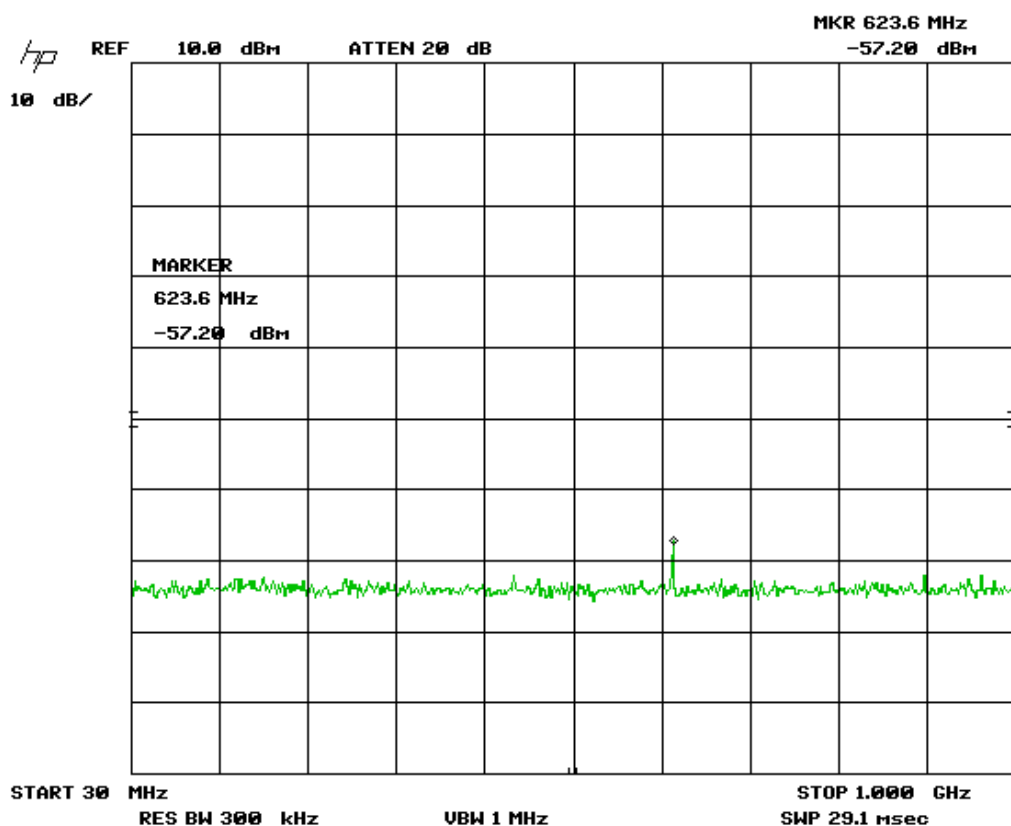
Frequencies below fundamental




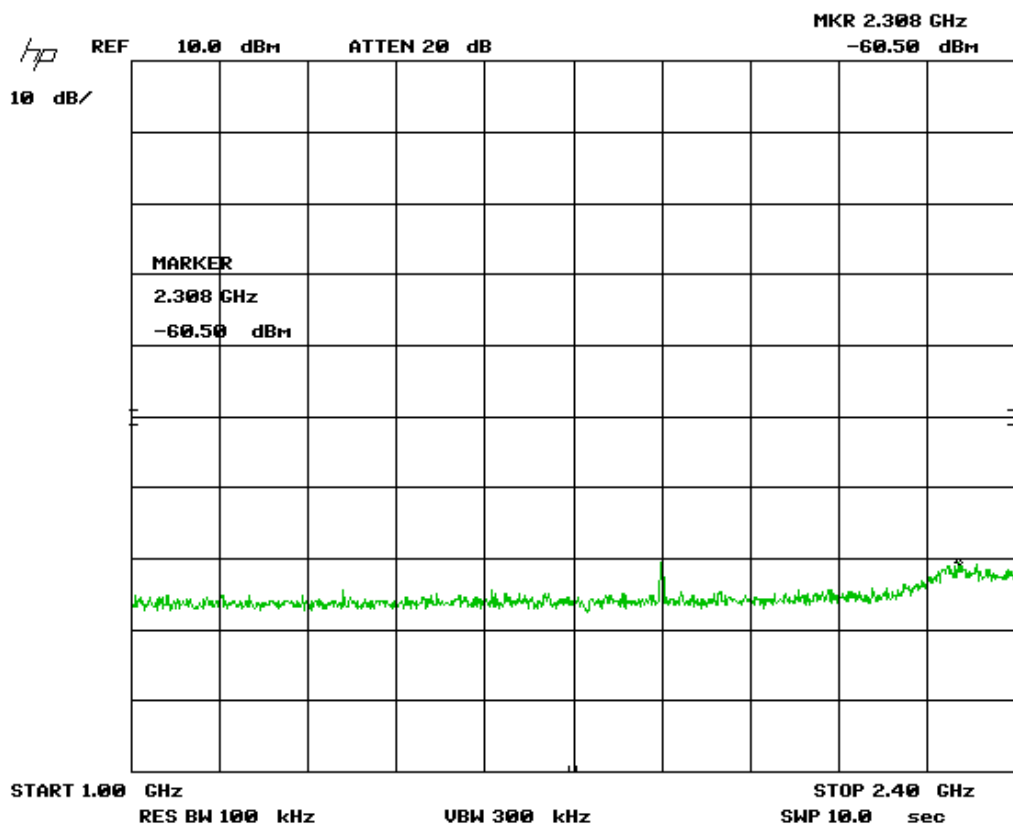
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




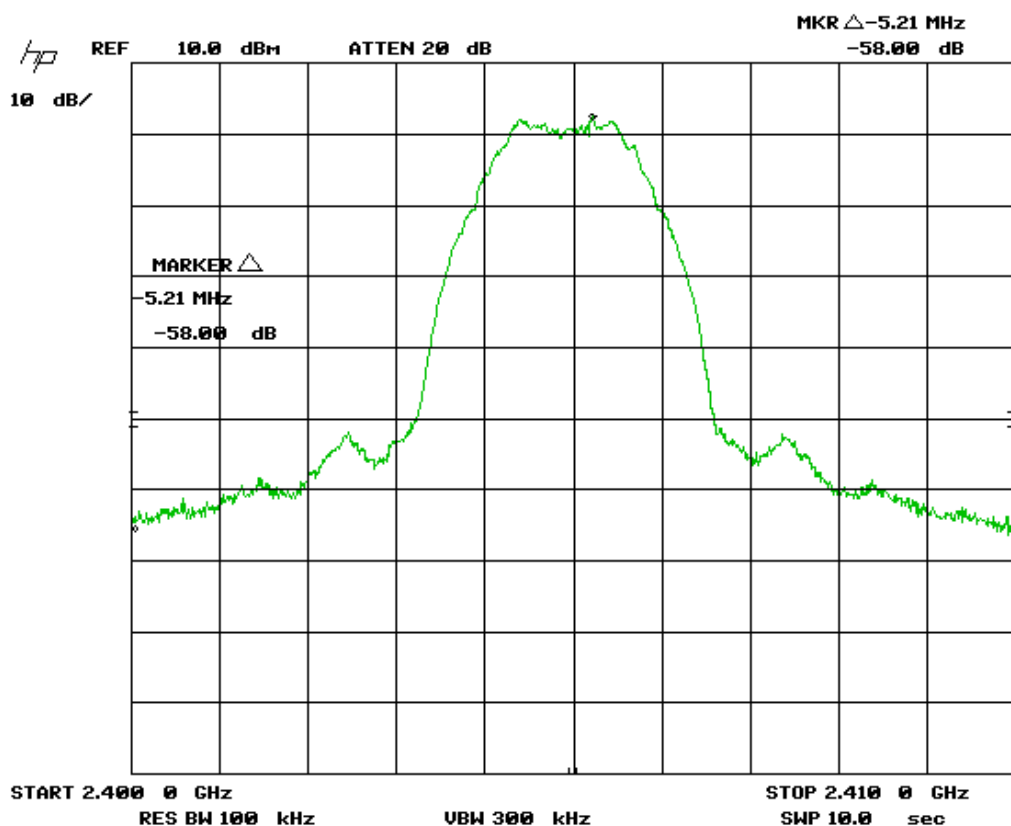
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

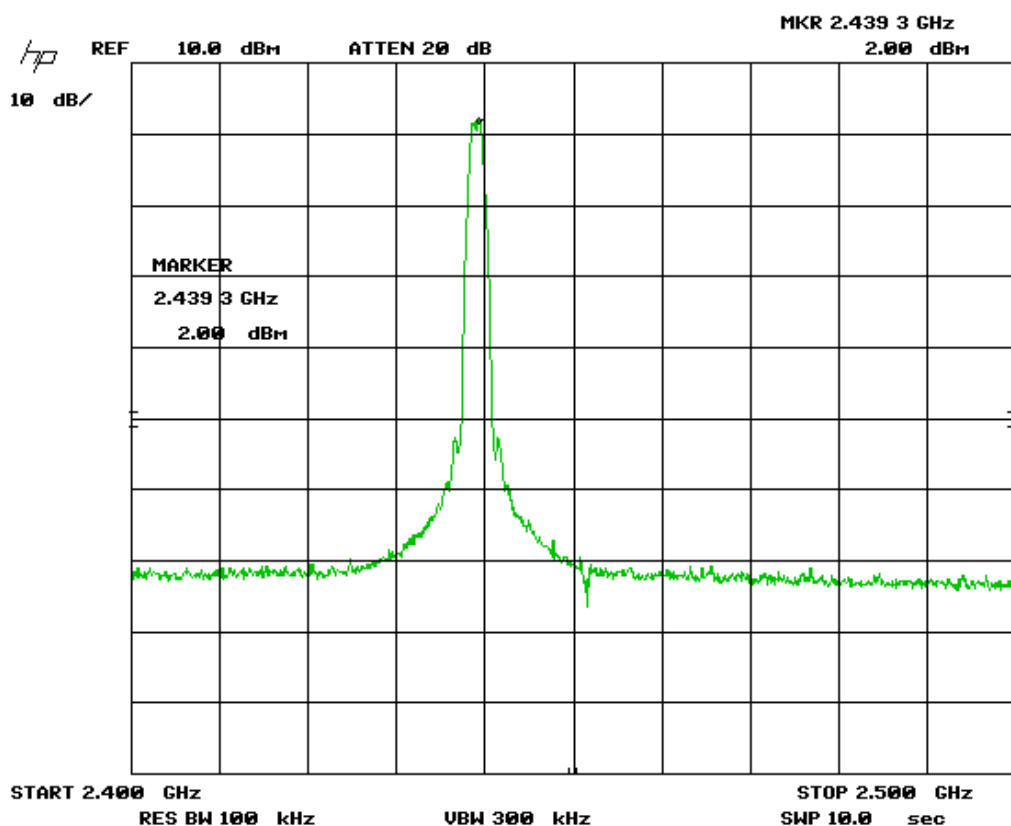


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




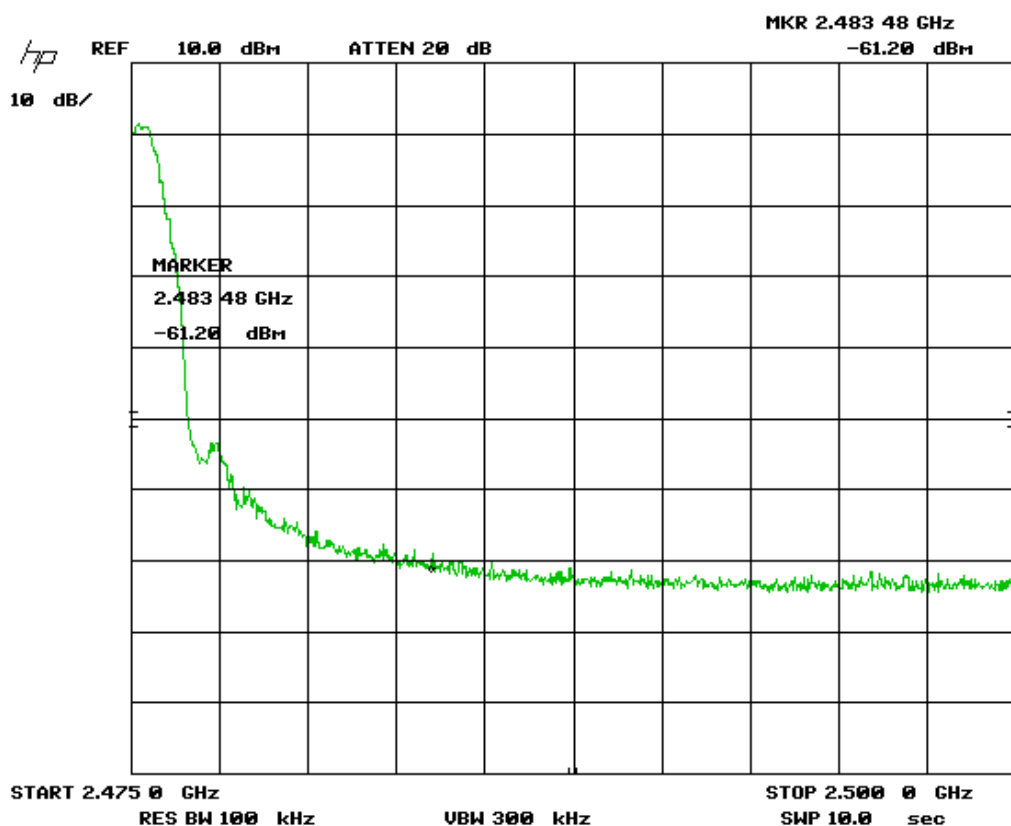
Worst case shown with low channel setting.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




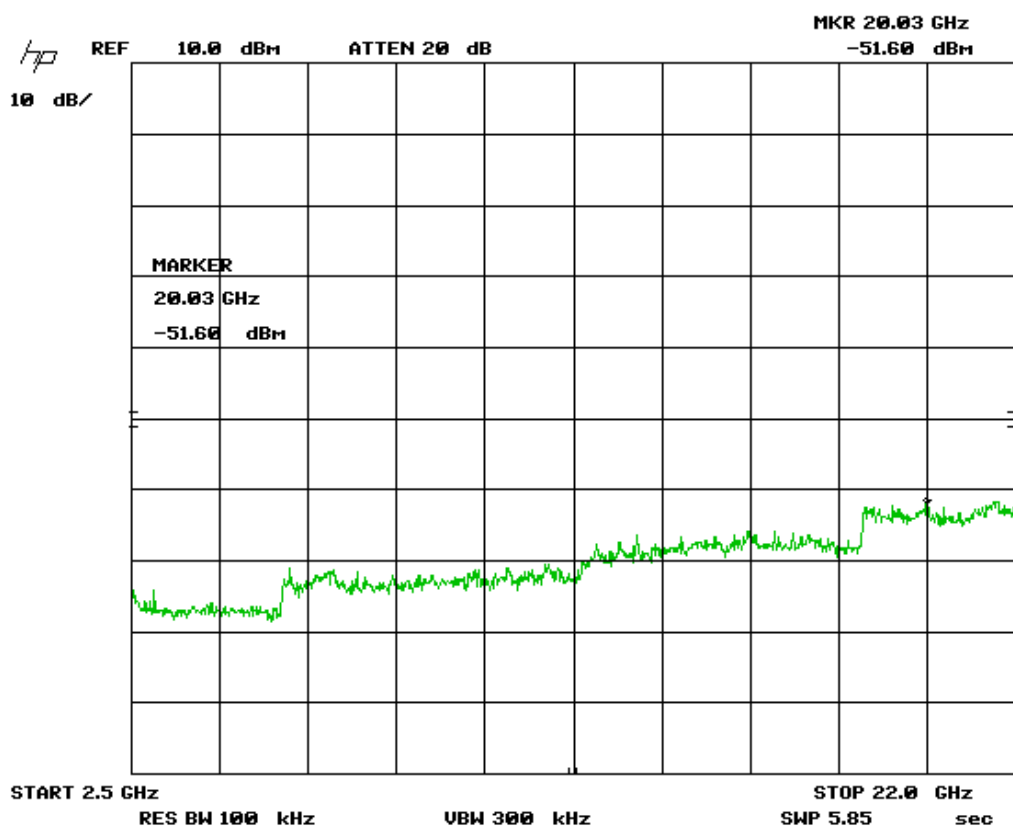
Mid channel shown above


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

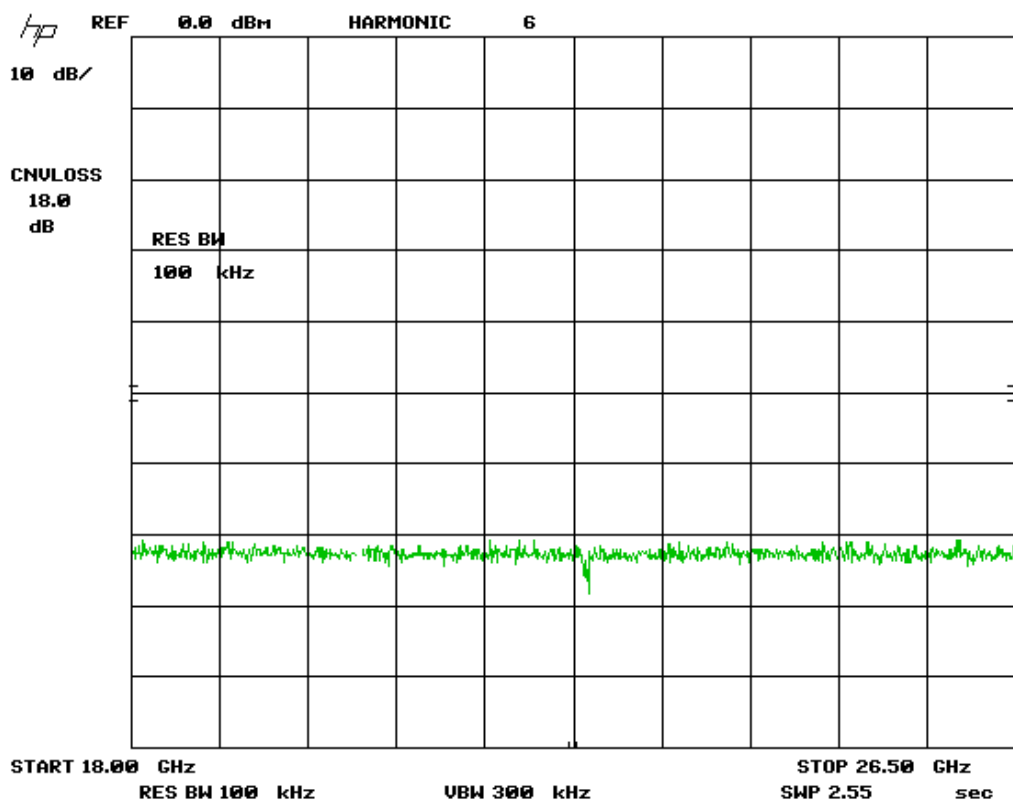


Worst case high channel shown above.


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




Note: The applicable relative limit would be -18 dBm in any 100 kHz band, no emissions were detected and the noise floor was below -30 dBm in any 100 kHz band.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date ¹	Next Calibration Date ¹	Asset #
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
Attenuator 3 dB	FP-50-3	Trilithic	1-28-15	1-28-17	4028
18.0-26.5 GHz Harmonic Mixer	11970K	HP	1-28-14	1-28-16	GEMC 158
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Emission software	0.1.87	TUV SUD Canada	1-28-15	1-28-17	58

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Power Spectral Density - DM

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

The limits are defined in 15.247(e).

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.


Method

Method was as per ANSI C63.10

Results

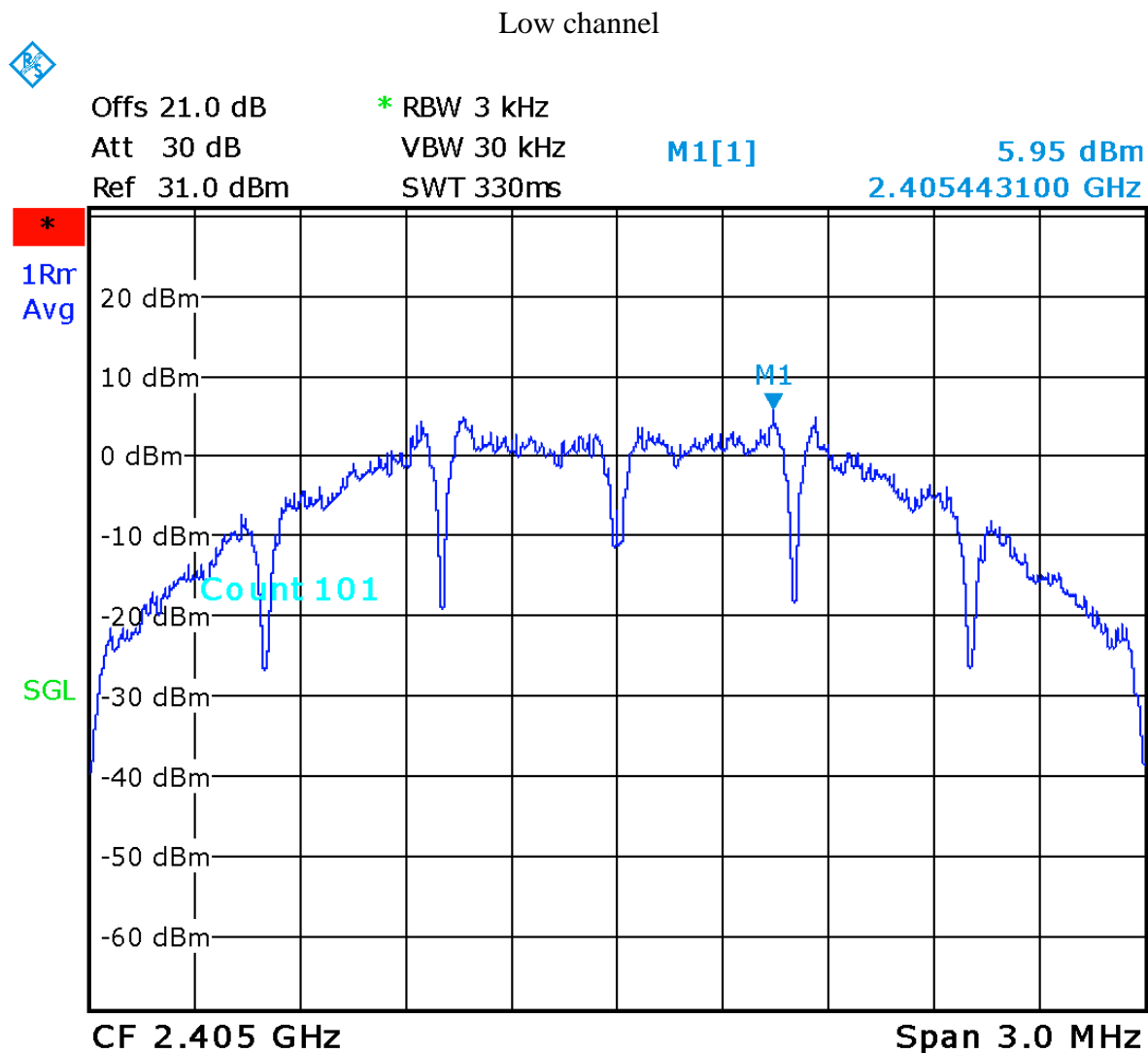
The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is 5.95 dBm as measured with a 3 kHz resolution bandwidth (maximum average conducted PSD power).

Band	Channel	Frequency (GHz)	PSD
Low	11	2.405	5.95
Medium	18	2.440	4.70
High	25	2.475	3.93

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Graph(s)

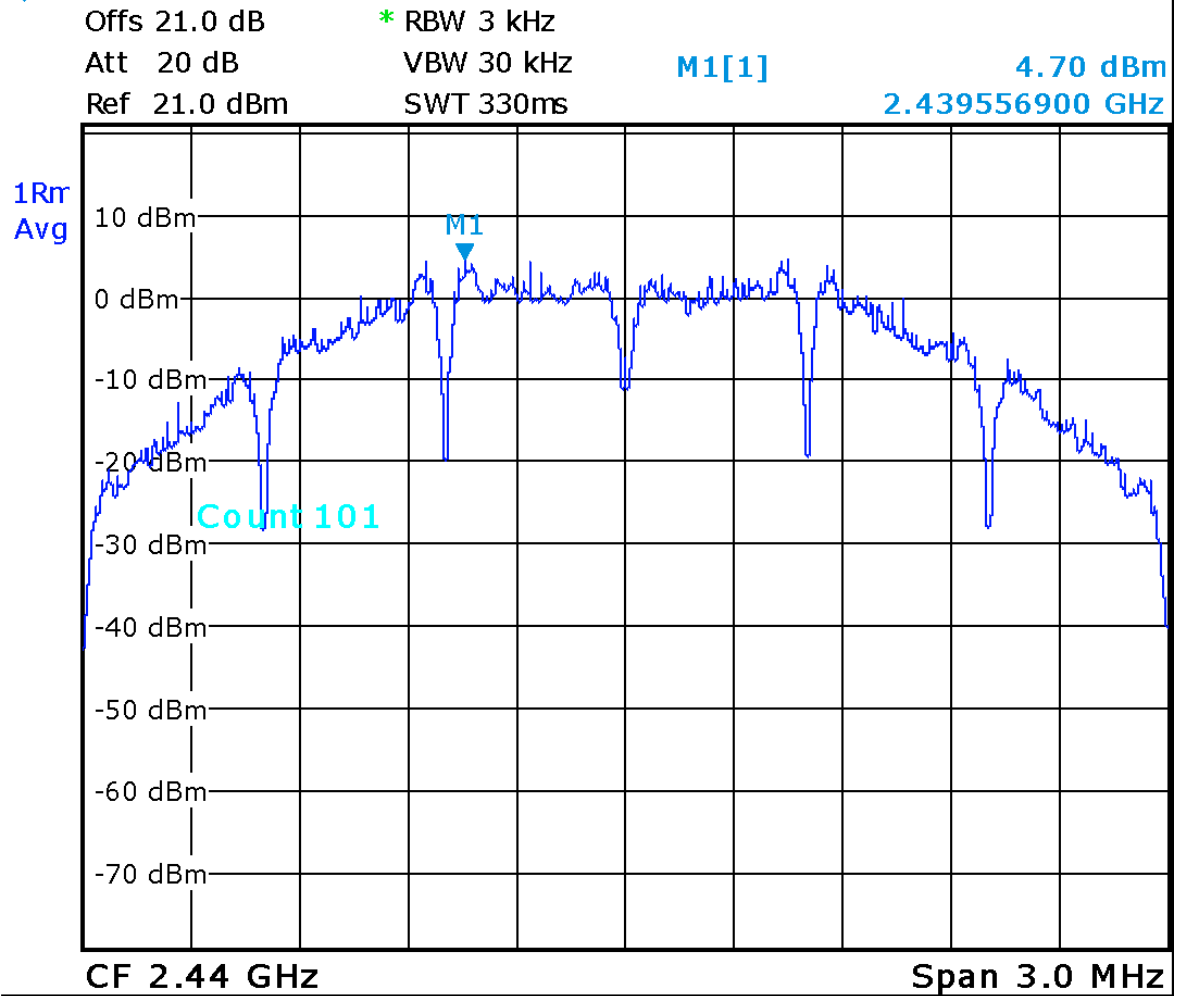
The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode, with the worst case being presented.




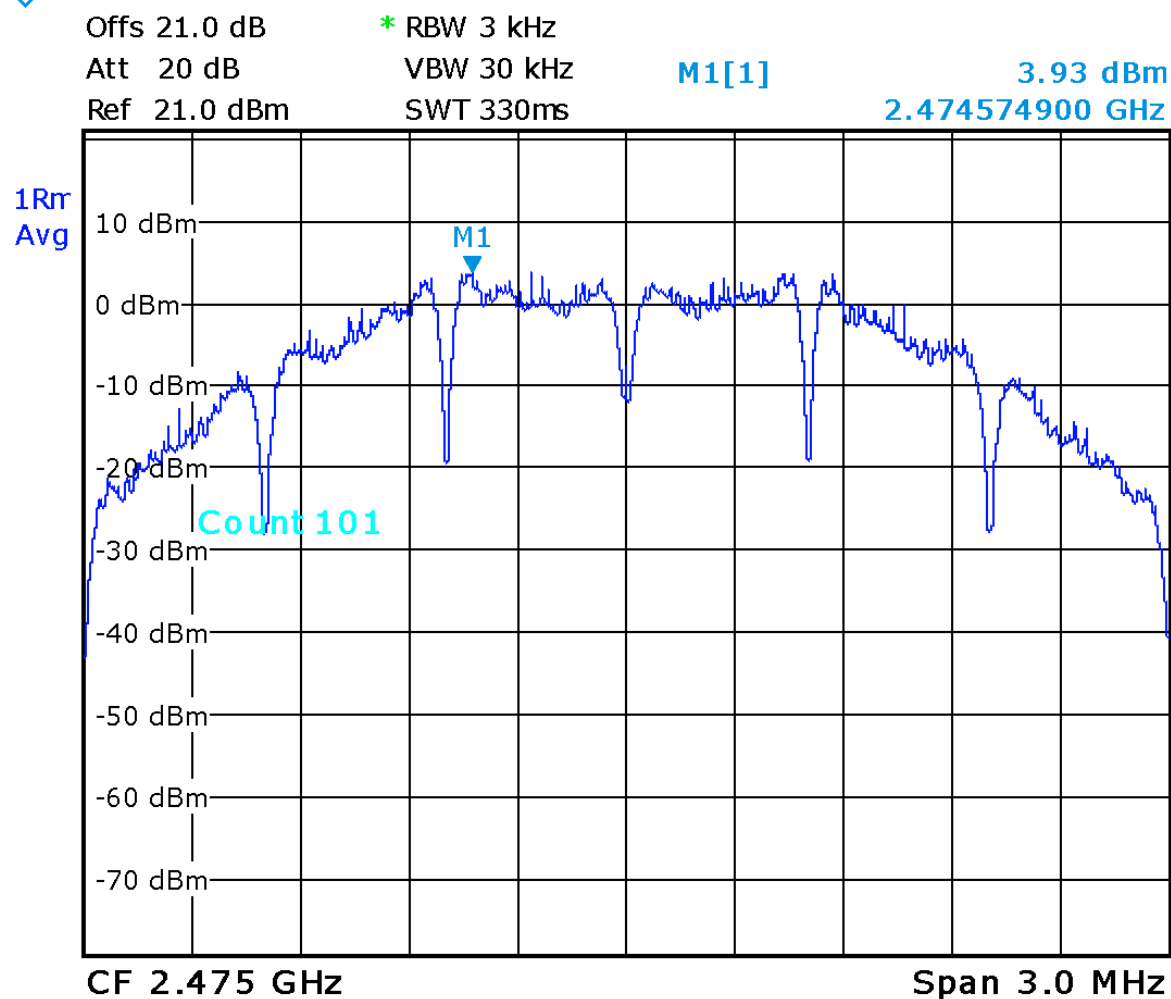
Date: 22.OCT.2015 12:52:01

Note: This was obtained with a worst case setting of 30 dBm at channel 11.


Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	




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

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	11-25-15	11-25-17	160
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	4039
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	4038


This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Appendix A – EUT Summary

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


Manufacturer	Trilliant Networks Canada Inc. 610 Du Luxembourg, Granby QC J2J 2V2 Canada
EUT Name	OSDI-4000-1D OSDI-4000-1A
HVIN	CL-R0353A-6.1
EUT revision	1.2
Host used (not restricted)	Trilliant OSDI-EVAL board CL-R0350D-2.
Software version	2.247
Equipment category	Network equipment
EUT is powered using	DC voltage
Input voltage range(s) (V)	12Vdc and 3Vdc
Rated input current (A)	60mA max. (in transmit)
Frequency of all clocks present in EUT	16 MHz, 2.4835 GHz (intentional)
I/O cable description Specify length and type	No
Approximate Size (LxWxH)	28mm X 35mm X 5mm
Equipment Category (Commercial / Residential / Medical)	Residential
Peripherals required for test	PC, Mesh Device
Minimum Separation distance from operator	See SAR test report
Types and lengths of all I/O cables	N/A
Description	The OSDI modules are low power 2.4GHz ISM band transceivers (IEEE 802.15.4).

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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 & Test Setup Photographs’.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	


Appendix B – EUT and Test Setup Photographs

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.


Radiated Emissions Below 30 MHz



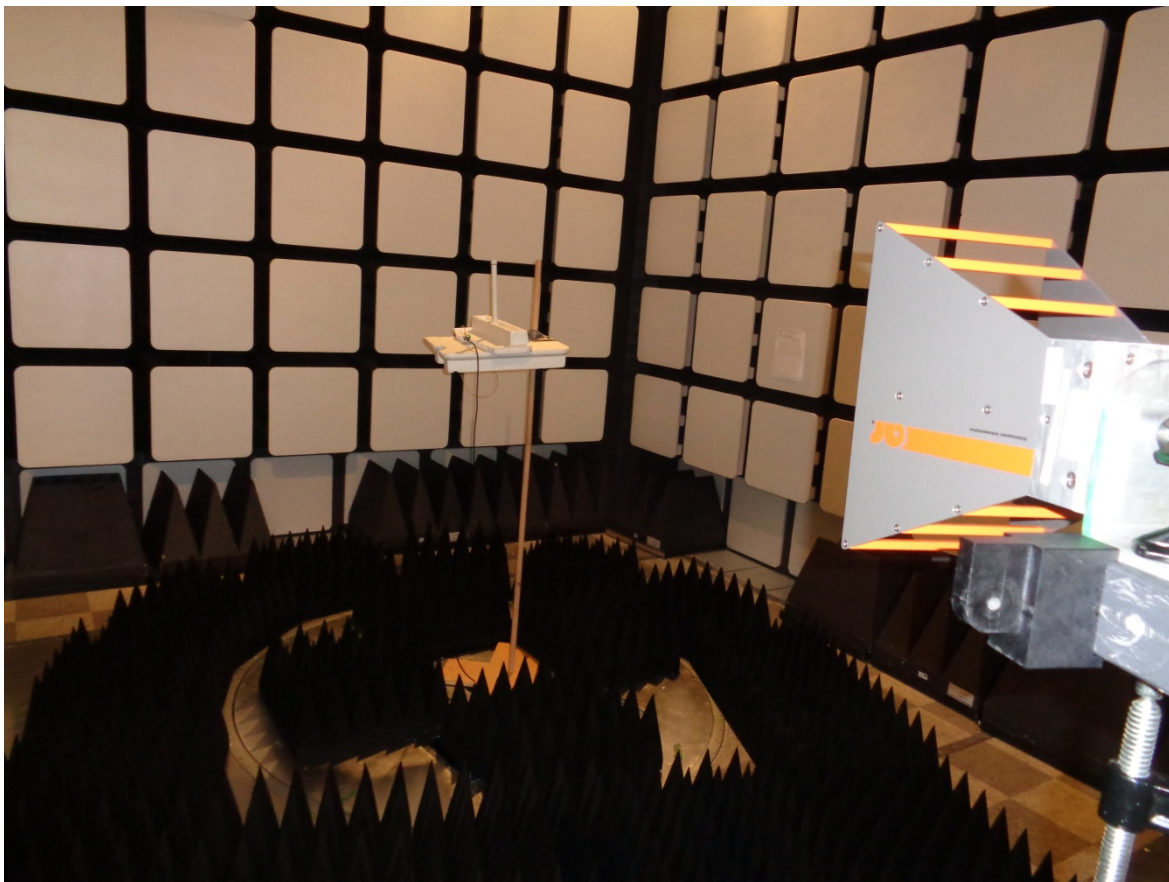
Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Radiated Emissions 30 MHz to 1 GHz




Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

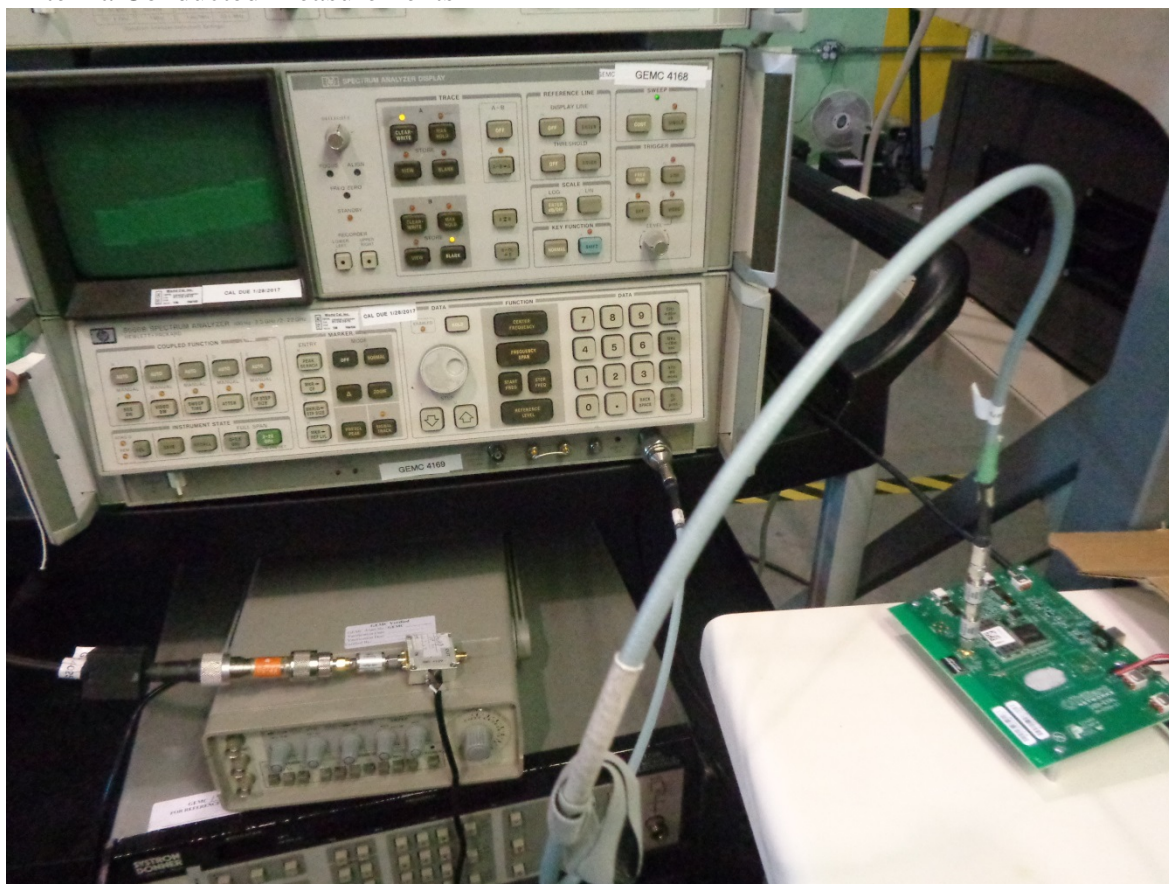
Radiated Emissions above 1 GHz




Note: Due to lack of IO cables and auxiliary equipment the device was tested on a small non-conductive platform at 1.5m from the groundplane.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

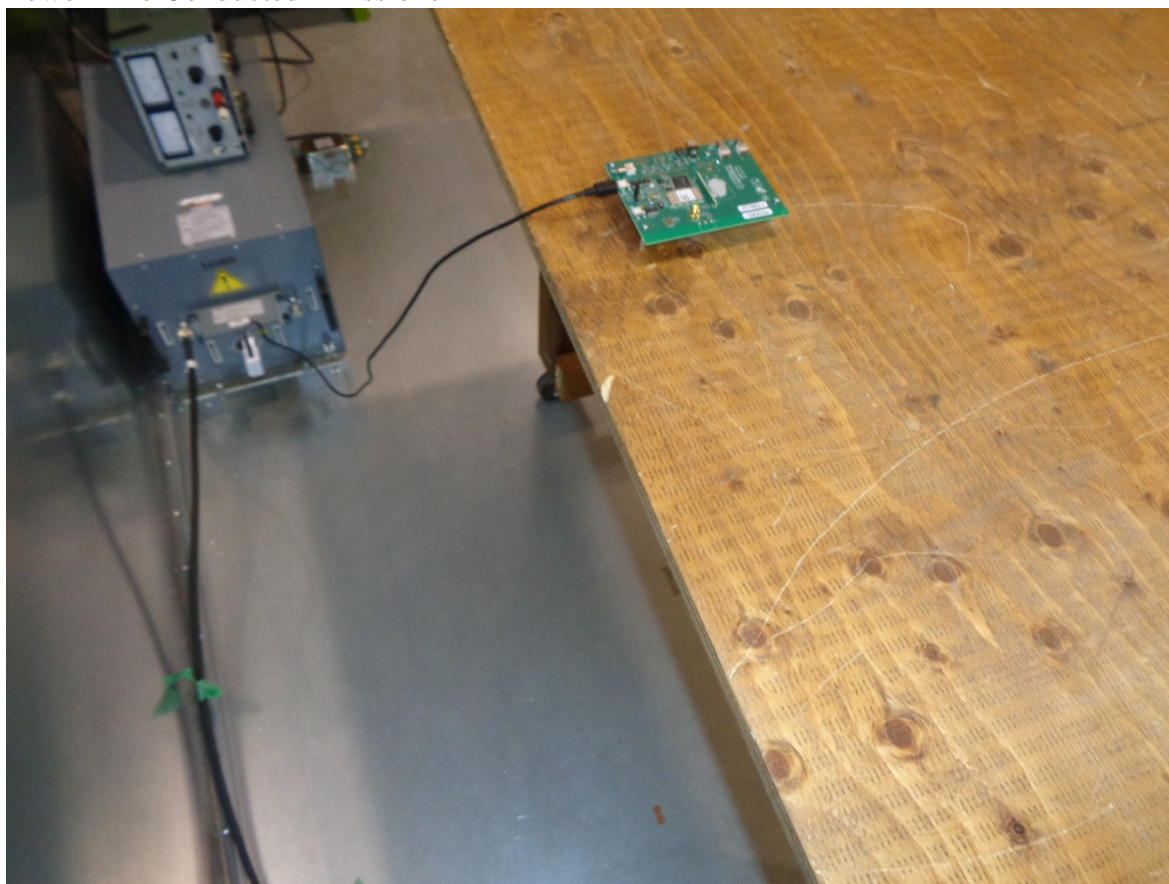
Antenna Conducted Measurements



Note: Conducted measurements shown with host used. Peak measurements were verified to be equivalent. This host uses a direct path from the module to the RF connector on the host.

Client	Trilliant Networks Canada Inc.	
Product	Open Smart Device Interface (OSDI) SecureMesh Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Power Line Conducted Emissions



Note: Power line conducted emissions shown with built in antenna and shown with host used as representative. However all antennas were investigated as was the module tested separately with the same power supply. The TX antenna and host used had no measureable effect on the power line conducted emissions.