

# EMC & RF Test Report

As per

## RSS-247 Issue 2 & FCC Part 15 Subpart 15.247

Unlicensed Intentional Radiators

on the

### SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)

**FCC ID: TMB-OSDI4W1**  
**IC: 6028A-OSDI4W1**

Issued by:

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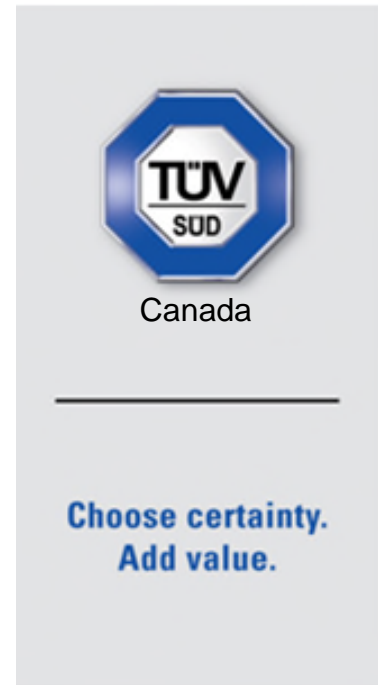
Abderrahmane  
Ferhat,  
Project Engineer




Testing produced for




See Appendix A for full client &  
EUT details.



Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

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Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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 Radio Module**, Model: **OSDI-4000-1x (x depends on firmware)** 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 15.247:2018

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	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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 Radio Module, Model: OSDI-4000-1x (x depends on firmware)
FCC Certification #, FCC ID:	TMB-OSDI4W1
Industry Canada Certification #, IC:	6028A-OSDI4W1
EUT passed all tests performed	Yes
Tests conducted by	Abderrahmane Ferhat


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

Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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	Pass 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 See Justification
FCC 15.247(b)1 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 See Justification
FCC 15.247(i) RSS-102	RF Exposure	> 20 cm separation.	Pass
<b>Overall Result</b>			<b>Pass</b>

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	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

### ***Notes, Justifications, or Deviations***

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

As per customer's request, this report is for purpose of Class two permissive change for the SecureMesh Radio Module product. The changes under this application is to add a new host PCB antenna trace layout. Only the output power, bandedge and spurious radiated emissions tests were performed, other tests were deemed to be in compliance as per the original approval of the RF module.

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 $\mu$ V/m – (50dB $\mu$ V + 10dB + 2.5dB – 20dB)

Margin = 8.0 dB (pass)

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## Applicable Standards, Specifications and Methods


- ANSI C63.4:2014 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
  
- ANSI C63.10:2013 American National Standard For Testing Unlicensed Wireless Devices
  
- CFR 47 FCC 15 Code of Federal Regulations – Radio Frequency Devices, Subpart C:2018 Intentional Radiators
  
- CISPR 22:2008 Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
  
- FCC KDB 558074: FCC KDB 558074 Digital Transmission Systems, measurements and procedures 2016
  
- ICES-003 Issue 6 Digital Apparatus - Spectrum Management and 2016 Telecommunications Policy Interference-Causing Equipment Standard
  
- RSS-GEN Issue 4 General Requirements and Information for the Certification of 2014 Radio Apparatus
  
- RSS-247 Issue 2:2017 Issue 1: Digital Transmission Systems (DTSSs), 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	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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## Document Revision Status

Revision 0    January 27, 2020    Initial Release



Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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.

Client	<b>Trilliant Networks Inc.</b>	
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Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


### ***Testing Environmental Conditions and Dates***

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

<b>Date</b>	<b>Test</b>	<b>Initials</b>	<b>Temperature (°C)</b>	<b>Humidity (%)</b>	<b>Pressure (kPa)</b>
2019-04-12	Conducted measurements	AF	20 – 24	40 – 51	98.0 – 102.0
2019-04-12 to 2019-04-15	Radiated Emissions	AF	20 – 24	40 – 51	98.0 – 102.0

Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

## Detailed Test Results Section

Client	Trilliant Networks Inc.	
Product	SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)	
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 with the 2 modulations. The following table show the peak power:

Modulation	Channel	Frequency (MHz)	Conducted Peak Power (dBm)	Peak Power (mW)
OQPSK	Low Channel (11)	2405.0	29.91	979.5
	Mid Channel (18)	2440.0	29.97	993.1
	Hi Channel (25)	2475.0	29.98	995.4
OFDM	Low Channel (3)	2403.2	28.11	647.1
	Mid Channel (48)	2439.2	27.35	543.3
	Hi Channel (84)	2468.0	27.70	588.8

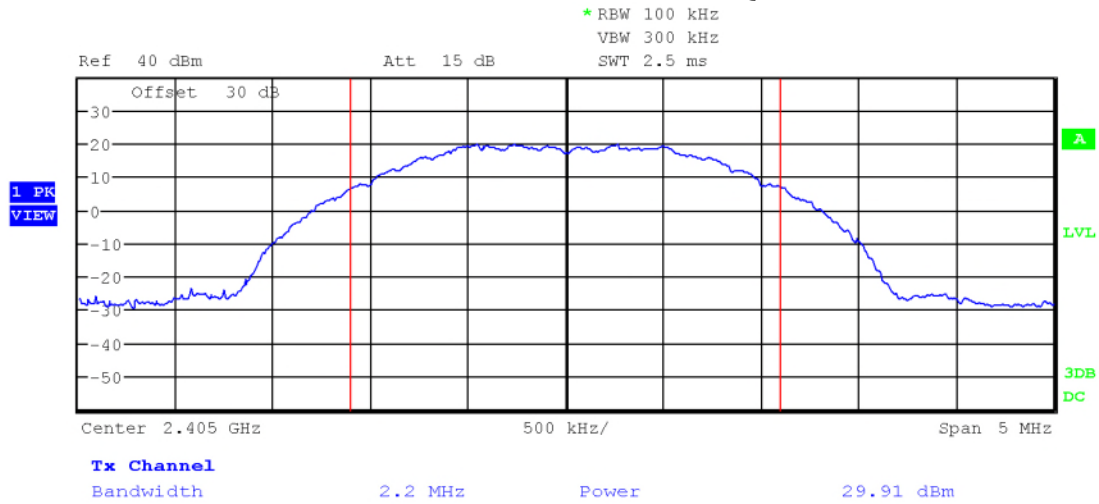
Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer

Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


## Graphs

The plots below show the antenna conducted measurements peak output power of the device during the transmit operation of the EUT and the OBW for both OQPSK and OFDM modulations.

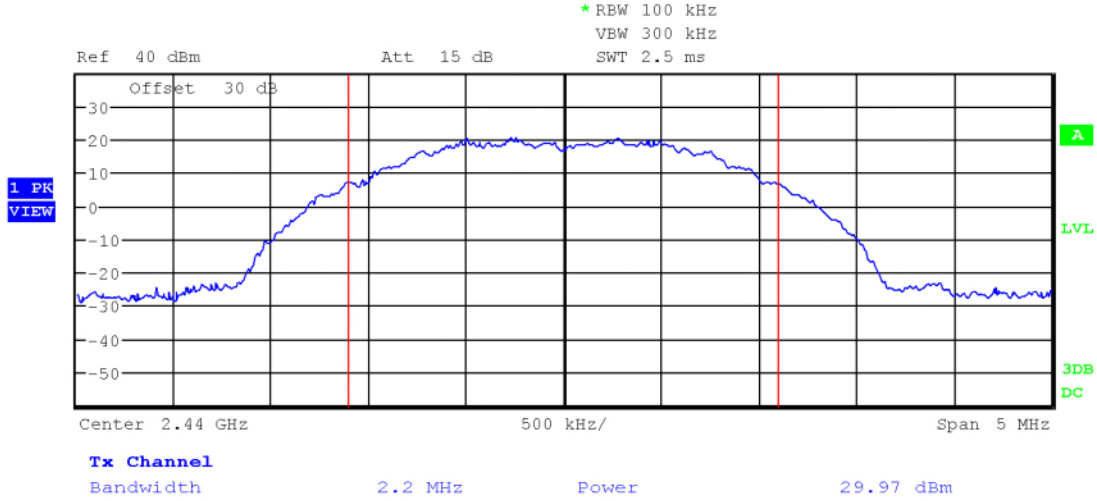
Peak Power – Low Channel 11 – OQPSK modulation



Date: 12.APR.2019 09:27:02


Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	

Peak Power – Mid Channel 18 – OQPSK modulation

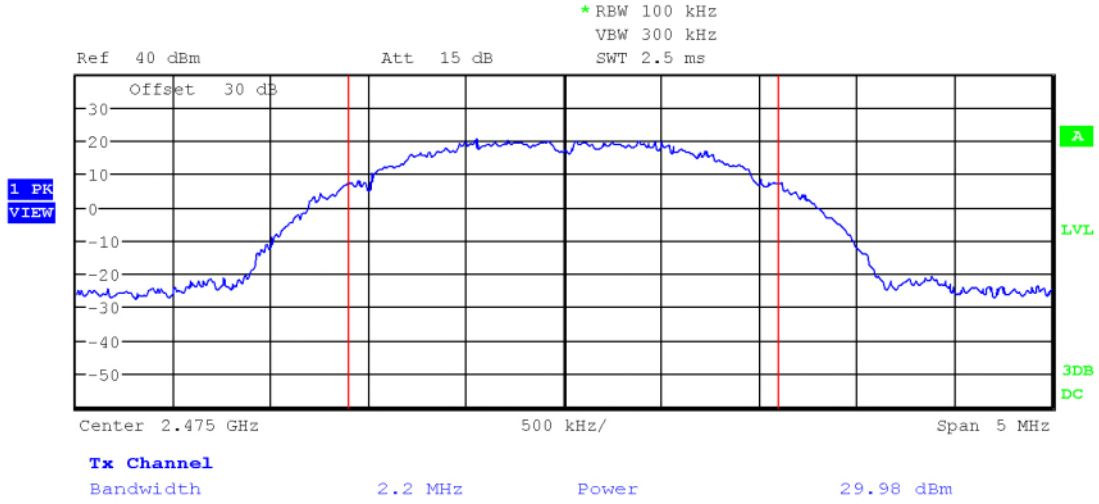


Date: 12.APR.2019 09:42:57

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Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	

Peak Power – High Channel 25 – OQPSK modulation

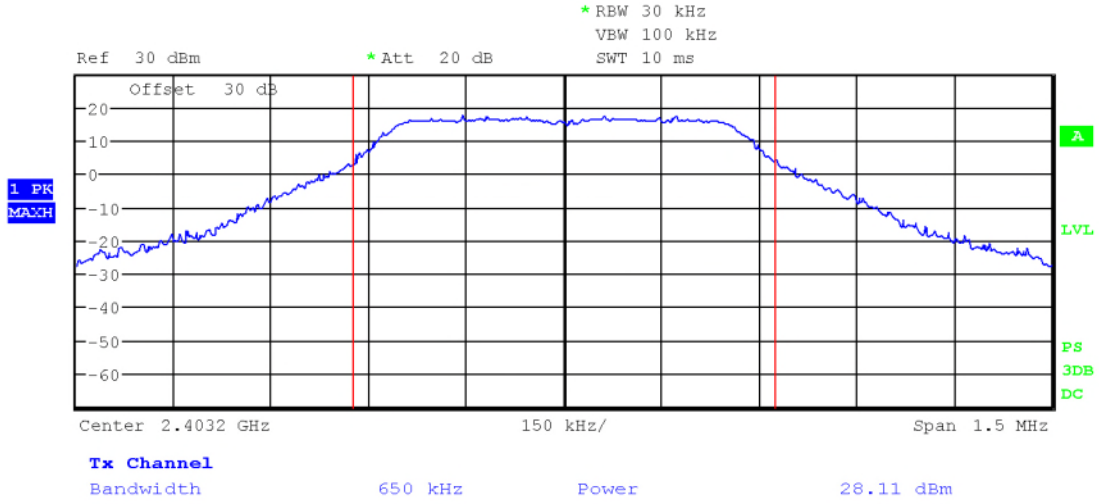


Date: 12.APR.2019 09:53:02




Client	Trilliant Networks Inc.	 Canada
Product	SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

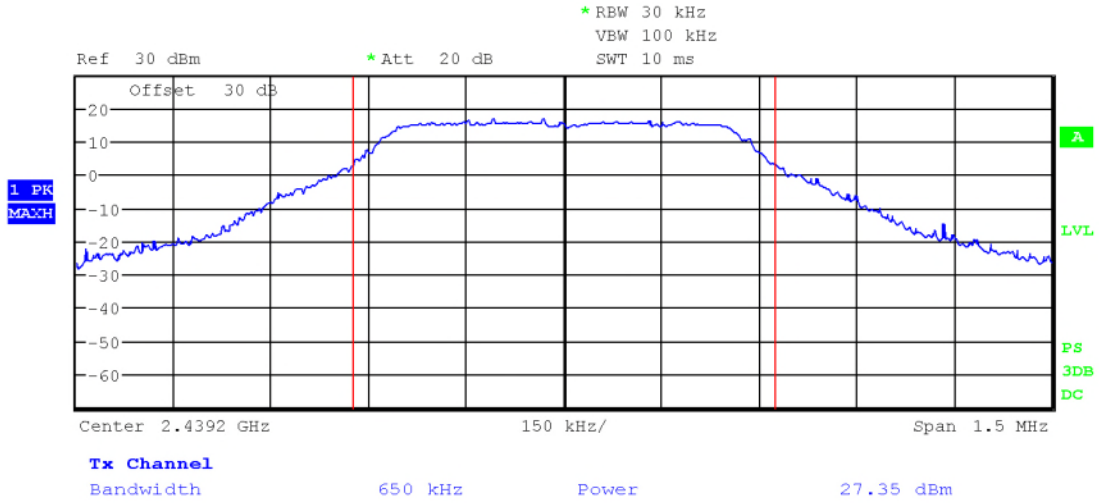
Peak Power – Low Channel 11 – OFDM modulation




Date: 12.APR.2019 11:07:18

Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	

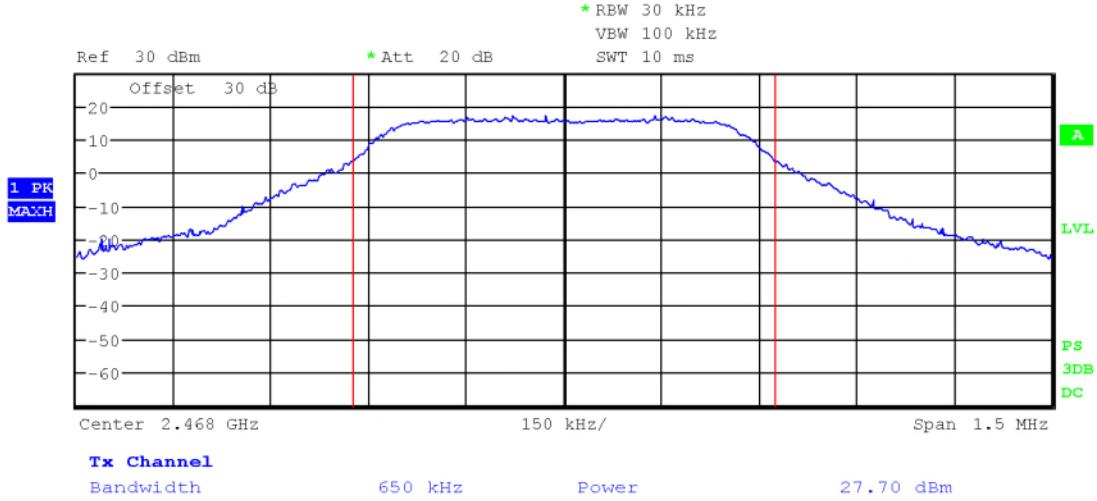
**Peak Power – Mid Channel 18 – OFDM modulation**



Date: 12.APR.2019 10:59:48


Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	

Peak Power – High Channel 25 – OFDM modulation

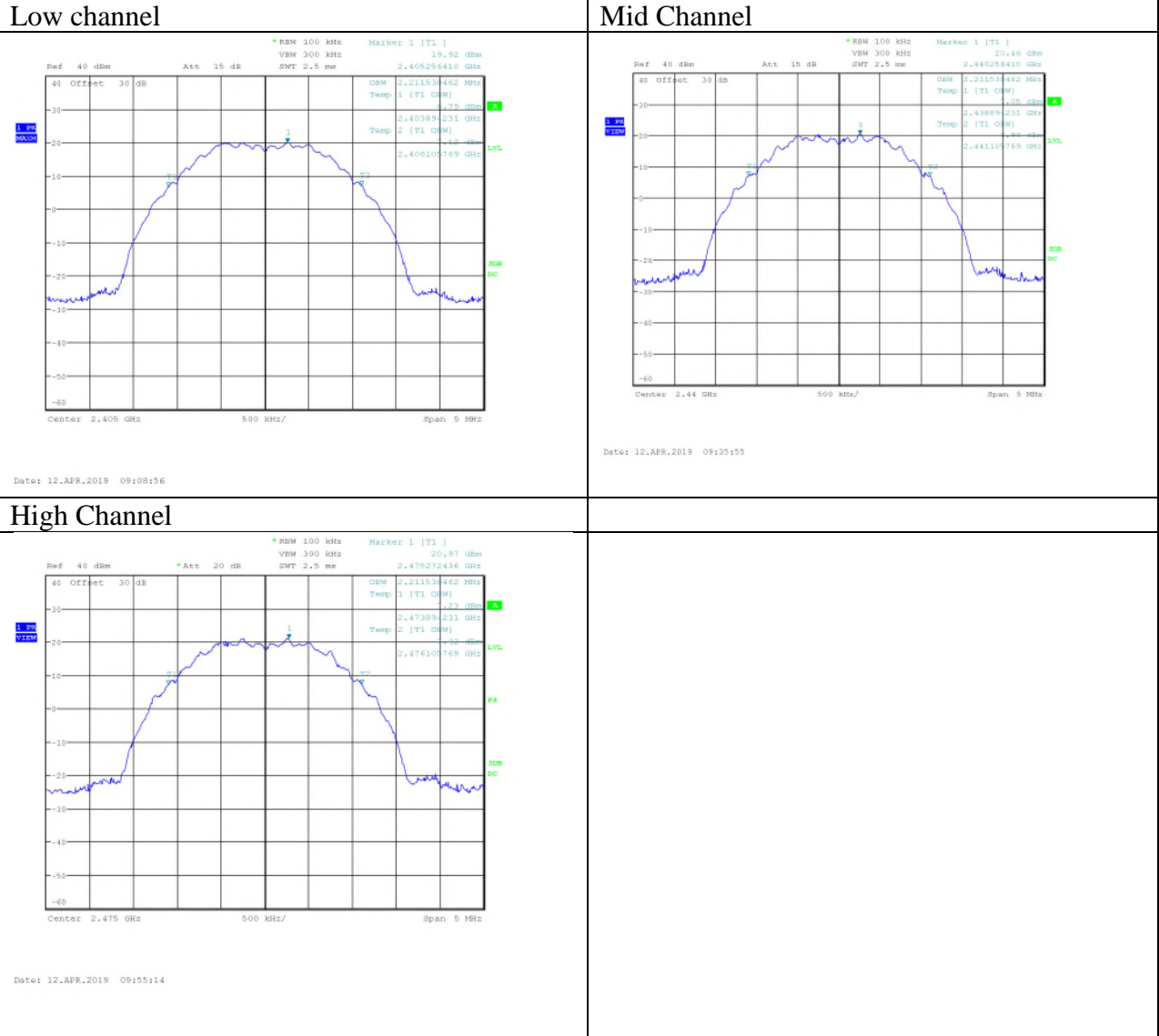



Date: 12.APR.2019 10:29:43

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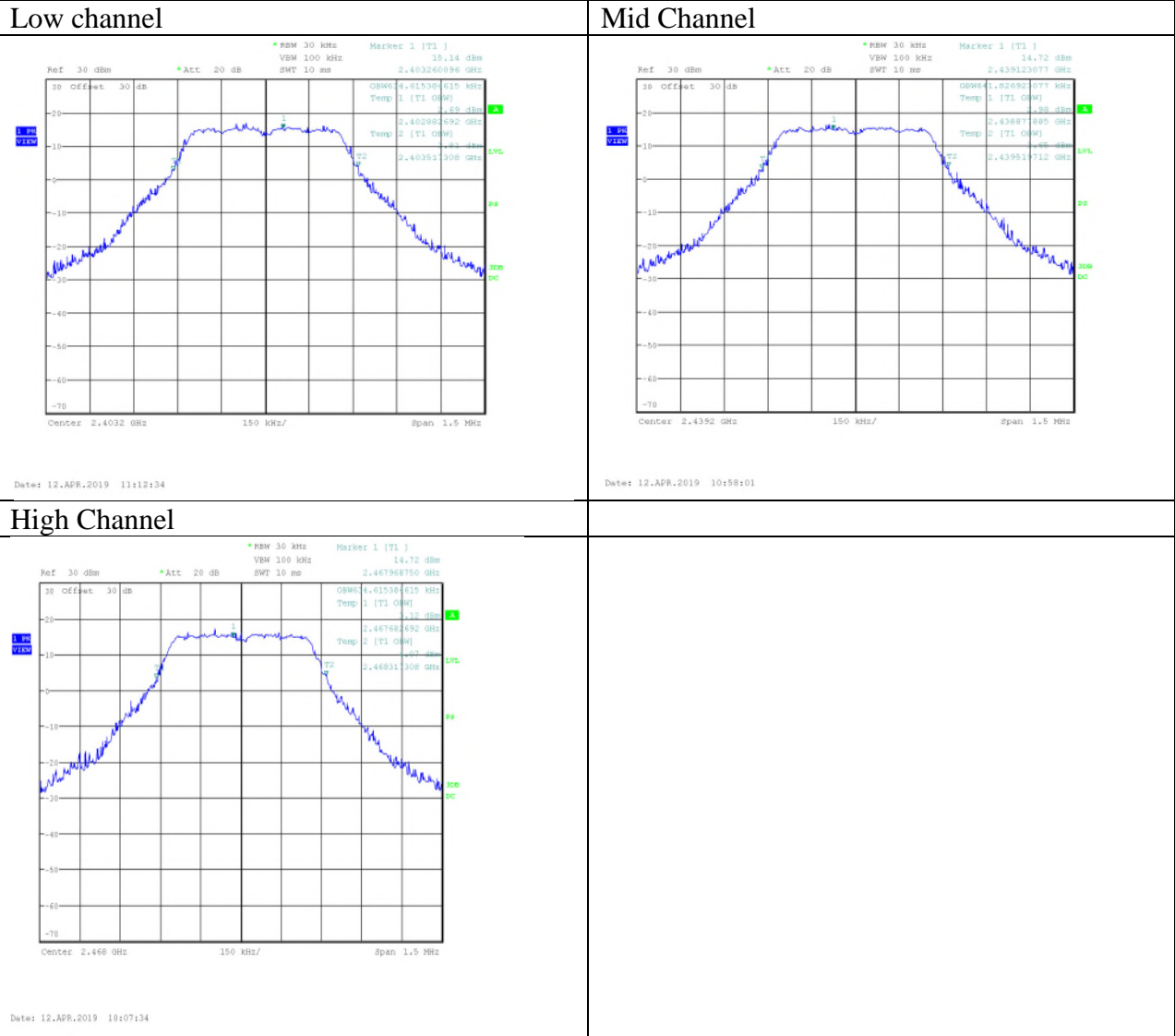
Client	Trilliant Networks Inc.	 TÜV SÜD Canada
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Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


### OBW – OQPSK modulation



Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	


### OBW – OFDM modulation



Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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
254mm RF SMA Cable 3	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Attenuator 10 dB	4779-10	narda	NCR	NCR	4096

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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).


<b>Frequency</b>	<b>Limit</b>
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m <sup>1</sup>
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m <sup>1</sup>
1.705 MHz – 30 MHz	30 uV/m at 30m <sup>1</sup>
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m <sup>1</sup> ) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m <sup>1</sup> ) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m <sup>1</sup> ) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m <sup>1</sup> ) at 3m
Above 1000 MHz	500 uV/m (54 dBuV/m <sup>2</sup> ) at 3m
Above 1000 MHz	5000 uV/m (74 dBuV/m <sup>3</sup> ) at 3m

<sup>1</sup>Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

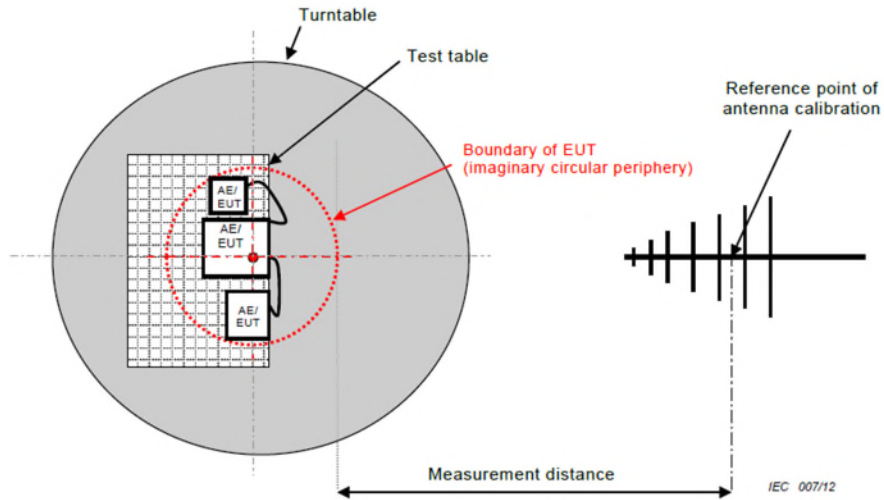
<sup>2</sup>Limit is with 1 MHz measurement bandwidth and using an Average detector

<sup>3</sup>Limit 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	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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 10<sup>th</sup> harmonic (a minimum of 24.835 GHz).

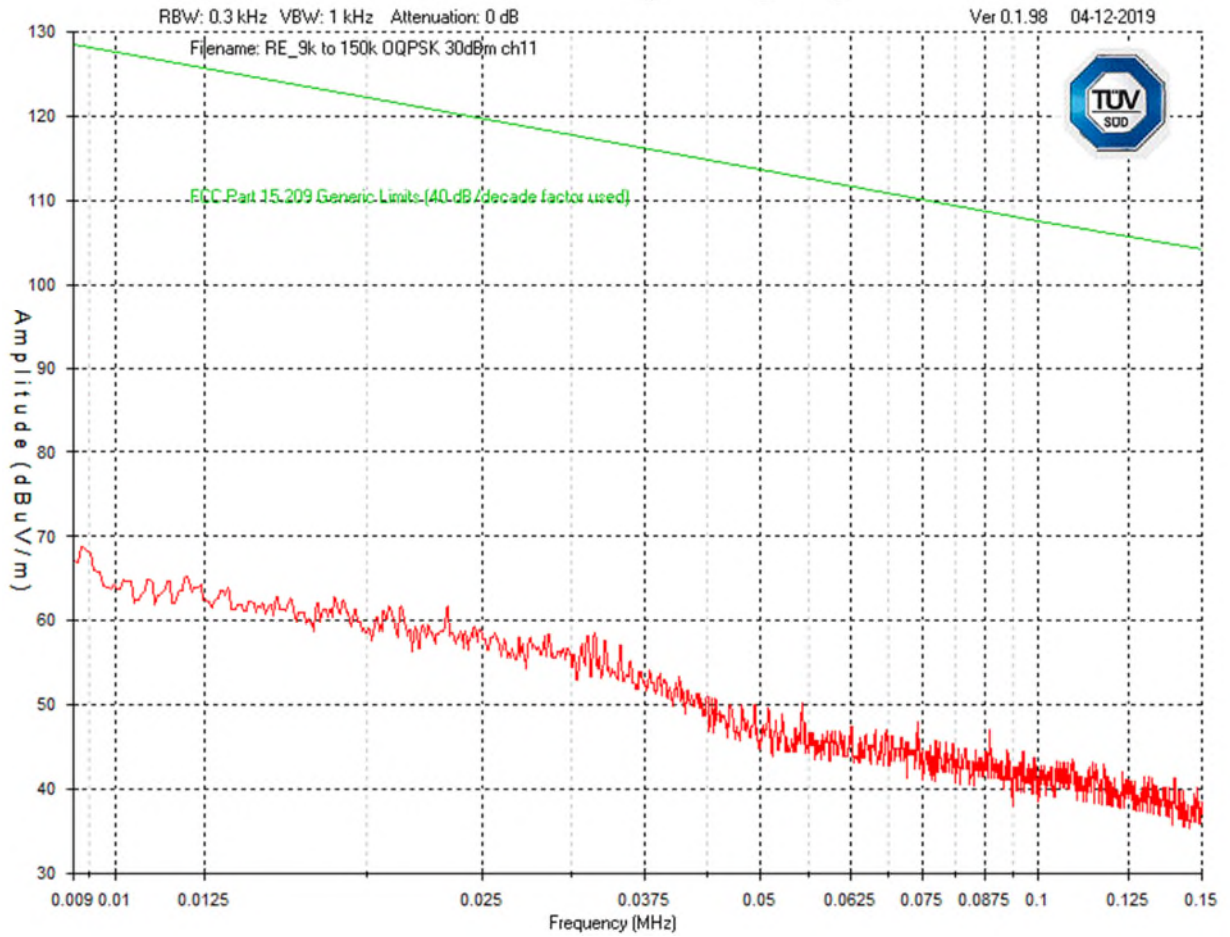
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m /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


Low, middle and high channels with both modulations OQPSK and OFDM, each in three orthogonal axis were checked. However, only the worst case graphs are presented here.



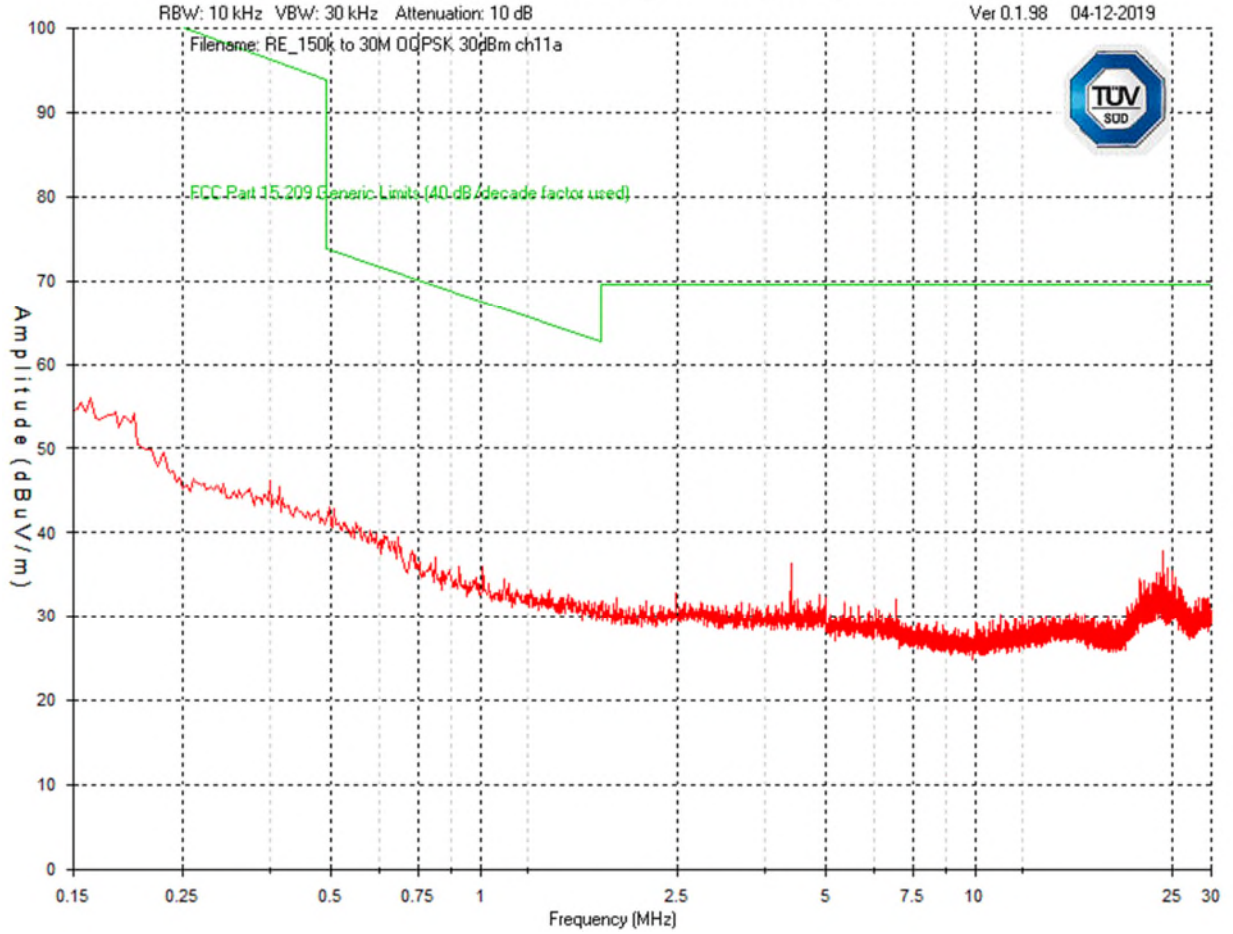
Client	<b>Trilliant Networks Inc.</b>	 TUV SUD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Low Channel – OQPSK modulation  
 9 kHz – 150 kHz  
 Peak Emission Graph – Loop 0deg



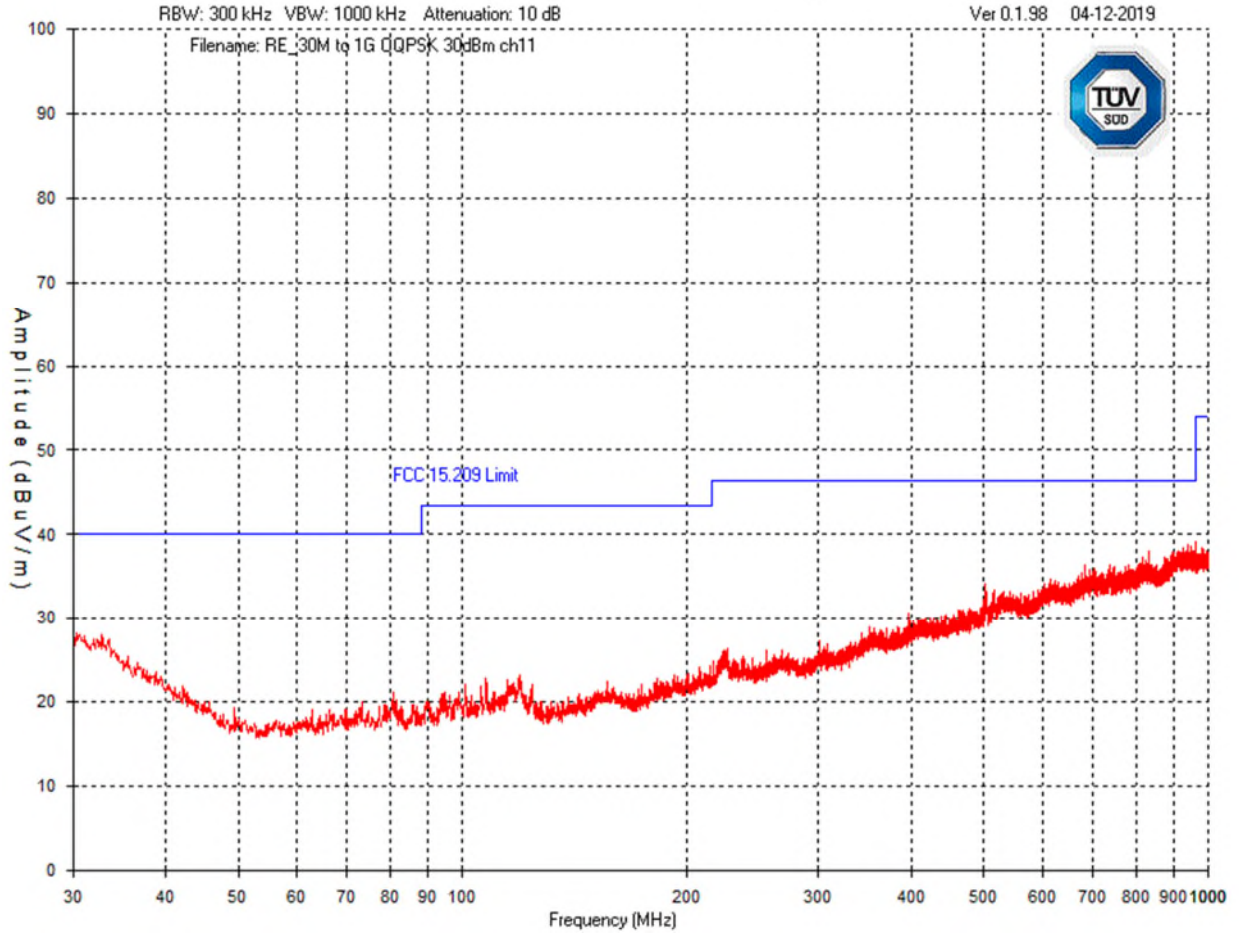
Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


Low Channel – OQPSK modulation  
 150 kHz – 30 MHz  
 Peak Emission Graph – Loop 0deg



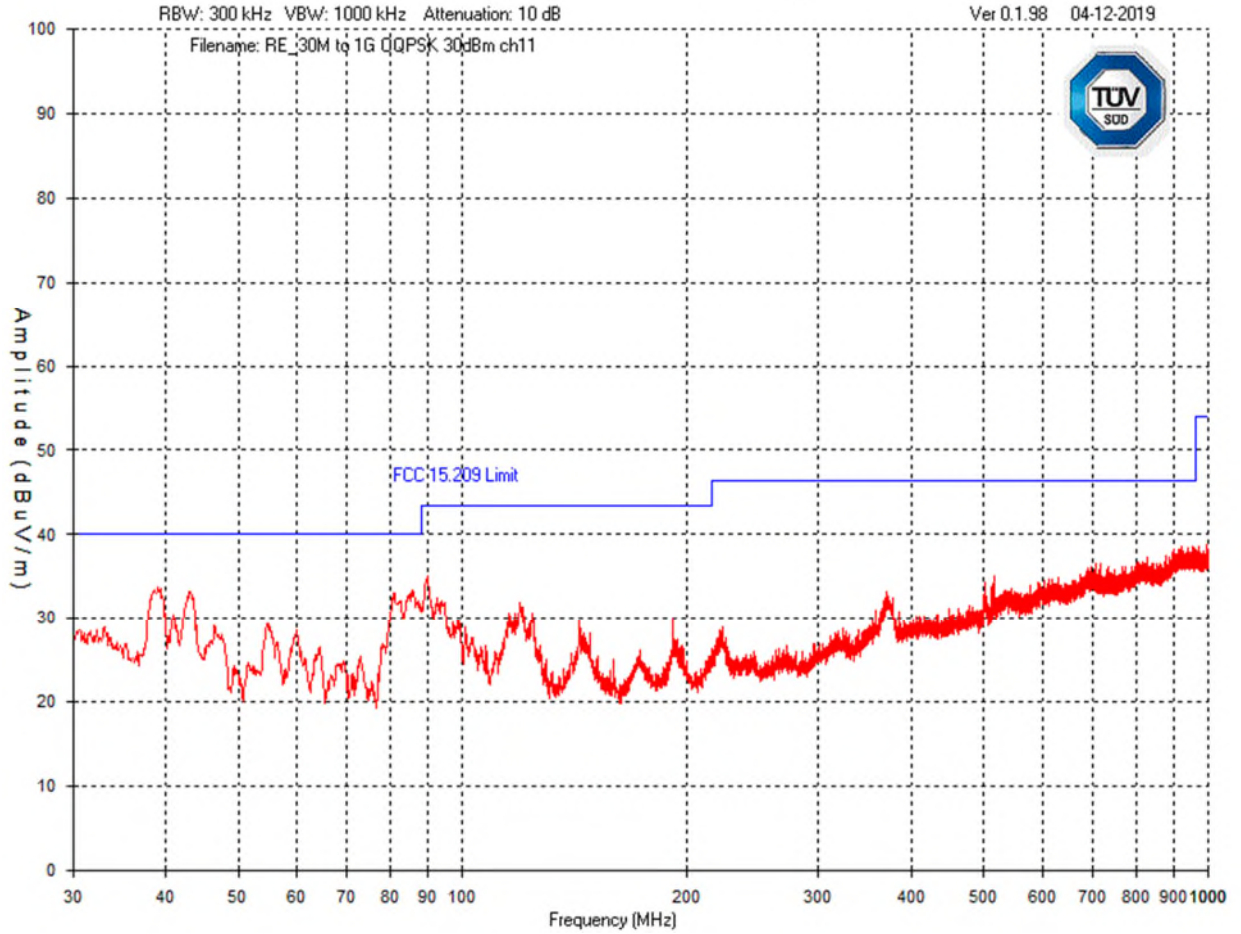
Client	<b>Trilliant Networks Inc.</b>	 TUV SUD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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Low Channel – OQPSK modulation – 30 MHz – 1 GHz  
Horizontal - Peak Emission Graph




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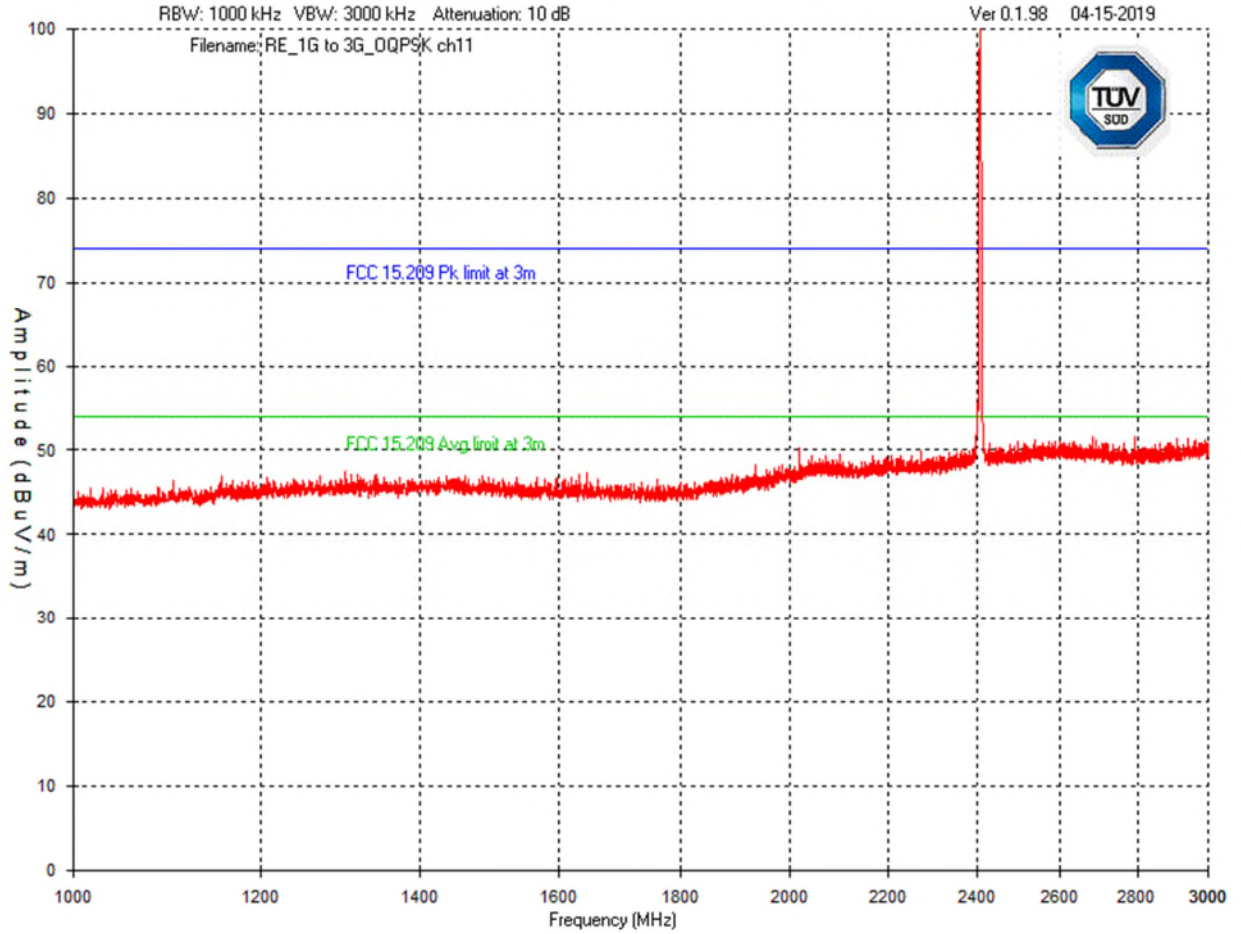
Low Channel – OQPSK modulation – 30 MHz – 1 GHz  
Vertical - Peak Emission Graph






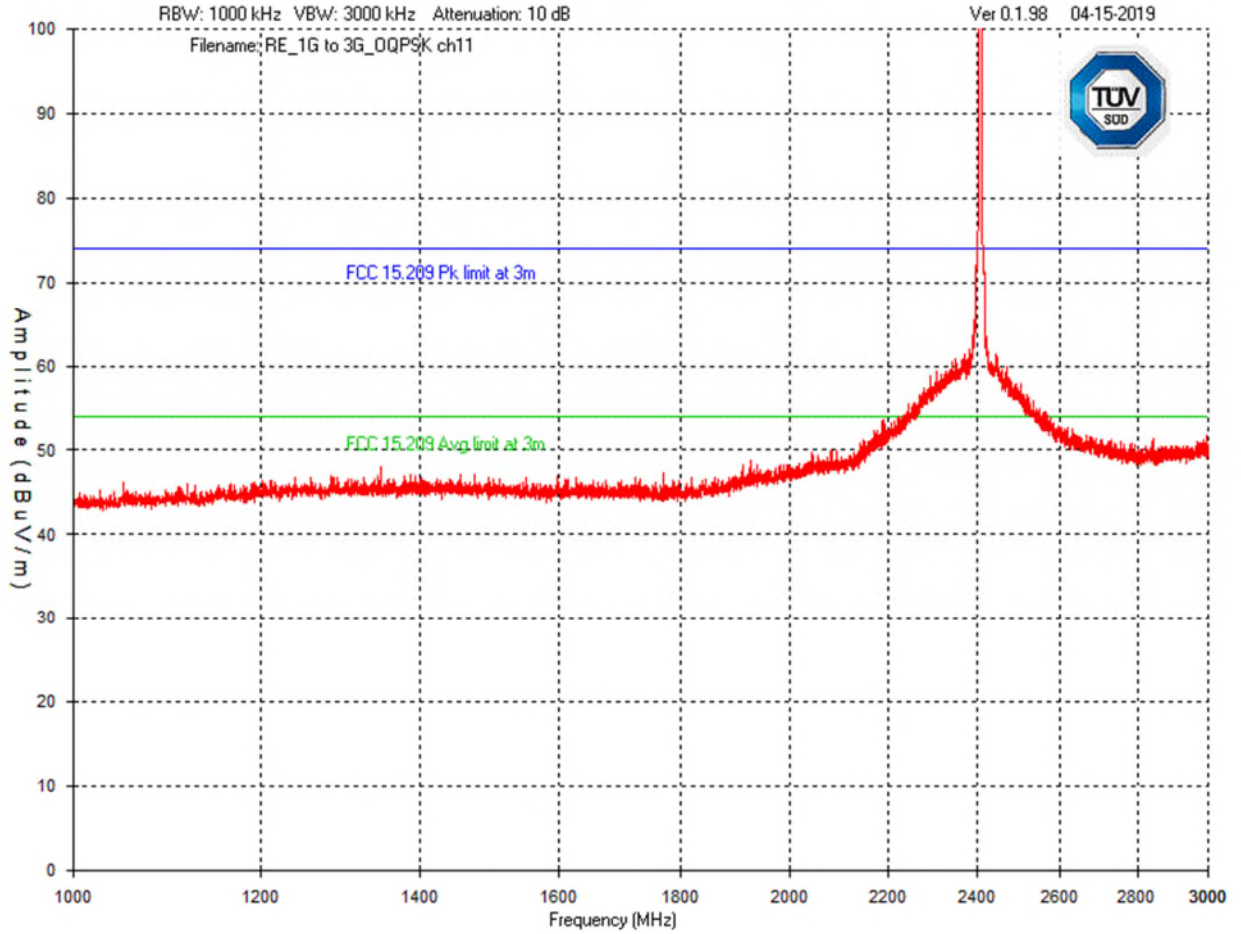
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Low Channel 11 – OQPSK modulation – 1 GHz – 3 GHz  
Horizontal - Peak Emission Graph



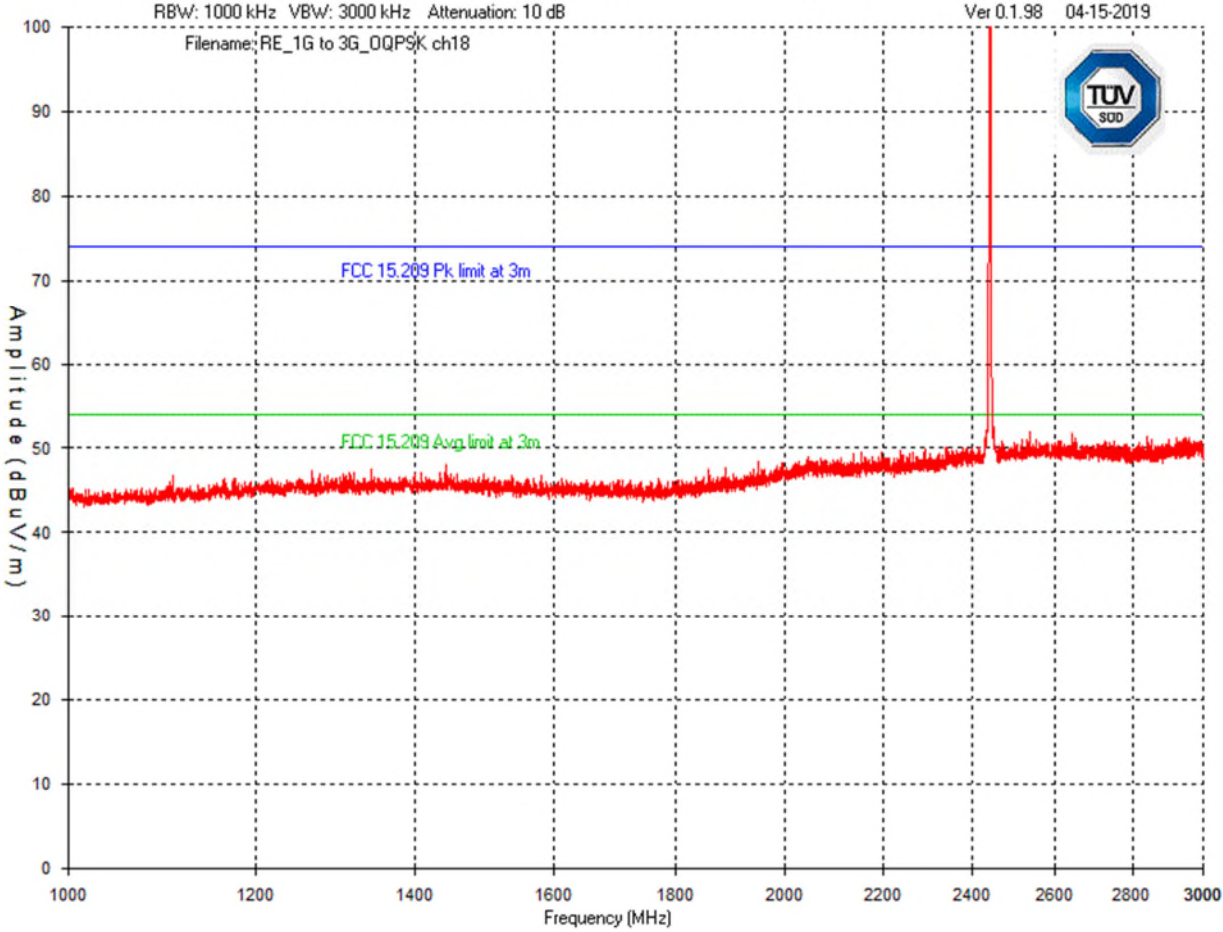
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Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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Low Channel 11 – OQPSK modulation – 1 GHz – 3 GHz  
Vertical - Peak Emission Graph



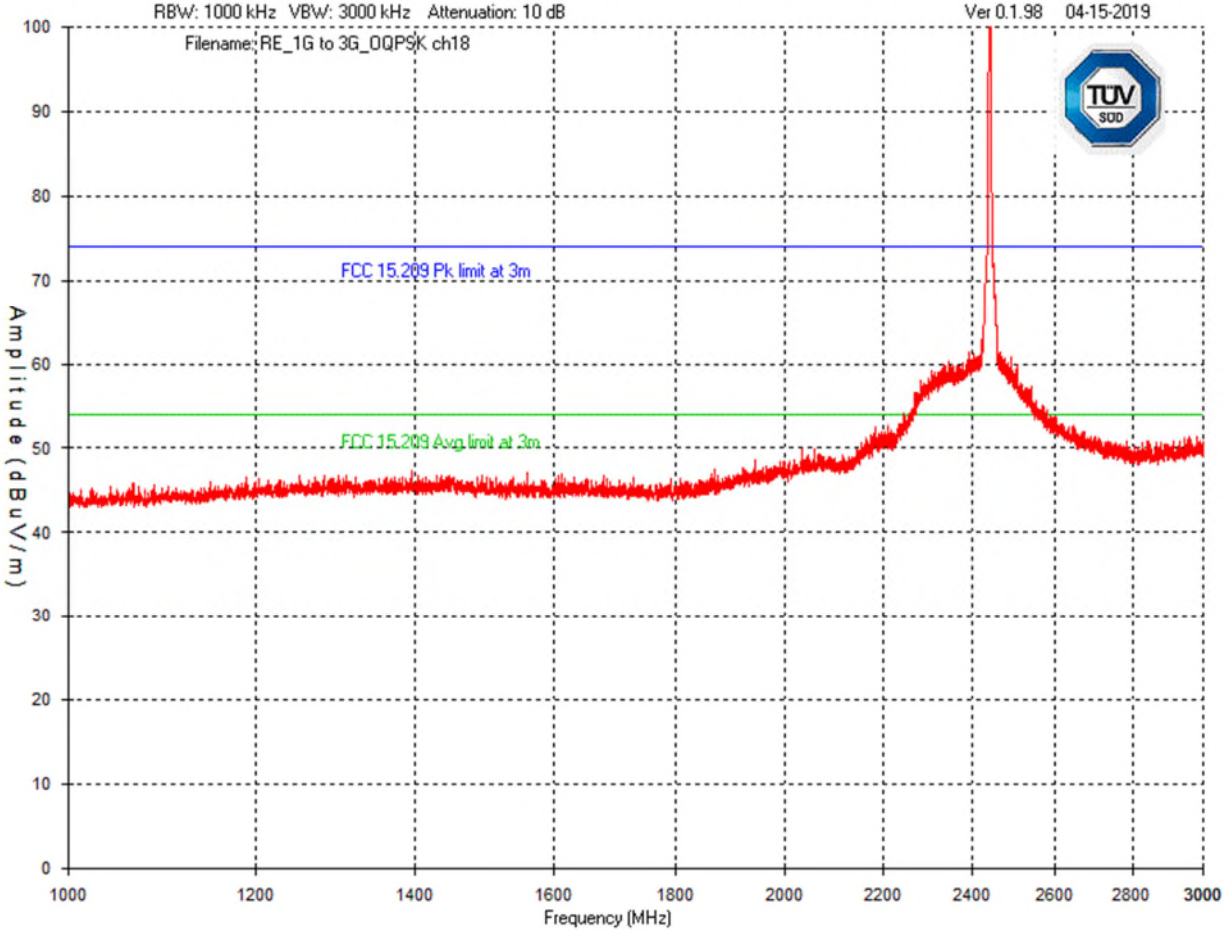
Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

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




Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

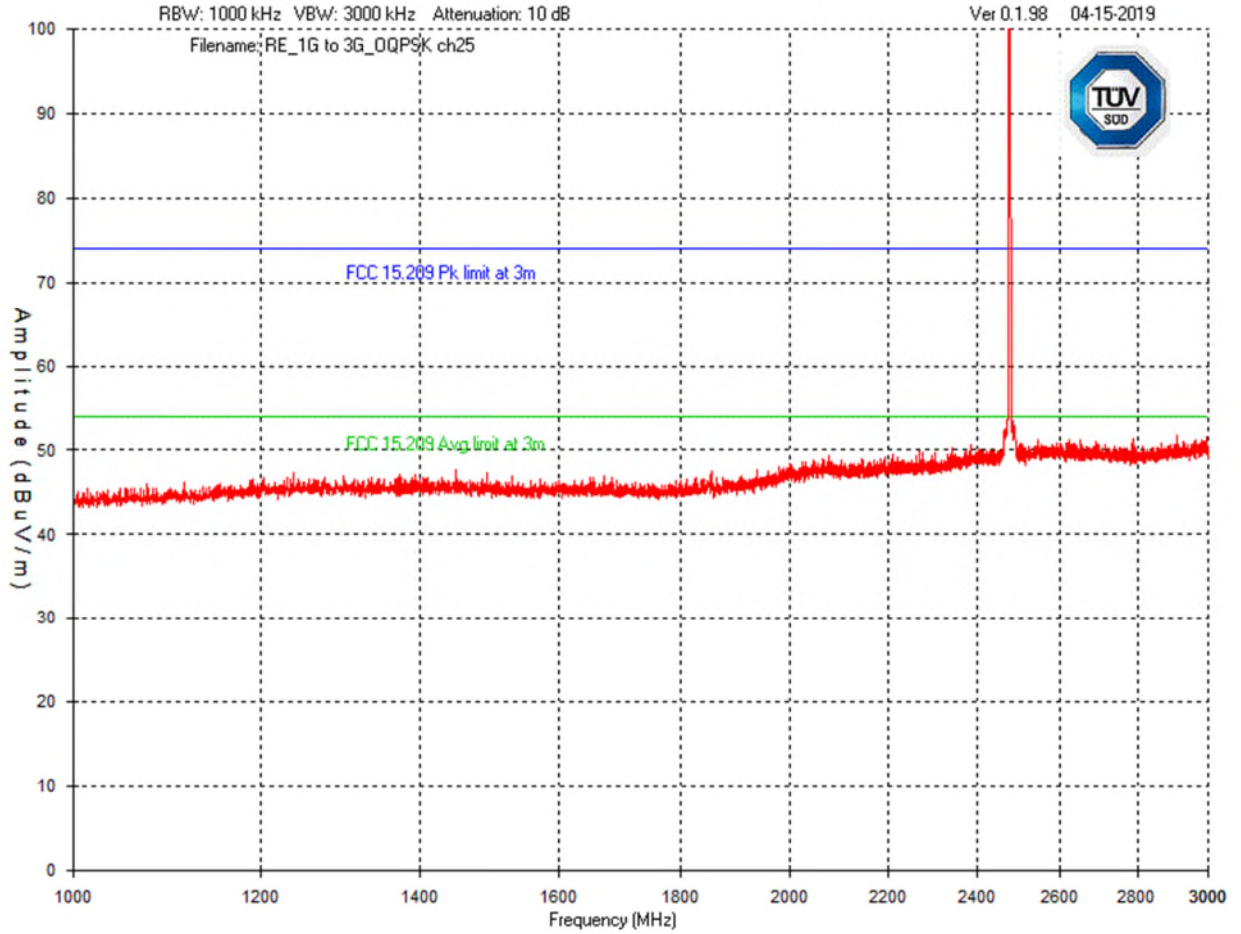
Mid Channel 18 – OQPSK modulation – 1 GHz – 3 GHz  
Vertical - Peak Emission Graph






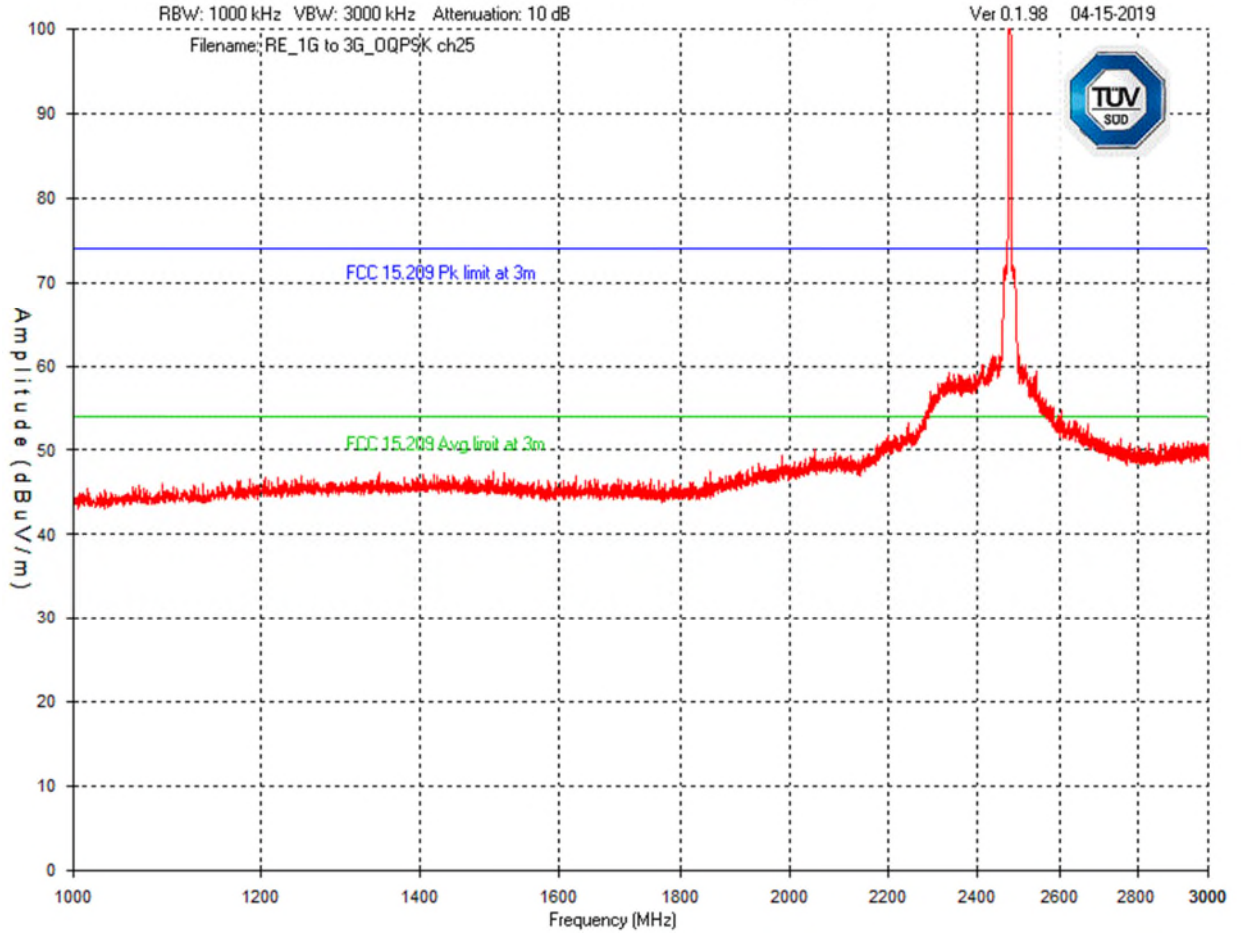
Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


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



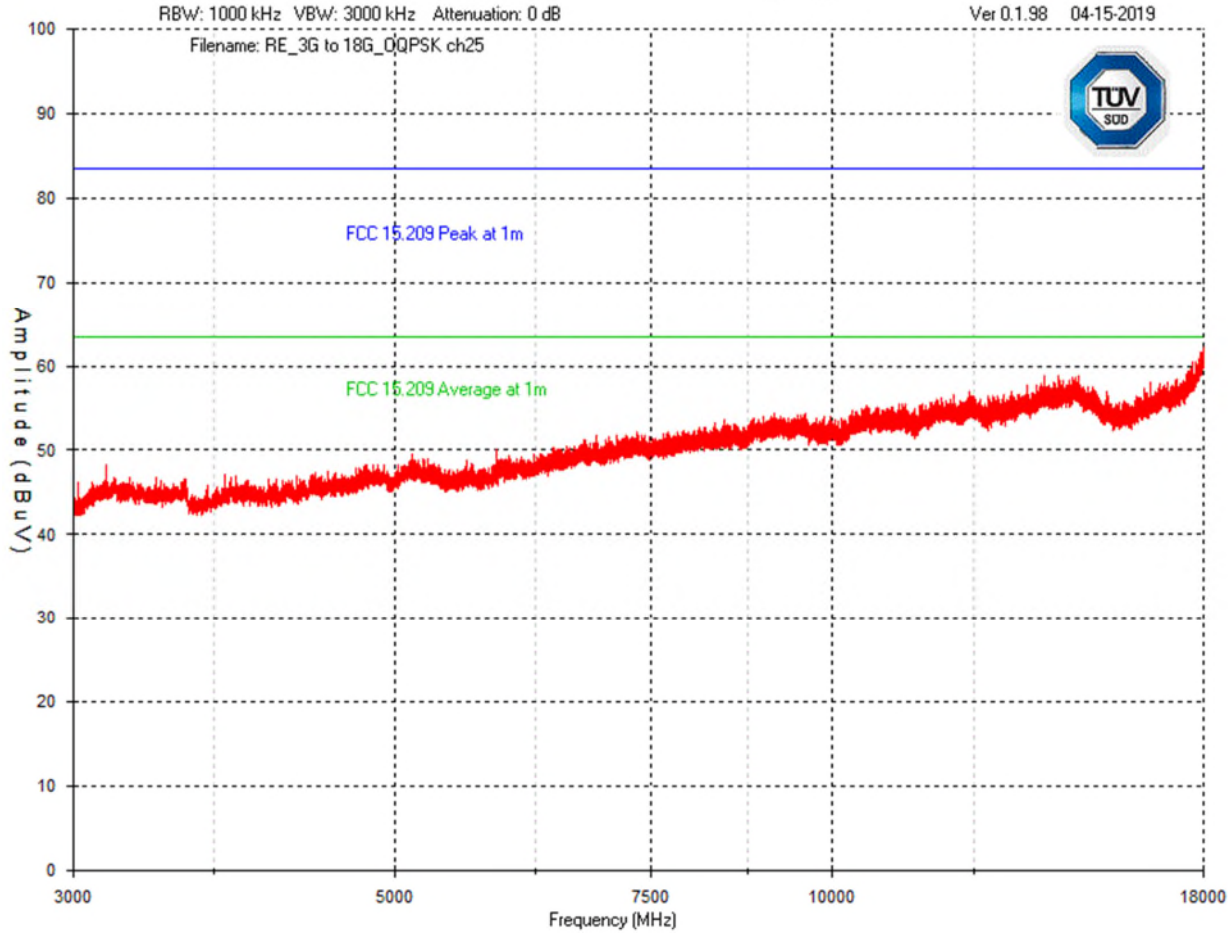
Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


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



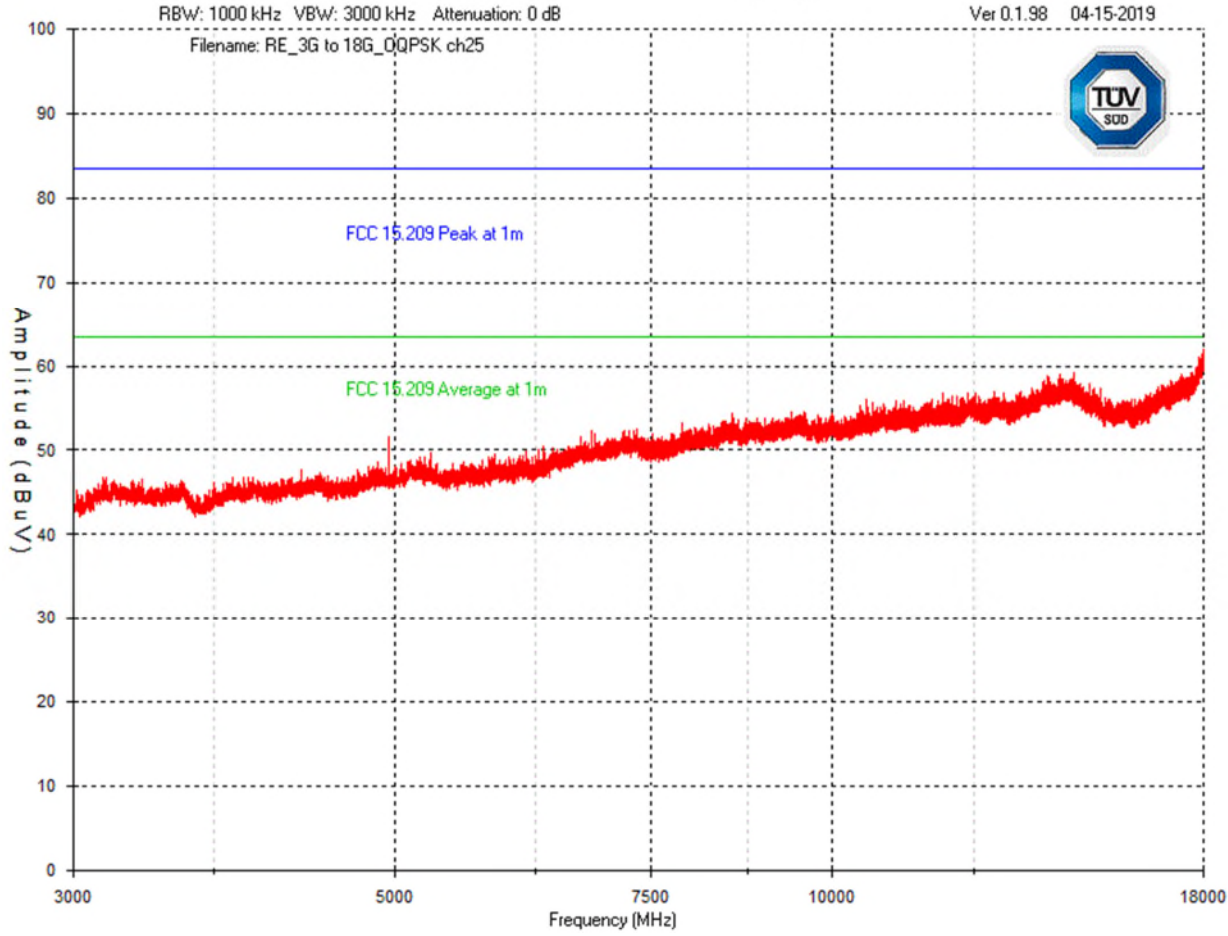
Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	


High Channel – OQPSK modulation – 3 GHz – 18 GHz  
 Horizontal - Peak Emission Graph @ 1m



Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

High Channel – OQPSK modulation – 3 GHz – 18 GHz  
 Vertical - Peak Emission Graph @ 1m



Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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 – OQPSK – 30MHz to 1GHz


Power Meter (Host) Supply			120V, 60Hz							
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										
30.0971	Peak	35.6	21.3	4	0.5	-32.4	29	40	11	Pass
500.63	Peak	38.9	22.8	4	1.7	-33.2	34.2	46.4	12.2	Pass
961.744	Peak	36.7	28	4	2.4	-32	39.1	54	14.9	Pass
80.5876	Peak	38.5	11.4	4	0.8	-33.4	21.3	40	18.7	Pass
226.913	Peak	38.7	15.7	4	1.2	-33.3	26.3	46.4	20.1	Pass
119.426	Peak	39.2	12.7	4	0.9	-33.5	23.3	43.5	20.2	Pass
Vertical Antenna Polarization										
39.03	Peak	46	16	4	0.6	-32.8	33.8	40	6.2	Pass
43.1081	Peak	48	13.8	4	0.6	-33	33.4	40	6.6	Pass
89.6176	Peak	52.5	11.2	4	0.8	-33.5	35	43.5	8.5	Pass
54.8569	Peak	47.3	10.7	4	0.7	-33.3	29.4	40	10.6	Pass
60.003	Peak	46.2	11	4	0.7	-33.3	28.6	40	11.4	Pass
119.329	Peak	47.8	12.7	4	0.9	-33.5	31.9	43.5	11.6	Pass

Note:

Peak = Peak measurement

QP = Quasi-Peak measurement

AVG = Average measurement

Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Band Edge Measurements Table – OQPSK

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											
2390	Peak	Horz	40.9	28.1	4.1	10.0	33.1	50.0	74.0	24.0	PASS
2390	Avg	Horz	27.6	28.1	4.1	10.0	33.1	36.7	54.0	17.3	PASS
2390	Peak	Vert	54.2	28.1	4.1	10.0	33.1	63.3	74.0	10.7	PASS
2390	Avg	Vert	40.6	28.1	4.1	10.0	33.1	49.7	54.0	4.3	PASS
High channel #25											
2483.5	Peak	Horz	43.9	28.5	4.2	10.0	33.1	53.5	74.0	20.5	PASS
2483.5	Avg	Horz	30.8	28.5	4.2	10.0	33.1	40.4	54.0	13.6	PASS
2483.5	Peak	Vert	63.3	28.5	4.2	10.0	33.1	72.9	74.0	1.1	PASS
2483.5	Avg	Vert	35.2	28.5	4.2	10.0	33.1	44.8	54.0	9.2	PASS


Note:

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	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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	2018-11-29	2020-11-29	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
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	0.1.98	Global EMC	NCR	NCR	58

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Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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/ cm<sup>2</sup>.

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 0.788 mW/cm<sup>2</sup>, this is significantly under the 1.0 mW/cm<sup>2</sup> requirement.

### **Calculations**

The maximum conducted measured power was 29.98 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<sub>t</sub> = 29.98dBm (995.4 mW) Peak power conducted output

Where G = 6 dBi (3.98)

Where R = 20 cm


$$P_d = (995.4 \text{ mW} * 3.98) / (4 * \pi * (20\text{cm})^2)$$

$$P_d = 3961.7 \text{ mW} / 5026.5 \text{ cm}^2$$


$$P_d = 0.788 \text{ mW/cm}^2$$

For RSS 102, the E.I.R.P of the EUT is 35.98 dBm (29.98dBm+6dBi) = 3.963W, however as per the manufacturer declaration the maximum duty cycle is 10% which allow to apply a reduction factor of 10\*log(10%) = -10dB. The new calculated EIRP value is then 25.98 dBm = 396.3 mW which is significantly less than the 2.7W RF Exposure exemption limit.



Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

## Appendix A – EUT Summary


Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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 Radio Module: OSDI-4000-1x (x depends on firmware)
FCC ID	TMB-OSDI4W1
Industry Canada #	6028A-OSDI4W1
Equipment Category	Digital Transmission System
Basic EUT Functionality	Smart metering
Input Voltage and Frequency	4.5Vdc (host:120V, 60Hz)
Rated Input Current	150 mA
Connectors available on EUT	N
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’.

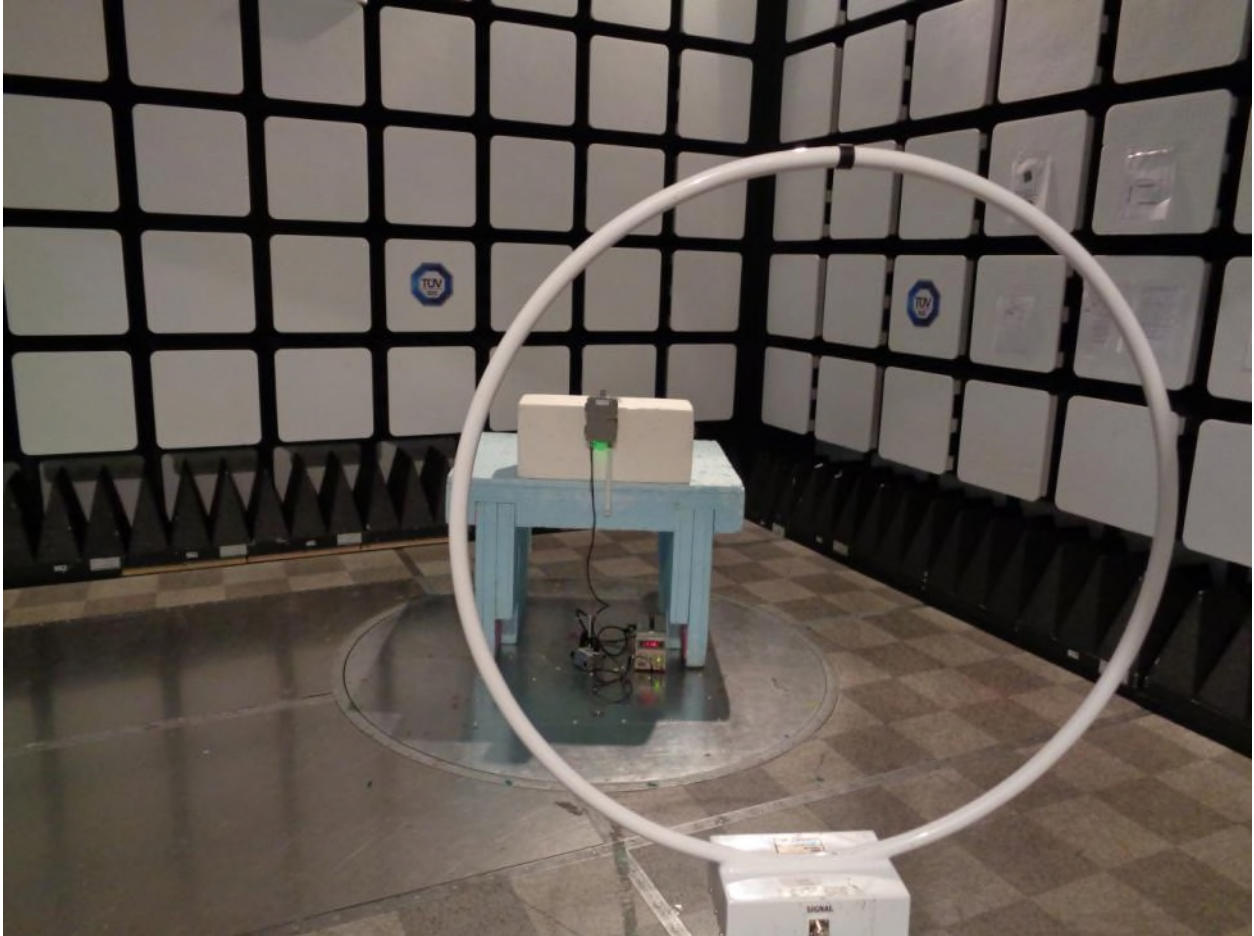
Client	<b>Trilliant Networks Inc.</b>	
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

## Appendix B – EUT and Test Setup Photos

Client	<b>Trilliant Networks Inc.</b>	 TUV SUD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
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.


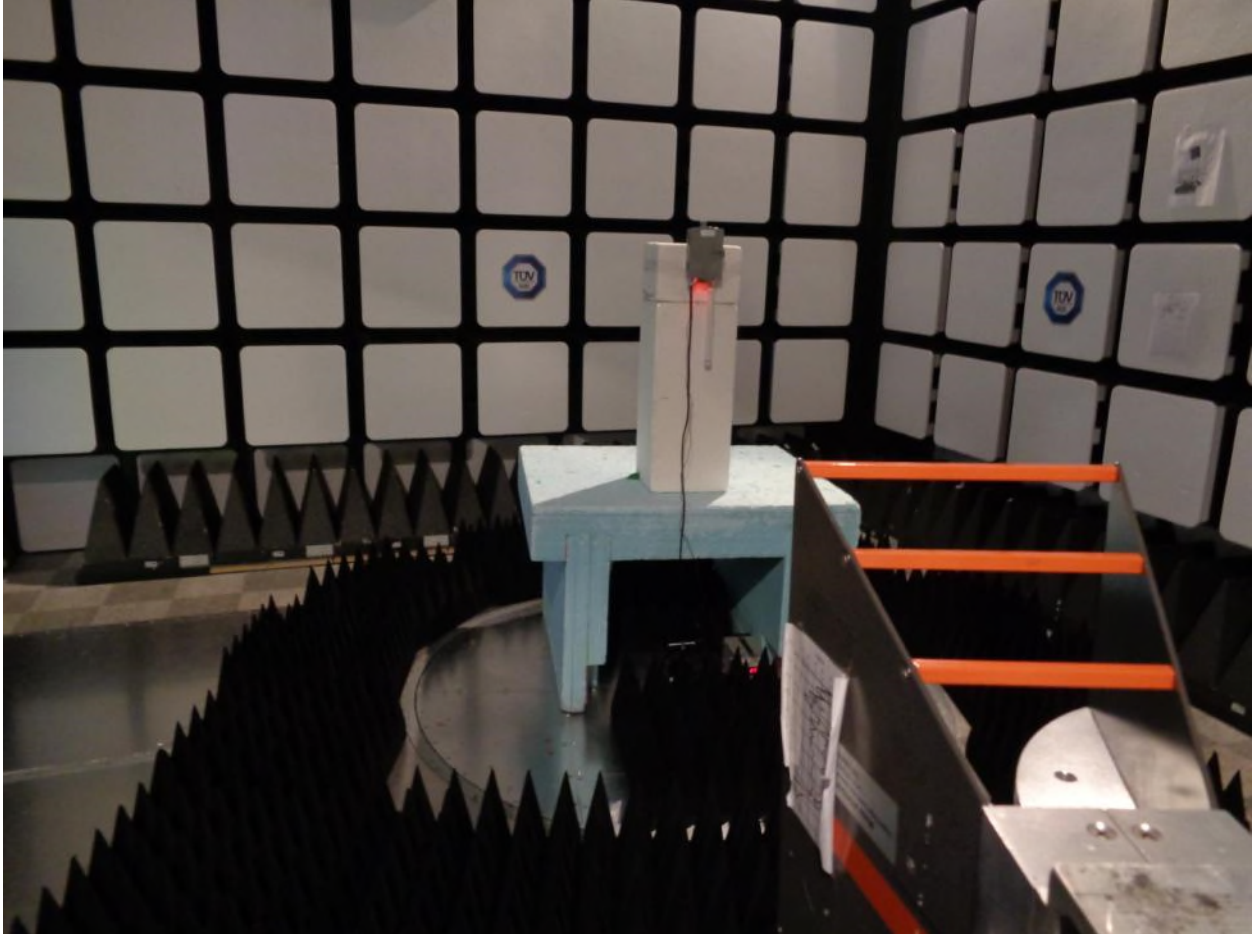
Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Figure 3 – Radiated Emissions Setup – 1 GHz to 3 GHz



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




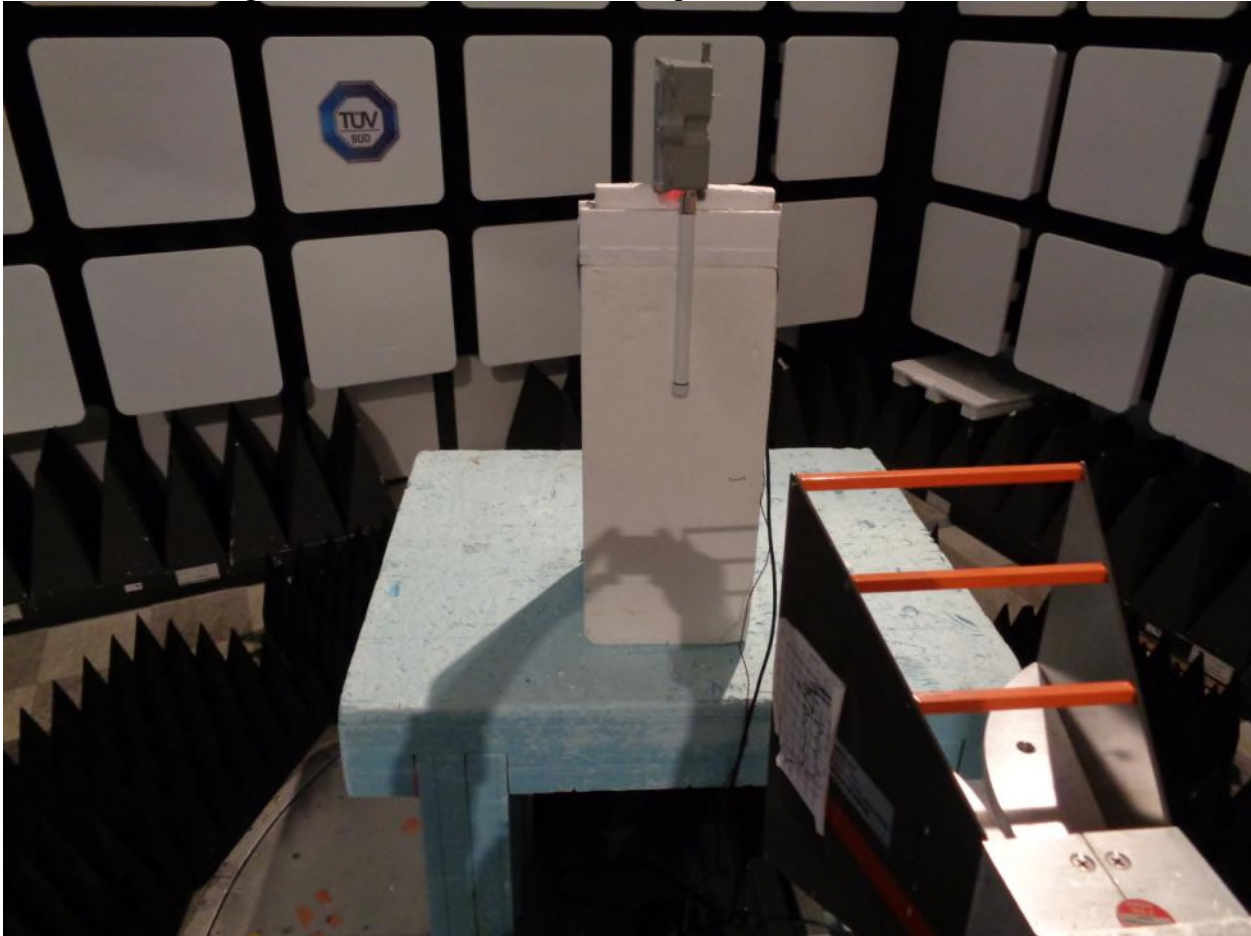
Client	<b>Trilliant Networks Inc.</b>	 Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	RSS 247 Issue 2, FCC Part 15 Subpart 15.247	

Figure 4 – Radiated Emissions Setup at 1m – 3 GHz to 18 GHz




Client	<b>Trilliant Networks Inc.</b>	 TÜV SÜD Canada
Product	<b>SecureMesh Radio Module: OSDI-4000-1x (x depends on firmware)</b>	
Standard(s)	<b>RSS 247 Issue 2, FCC Part 15 Subpart 15.247</b>	

Figure 5 – Antenna Port Conducted Measurements

