Certification Test Report

FCC ID: SK9G5R1
IC: 864G-G5R1

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

Report Number: AT72160720-3C0

Manufacturer: Itron, Inc.
Model: G5R1

Test Begin Date: May 26, 2020
Test End Date: August 25, 2020

Report Issue Date: August 27, 2020

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 25 pages

TABLE OF CONTENTS

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 Itron G5R1 is an electricity metering module which includes a 902.3 MHz to 927.6 MHz transmitter as well as 2.4GHz WLAN transceiver. The module operates on AC as well as DC voltage which is supplied by a host device.

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

Technical Information:

Detail	Description
Frequency Range	903.2 – 926 MHz
Number of Channels	20
Modulation Format	OFDM
Data Rates	1200/2400 kbps
Operating Voltage	24Vdc
Antenna Type / Gain	PCB Embedded Antenna / 3.6dBi

Manufacturer Information:
Itron, Inc.
313 N Hwy 11
West Union, SC 29696

Test Sample Serial Number: Radiated Emissions: 113200003145
Power Line Conducted Emissions: 113200003145
RF Conducted Emissions: 113200003139

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 for radiated spurious emissions was 2400kbps data rate.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was X-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: 22

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 Designation Accreditation Number:	US1233
FCC Test Site 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.

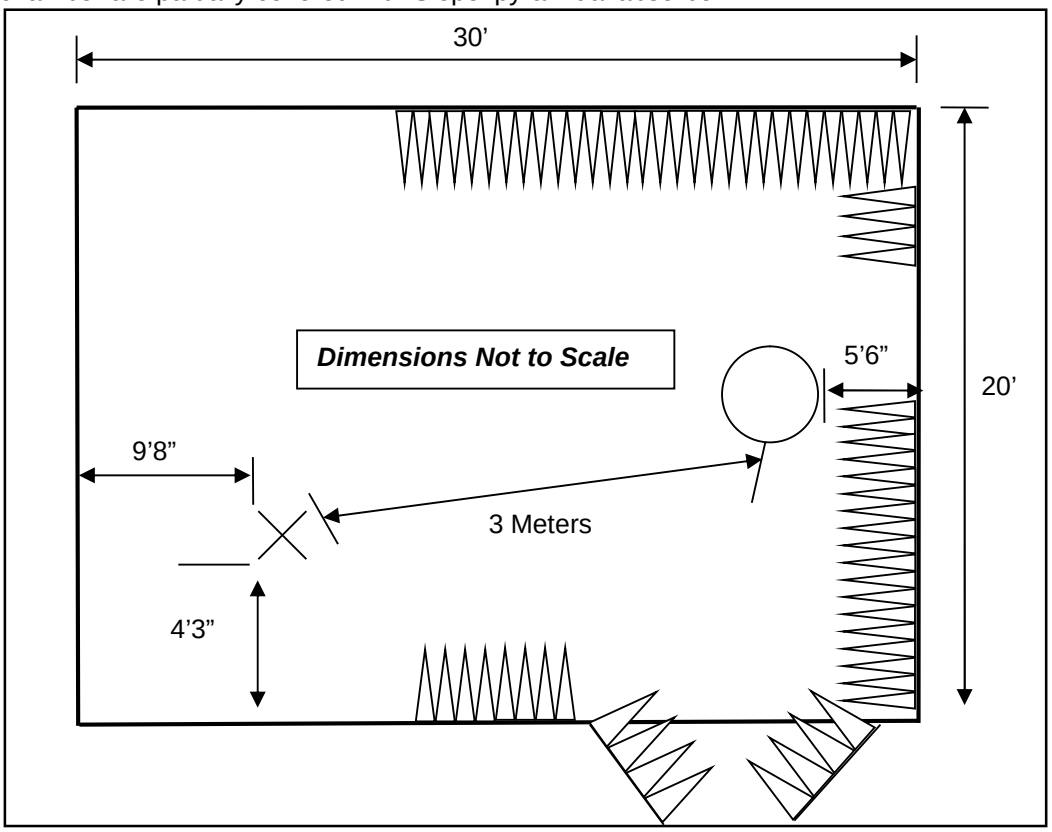


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

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.

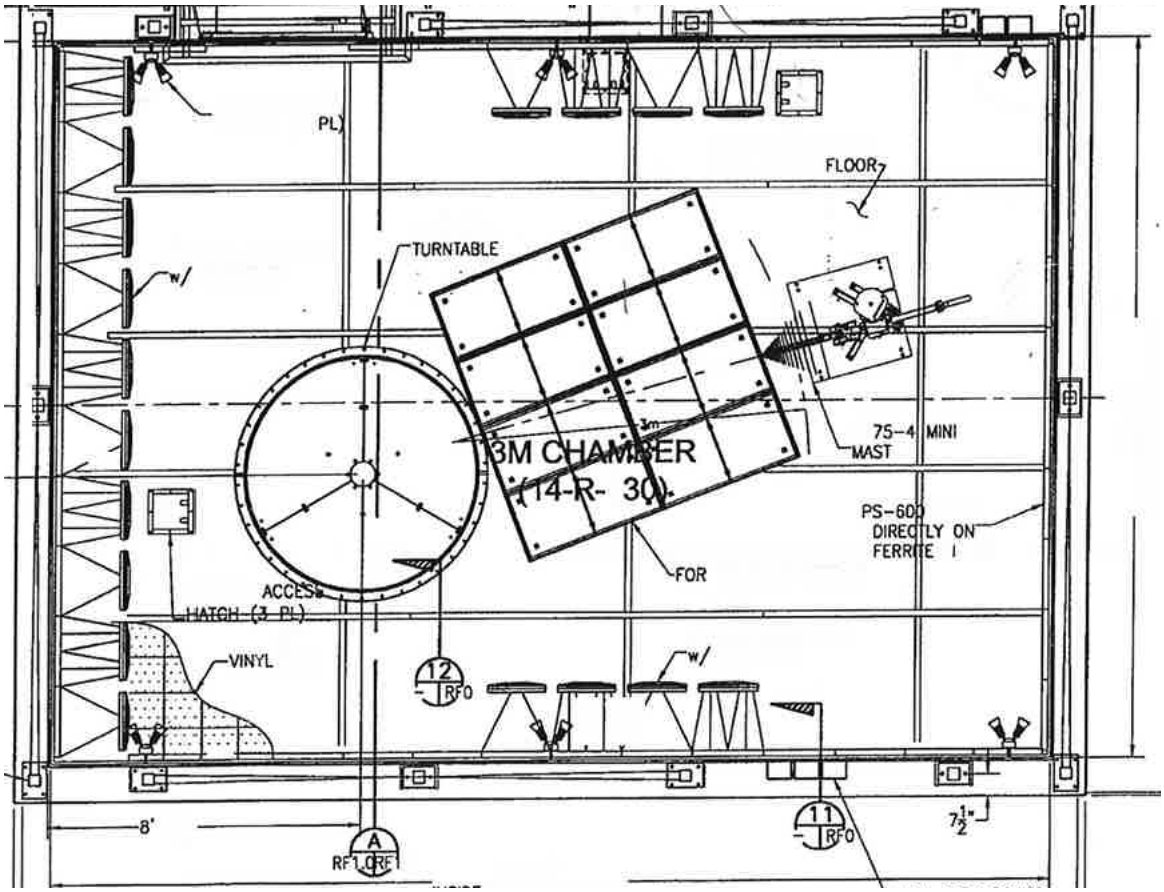


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

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 by 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 tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

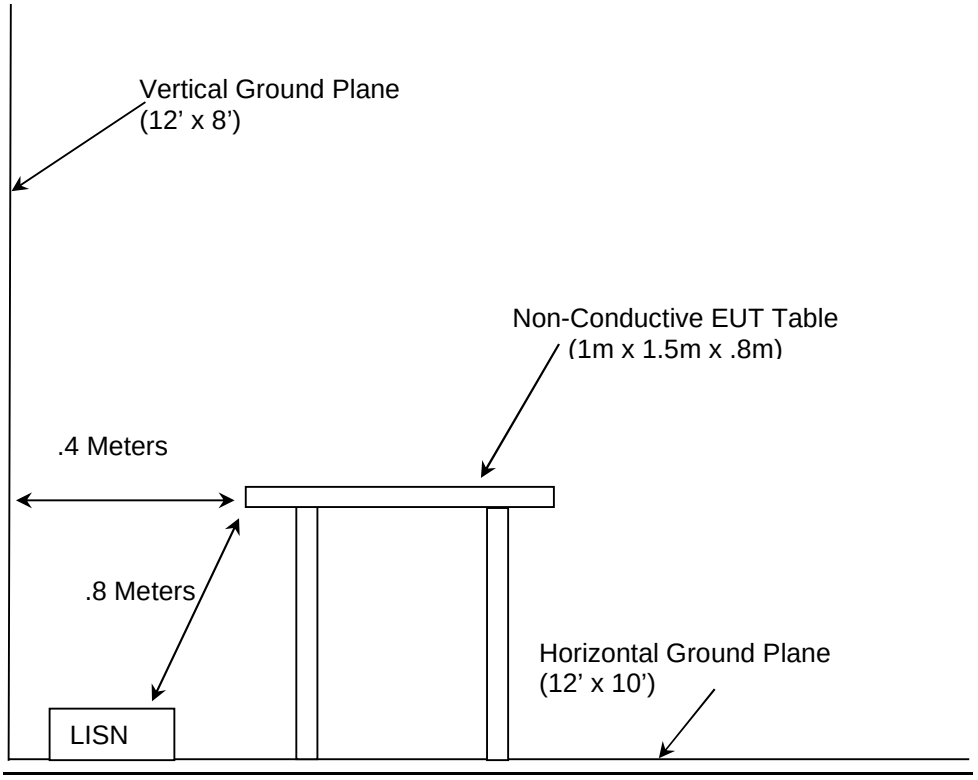


Figure 2.4.1-1: AC Mains Conducted EMI Site

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, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules, 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, 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
213	TEC	PA 102	Amplifier	44927	07/22/2019	07/22/2020
324	ACS	Belden	Conducted EMI Cable	8214	4/3/2020	4/3/2021
337	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	282706	05/31/2019	05/31/2020
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2019	07/15/2021
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	3/3/2020	3/3/2021
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	5/11/2020	5/11/2021
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
857	ETS Lindgren	3117	Horn Antenna 1-18GHz	00153608	11/12/2019	11/12/2021
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/10/2019	07/10/2020
RE880	Rhode & Schwarz USA	ESW44	Test Receiver	1206247	11/06/2019	11/6/2020

NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	AC/DC Adapter	CUI, Inc.	SW125-24-N	N/A

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

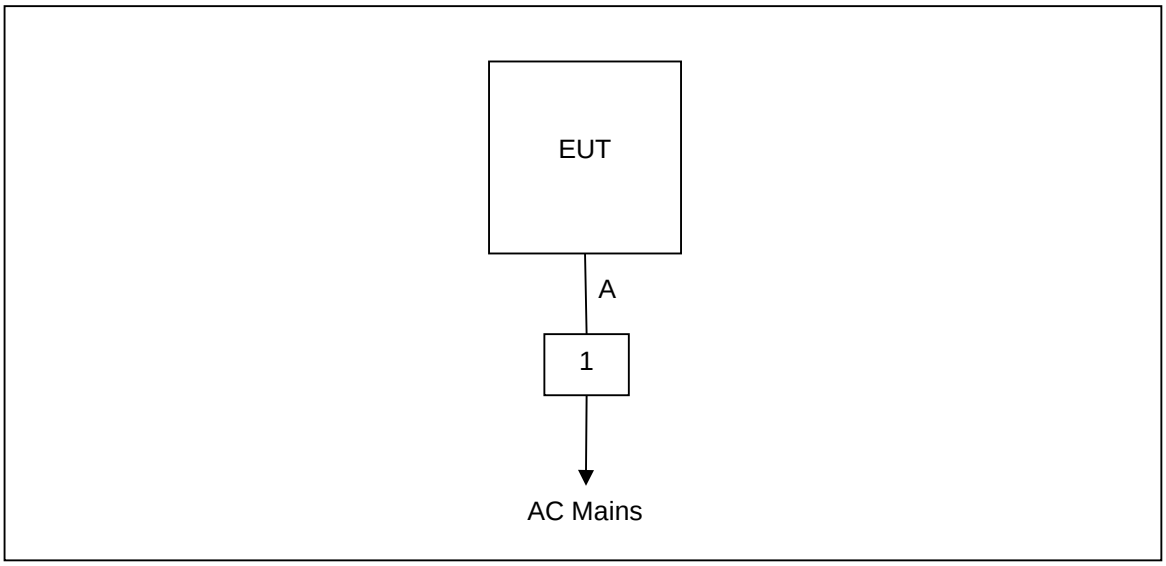


Figure 6-1: Test Setup Block Diagram

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 PCB embedded slot antenna. The antenna is integral to the device and cannot be removed or replaced by the end user. The gain of the antenna is 3.6 dBi.

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: Sean Vick

Table 7.2.2-1: Conducted EMI Results (Line)

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	50.18	33.55	79	66	-28.82	-32.45	9.43
0.154	49.42	34.8	79	66	-29.58	-31.2	9.43
0.166	48.98	29.63	79	66	-30.02	-36.37	9.44
0.182	46.98	25.12	79	66	-32.02	-40.88	9.44
0.202	43.14	22.54	79	66	-35.86	-43.46	9.45
0.21	41.36	24.21	79	66	-37.64	-41.79	9.45
0.238	41.68	32.93	79	66	-37.32	-33.07	9.46
0.302	42.6	36.3	79	66	-36.4	-29.7	9.48
0.31	45.65	38.68	79	66	-33.35	-27.32	9.48
0.318	46.1	39.14	79	66	-32.9	-26.86	9.48

Table 7.2.2-2: Conducted EMI Results (Neutral)

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	49.71	31.23	79	66	-29.29	-34.77	9.41
0.158	48.95	31.84	79	66	-30.05	-34.16	9.41
0.166	48.69	27.41	79	66	-30.31	-38.59	9.41
0.19	46.45	23.4	79	66	-32.55	-42.6	9.42
0.206	41.96	22.48	79	66	-37.04	-43.52	9.42
0.222	41.06	24.35	79	66	-37.94	-41.65	9.42
0.234	41.58	30.69	79	66	-37.42	-35.31	9.42
0.25	41.56	31.31	79	66	-37.44	-34.69	9.42
0.314	45.24	37.94	79	66	-33.76	-28.06	9.43
0.33	45.02	36.09	79	66	-33.98	-29.91	9.43

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]	Data Rate (kbps)	6dB Bandwidth (kHz)	99% Bandwidth (MHz)
903.2	1200	1130	1123
914	1200	1120	1124
926	1200	1100	1136
903.2	2400	1140	1124
914	2400	1110	1124
926	2400	1080	1138

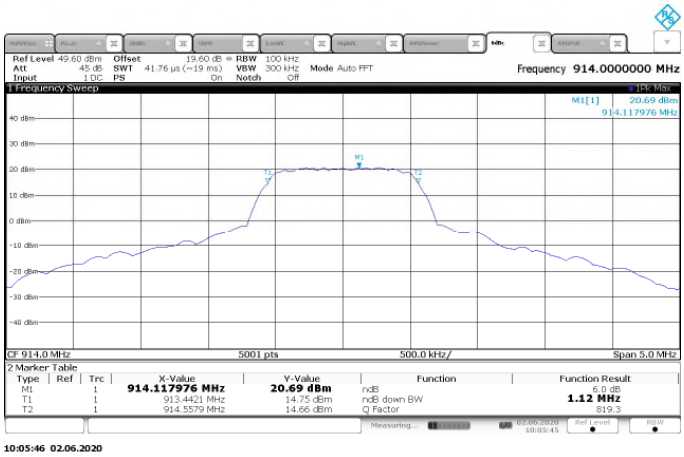


Figure 7.3.2-1: Sample 6dB Bandwidth – MCH (1200k)

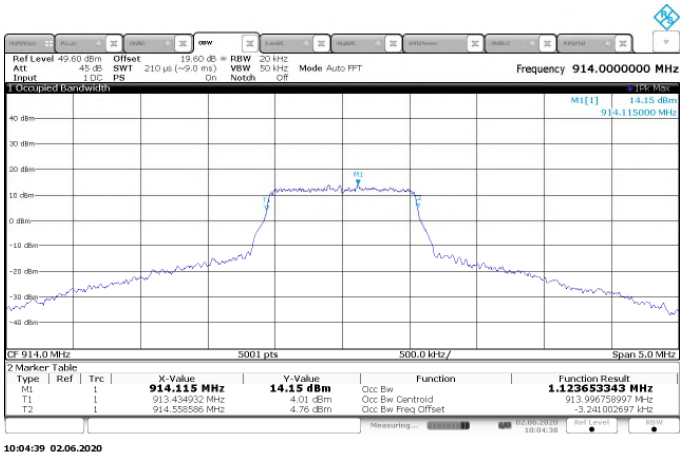


Figure 7.3.2-2: Sample 99% Occupied Bandwidth – MCH (1200k)

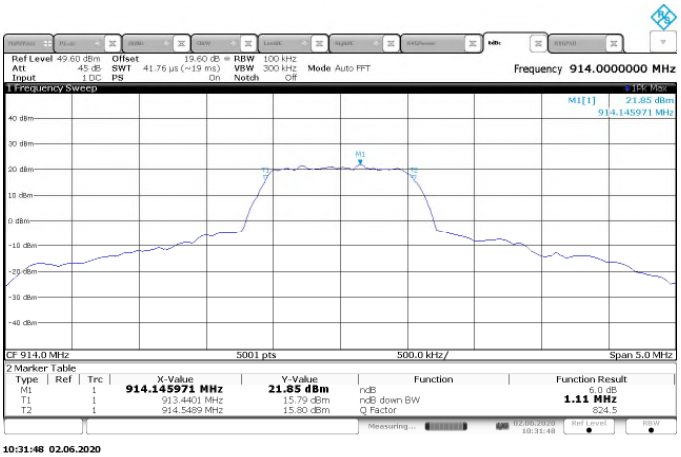


Figure 7.3.2-3: Sample 6dB Bandwidth – MCH (2400k)

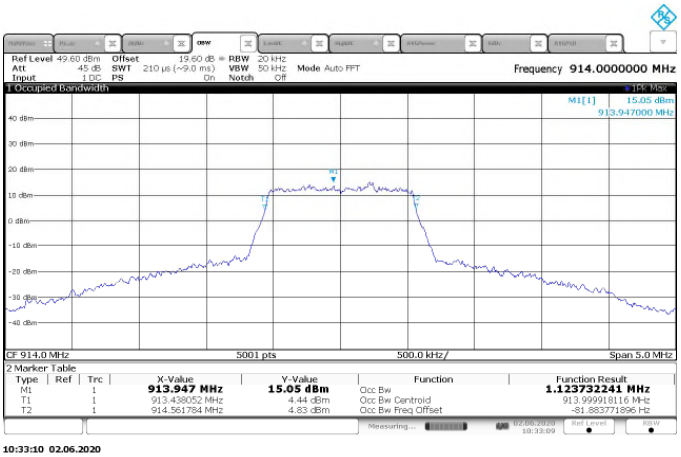


Figure 7.3.2-4: Sample 99% Occupied Bandwidth – MCH (2400k)

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 and ANSI C63.10 utilizing clause 11.9.2.2.3 Method AVGPM. 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)	Modulation Format	Data Rate (kbps)
903.2	20.50	OFDM	1200
914	21.1	OFDM	1200
926	20.7	OFDM	1200
903.2	20.6	OFDM	2400
914	21.3	OFDM	2400
926	20.9	OFDM	2400

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 ≥ 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. For spurious emissions, only the worst-case modulation with respect to output power was evaluated (2400k).

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

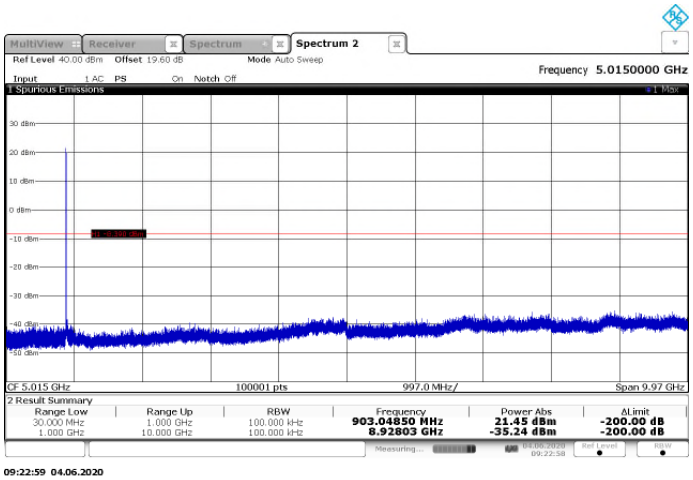


Figure 7.5.1.2-1: 30 MHz – 10 GHz – Low Channel (2400k)

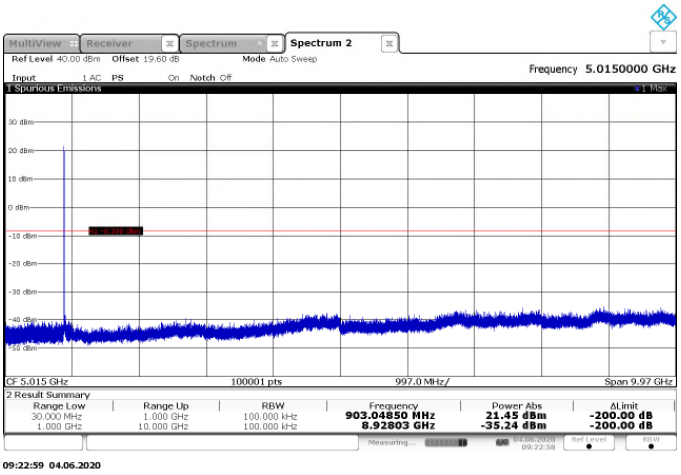


Figure 7.5.1.2-2: 30 MHz – 10 GHz – Middle Channel (2400k)

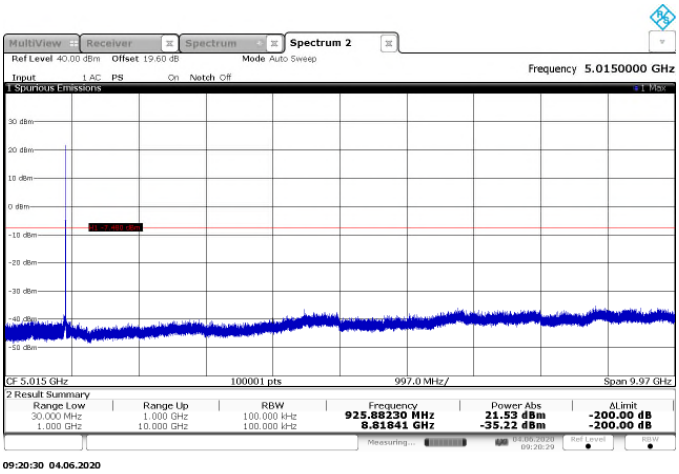


Figure 7.5.1.2-3: 30 MHz – 10 GHz –High Channel (2400k)

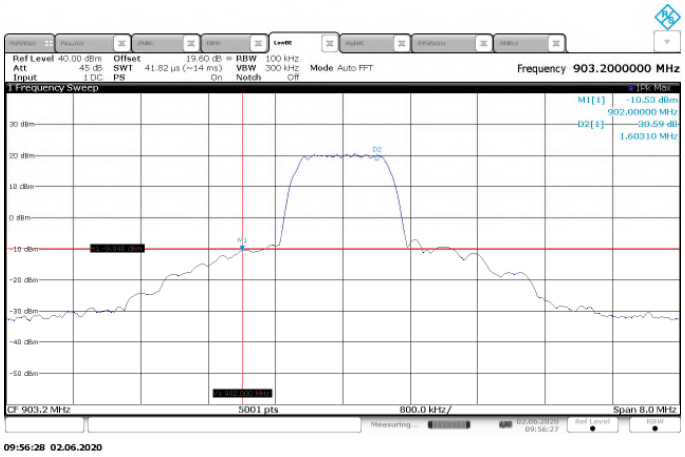


Figure 7.5.1.2-4: Lower Band-edge (1200k)

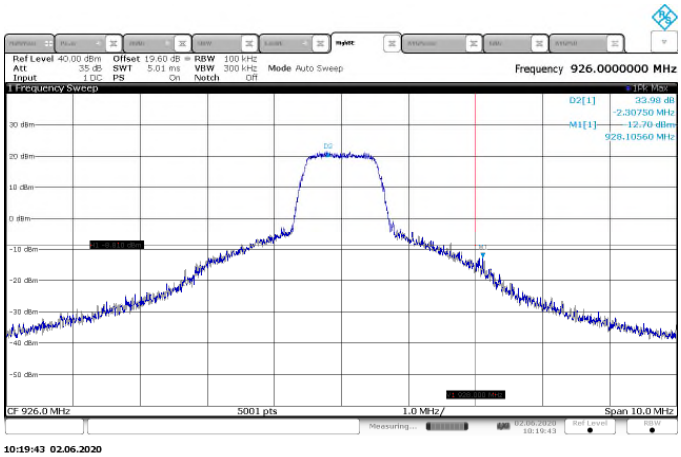


Figure 7.5.1.2-5: Upper Band-edge (1200k)

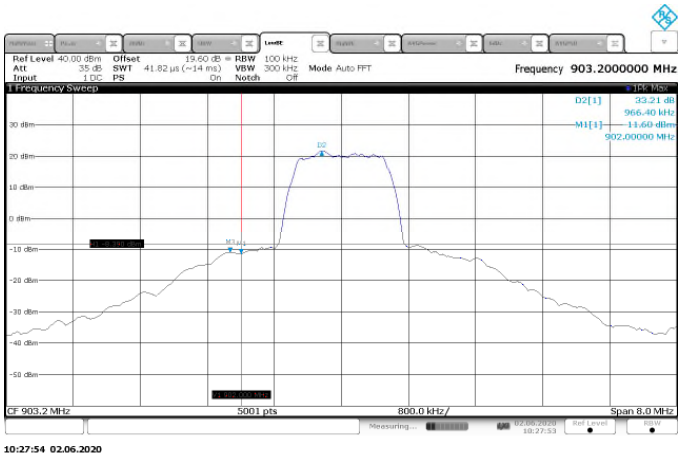


Figure 7.5.1.2-6: Lower Band-edge (2400k)

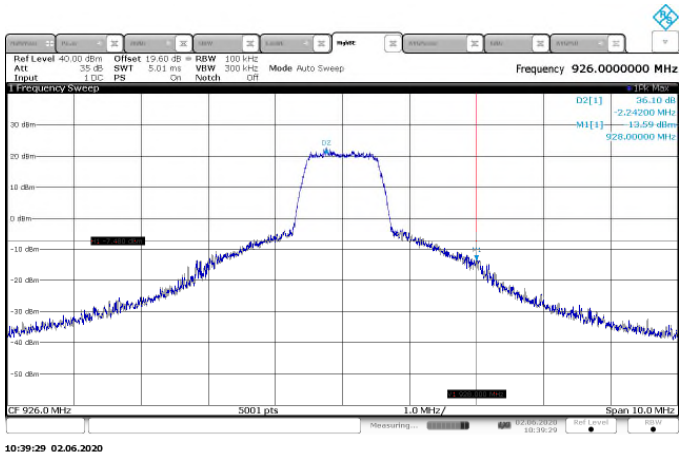


Figure 7.5.1.2-7: Upper Band-edge (2400k)

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 9 kHz 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 (2400k)

Frequency (MHz)	Level (dBµV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
3612.8	47.10	34.80	H	2.56	49.66	37.36	74.0	54.0	24.3	16.6
3612.8	47.10	34.40	V	2.56	49.66	36.96	74.0	54.0	24.3	17.0
Middle Channel										
3656	47.4	35.3	H	2.71	50.11	38.01	74.0	54.0	23.9	16.0
3656	46.9	34.5	V	2.71	49.61	37.21	74.0	54.0	24.4	16.8
High Channel										
3704	48.3	36.6	H	2.86	51.16	39.46	74.0	54.0	22.8	14.5
3704	47.9	35	V	2.86	50.76	37.86	74.0	54.0	23.2	16.1

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: 48.3 + 2.86 = 51.16dBuV/m
Margin: 74dBuV/m – 51.16dBuV/m = 22.8dB

Example Calculation: Average

Corrected Level: 36.6 + 2.86 - 0 = 39.46dBuV
Margin: 54dBuV – 39.46dBuV = 14.5dB

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

7.6.1 Measurement Procedure

Because the duty cycle of the fundamental was >98%, the power spectral density was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance and ANSI C63.10 utilizing clause 11.10.3 Method AVGPSD-1. 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 at least 3x the RBW. The span was set to >1.5 times the Occupied Bandwidth. The detector was set to RMS and trace averaging was employed over >100 sweeps. Since the initial measurements exceeded the 8dBm limit, the RBW/VBW were reduced incrementally until a passing result was measured. The 3kHz RBW minimum limit was not exceeded.

7.6.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.6.2-1: Power Spectral Density

Frequency (MHz)	PSD Level (dBm/30kHz)	Modulation Format	Data Rate (kbps)
903.2	5.21	OFDM	1200
914	6.09	OFDM	1200
926	5.73	OFDM	1200
903.2	4.99	OFDM	2400
914	6.05	OFDM	2400
926	5.48	OFDM	2400

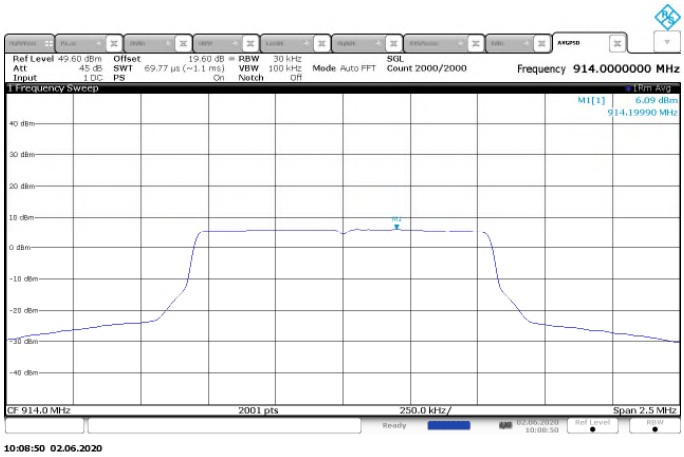


Figure 7.6.2-1: Sample Power Spectral Density – MCH (1200k)

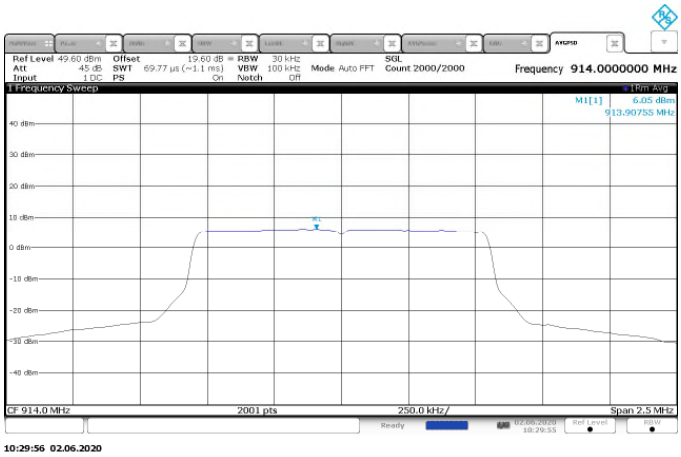


Figure 7.6.2-2: Sample Power Spectral Density – MCH (2400k)

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%.

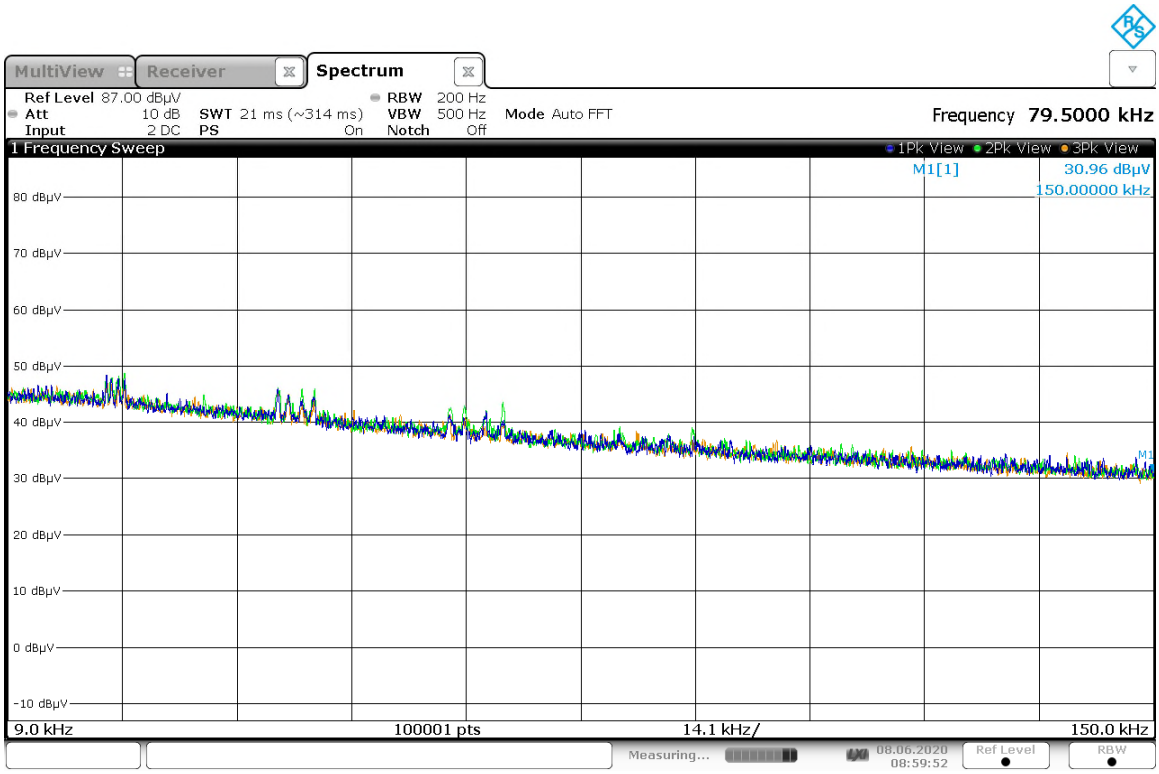
Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

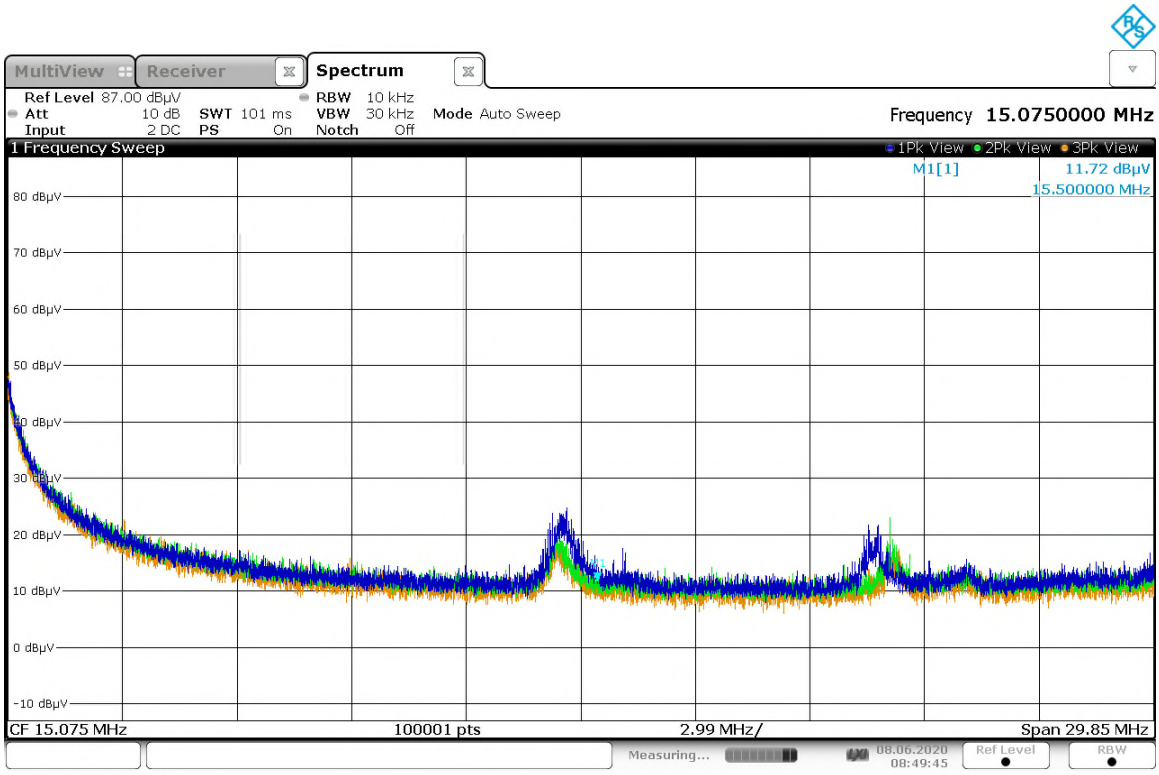
In the opinion of TÜV SÜD America, Inc. the G5R1, manufactured by Itron, Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

Appendix A: Plots



08:59:53 08.06.2020

Figure A-1: Radiated Spurious Emissions – 9 kHz – 150 kHz



08:49:45 08.06.2020

Figure A-2: Radiated Spurious Emissions – 150 kHz to 30 MHz

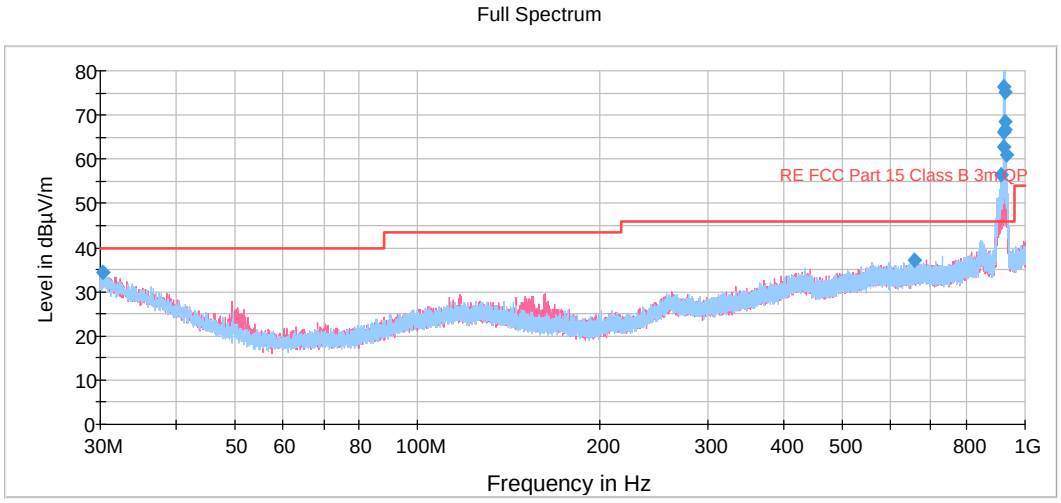


Figure A-3: Radiated Spurious Emissions – 30 MHz – 1GHz

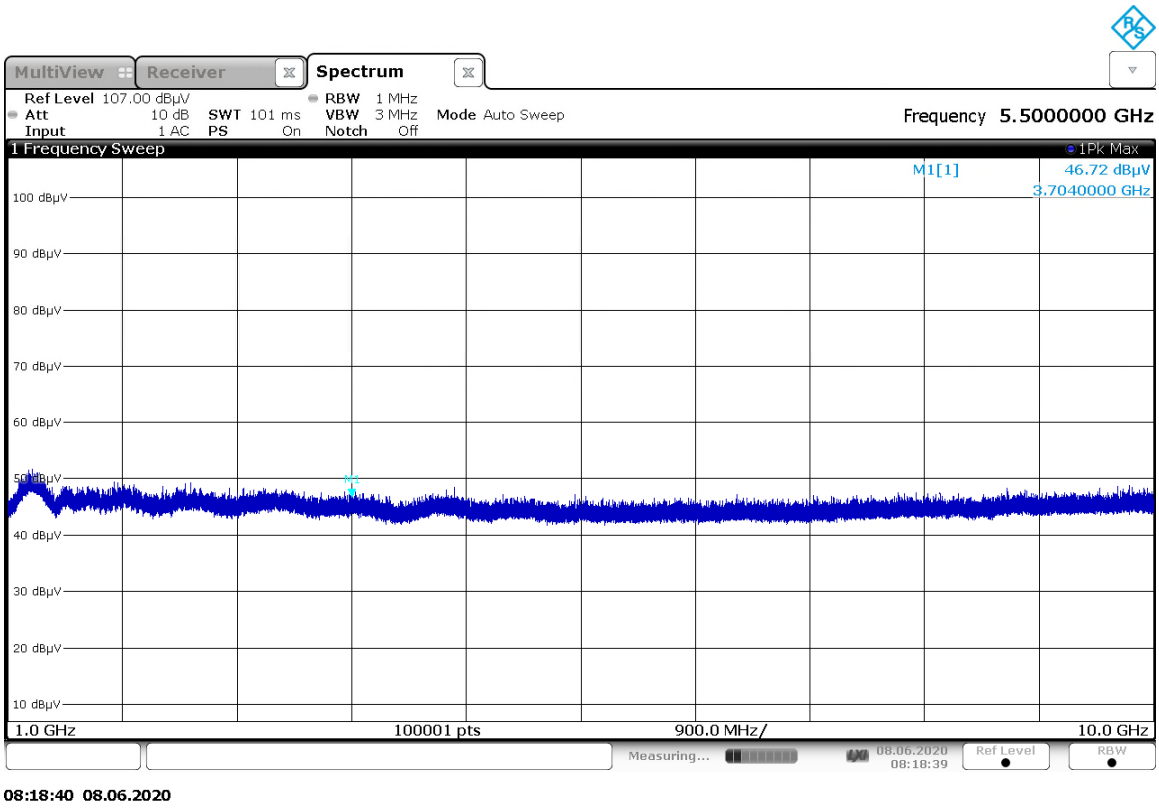


Figure A-4: Radiated Spurious Emissions – 1 GHz – 10 GHz

END REPORT