

EMC & RF Test Report
As per
RSS-247 Issue 2
&
FCC Part 15 Subpart 15.247
Unlicensed Intentional Radiators
on the
SecureMesh FocusP Radio
Module, CL-R0249C-4.1



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Project Engineer

Testing produced for
 Trilliant

See Appendix A for full client &
EUT details.





Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

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Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Report Scope

This report addresses the EMC verification testing and test results of the **SecureMesh FocusP Radio Module**, Models: **CL-R0249C-4.1** and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:


RSS-247 Issue 2: 2017

FCC Part 15 Subpart C 15.247:2016

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.


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Summary

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

EUT:	SecureMesh FocusP Radio Module, CL-R0249C-4.1
FCC Certification #, FCC ID:	TMB- G35FOCUSP
Industry Canada Certification #, IC:	6028A- G35FOCUSP
EUT passed all tests performed	Yes
Tests conducted by	Abderrahmane Ferhat


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

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

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 See Justification
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(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(4)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna Conducted Spurious	< 20 dBc	Pass See Justifications
FCC 15.247(e) RSS-247 5.2(2)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) RSS-102	RF Exposure	> 20 cm separation.	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 '*'.

Client	Trilliant Networks Inc.	
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Notes, Justifications, or Deviations

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

For the Antenna requirement specified in FCC 15.203, the unit uses a PCB trace antenna having a maximum gain of 1.1 dBi which is less than 6 dBi gain.

No Power Line Conducted Emissions since the EUT is a module is 15Vdc powered.

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

For the 20dBc requirement specified in FCC 15.247(d)/ RSS-247, 5.5, the spurious emissions measured are below the FCC 15.209 limit everywhere.

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.

For the scope of this test report, the EUT was mounted in three orthogonal axis to maximize emissions. Worst case results are presented.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 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 follows later in this report.


Sample Calculation(s)

Radiated Emission Test

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

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

Margin = 8.0 dB (pass)

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

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:2016 Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators

- CISPR 22:2008 Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement


- FCC KDB 558074: 2016 FCC KDB 558074 Digital Transmission Systems, measurements and procedures

- ICES-003 Issue 6 2016 Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard

- RSS-GEN Issue 4 2014 General Requirements and Information for the Certification of Radio Apparatus


- RSS-247 Issue 2:2017 Issue 1: Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

- ISO 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Document Revision Status

Revision 0 February 14, 2019 Initial Release

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Definitions and Acronyms

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

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

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 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 Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab in Laval, near Montréal, Québec, Canada. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on an EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable. For ESD testing, the HCP is 1.6m x 0.8m and the VCP is 0.5m x 0.5m. The reference ground plane, when applicable, is 1.6m x 1.6m.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6845) and Industry Canada (IC, 6844B-1). 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 bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates

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

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
2019-01-16 to 2019-02-03	Radiated Emissions	AF	20 – 24	40 – 51	98.0 – 102.0
2019-01-16	6 dB Bandwidth	AF	20 – 24	40 – 51	98.0 – 102.0
2019-01-16	Max Output Power	AF	20 – 24	40 – 51	98.0 – 102.0
2019-01-16	Spectral Density	AF	20 – 24	40 – 51	98.0 – 102.0

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

Detailed Test Results Section

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

6dB Bandwidth of Digitally Modulated Systems – 15.247

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 Methods

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

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

Results

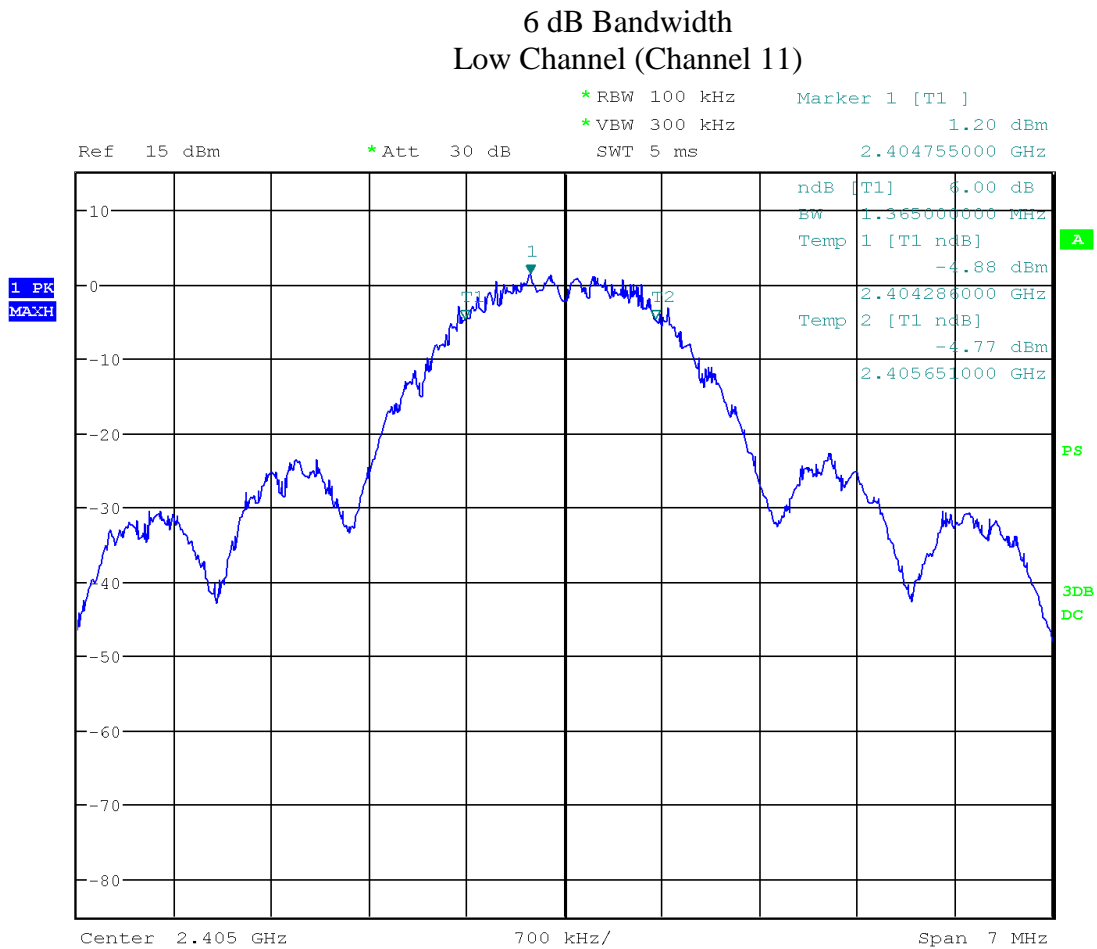
The EUT passed. The minimum measured 6 dB BW was 1245 kHz and the maximum 99% BW at full power setting is 2.34 MHz.

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (MHz)
Low Channel (11)	2405	1365	2.26
Mid Channel (18)	2440	1245	2.26
High Channel (25)	2475	1344	2.34


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Graph(s)

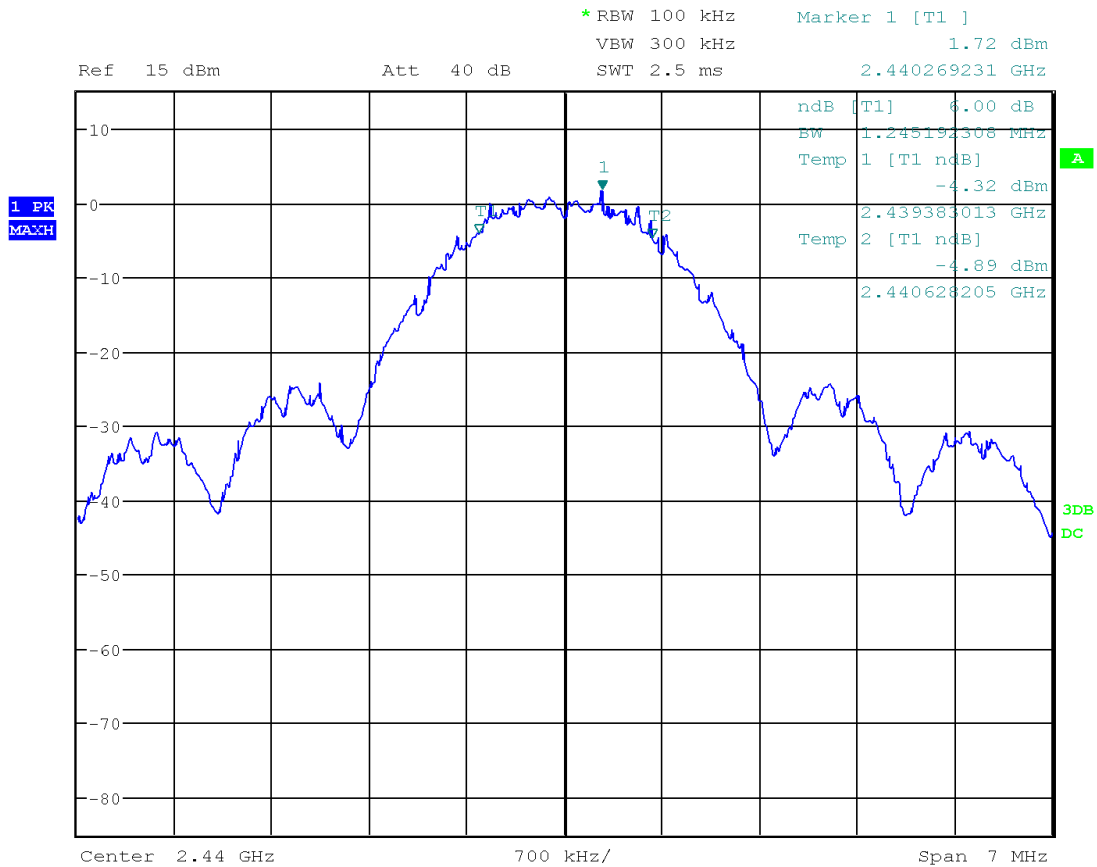
The graphs showed below shows the OBW during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement.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




Date: 16.JAN.2019 15:22:19

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

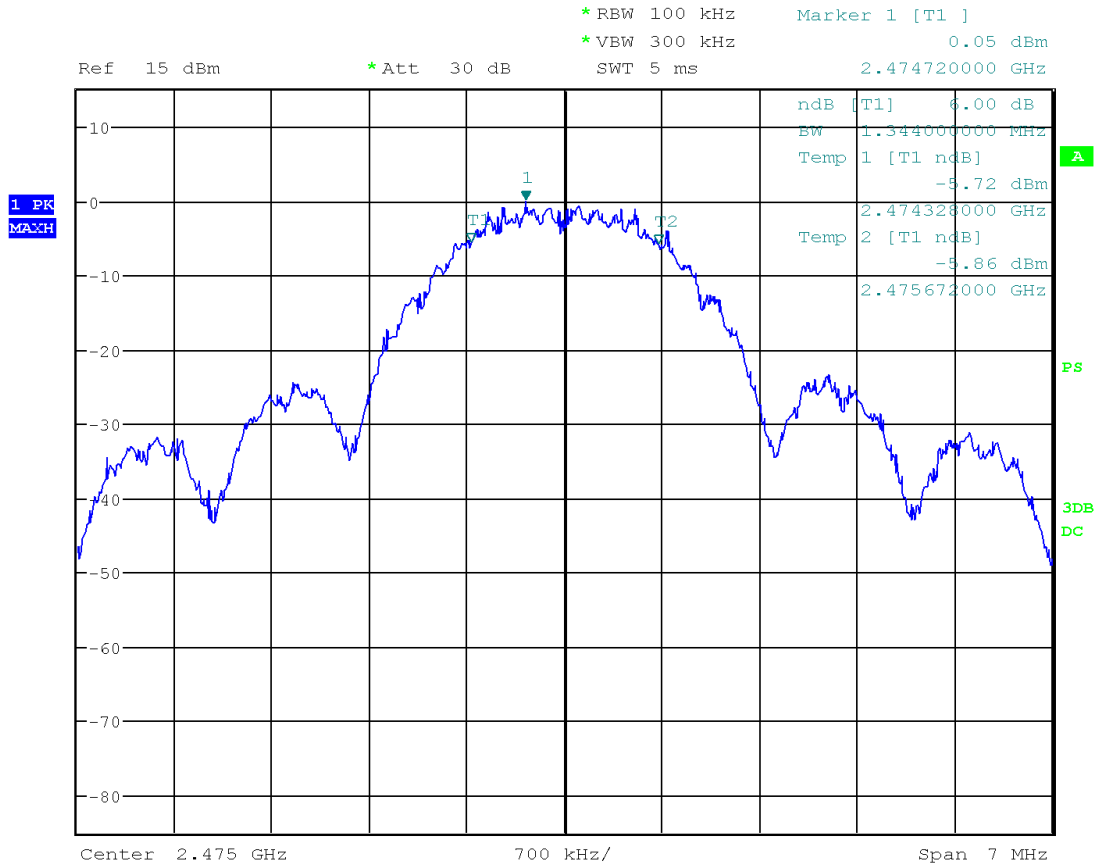
6 dB Bandwidth
Mid Channel (Channel 18)




Date: 16.JAN.2019 17:04:40

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

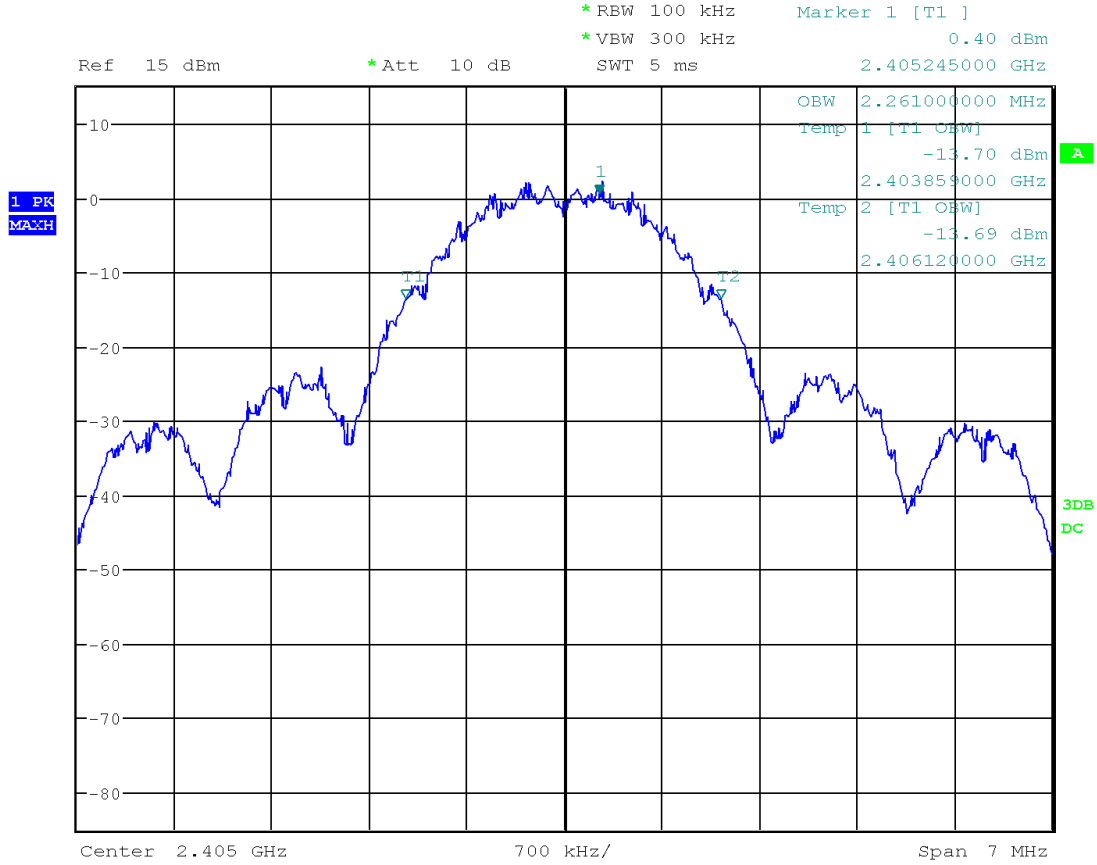
**6 dB Bandwidth
High Channel (Channel 25)**




Date: 16.JAN.2019 15:39:43

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

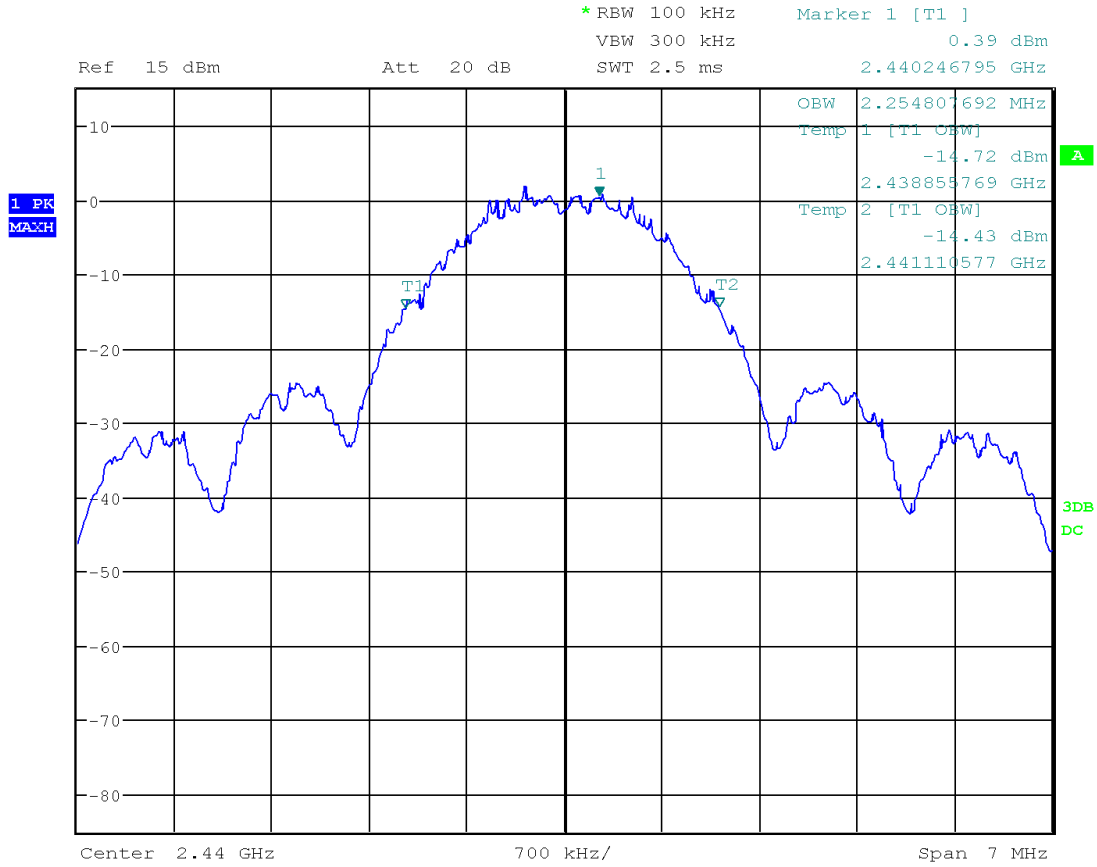
99% BW – Low Channel (11)




Date: 16.JAN.2019 15:14:18

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

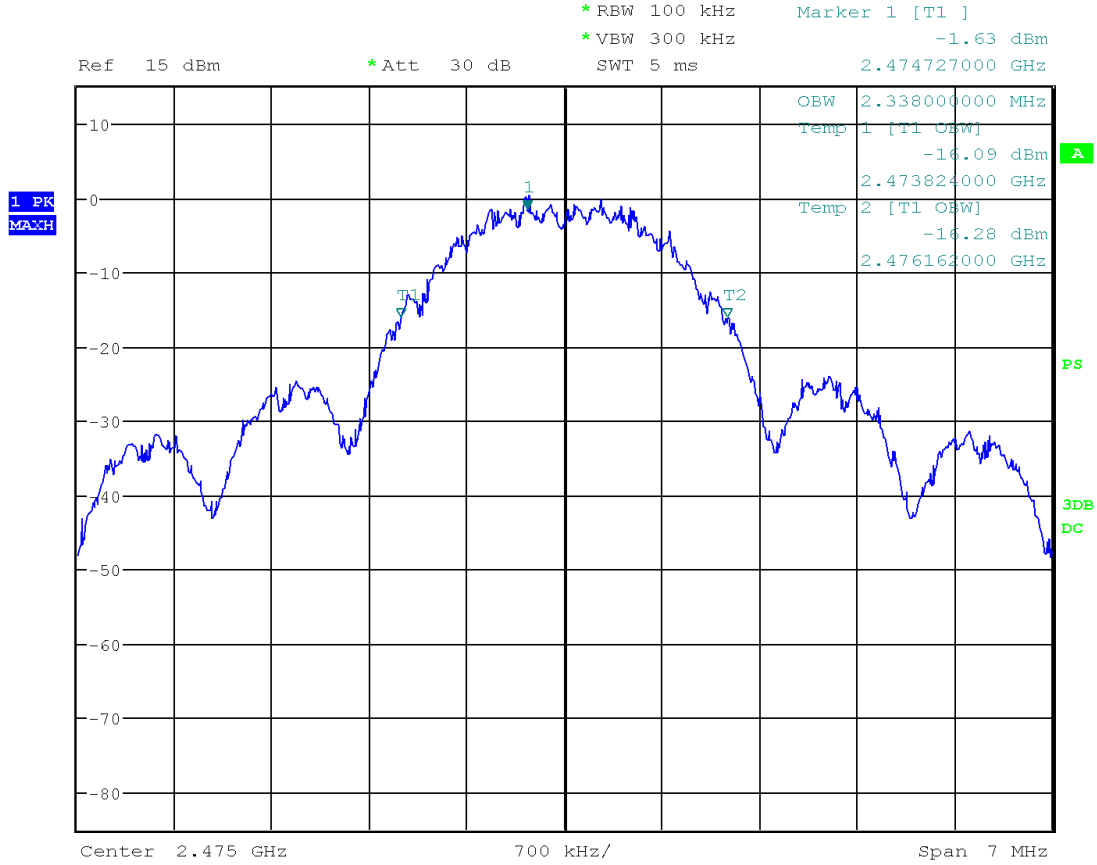
99% BW – Mid Channel (18)




Date: 16.JAN.2019 17:10:05

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

99% BW – High Channel (25)




Date: 16.JAN.2019 15:45:15

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
Horn Antenna	ATH1G18G	AR	2017-04-25	2019-04-25	4003
1-26.5GHz preamp	8449B	Agilent	2017-09-09	2019-09-09	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
254mm RF SMA Cable 3	Minibend-10	Huber+ Suhner	NCR	NCR	4080

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Maximum Peak Envelope Conducted Power - DM

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.


For systems using digital modulation in the 2400-2483.5 MHz band, the peak limit is 1 watt (30 dBm).

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

Results


The EUT passed. Three channels were measured. The following table show the peak power:

Channel	Frequency (MHz)	EIRP dBm	PCB trace Antenna Gain (dBi)	Calculated Conducted Peak Power dBm	Peak Power (mW)
Low Channel (11)	2405	25.6 (363 mW)	1.1	24.6	281.8
Mid Channel (18)	2440	24.9 (309 mW)	1.1	23.9	245.5
Hi Channel (25)	2475	24.8 (302 mW)	1.1	23.8	239.9

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

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
Horn Antenna	ATH1G18G	AR	2017-04-25	2019-04-25	4003
1-26.5GHz preamp	8449B	Agilent	2017-09-09	2019-09-09	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
254mm RF SMA Cable 3	Minibend-10	Huber+ Suhner	NCR	NCR	4080

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Power Spectral Density – 15.247 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 and Methods

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.

The method is given in Section 10.2 of FCC KDB 558074.

Results

The EUT passed. Low, medium, and high band was tested. The worst case PSD is -11.1 dBm/3 kHz.

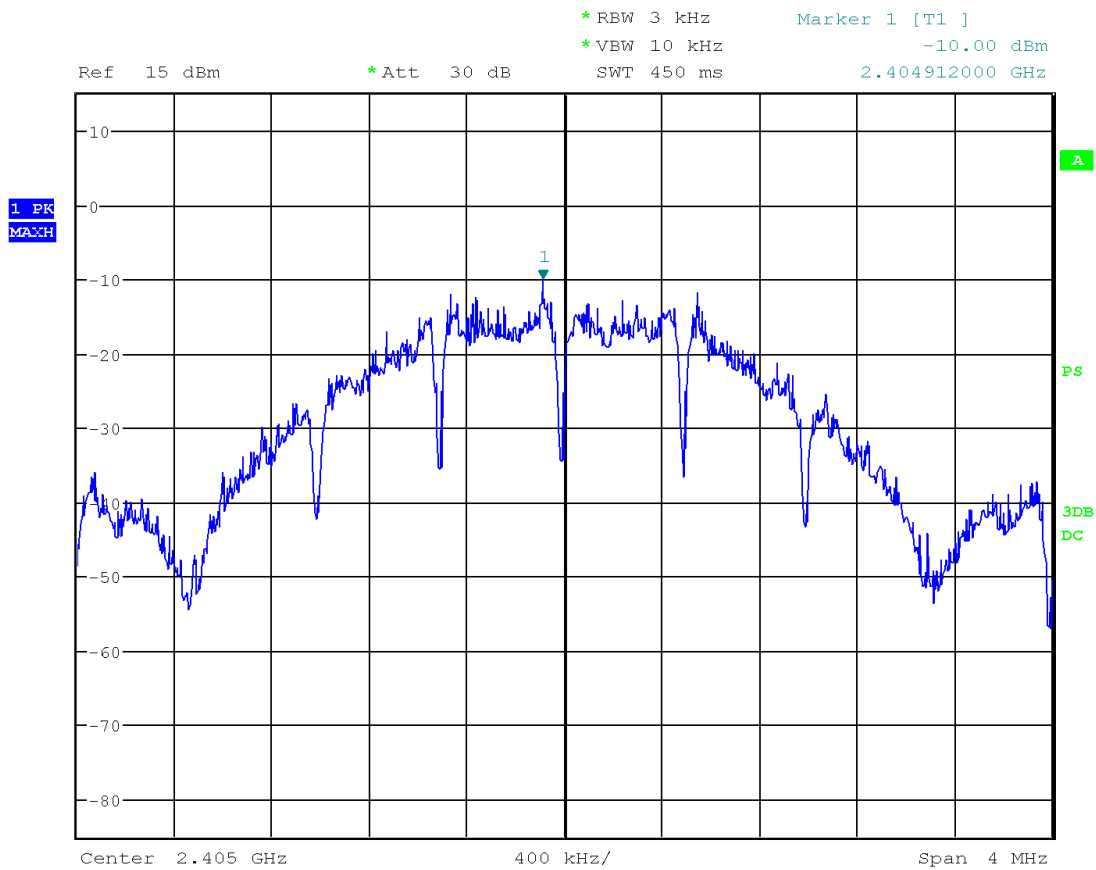
Channel	Frequency (MHz)	Measured PSD (dBm)	Antenna gain (dBi)	Corrected PSD (dBm)	Limit (dBm)	Pass/Fail
Lo Channel 11	2405	-10.0	1.1	-11.1	8	Pass
Mid Channel 18	2440	-10.4	1.1	-11.5	8	Pass
Hi Channel 25	2470	-11.5	1.1	-12.6	8	Pass

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Graph(s)

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

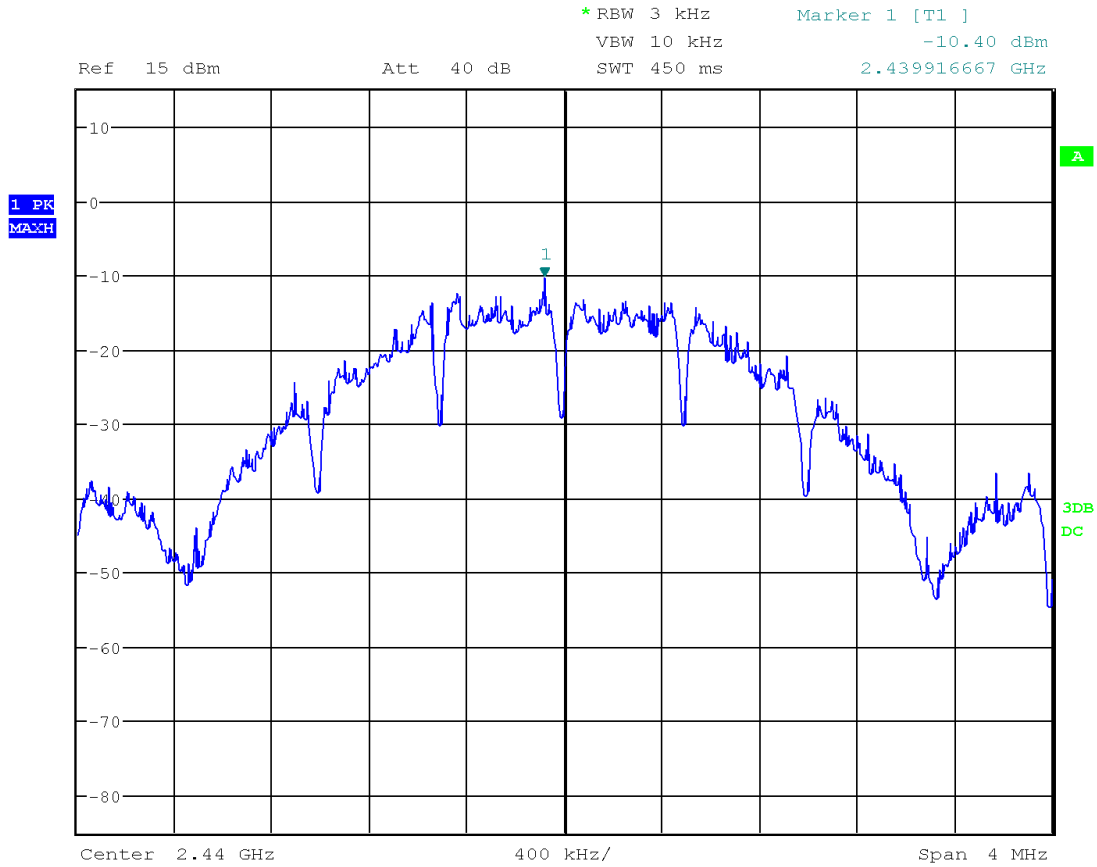
PSD – Low Channel 11




Date: 16.JAN.2019 15:24:32

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

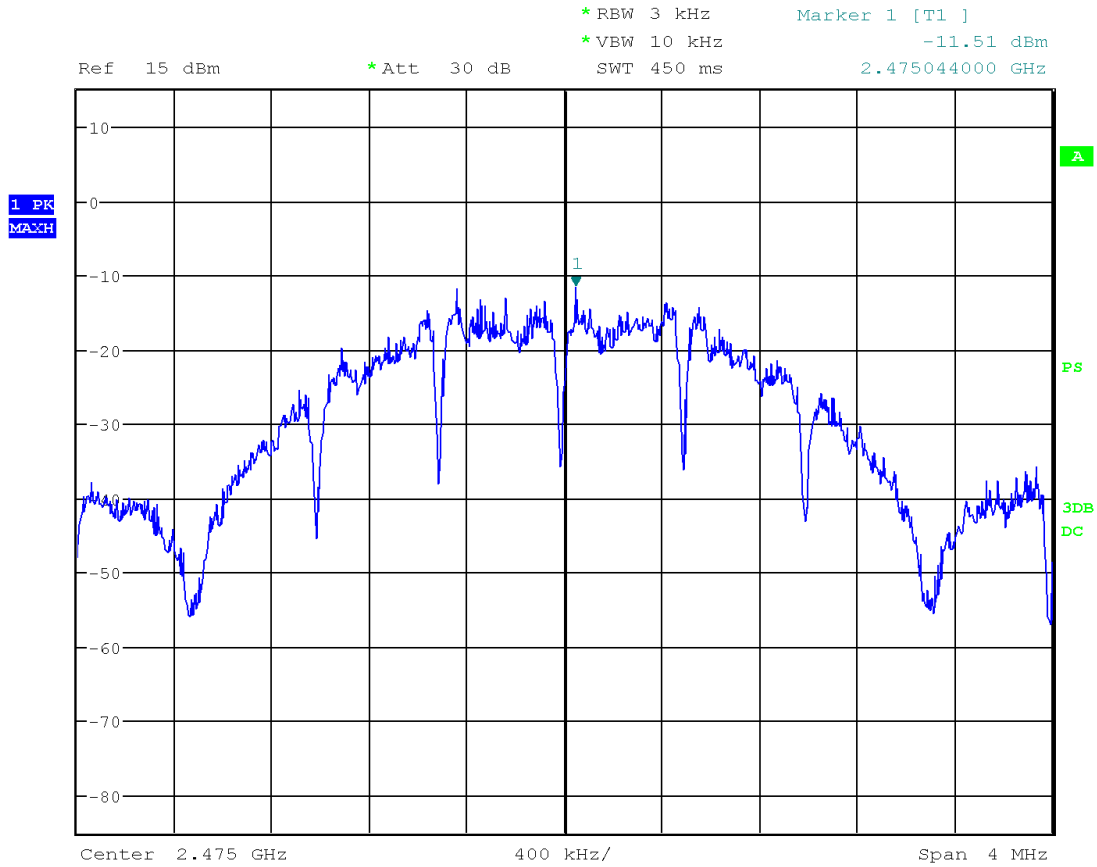
PSD – Mid Channel 18




Date: 16.JAN.2019 17:13:15

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

PSD – High Channel 18




Date: 16.JAN.2019 15:29:55

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
Horn Antenna	ATH1G18G	AR	2017-04-25	2019-04-25	4003
1-26.5GHz preamp	8449B	Agilent	2017-09-09	2019-09-09	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
254mm RF SMA Cable 3	Minibend-10	Huber+ Suhner	NCR	NCR	4080

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Transmitter Spurious Radiated Emissions

Purpose

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

Limits and Method

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

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

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


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

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

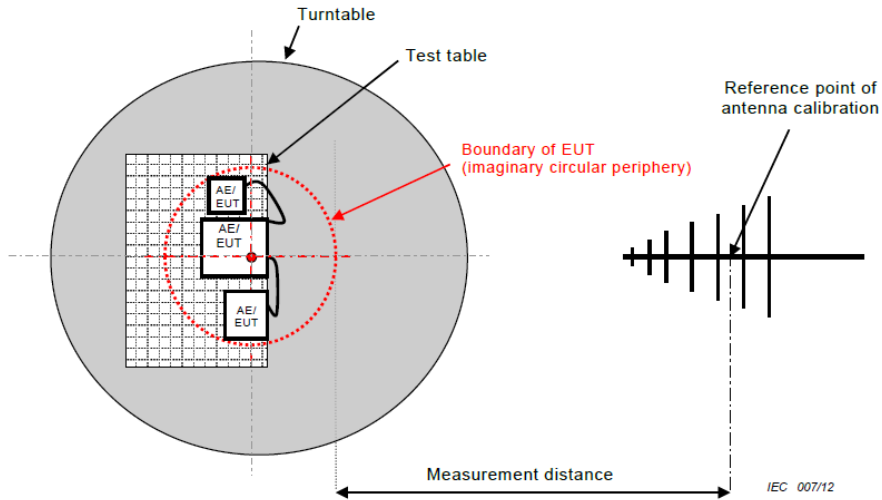
²Limit is with 1 MHz measurement bandwidth and using an Average detector

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

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

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, 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 $\pm 4.25\text{dB}$ for 30MHz – 1GHz and $\pm 4.93\text{dB}$ for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.


Preliminary Graphs

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

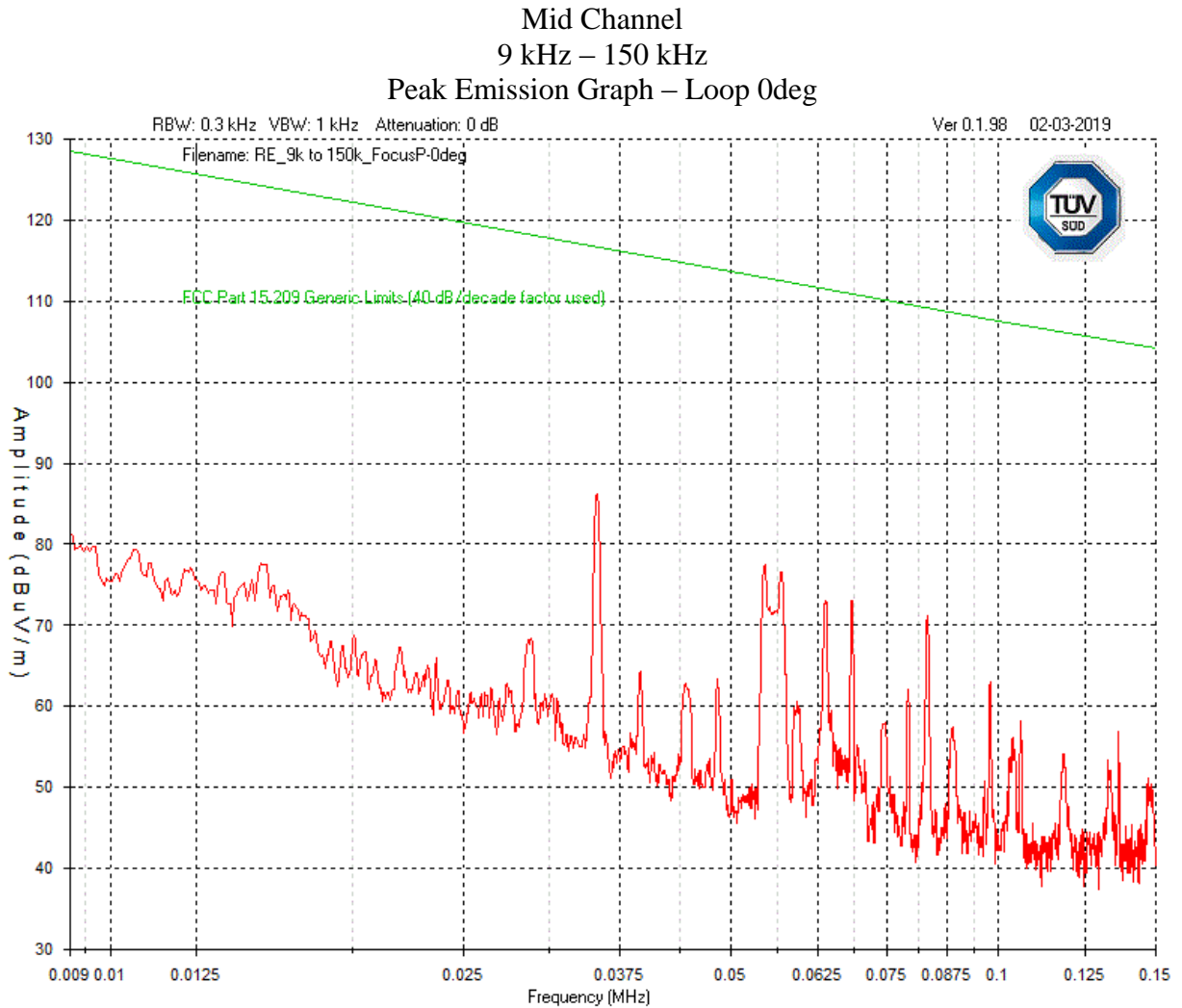
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of 24.835 GHz).


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

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

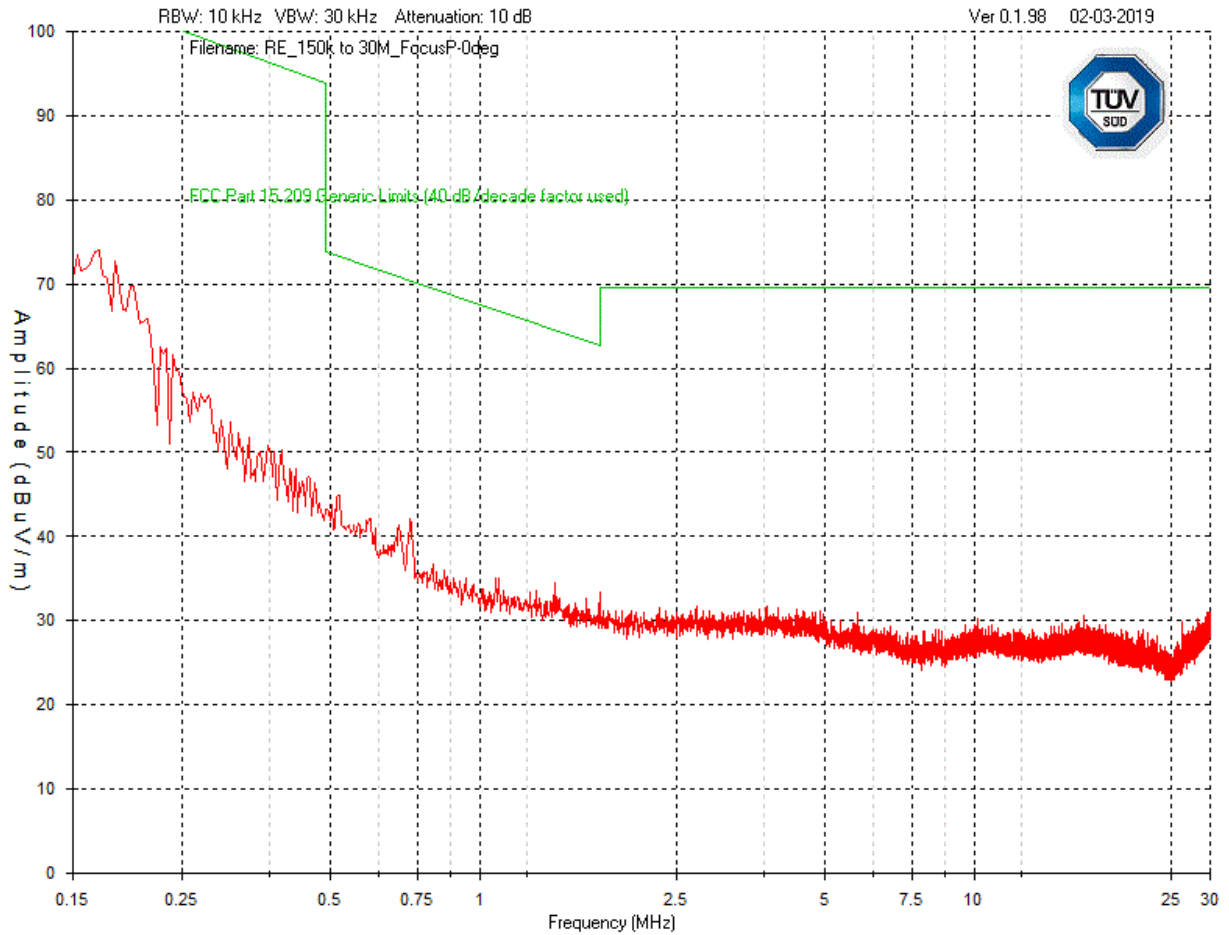
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


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



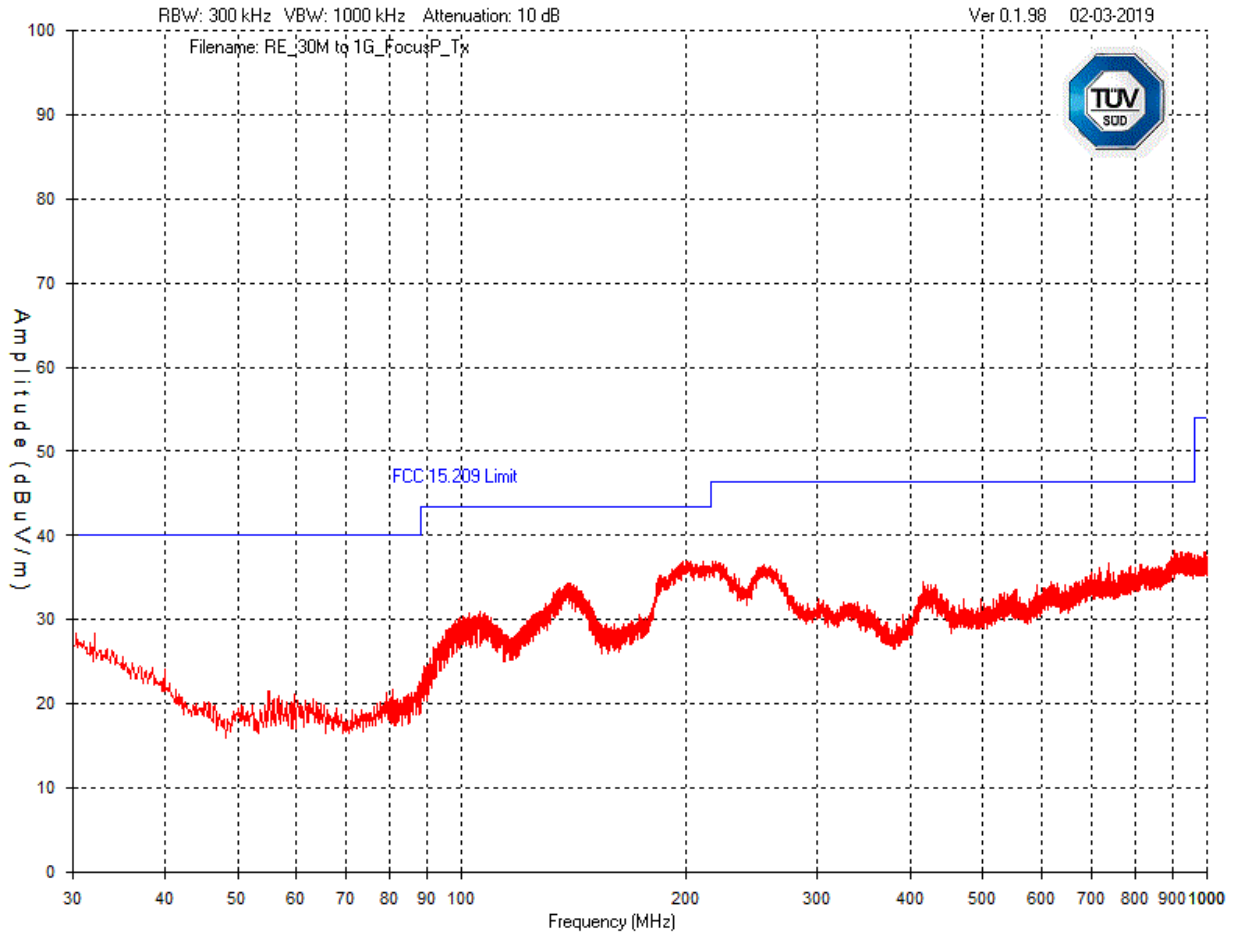
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Mid Channel
150 kHz – 30 MHz
Peak Emission Graph – Loop 0deg



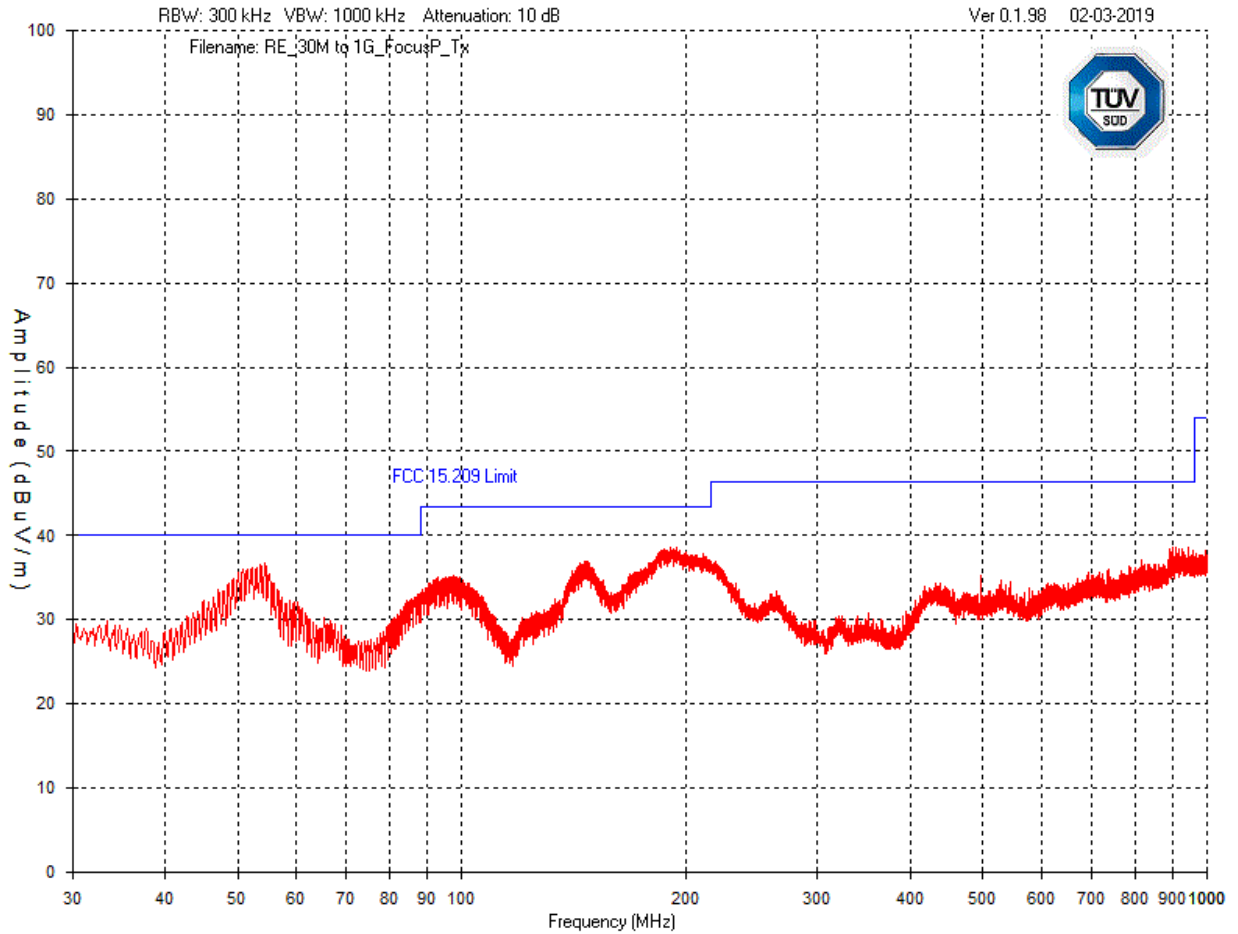
Client	Trilliant Networks Inc.	 TUV SUD Canada
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


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



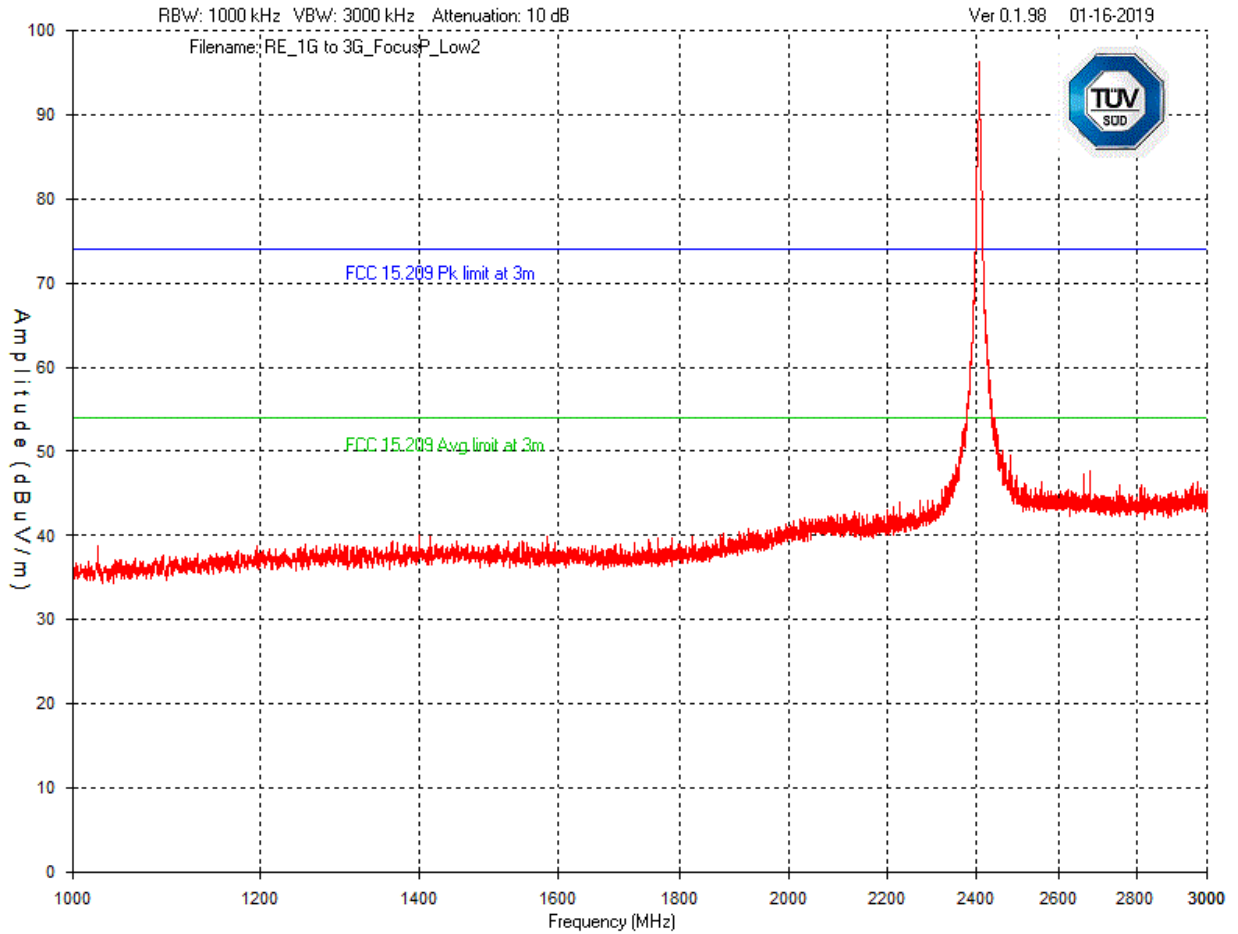
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


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



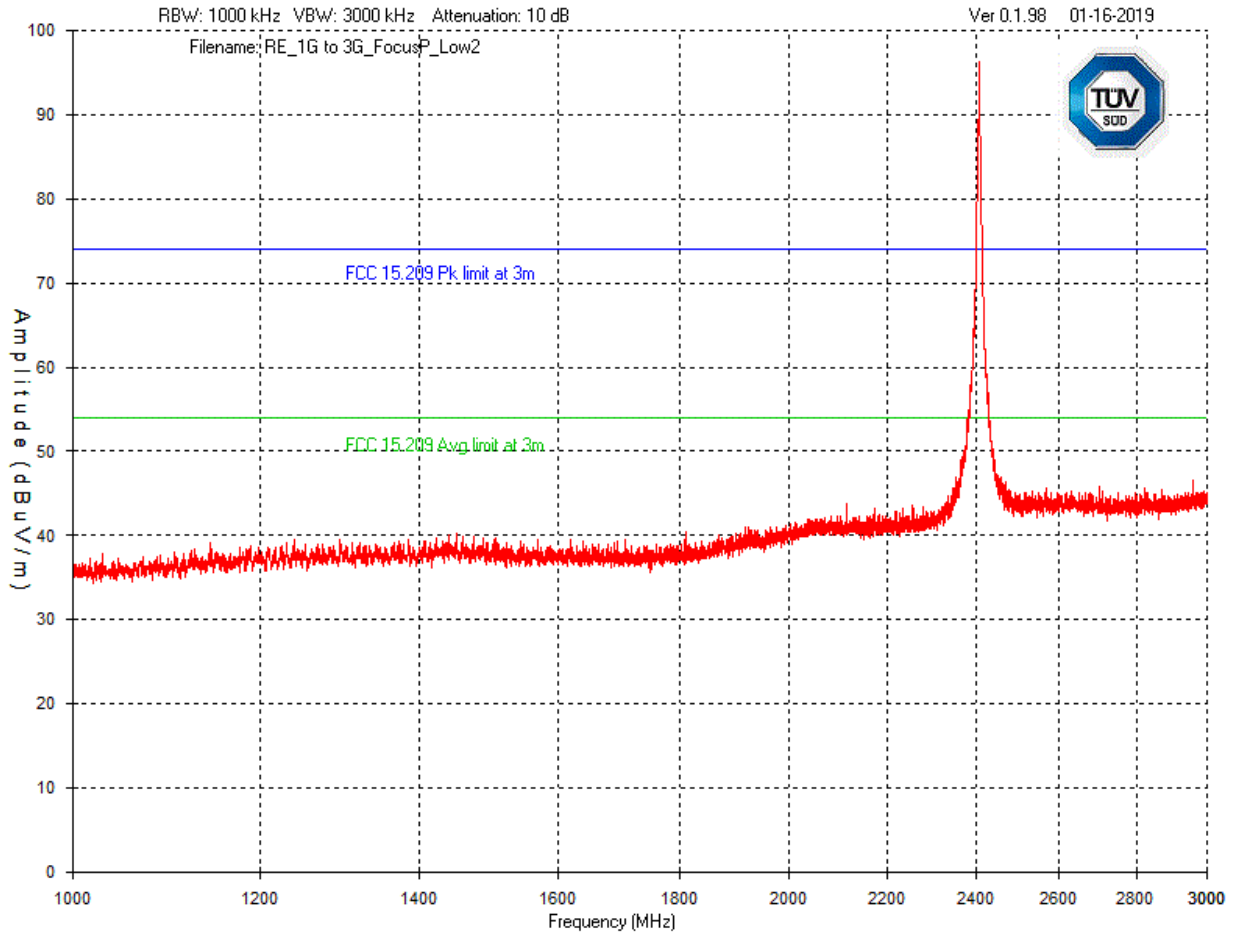
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**Low Channel 11 – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph**



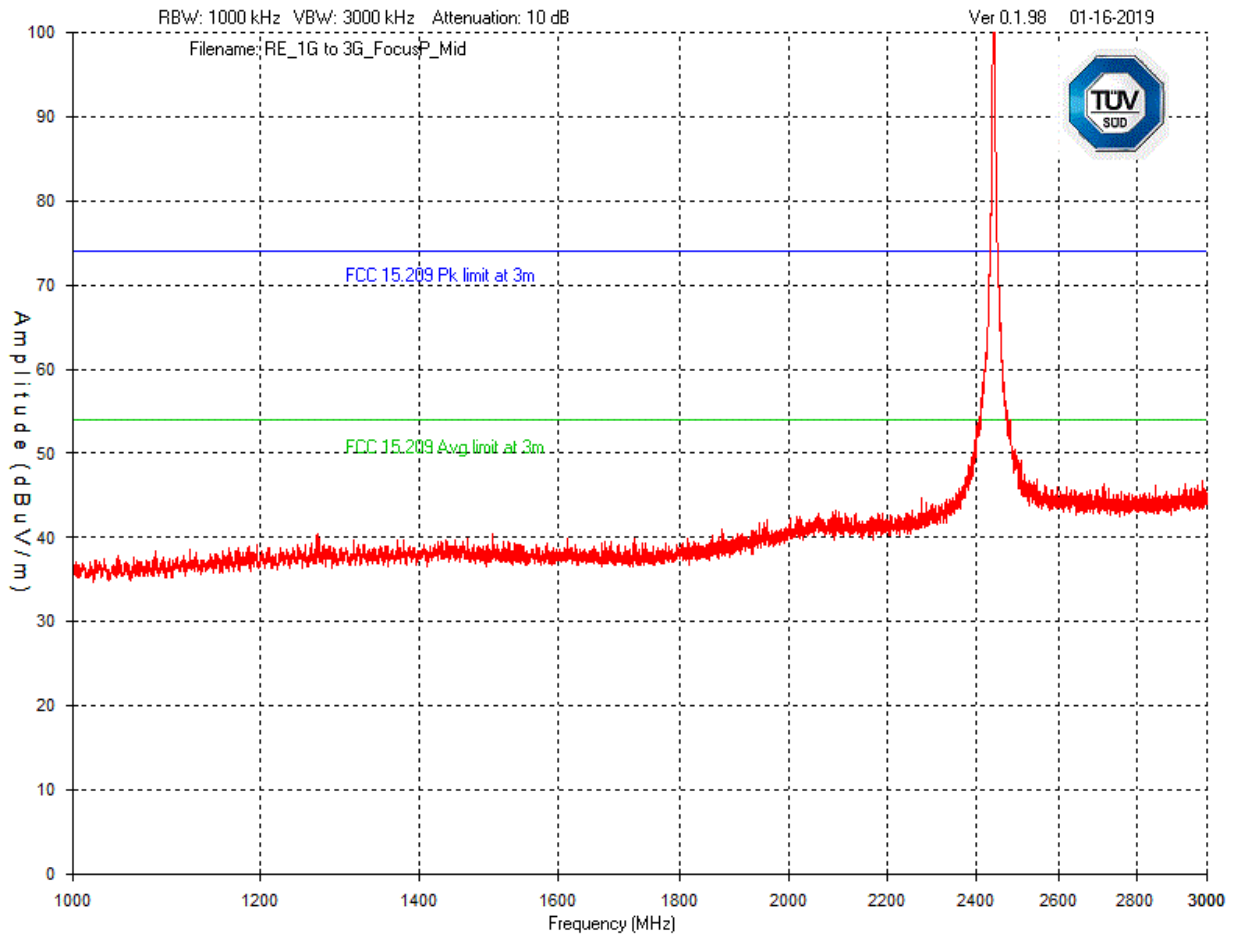
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**Low Channel 11 – 1 GHz – 3 GHz
Vertical - Peak Emission Graph**



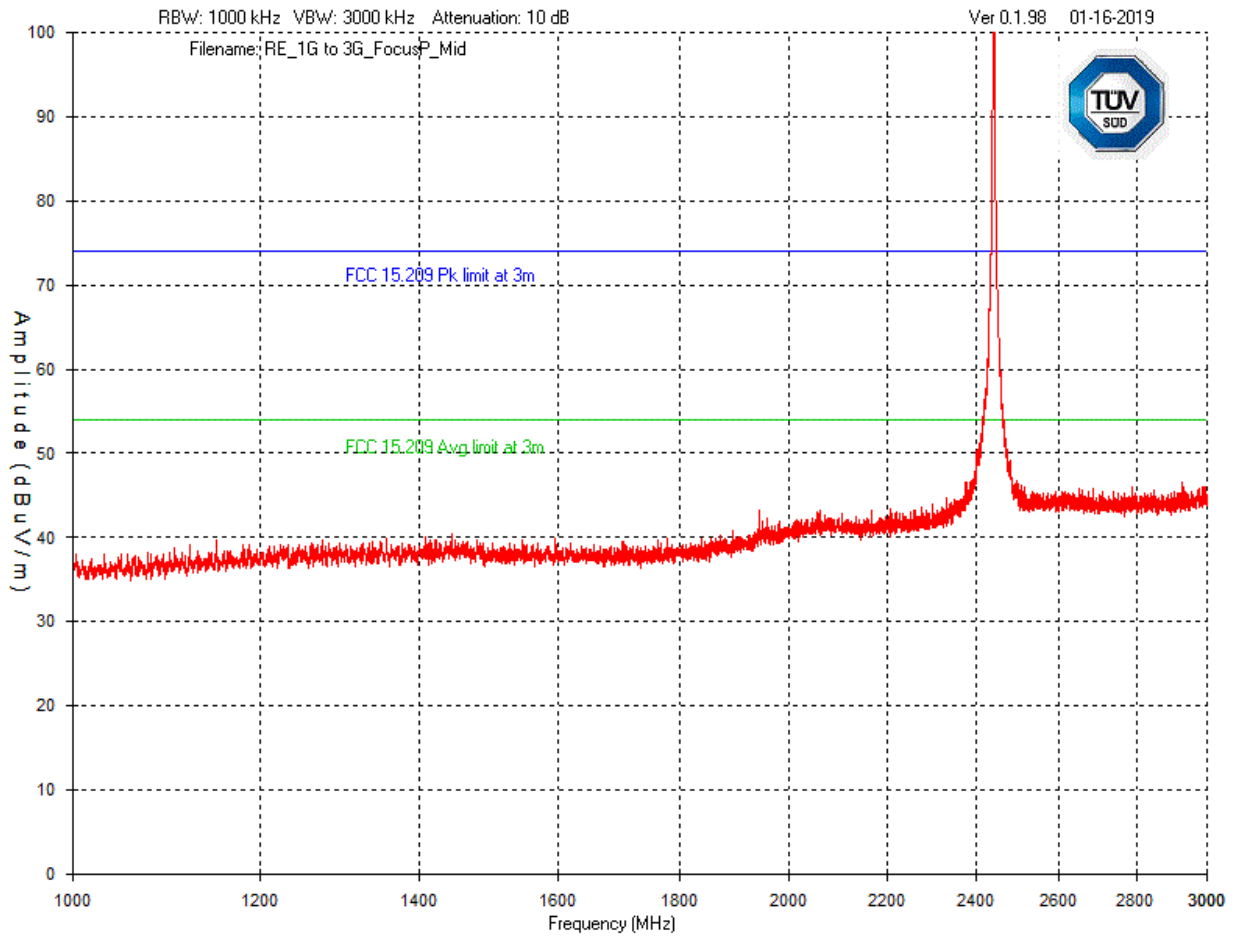
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**Mid Channel 18 – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph**



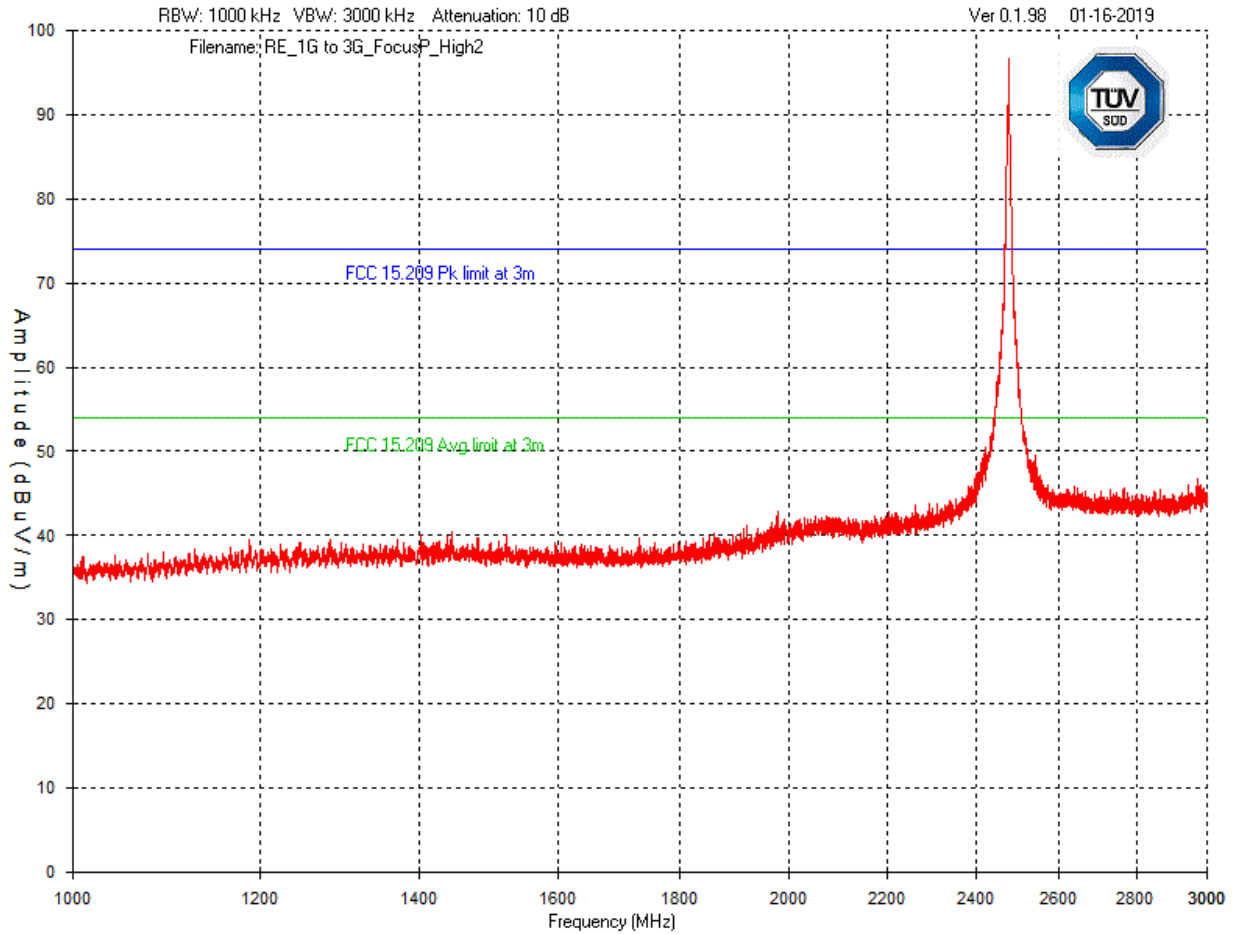
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**Mid Channel 18 – 1 GHz – 3 GHz
Vertical - Peak Emission Graph**



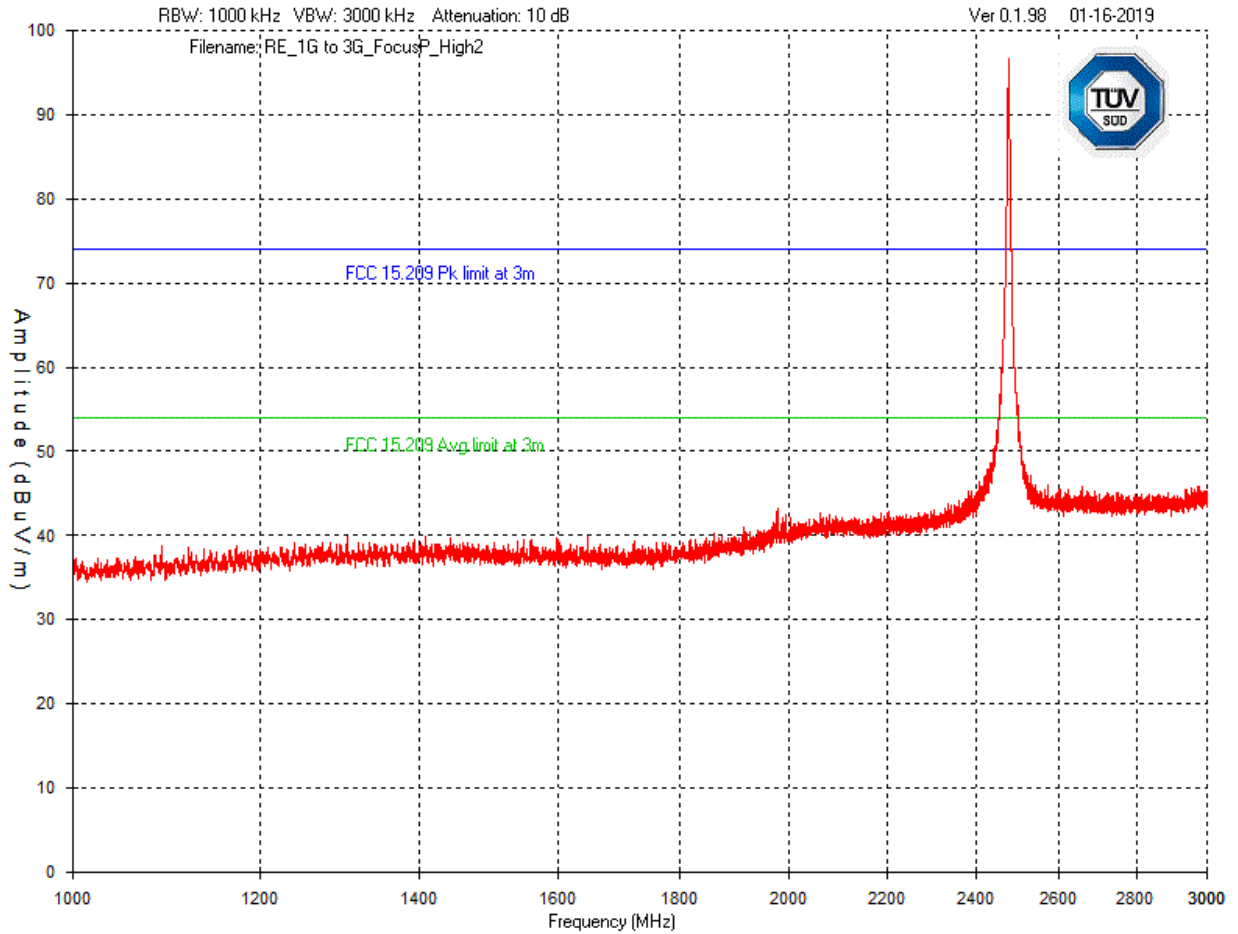
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**High Channel 25 – 1 GHz – 3 GHz
Horizontal - Peak Emission Graph**



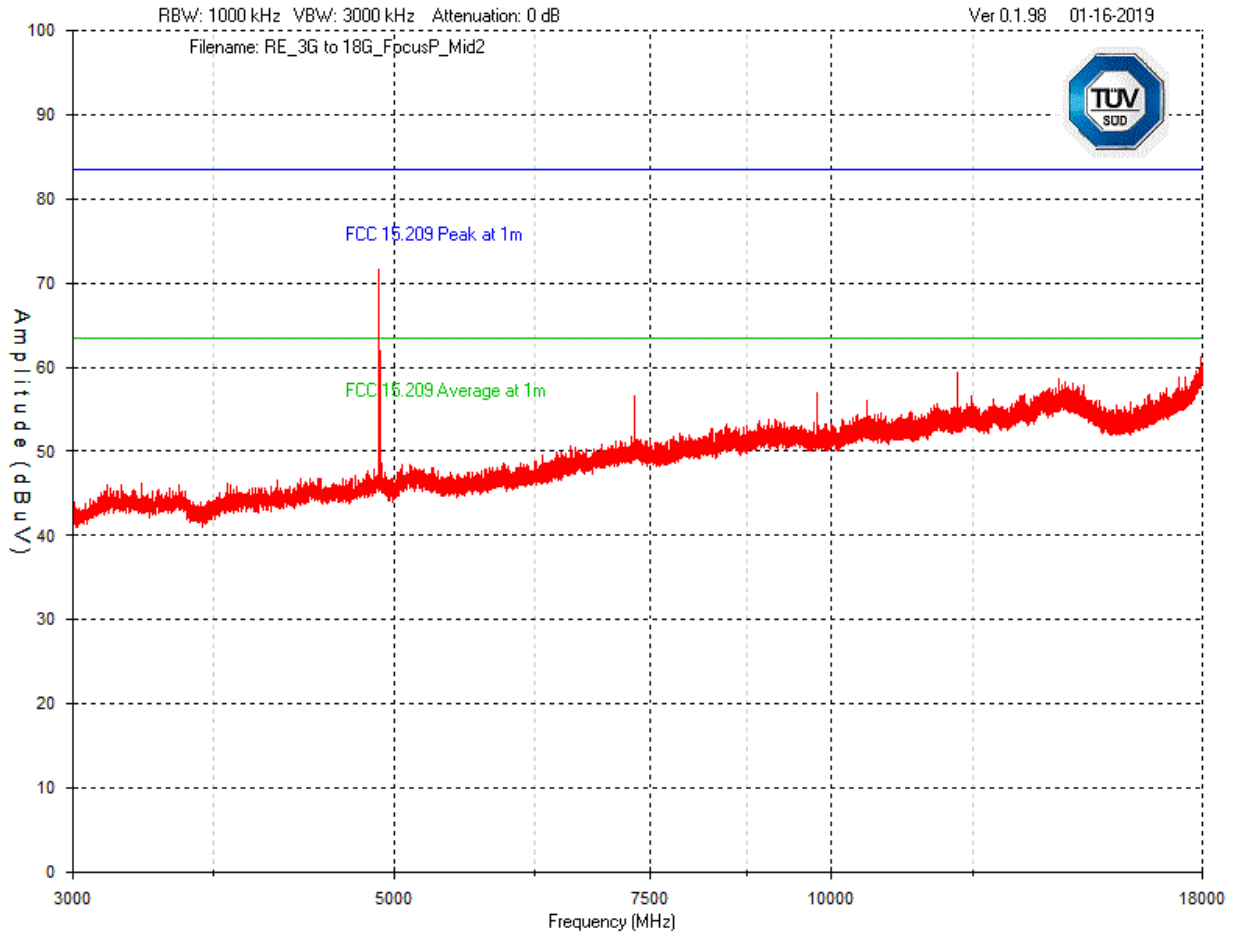
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**High Channel 25 – 1 GHz – 3 GHz
Vertical - Peak Emission Graph**



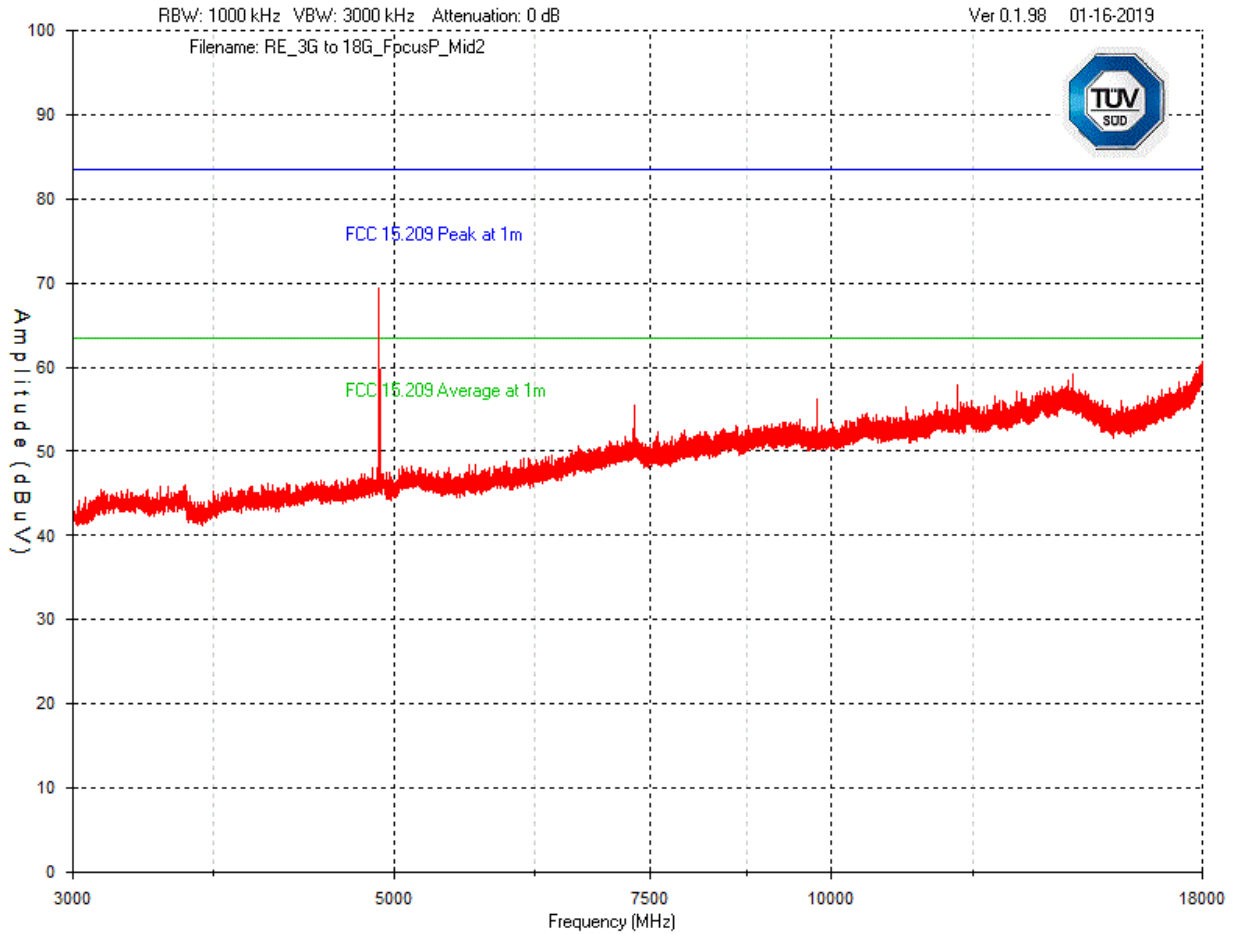
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


**Mid Channel – 3 GHz – 18 GHz
Horizontal - Peak Emission Graph @ 1m**



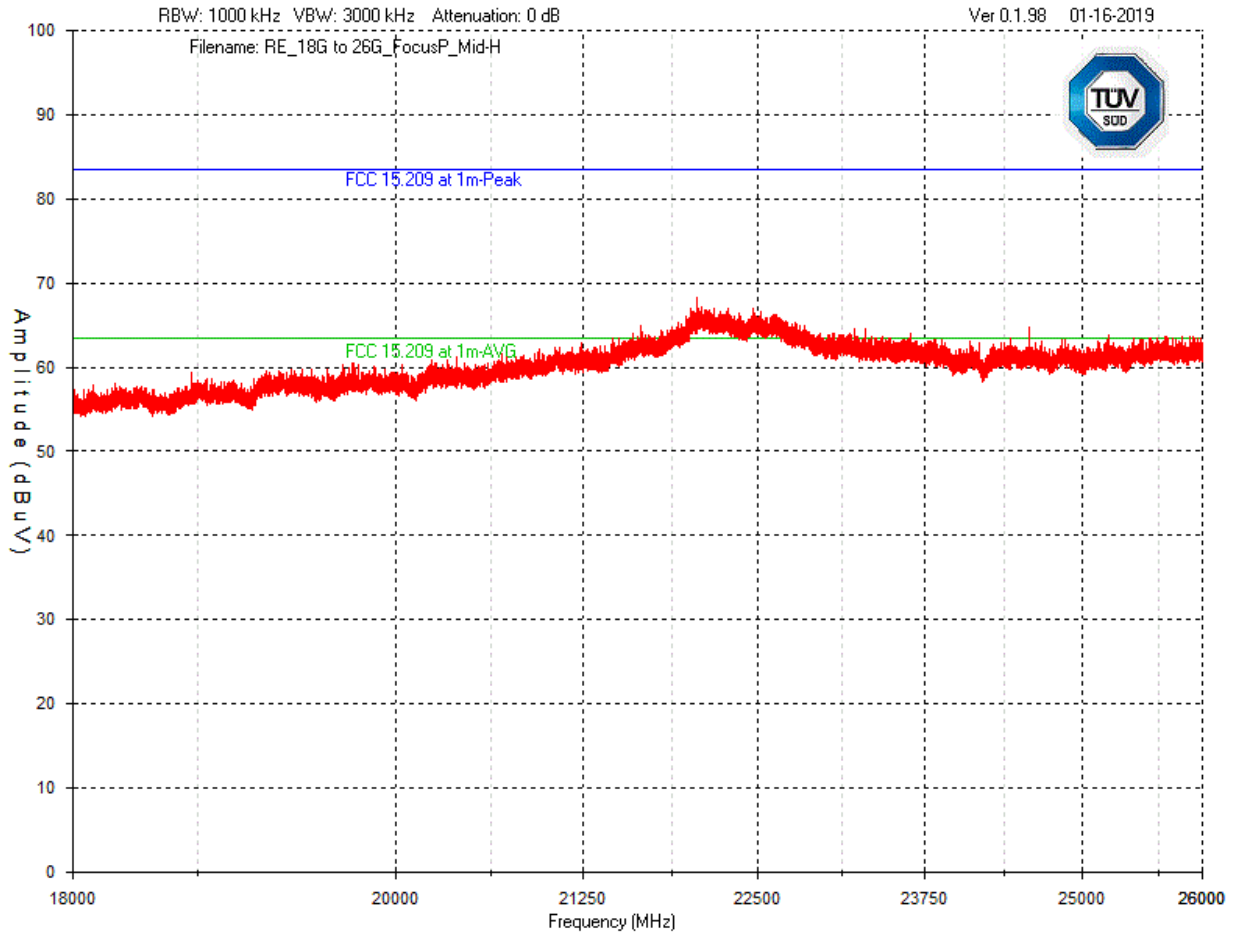
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

**Mid Channel – 3 GHz – 18 GHz
Vertical - Peak Emission Graph @ 1m**




Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

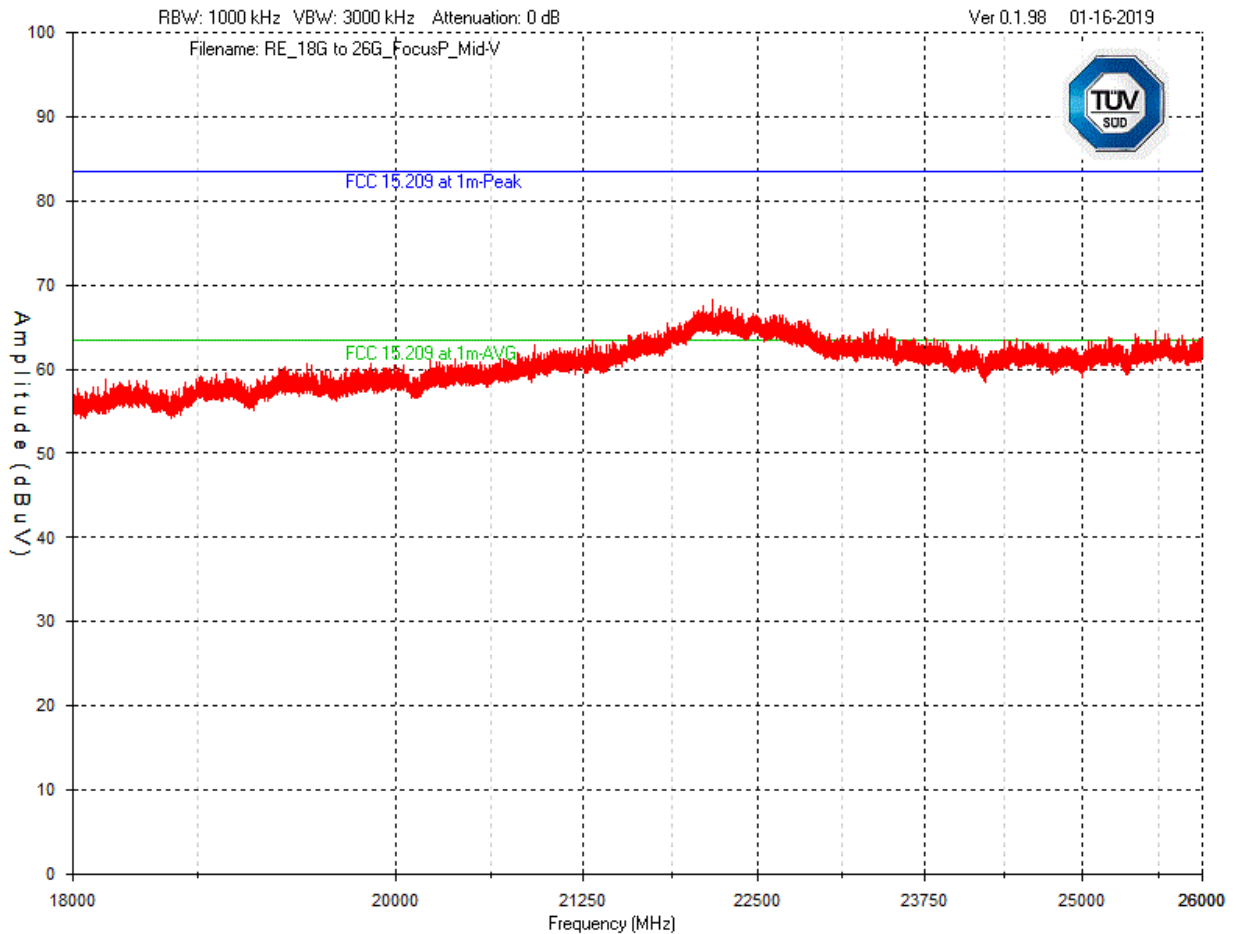
Mid Channel – 18 GHz – 26 GHz
Horizontal - Peak Emission Graph @ 1m




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	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

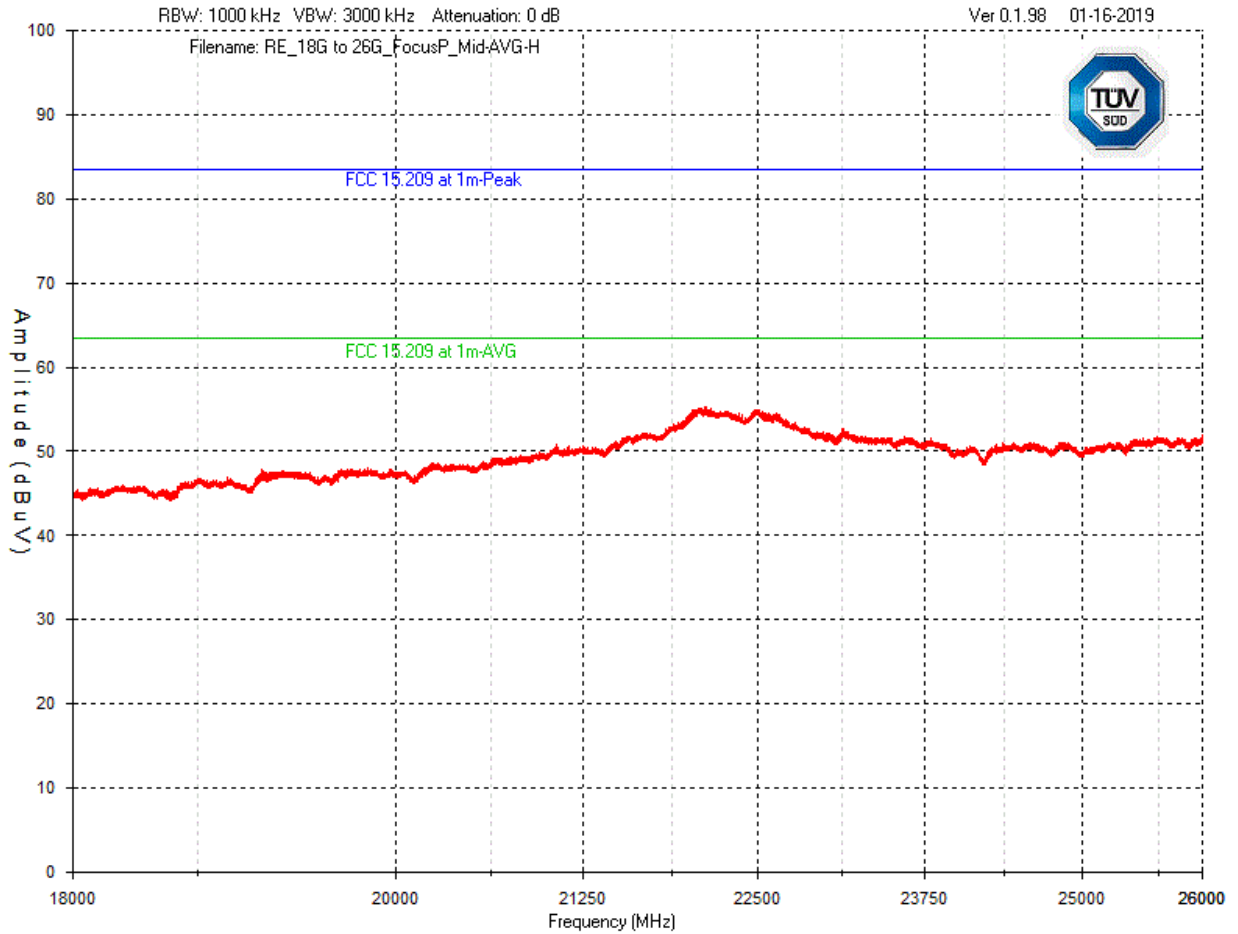
Mid Channel – 18 GHz – 26 GHz
Vertical - Peak Emission Graph @ 1m




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

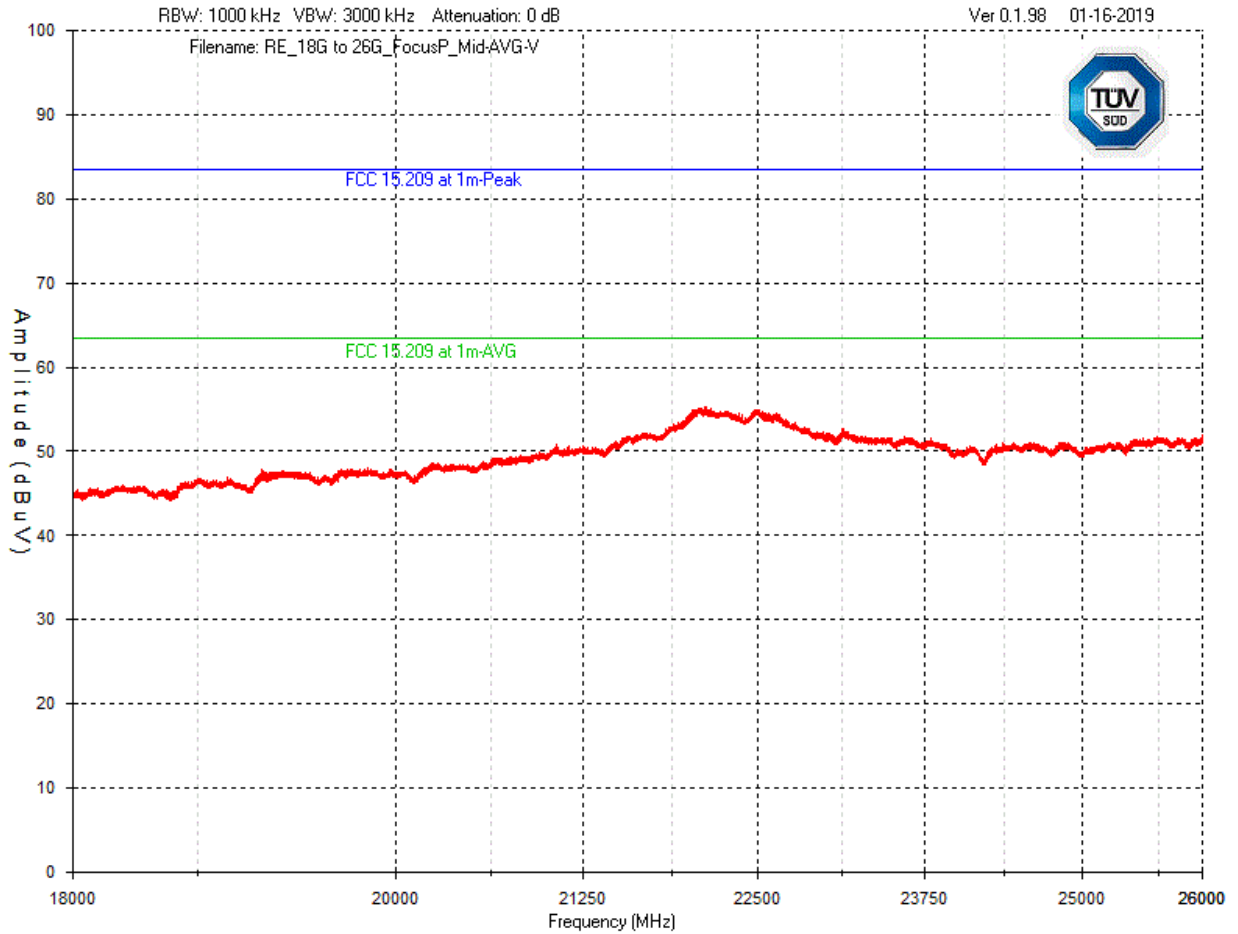
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Mid Channel – 18 GHz – 26 GHz
Horizontal - Average Emission Graph @ 1m



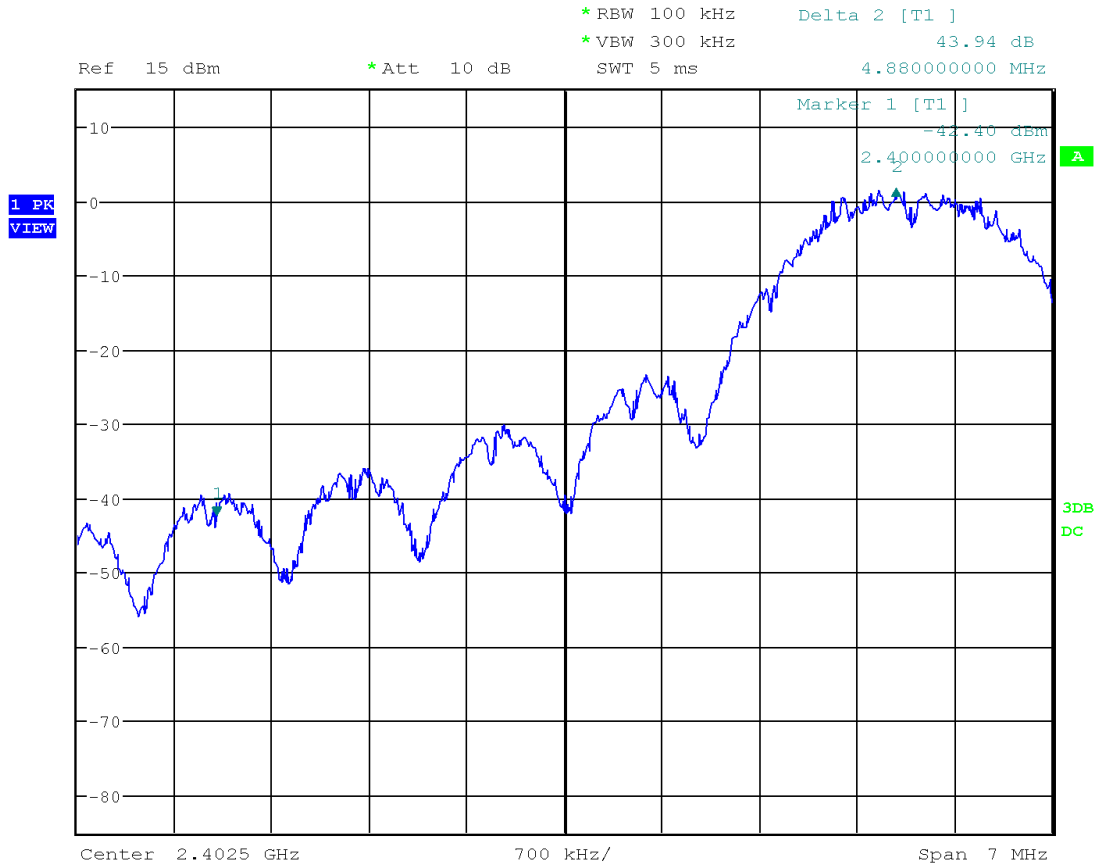
Client	Trilliant Networks Inc.	 Canada
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Mid Channel – 18 GHz – 26 GHz
Vertical - Average Emission Graph @1m




Client	Trilliant Networks Inc.	 Canada
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Band Edge – Low Channel (11)
Horizontal - Peak Emission

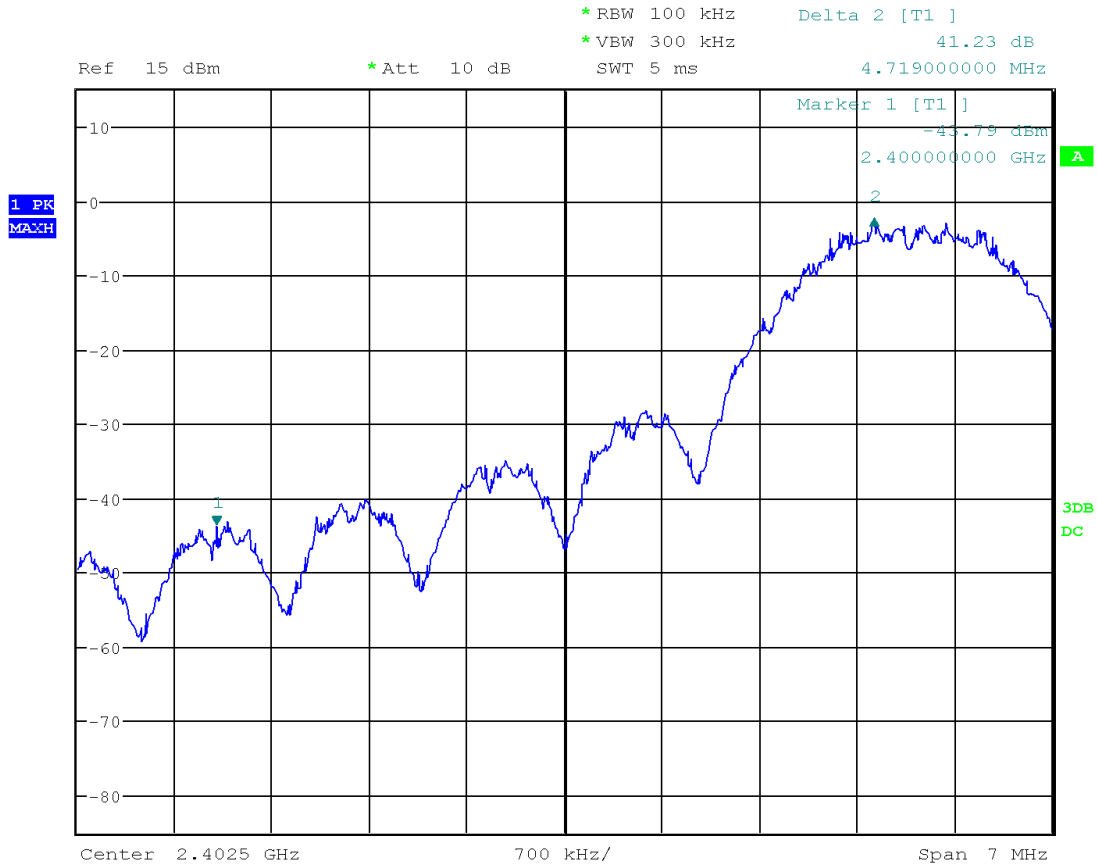


Date: 16.JAN.2019 15:09:25

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


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

**Band Edge – Low Channel (11)
Vertical - Peak Emission**

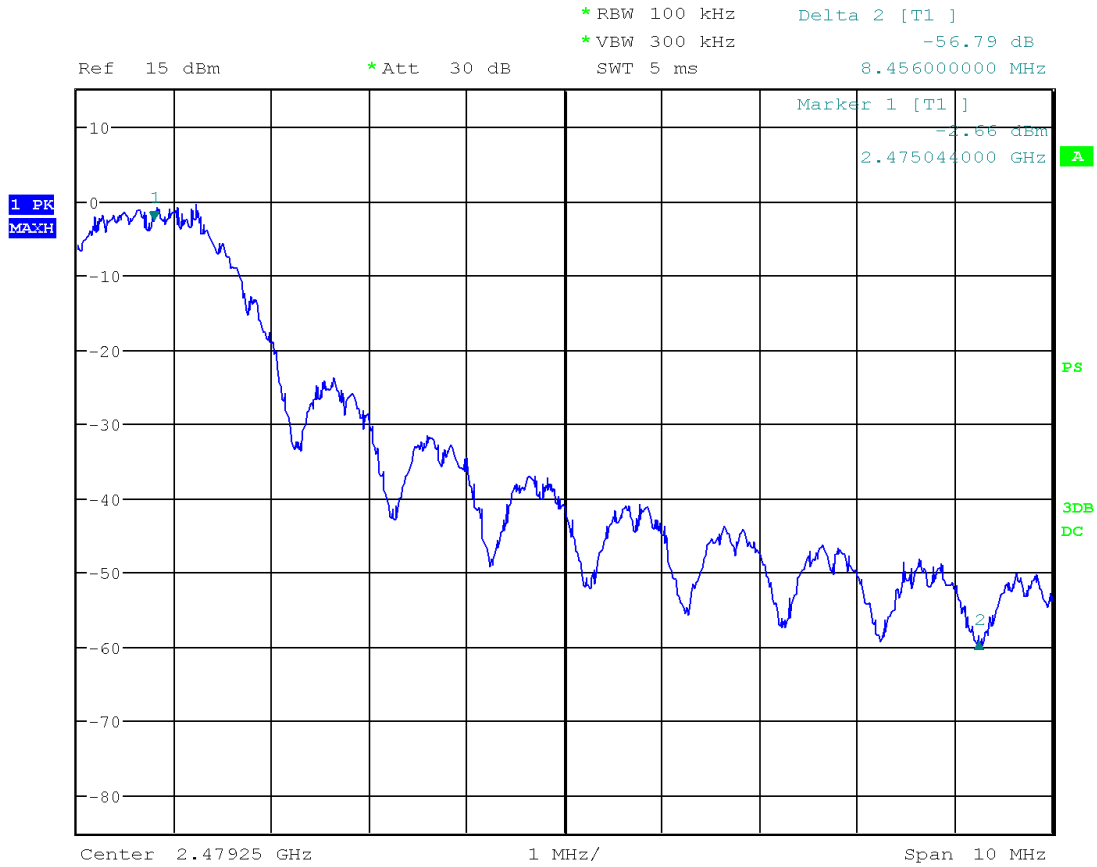


Date: 16.JAN.2019 15:10:36

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


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Band Edge – Hi Channel (25)
Horizontal - Peak Emission

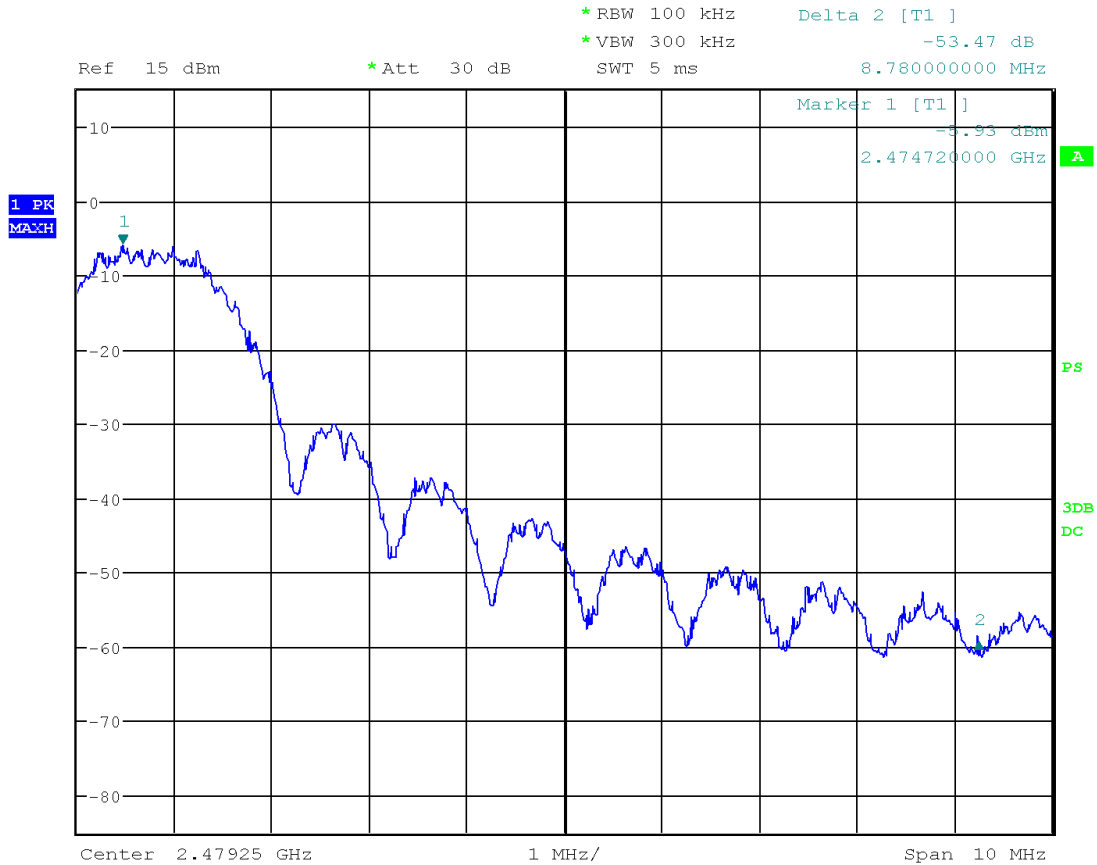


Date: 16.JAN.2019 15:35:44

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


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

**Band Edge – Hi Channel (25)
Vertical - Peak Emission**



Date: 16.JAN.2019 15:37:01

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

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Final Measurements and Results

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

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

Quasi-Peak Emissions Table – 30MHz to 1GHz


Power Meter (Host) Supply			15 Vdc							
Frequency (MHz)	Detector Peak/QP	Received Signal (dBμV)	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBμV/m)	QP Limit (dB)	QP Margin (dB)	Pass / Fail
Horizontal Antenna Polarization										
54.3485	QP	52.3	10.8	4	0.7	-33.3	34.5	40	5.5	Pass
194.225	QP	48.6	14.5	4	1.1	-33.3	34.9	43.5	8.6	Pass
145.934	QP	49.4	13.1	4	1	-33.4	34.1	43.5	9.4	Pass
908.632	Peak	36.5	28.2	4	2.3	-32.3	38.7	46.4	7.7	Pass
97.2883	Peak	51.6	12.2	4	0.8	-33.5	35.1	43.5	8.4	Pass
65.4404	Peak	47.6	11.4	4	0.7	-33.4	30.3	40	9.7	Pass
Vertical Antenna Polarization										
211.086	Peak	49.9	15.2	4	1.1	-33.3	36.9	43.5	6.6	Pass
902.612	Peak	36.3	28	4	2.3	-32.3	38.3	46.4	8.1	Pass
140.011	Peak	49.9	13	4	0.9	-33.4	34.4	43.5	9.1	Pass
815.613	Peak	35.4	27.1	4	2.1	-32.8	35.8	46.4	10.6	Pass
32.1361	Peak	36.3	20.1	4	0.5	-32.5	28.4	40	11.6	Pass
416.058	Peak	40.5	21.7	4	1.5	-33.3	34.4	46.4	12	Pass

Note:

Peak = Peak measurement

QP = Quasi-Peak measurement

AVG = Average measurement

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Average Emissions Table – Mid channel #18 – Over 1GHz

Power Meter (Host) Supply			15Vdc							
Frequency (MHz)	Detector Peak/AVG	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable 1 Factor (dB)	Cable 2 Factor (dB)	Pre-Amp (dB)	Level (dBμV/m)	AVG Limit (dB)	AVG Margin (dB)	Pass / Fail
Horizontal Antenna Polarization										
4880	AVG	57	33.2	2	2	-32.8	61.4	63.5	3.1	Pass
12201.8	Peak	47.7	40.2	2.1	2.1	-32.8	59.3	63.5	4.2	Pass
14331.5	Peak	44.4	41.7	2.1	2.1	-31.7	58.6	63.5	4.9	Pass
9759.18	Peak	47.8	38.7	2	2	-33.6	56.9	63.5	6.6	Pass
7319	Peak	48.6	37	2	2	-33	56.6	63.5	6.9	Pass
4292.26	Peak	42.3	31.9	1.7	1.7	-32.9	44.7	63.5	18.8	Pass
Vertical Antenna Polarization										
4880	AVG	58.5	33.2	2	2	-32.8	62.9	63.5	6.8	Pass
17992.3	Peak	44.6	45.1	1.6	1.6	-32.3	60.6	63.5	2.9	Pass
14637.1	Peak	45.4	41.9	2	2	-32.1	59.2	63.5	4.3	Pass
9762.57	Peak	47	38.8	2	2	-33.6	56.2	63.5	7.3	Pass
7322.39	Peak	47.4	37	2	2	-33	55.4	63.5	8.1	Pass
12244.9	Peak	41.3	40.2	2.1	2.1	-32.8	52.9	63.5	10.6	Pass

Note:

Peak = Peak measurement

AVG = Average measurement

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

High, Mid, Low Channels and Band Edge Measurements Table

Test Freq. (MHz)	Detection mode (Q-Peak)	Ant. polarity (Horz/Vert)	Raw signal dB(μV)	Ant. factor dB	Cable loss dB + Presel.	Atten. dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result PASS/FAIL
Low Channel #11											
2405	Peak	Horz	111.3	28.2	3.3	10.0	33.1	119.7			PASS
2405	Avg	Horz	108.9	28.2	3.3	10.0	33.1	117.3			PASS
2405	Peak	Vert	107.0	28.2	3.3	10.0	33.1	115.4			PASS
2405	Avg	Vert	104.6	28.2	3.3	10.0	33.1	113.0			PASS
2390	Peak	Horz	64.6	28.1	3.3	0.0	33.1	62.9	74.0	11.1	PASS
2390	Avg	Horz	55.5	28.1	3.3	0.0	33.1	53.8	54.0	0.2	PASS
2390	Peak	Vert	61.7	28.1	3.3	0.0	33.1	60.0	74.0	14.0	PASS
2390	Avg	Vert	52.7	28.1	3.3	0.0	33.1	51.0	54.0	3.0	PASS
Mid Channel #18											
2440	Peak	Horz	110.6	28.2	3.6	10.0	33.1	119.3			PASS
2440	Avg	Horz	108.3	28.2	3.6	10.0	33.1	117.0			PASS
2440	Peak	Vert	105.1	28.2	3.6	10.0	33.1	113.8			PASS
2440	Avg	Vert	102.7	28.2	3.6	10.0	33.1	111.4			PASS
High channel #25											
2475	Peak	Horz	109.8	28.5	3.9	10.0	33.1	119.1			PASS
2475	Avg	Horz	107.3	28.5	3.9	10.0	33.1	116.6			PASS
2475	Peak	Vert	104.2	28.5	3.9	10.0	33.1	113.5			PASS
2475	Avg	Vert	101.7	28.5	3.9	10.0	33.1	111.0			PASS
2483.5	Peak	Horz	64.2	28.5	3.9	10.0	33.1	73.5	74.0	0.5	PASS
2483.5	Avg	Horz	43.7	28.5	3.9	10.0	33.1	53.0	54.0	1.0	PASS*
2483.5	Peak	Vert	58.3	28.5	3.9	10.0	33.1	67.6	74.0	6.4	PASS
2483.5	Avg	Vert	38.0	28.5	3.9	10.0	33.1	47.3	54.0	6.7	PASS*


Note:

(*) The measurement was taken with a 10% duty cycle as this was the maximum declared by the manufacturer during operation.

Peak = Peak measurement

AVG = Average measurement


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

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	2017-04-20	2019-04-20	4092
BiLog Antenna	3142-E	ETS	2016-11-16	2018-11-16	4002
Horn Antenna	ATH1G18G	AR	2017-04-25	2019-04-25	4003
Biconical Antenna	EM-6913	Electro-Metrics	2017-05-02	2019-05-02	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	2015-04-20	2019-04-20	4087
Horn Antenna	3116	ETS	2017-03-02	2019-03-02	4210
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	4028
Attenuator 10dB	4779-10	Narda	NCR	NCR	4096
LNA pre-amp	LNA-1450	RF Bay Inc.	2017-07-22	2019-07-22	4089
1-26.5GHz preamp	8449B	Agilent	2017-09-09	2019-09-09	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
152in RF SMA Cable 1	Lab-Flex 335	FLORIDA RF LABS	NCR	NCR	4078
36in RF SMA Cable 2	Lab-Flex 160	FLORIDA RF LABS	NCR	NCR	4079
254mm RF SMA Cable 3	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Emission software	0.1.95	Global EMC	NCR	NCR	58

FCC - 15.209 -Radiated Emissions_Rev1

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

RF Exposure

Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

Limits and Method

The limits, as defined in FCC 15.247(i) and FCC 1.1310 Table 1 (B), limits for general public exposure were applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied. This is a limit of 1.0 mW/ cm².

For RSS 102 the RF exposure exemption limit for a 2475 MHz transmitter is:
 $1.31 \times 10^{-2} * f^{0.6834}$ W which is 2.7 W.

The distance used for calculations was 20cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

Results

The EUT passed the requirements. The worst case calculated power density was 0.072 mW/cm², this is significantly under the 1.0 mW/cm² requirement.

For RSS 102, the E.I.R.P of the EUT is 25.6 dBm (0.363 W) which is significantly less than the 2.7W RF Exposure exemption limit.

Calculations

The maximum EIRP measured was 25.6 dBm.

For a distance of 20cm, the power density is:

$$P_d = (P_t * G) / (4 * \pi * R^2) = \text{EIRP} / (4 * \pi * R^2)$$

Where P_t : Peak power conducted output


Where G = 1.1dBi Antenna gain

Where R = 20 cm


$$P_d = (363) / (4 * \pi * 20\text{cm}^2)$$

$$P_d = 363 \text{ mW} / 5026.5 \text{ cm}^2$$

$$P_d = 0.072 \text{ mW/cm}^2$$

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

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


General EUT Description

EUT Details	
EUT Name	SecureMesh FocusP Radio Module, CL-R0249C-4.1
FCC ID	TMB- G35FOCUSP
Industry Canada #	6028A- G35FOCUSP
Equipment Category	Digital Transmission System
Basic EUT Functionality	Smart metering
Input Voltage and Frequency	15 Vdc
Rated Input Current	150 mA
Connectors available on EUT	u.fl
Peripherals Required for Test	Power meter
Intentional Radiator Frequency	2400 – 2483.5 MHz
EUT Configuration	Wireless configured to transmit continuously at 100% duty cycle

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

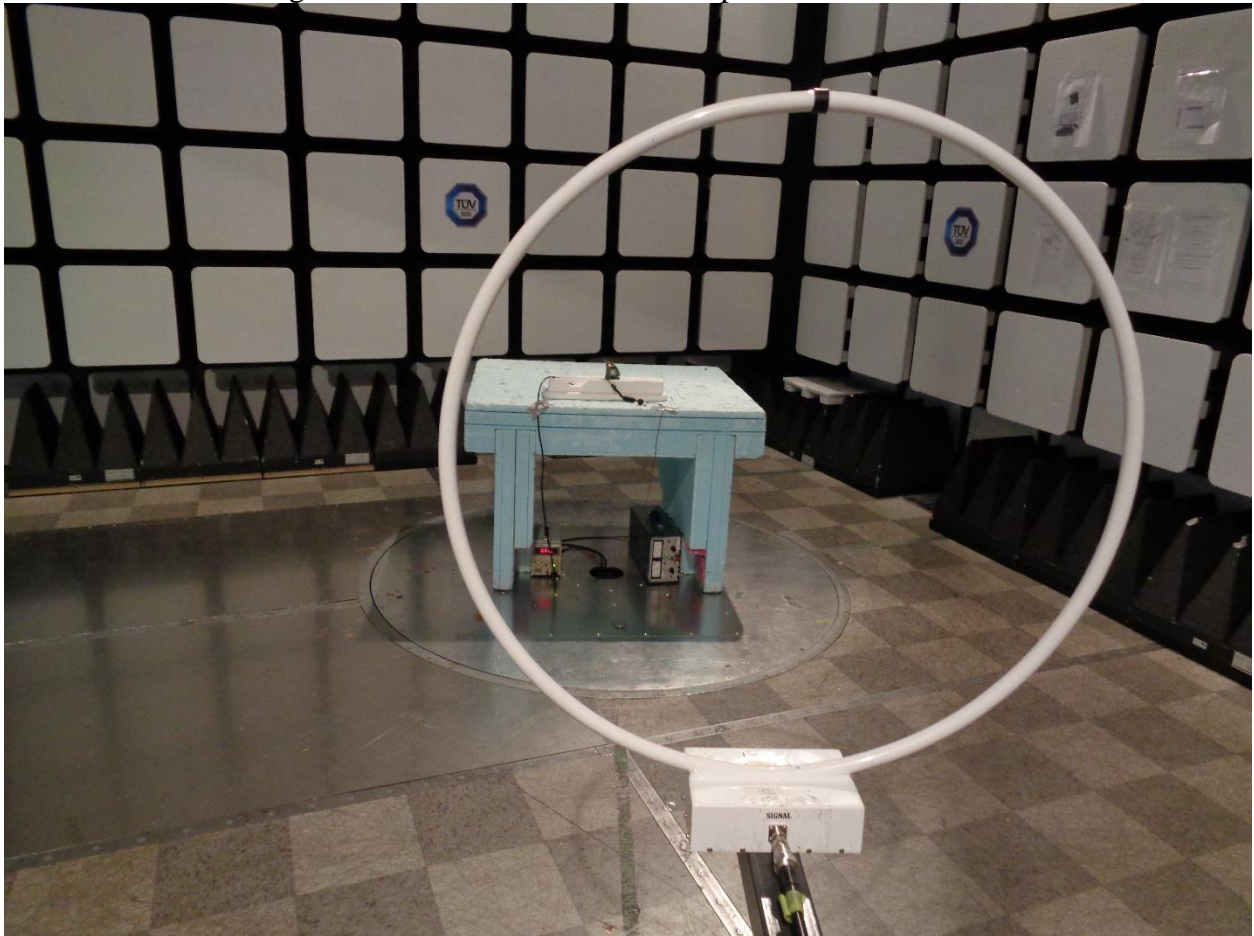
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Appendix B – EUT and Test Setup Photos

Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Note: These photos are for informational purposes. Also refer to the PDF files which are separate from this test report.

Figure 1 – Radiated Emissions Setup – 9 kHz to 30 MHz




Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Figure 2 – Radiated Emissions Setup – 30 MHz to 1 GHz



Note: As per ANSI C63.10 Clause 6.3.1, below 1GHz, the height of the EUT was set to 80cm. Above 1GHz, the height was raised to 1.5m.


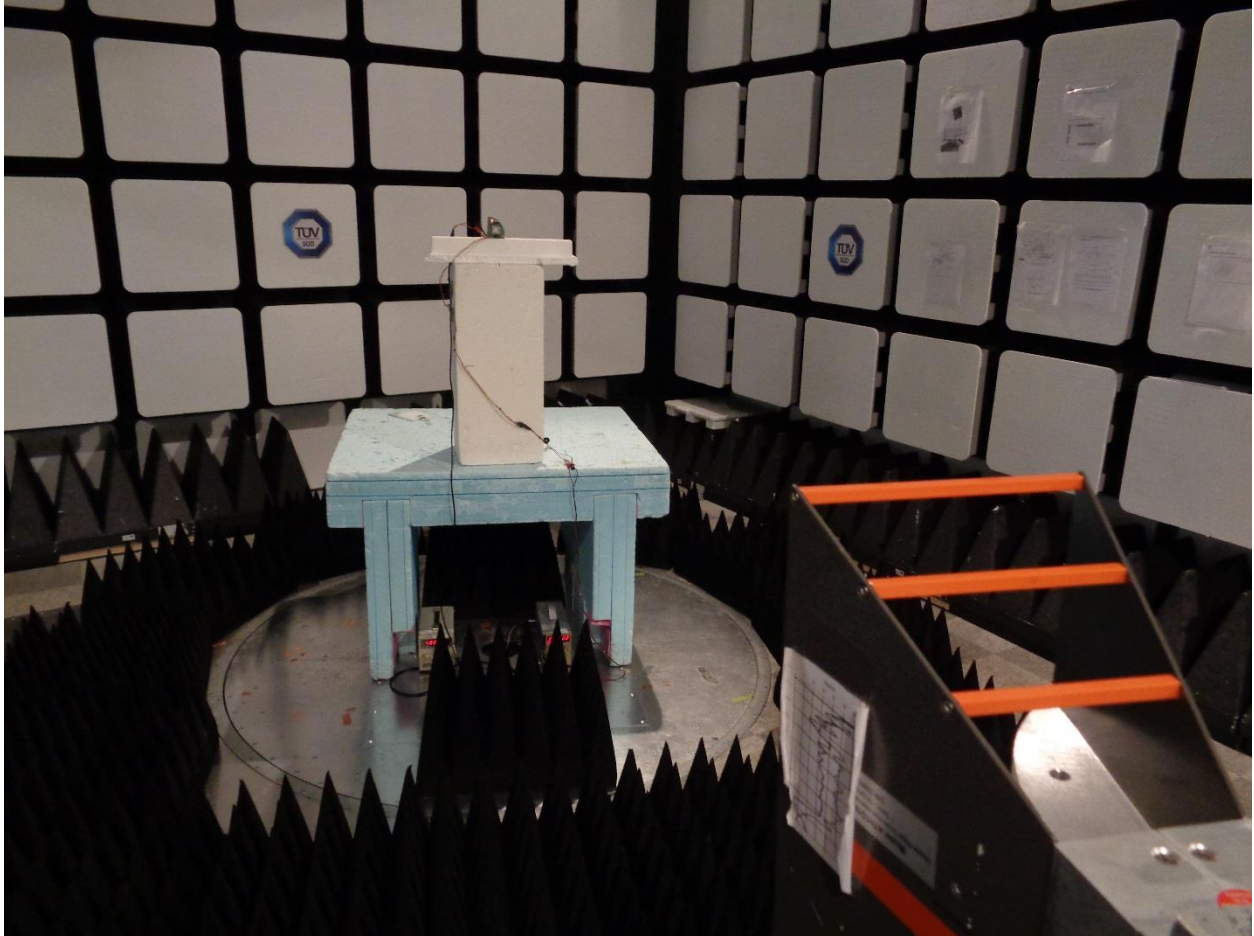
Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Figure 3 – Radiated Emissions Setup above 1 GHz @ 3m



Note: As per ANSI C63.10 Clause 6.3.1, above 1GHz, the height of the EUT was set to 1.5m.


Client	Trilliant Networks Inc.	
Product	SecureMesh FocusP Radio Module, CL-R0249C-4.1	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Figure 4 – Radiated Emissions Setup above 3GHz @ 1m

