



Certification Test Report

**FCC ID: R7PNG0R1S4
IC: 5294A-NG0R1S4**

**FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247**

Report Number: AT72146310-3C5

**Manufacturer: Landis+Gyr Technology, Inc.
Model: Series-6 RF Mesh mSBR Card**

**Test Begin Date: December 11, 2018
Test End Date: February 6, 2019**

Report Issue Date: October 3, 2019



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 21 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 Certification for modular approval.

1.2 Product Description

The Landis & Gyr Series-6 RF Mesh mSBR Card radio is an electricity metering module which includes a 902.4 MHz to 927.6 MHz transmitter as well as a 2.4GHz OFDM transmitter.

This test report documents the compliance of the 900 MHz DTS transceiver mode of operation.

Technical Information:

Detail	Description
Frequency Range	904 – 926.8 MHz
Modulation Format	IEEE 802.15.4 SUN OFDM
Data Rates	Option 1: MCS0 - MCS6
Operating Voltage	3.3 Vdc
Antenna Type(s) / Gain(s)	Dual Band Dipole / 4.5dBi

Manufacturer Information:

Landis+Gyr Technology, Inc.
30000 Mill Creek Ave., Suite 100
Alpharetta, GA 30022

Test Sample Serial Number: LAN ID: 61293EB1

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable. The worst-case data rate for OFDM modulation was MCS0.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was Z-position. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

For power line conducted emissions, the EUT was powered by a representative wall wart power supply.

For RF Conducted measurements, the EUT was connected to the test equipment with a U.FL to SMA connector. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

Software power setting during test: 26

2 TEST FACILITIES**2.1 Location**

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5' in diameter and is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

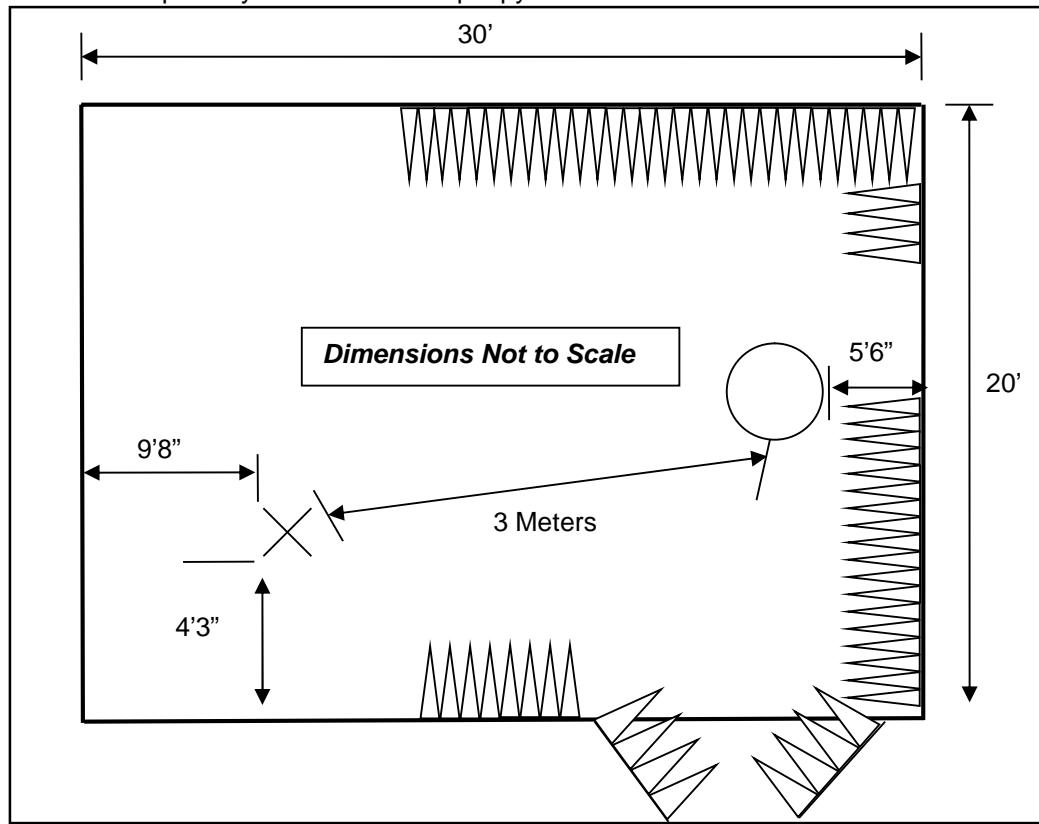


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

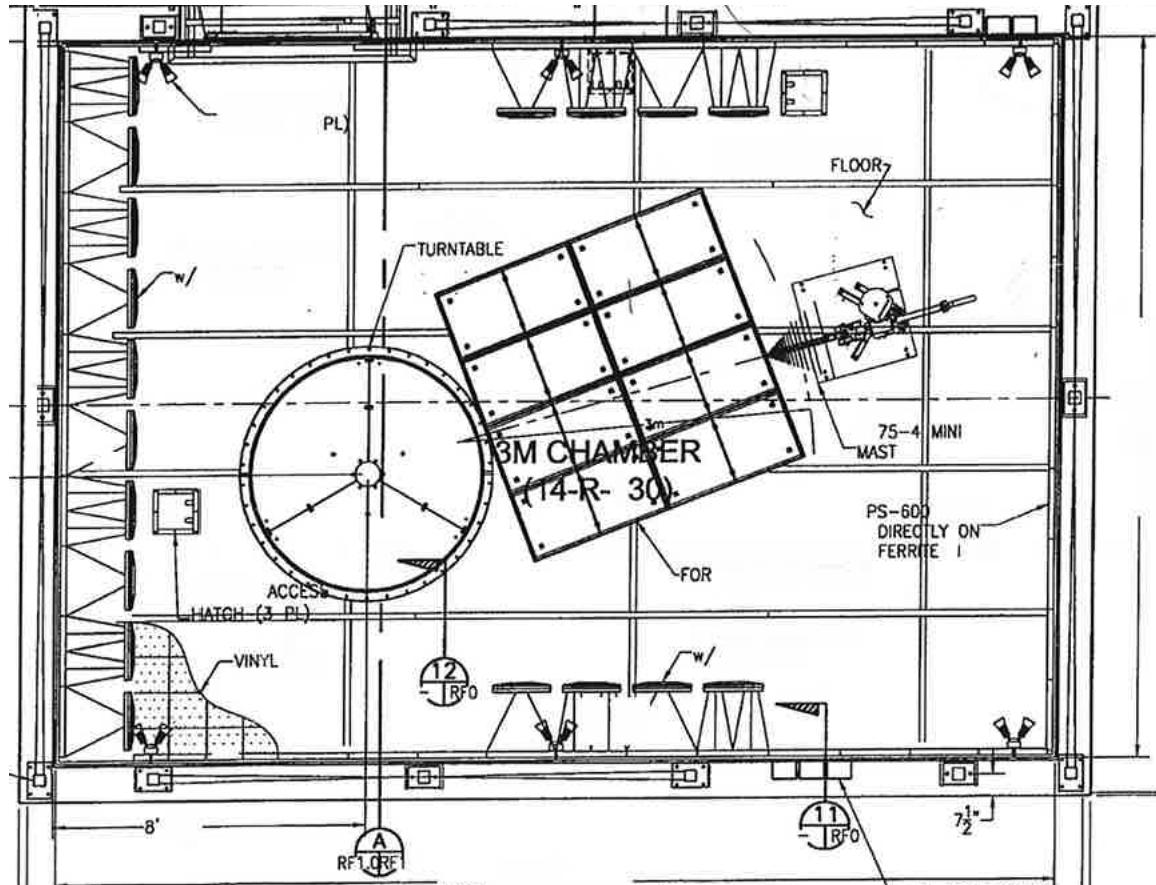


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

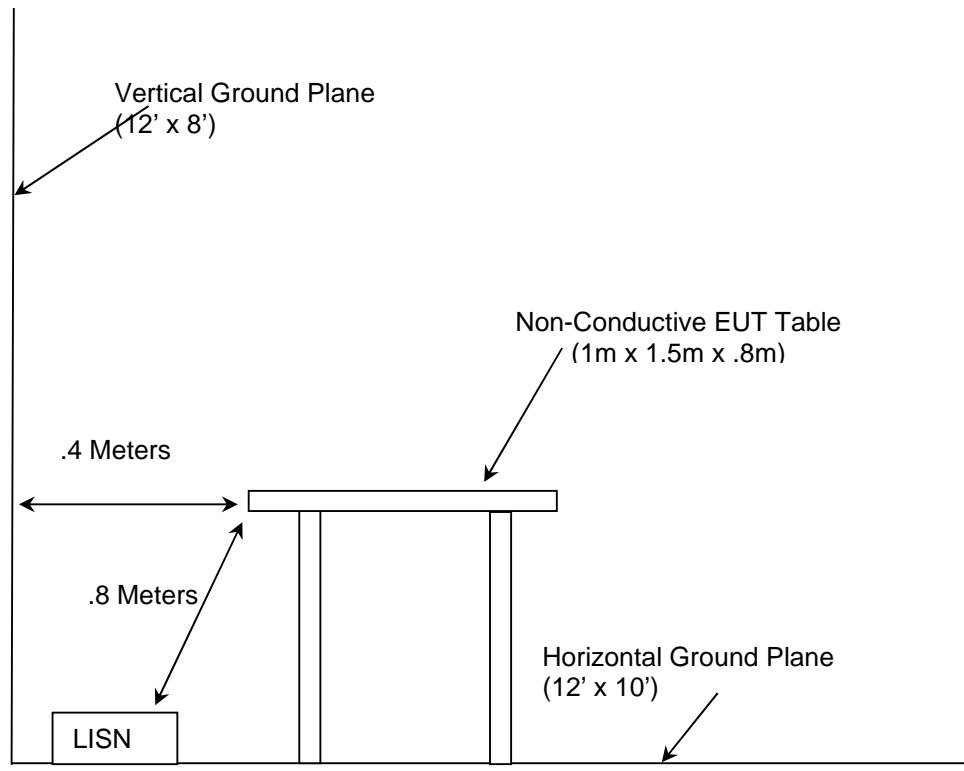


Figure 2.4.1-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2019
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2019
- ❖ FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 2, 2019
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018 + Amendment 1, March 2019

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
22	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A00526	07/11/2018	07/11/2020
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
213	TEC	PA 102	Amplifier	44927	07/19/2018	07/19/2019
324	ACS	Belden	Conducted EMI Cable	8214	04/05/2018	04/05/2019
337	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	282706	05/16/2018	05/16/2019
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/30/2018	07/30/2020
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2016	02/11/2019
654	Micro-Tronics	BRC50722	Band Reject Filter	-10	10/07/2017	10/07/2018
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	02/12/2018	02/12/2019
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/06/2018	11/06/2019
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	08/13/2018	08/13/2019
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/01/2018	05/01/2019
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2019
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/11/2018	07/11/2019

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Host Board	Landis & Gyr	ICB Host	Not Labeled
2	DC Power Supply ¹	Hewlett Packard	E3630A ¹	KR64308603
	AC Adapter ²	Unidentified	PS0538 ²	Not Labeled

1) Radiated emissions testing
2) Conducted emissions testing

Table 5-2: Cable Description

Cable	Cable Type	Length	Shield	Termination
A	DC Power Cable	1.75 m	No	EUT to Power Supply

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

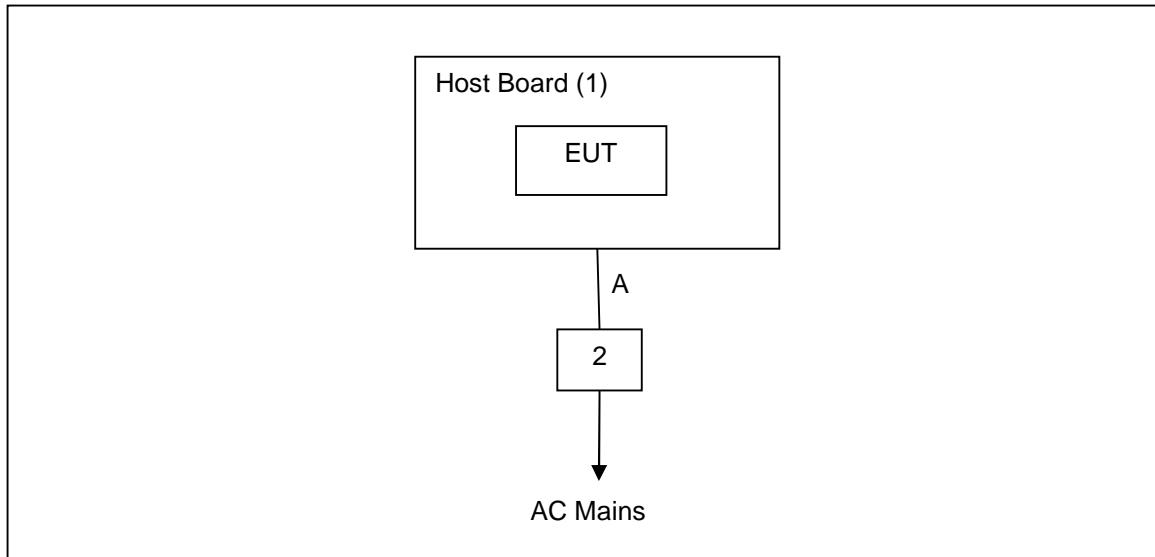


Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The EUT utilizes a dual band dipole antenna. Connection to the module is via a U.fl to SMA adapter cable which is a unique connection. The max gain of the antenna is 4.5dBi in the 900MHz band.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Corrected Reading – Applicable Limit

7.2.2 Measurement Results

Performed by: Jeremy Pickens / Sean Vick

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dB μ V)	(dB μ V)	(dB μ V)	(dB μ V)	(dB)	(dB)	
0.15	37.4	22.34	66	56	-28.6	-33.66	9.59
0.154	36.68	20.13	65.78	55.78	-29.1	-35.65	9.58
0.17	41.13	25.74	64.96	54.96	-23.83	-29.22	9.58
0.206	40.42	23.92	63.37	53.37	-22.95	-29.45	9.58
0.214	38.42	27.32	63.05	53.05	-24.63	-25.73	9.58
0.222	38.3	25.22	62.74	52.74	-24.44	-27.52	9.58
0.242	37.65	22.73	62.03	52.03	-24.38	-29.3	9.58
0.254	33.94	22.6	61.63	51.63	-27.69	-29.03	9.58
0.294	34.41	16.49	60.41	50.41	-26	-33.92	9.58
0.414	33.81	25.93	57.57	47.57	-23.76	-21.64	9.59

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dB μ V)	(dB μ V)	(dB μ V)	(dB μ V)	(dB)	(dB)	
0.154	38.01	22.95	65.78	55.78	-27.77	-32.83	9.58
0.178	42.34	27.91	64.58	54.58	-22.24	-26.67	9.58
0.194	41.75	22.66	63.86	53.86	-22.11	-31.2	9.58
0.206	40.85	22.79	63.37	53.37	-22.52	-30.58	9.58
0.226	40.32	22.51	62.6	52.6	-22.28	-30.09	9.58
0.246	39.73	22.42	61.89	51.89	-22.16	-29.47	9.58
0.418	39.37	22.41	57.49	47.49	-18.12	-25.08	9.59
2.962	31.04	22.79	56	46	-24.96	-23.21	9.62
3.246	30.74	22.49	56	46	-25.26	-23.51	9.62
23.418	32.7	23.83	60	50	-27.3	-26.17	9.82

7.3 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2); ISED Canada: RSS-247 5.2(a)

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

7.3.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.3.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [kHz]	99% Bandwidth [kHz]
904.0	1097.0	1094.5
914.8	1079.5	1092.0
926.8	1097.0	1087.0

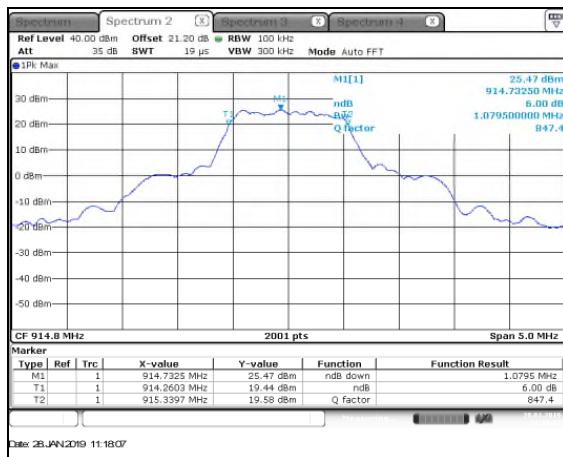


Figure 7.3.2-1: Sample 6dB Bandwidth – MCH

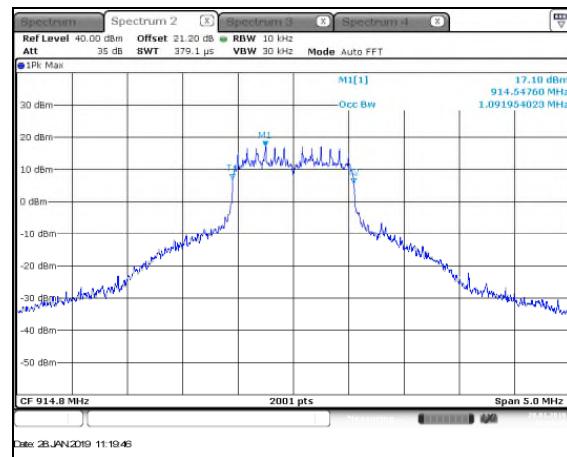


Figure 7.3.2-2: Sample 99% Occupied Bandwidth – MCH

7.4 Fundamental Emission Output Power – FCC: Section 15.247(b)(3); ISED Canada: RSS-247 5.4(d)**7.4.1 Measurement Procedure**

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance utilizing an average power meter with a video bandwidth of 30MHz. The RF output of the equipment under test was directly connected to the input of the power meter applying suitable attenuation.

7.4.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.4.2-1: Maximum Conducted Output Power (AVG)

Frequency [MHz]	Level [dBm]
904.0	25.7
914.8	26.3
926.8	25.0

7.5 Emission Levels

7.5.1 Emissions into Non-restricted Frequency Bands – FCC 15.247(d); ISED Canada: RSS-247 5.5

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 DTS Meas Guidance. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to \geq 300 kHz. Span was set to 1.5 times the DTS bandwidth centered on each channel evaluated. The trace was set to max hold with a peak detector active. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 30 dBc limit. The spectrum span was then adjusted for the measurement of spurious emissions from 30 MHz to 10 GHz, 10 times the highest fundamental frequency.

Band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.5.1.2 Measurement Results

Performed by: Jeremy Pickens

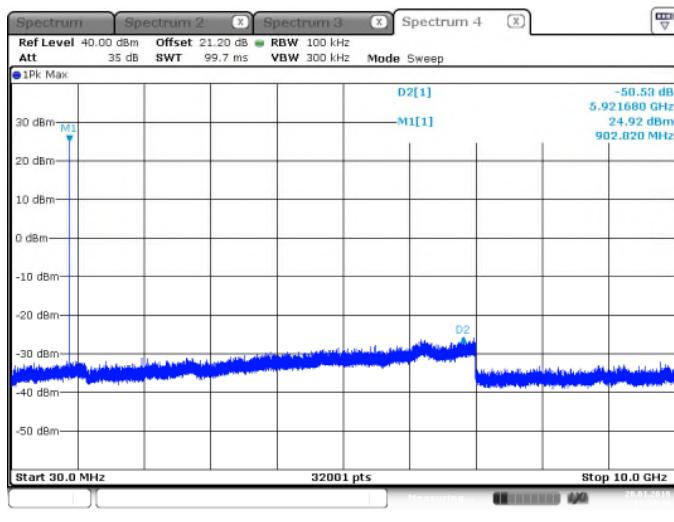


Figure 7.5.1.2-1: 30 MHz – 10 GHz – Low Channel

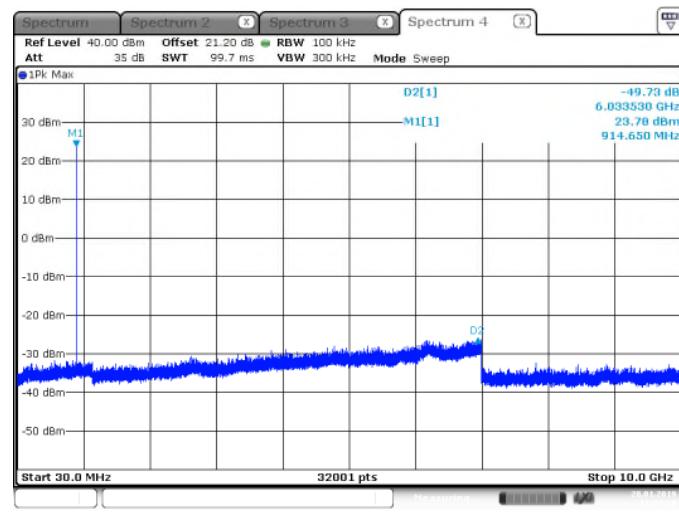
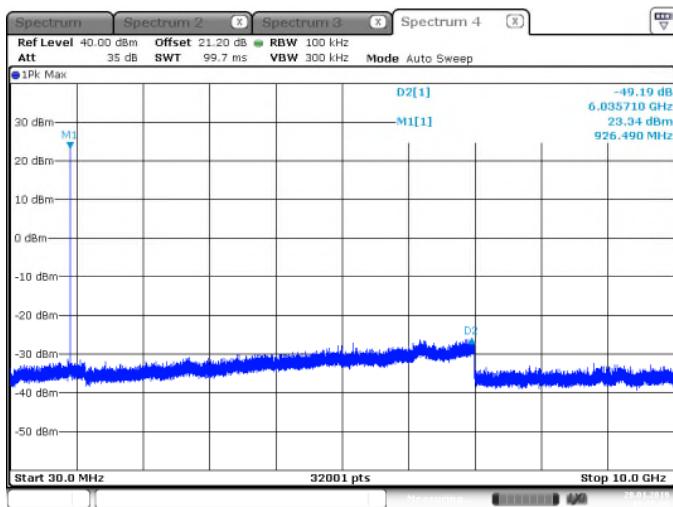
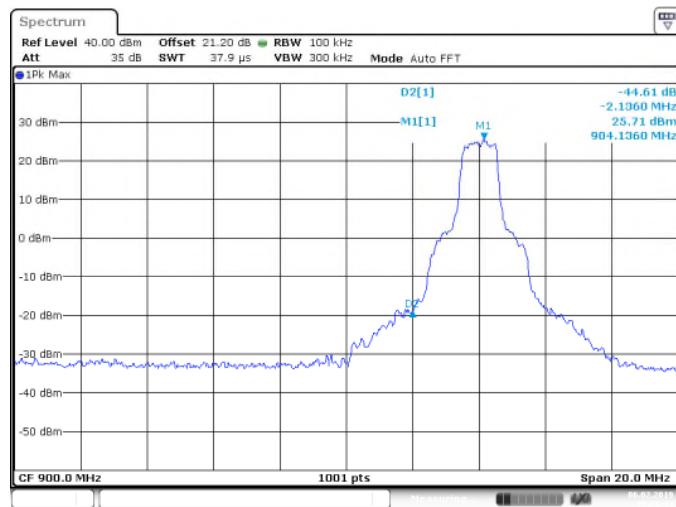


Figure 7.5.1.2-2: 30 MHz – 10 GHz – Middle Channel



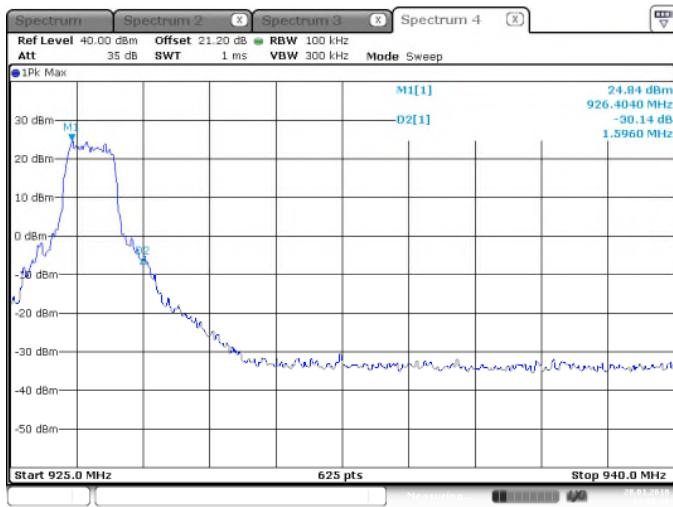
Date 28JAN2019 10:56:01

Figure 7.5.1.2-3: 30 MHz – 10 GHz –High Channel



Date 6FEB2019 08:28:44

Figure 7.5.1.2-4: Lower Band-edge



Date 28JAN2019 11:06:29

Figure 7.5.1.2-5: Upper Band-edge

7.5.2 Emissions into Restricted Frequency Bands – FCC: 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30 MHz to 10 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.5.2.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.5.2.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dB μ V)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2712	50.80	38.70	H	1.99	52.79	40.69	74.0	54.0	21.2	13.3
2712	58.20	44.90	V	1.99	60.19	46.89	74.0	54.0	13.8	7.1
4520	44.80	31.70	H	6.74	51.54	38.44	74.0	54.0	22.5	15.6
4520	44.10	33.20	V	6.74	50.84	39.94	74.0	54.0	23.2	14.1
Middle Channel										
2744.4	56.10	42.10	H	2.13	58.23	44.23	74.0	54.0	15.8	9.8
2744.4	59.70	46.70	V	2.13	61.83	48.83	74.0	54.0	12.2	5.2
4574	44.40	34.10	H	7.00	51.40	41.10	74.0	54.0	22.6	12.9
4574	49.40	34.90	V	7.00	56.40	41.90	74.0	54.0	17.6	12.1
High Channel										
2780.4	52.4	41.5	H	2.26	54.66	43.76	74.0	54.0	19.3	10.2
2780.4	61.8	49	V	2.26	64.06	51.26	74.0	54.0	9.9	2.7
4634	45.60	35.50	H	7.25	52.85	42.75	74.0	54.0	21.2	11.3
4634	48.90	40.40	V	7.25	56.15	47.65	74.0	54.0	17.9	6.4

7.5.2.3 Sample Calculation:

$$R_c = R_u + CF_T$$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)

R_u = Uncorrected Reading

R_c = Corrected Level

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

DC = Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: $61.8 + 2.26 = 64.06 \text{ dBuV/m}$

Margin: $74 \text{ dBuV/m} - 64.06 \text{ dBuV/m} = 9.9 \text{ dB}$

Example Calculation: Average

Corrected Level: $49.0. + 2.26 - 0 = 51.26 \text{ dBuV}$

Margin: $54 \text{ dBuV} - 51.26 \text{ dBuV} = 2.7 \text{ dB}$

7.6 Maximum Power Spectral Density – FCC: Section 15.247(e) ISED Canada: RSS-247 5.3(b)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance utilizing the AVGPSD-2 method. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 3 kHz. The Video Bandwidth (VBW) was set to 10 kHz. Span was set to 1.65 MHz. The detector was set to RMS and trace averaging was employed over >100 sweeps. The marker to peak function was then used to find the highest average PSD within the emission envelope. Because the duty cycle was less than 98%, following measurement, a Duty Cycle Correction Factor was applied. Using a spectrum analyzer, the duty-cycle was found to be constant and calculated based on the on-time per pulse and the repetition period. The on time was measured to be 41.6ms per pulse with a period of 54.1ms. $41.6/54.1 = 0.769$.

7.6.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.6.2-1: Power Spectral Density

Frequency [MHz]	Measured PSD [dBm/3kHz]	DCCF [dB]	PSD Level [dBm/3kHz]
904.0	0.85	1.14	1.99
914.8	3.68	1.14	4.82
926.8	0.49	1.14	1.63

Measured DC = 76.9%
 $DCCF = 10 \cdot \log(1/DC) = 1.14 \text{ dB}$

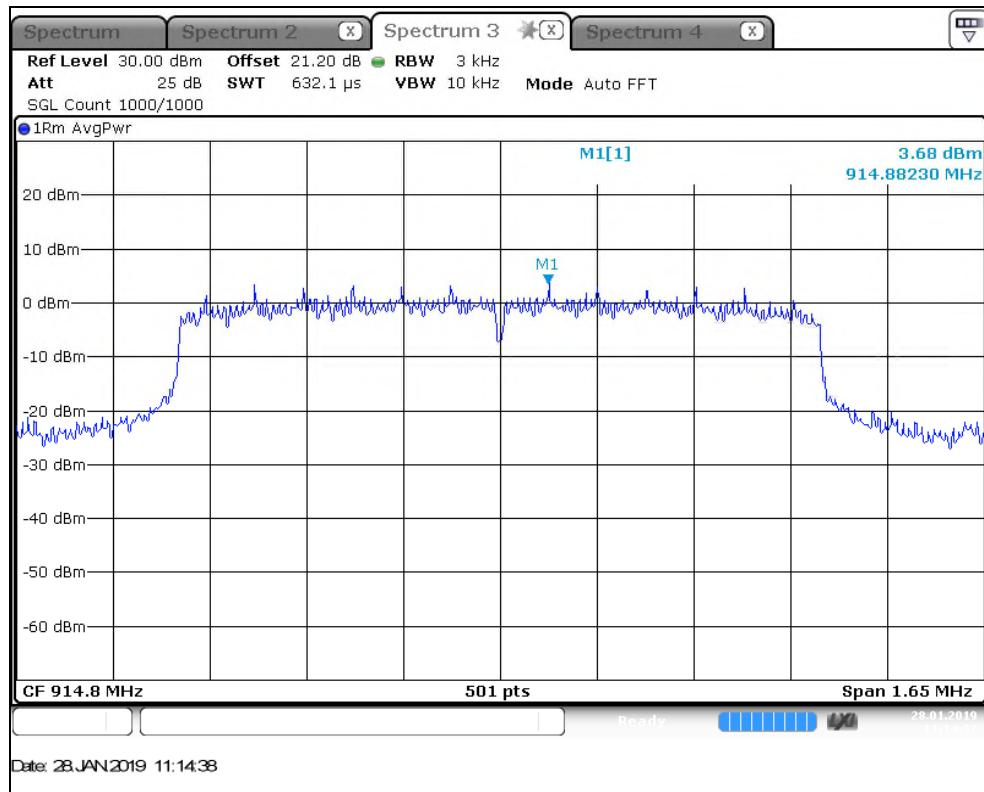


Figure 7.6.2-1: Sample Power Spectral Density – MCH

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the Series-6 RF Mesh mSBR Card, manufactured by Landis+Gyr Technology, Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT