



## Certification Test Report

**FCC ID: SK9G5R1  
IC: 864G-G5R1**

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

**Report Number: AT72160720-2C0**

**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 33 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 Applicant Information

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

### 1.3 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 902.3 MHz to 927.6 MHz Frequency Hopping Spread Spectrum transceiver mode of operation.

Technical Details:

Detail	Description
Frequency Range	FSK 100, GFSK 150/200: 902.3 – 926.9 MHz FSK 150, GFSK 300, OFDM: 902.4 – 927.6
Number of Channels	FSK 100, GFSK 150/200: 83 FSK 150, GFSK 300, OFDM: 64
Channel Spacing	FSK 100, GFSK 150/200: 300kHz FSK 150, GFSK 300, OFDM: 400kHz
Modulation Format	FSK, GFSK, OFDM
Data Rates	FSK: 100, 150kbps GFSK: 150, 200, 300kbps OFDM: 600, 1200, 2400kbps <sup>(1)</sup>
Operating Voltage	24Vdc
Antenna Type(s) / Gain(s)	PCB Embedded Antenna / 3.6dBi

(1) Note: The 1200kbps and 2400kbps results are recorded in a separate DTS test report

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.

#### 1.4 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 FSK modulation was 100kbps. The worst-case data rate for GFSK modulation was 150kbps. The worst-case data rate for OFDM modulation was 600kbps.

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:        FSK/GFSK: 29.5  
  OFDM: 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

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.

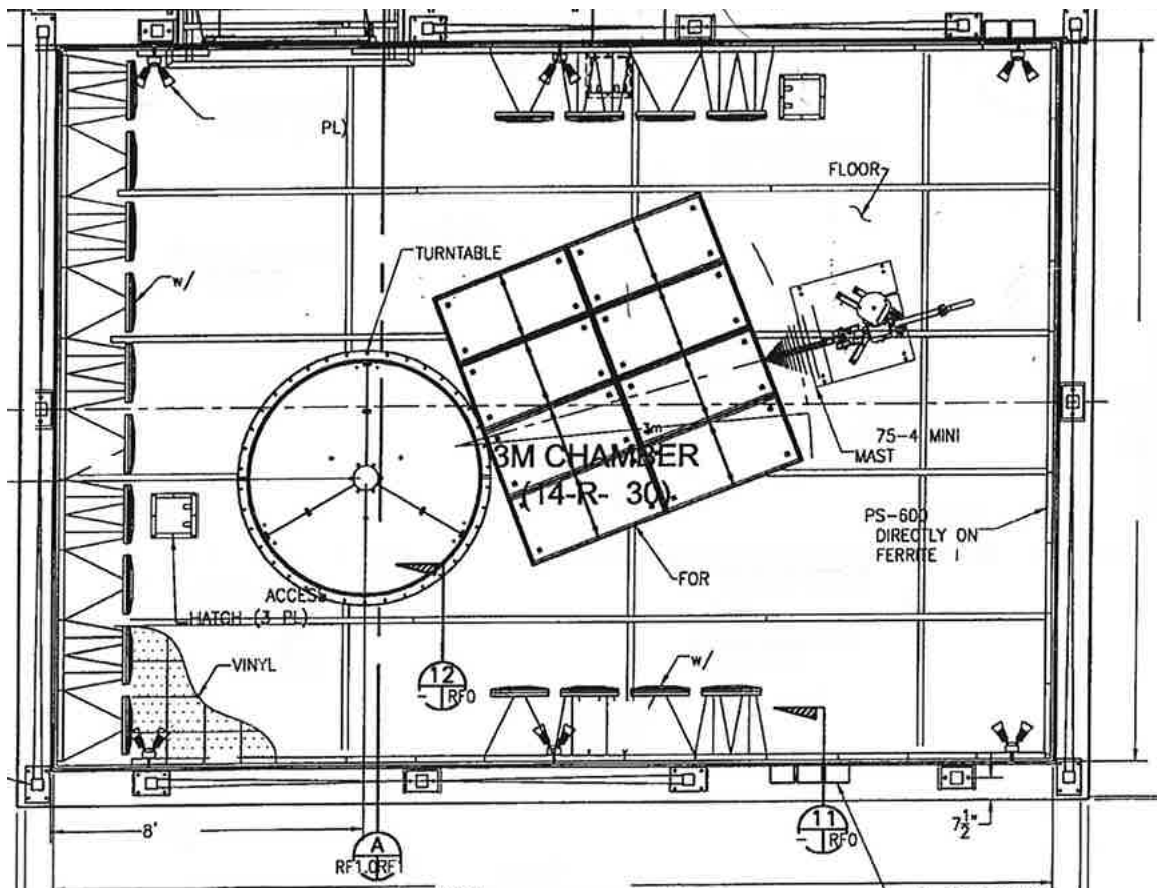


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

## 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 HCP 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.

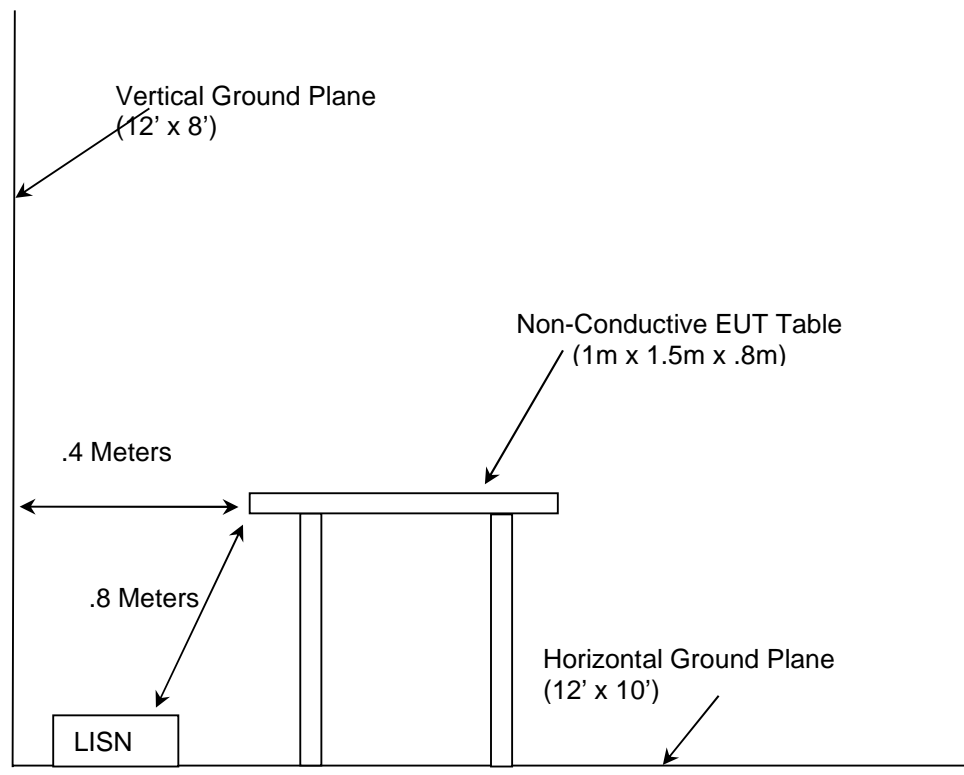


Figure 2.4.1-1: AC Mains Conducted EMI Site

### 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
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTs), 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	04/03/2020	04/03/2021
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	03/03/2020	03/03/2021
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/11/2020	05/11/2021
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
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	06/23/2020	06/23/2021
RE880	Rhode & Schwarz USA	ESW44	Test Receiver	1206247	11/06/2019	11/06/2020

**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

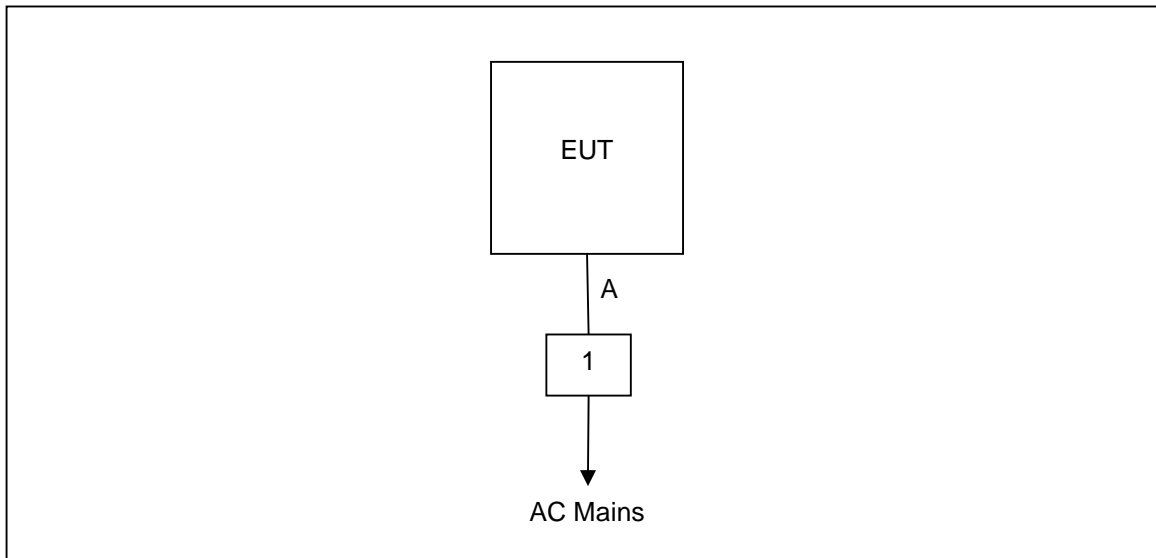


Figure 6-1: Test Setup Block Diagram

## 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: Section 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: Section 15.207; ISED Canada: RSS-Gen 8.8

#### 7.2.1 Measurement Procedure

ANSI C63.10 was the guiding document for this evaluation. 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 = Applicable Limit - Corrected Reading**

#### 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	
	(dB $\mu$ V)	(dB $\mu$ V)	(dB $\mu$ V)	(dB $\mu$ V)	(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 Peak Output Power – FCC: Section 15.247(b)(2); ISED Canada: RSS-247 5.4(a)

#### 7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a peak power meter using suitable attenuation. The device employs > 50 channels at any given time therefore the power is limited to 1 Watt.

#### 7.3.2 Measurement Results

Performed by: Jeremy Pickens

**Table 7.3.2-1: Maximum Conducted Peak Output Power**

Frequency (MHz)	Level (dBm)	Modulation Format	Data Rate (kbps)
902.3	29.2	FSK	100
915.2	29.2	FSK	100
926.9	29.2	FSK	100
902.4	29.1	FSK	150
915.2	29.3	FSK	150
927.6	29.0	FSK	150
902.3	29.1	GFSK	150
915.2	29.1	GFSK	150
926.9	29.1	GFSK	150
902.3	29.2	GFSK	200
915.2	29.1	GFSK	200
926.9	29.0	GFSK	200
902.4	29.1	GFSK	300
915.2	29.1	GFSK	300
927.6	29.0	GFSK	300
902.4	29.6	OFDM	600
915.2	29.7	OFDM	600
927.6	29.5	OFDM	600

### 7.4 Channel Usage Requirements

#### 7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(b)

##### 7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with suitable attenuation. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW started at approximately 30% of the channel spacing and adjusted as necessary to best identify the center of each individual channel. The VBW was set to  $\geq$  RBW.

Carrier frequency separation was measured for all modes of operation and data presented in section 7.4.1.2 below.

##### 7.4.1.2 Measurement Results

Performed by: Jeremy Pickens

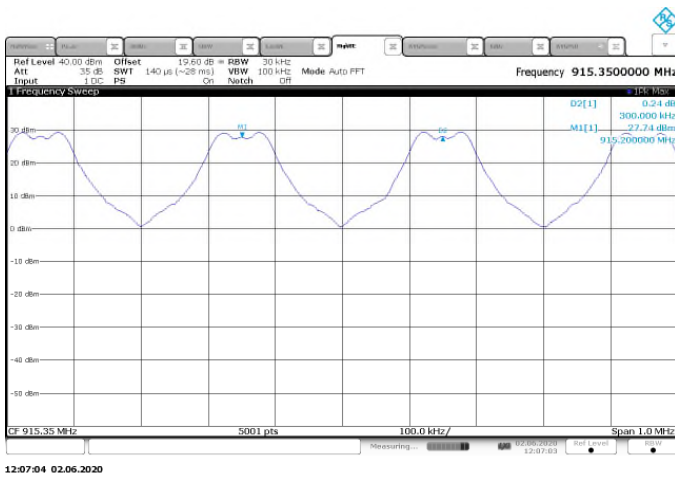


Figure 7.4.1.2-1: Freq. Separation – FSK – 100kbps

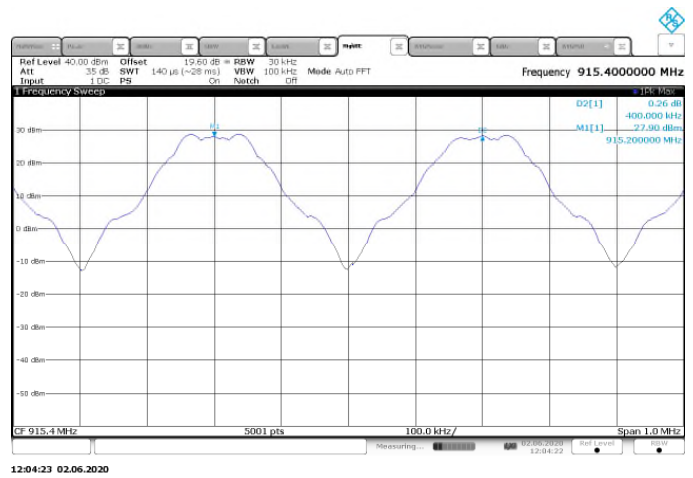


Figure 7.4.1.2-2: Freq. Separation – FSK – 150kbps

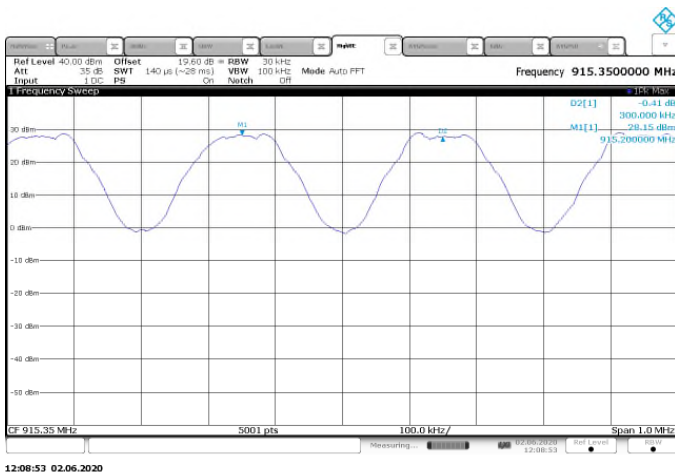


Figure 7.4.1.2-3: Freq. Separation – GFSK – 150kbps

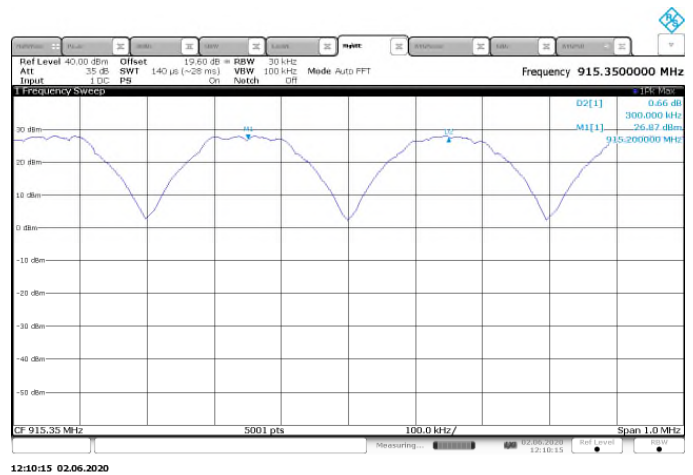


Figure 7.4.1.2-4: Freq. Separation – GFSK – 200kbps

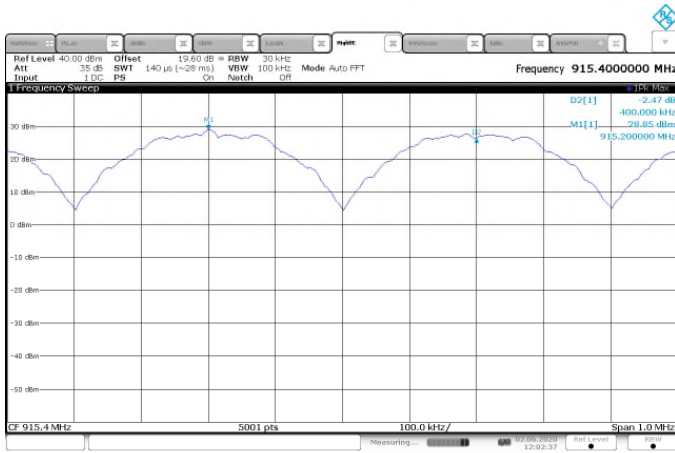


Figure 7.4.1.2-5: Freq. Separation – GFSK – 300kbps

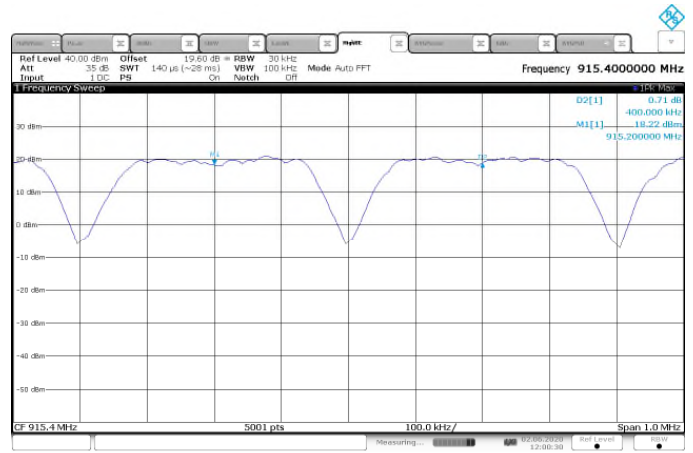


Figure 7.4.1.2-6: Freq. Separation – OFDM – 600kbps

### 7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i); ISD Canada: RSS-247 5.1(c)

#### 7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with suitable attenuation. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to less than 30% of the channel spacing or the 20dB bandwidth, whichever is smaller. The VBW was set to ≥ RBW.

The number of hopping channels was measured for the modes of operation and data presented in section 7.4.2.2 below.

#### 7.4.2.2 Measurement Results

Performed by: Jeremy Pickens

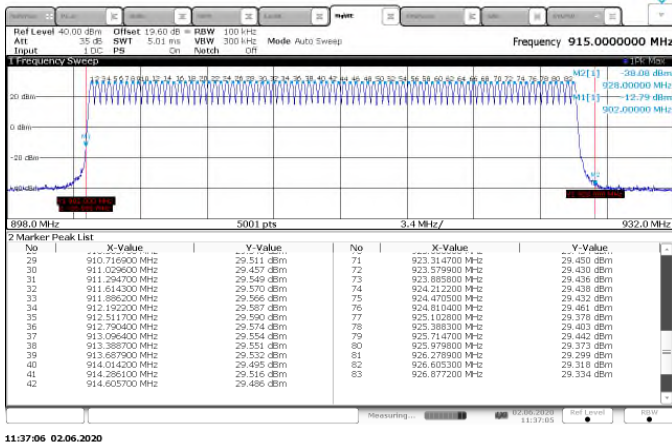


Figure 7.4.2.2-1: No. of Channels – FSK – 100kbps

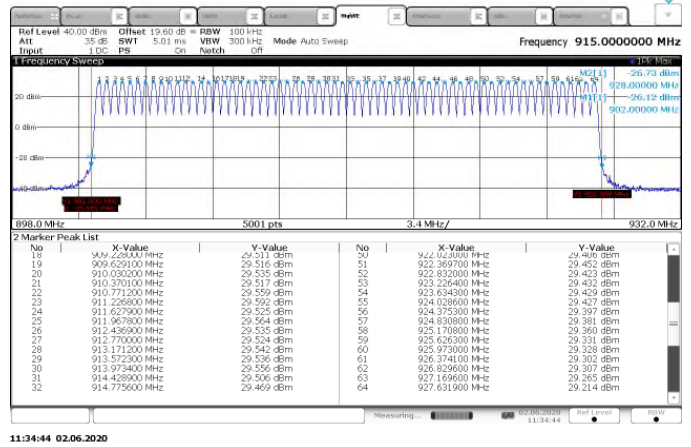


Figure 7.4.2.2-2: No. of Channels – FSK – 150kbps

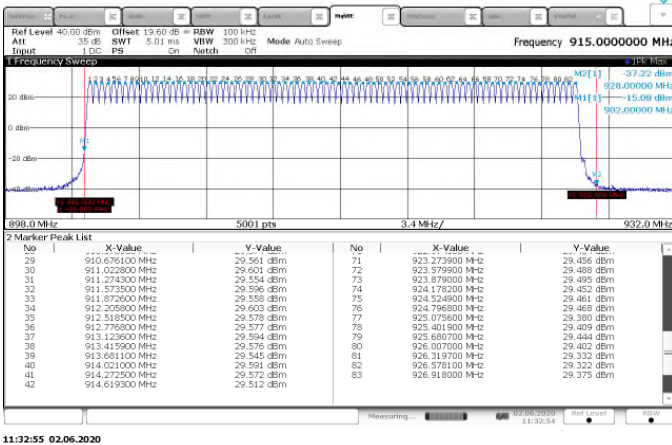


Figure 7.4.2.2-3: No. of Channels – GFSK – 150kbps

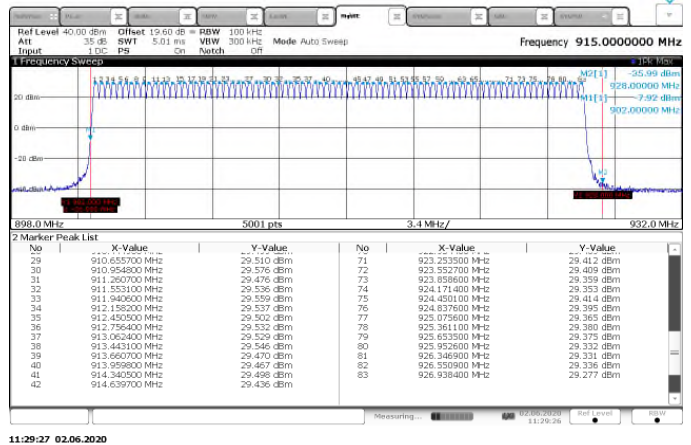


Figure 7.4.2.2-4: No. of Channels – GFSK – 200kbps

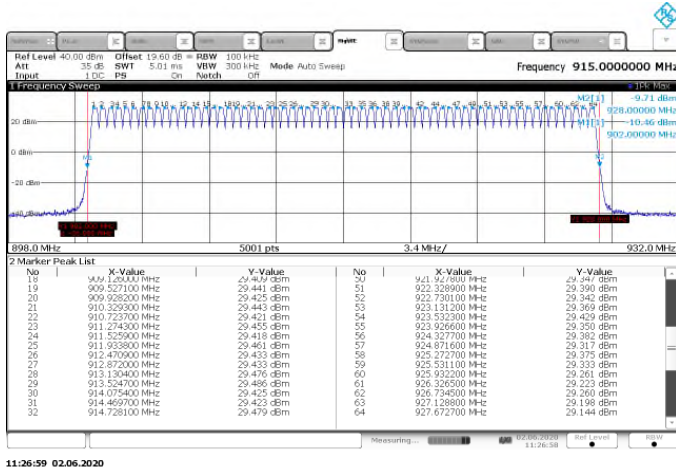


Figure 7.4.2.2-5: No. of Channels – GFSK – 300kpbs

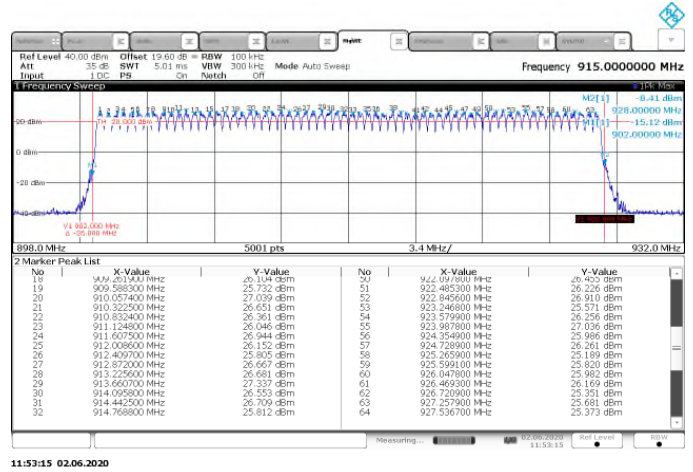


Figure 7.4.2.2-6: No. of Channels – OFDM – 600kpbs



7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c)

7.4.3.1 Measurement Procedure

Dwell time measurements were recorded using the test methods defined in ANSI C63.10, Section 7.8.4. The limit is 0.4 seconds within a 20 second period for devices using more than 50 hopping channels or within 10 seconds for devices using more than 25 hopping channels.

The worst-case modulation and data rate for dwell time was FSK 100k as determined by Itron, Inc.

7.4.3.2 Measurement Results

Performed by: Ryan McGann

Worst-Case Channel Spacing (kHz)	Modulation Format	Data Rate (kbps)	Time on Single Hop (ms)	Number of hops per 20 seconds	Time on channel per 20 seconds (ms)	Limit (ms)
300	FSK	100	96.01	3	288.03	400

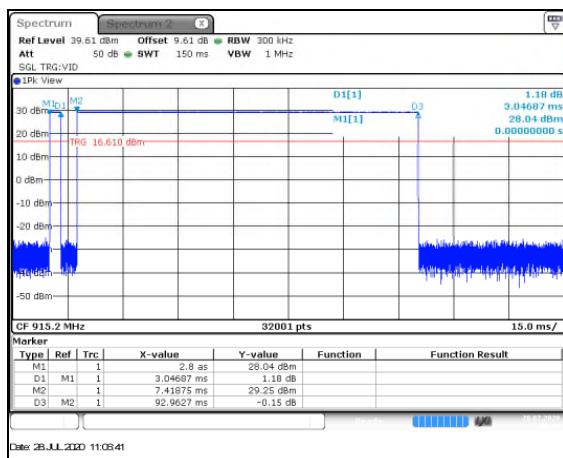


Figure 7.4.3.2-1: Dwell Time – 300kHz Spacing – Single Hop

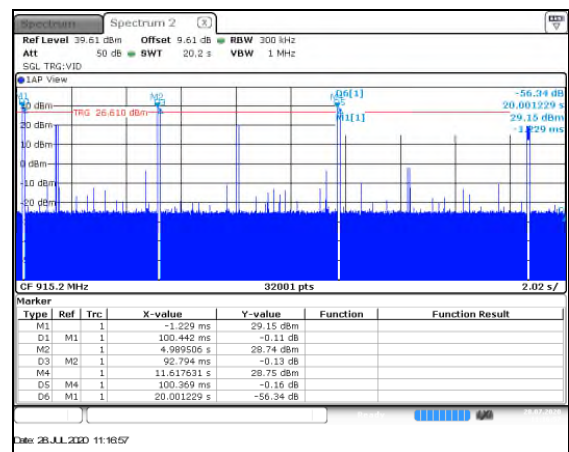


Figure 7.4.3.2-2: Dwell Time – 300kHz Spacing – 20 Seconds

**7.4.4 20dB / 99% Bandwidth – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c)****7.4.4.1 Measurement Procedure**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with suitable attenuation. The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The ndB down function of the analyzer was utilized to determine the 20 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 to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

**7.4.4.2 Measurement Results**

Performed by: Jeremy Pickens

**Table 7.4.4.2-1: 20dB / 99% Bandwidth**

Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	Data Rate (kbps)	Mode(s)
902.3	132.17	127.85	100	FSK
915.2	132.57	127.51	100	FSK
926.9	132.07	128.42	100	FSK
902.4	196.06	172.93	150	FSK
915.2	197.36	172.63	150	FSK
927.6	196.36	172.73	150	FSK
902.3	185.16	160.49	150	GFSK
915.2	185.26	160.69	150	GFSK
926.9	185.06	160.89	150	GFSK
902.3	245.75	215.54	200	GFSK
915.2	247.15	215.44	200	GFSK
926.9	243.55	215.36	200	GFSK
902.4	368.93	319.42	300	GFSK
915.2	366.53	319.42	300	GFSK
927.6	366.53	319.46	300	GFSK
902.4	334.73	297.36	600	OFDM
915.2	336.53	298.15	600	OFDM
927.6	337.93	302.30	600	OFDM

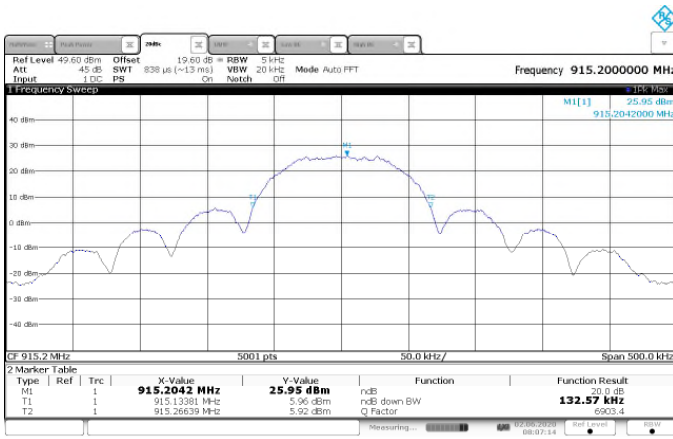


Figure 7.4.4.2-1: Sample Plot 20dB BW - FSK – 100kbps

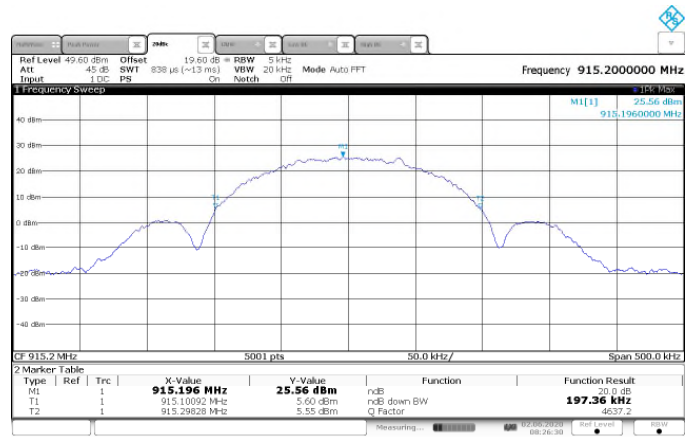


Figure 7.4.4.2-2: Sample Plot 20dB BW - FSK – 150kbps

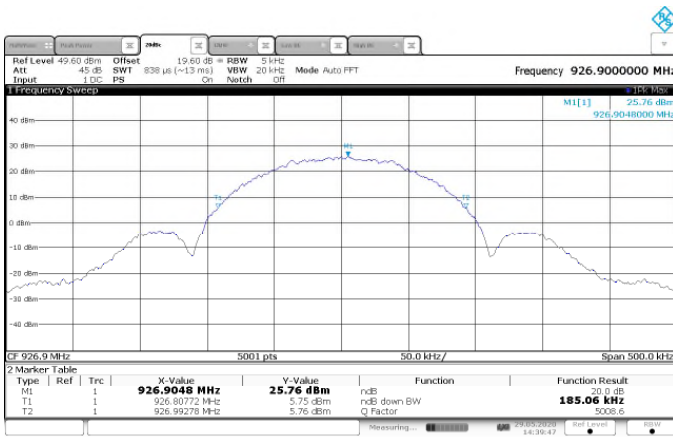


Figure 7.4.4.2-3: Sample Plot 20dB BW - GFSK – 150kbps

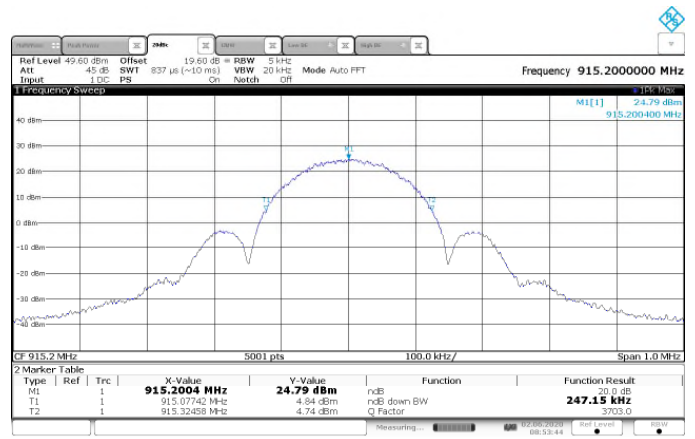


Figure 7.4.4.2-4: Sample Plot 20dB BW - GFSK – 200kbps

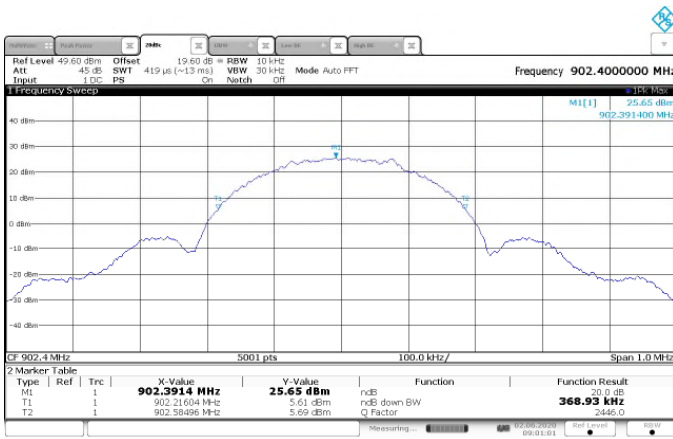


Figure 7.4.4.2-5: Sample Plot 20dB BW - GFSK – 300kbps

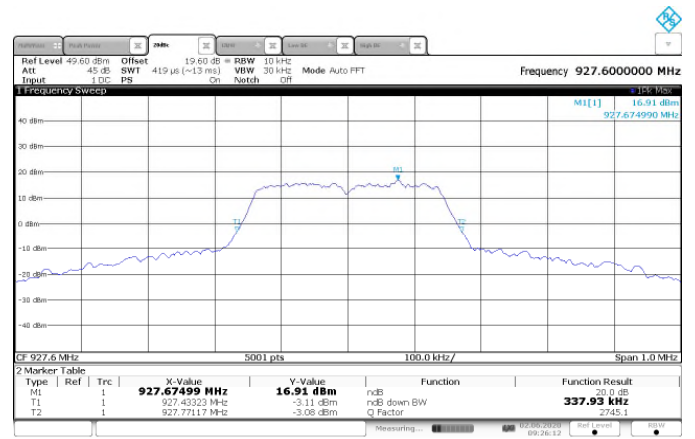


Figure 7.4.4.2-6: Sample Plot 20dB BW - OFDM – 600kbps

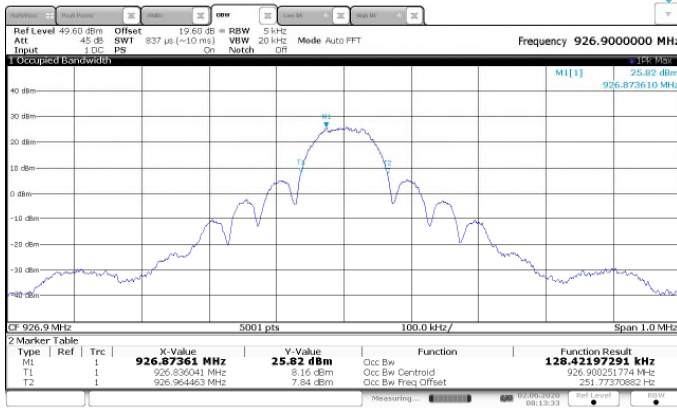


Figure 7.4.4.2-7: Sample Plot 99% OBW - FSK – 100kbps

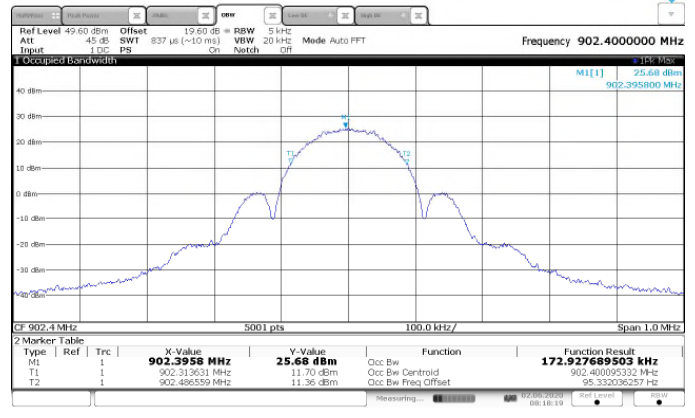


Figure 7.4.4.2-8: Sample Plot 99% OBW - FSK – 150kbps

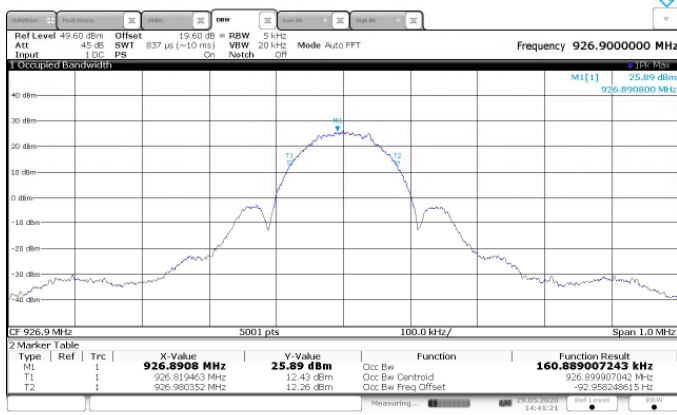


Figure 7.4.4.2-9: Sample Plot 99% OBW - GFSK – 150kbps

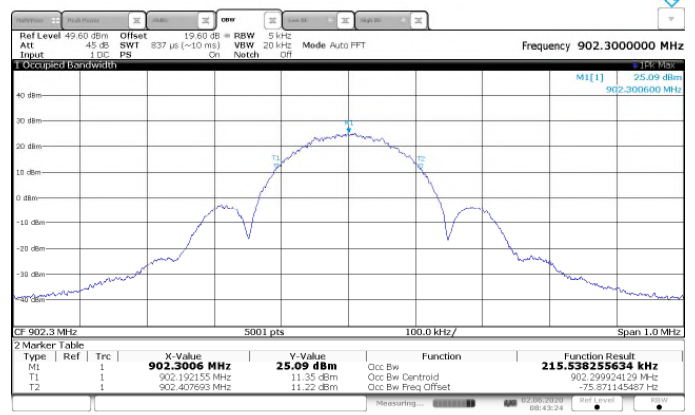


Figure 7.4.4.2-10: Sample Plot 99% OBW - GFSK – 200kbps

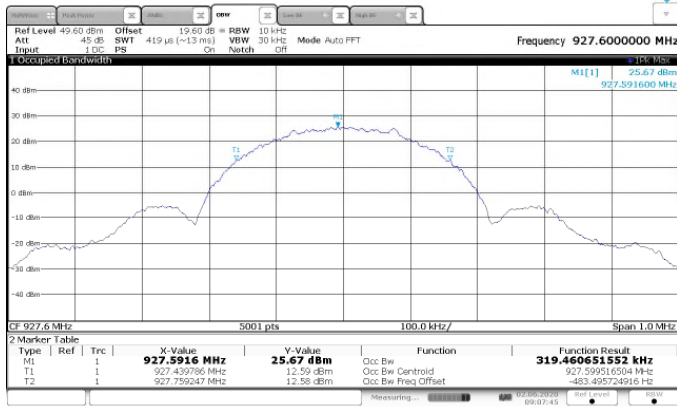


Figure 7.4.4.2-11: Sample Plot 99% OBW - GFSK – 300kbps

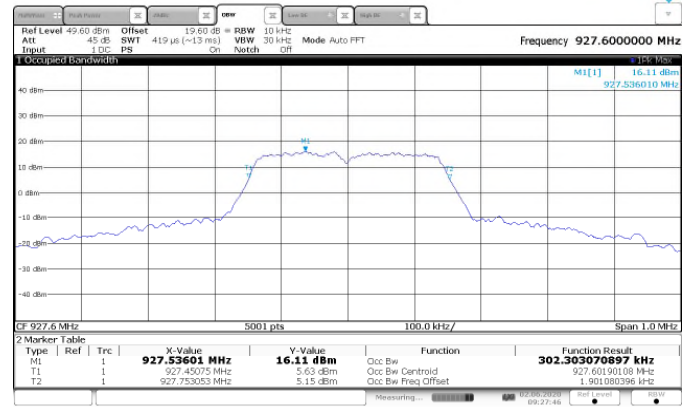


Figure 7.4.4.2-12: Sample Plot 99% OBW - OFDM – 600kbps

### 7.5 Band-Edge Compliance and Spurious Emissions

#### 7.5.1 Band-Edge Compliance of RF Conducted Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

##### 7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement, the spectrum analyzer's RBW was set to 100kHz and the VBW was set to 300kHz.

Band-edge was evaluated for all combinations of operating modes and data rates.

##### 7.5.1.2 Measurement Results

Performed by: Jeremy Pickens

##### NON-HOPPING MODE:

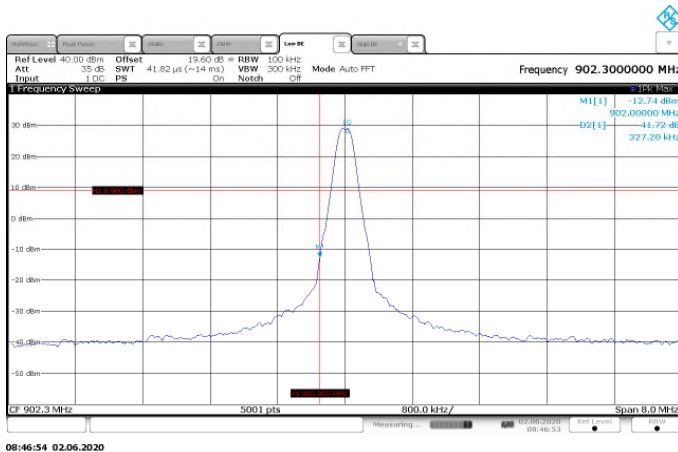


Figure 7.5.1.2-1: Lower Band-edge – FSK – 100kbps

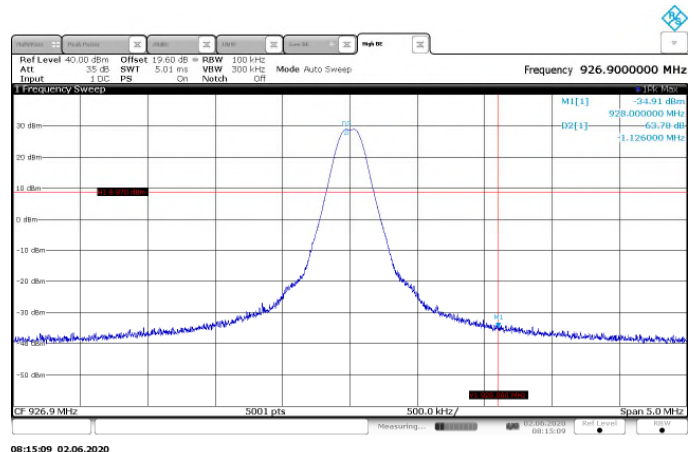


Figure 7.5.1.2-2: Upper Band-edge – FSK – 100kbps

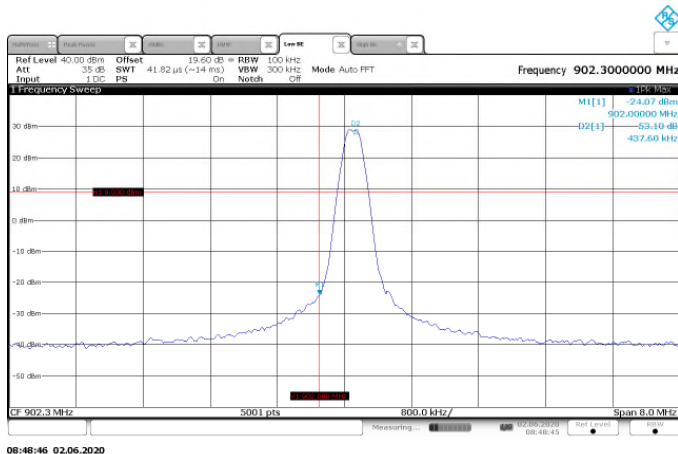


Figure 7.5.1.2-3: Lower Band-edge – FSK – 150kbps

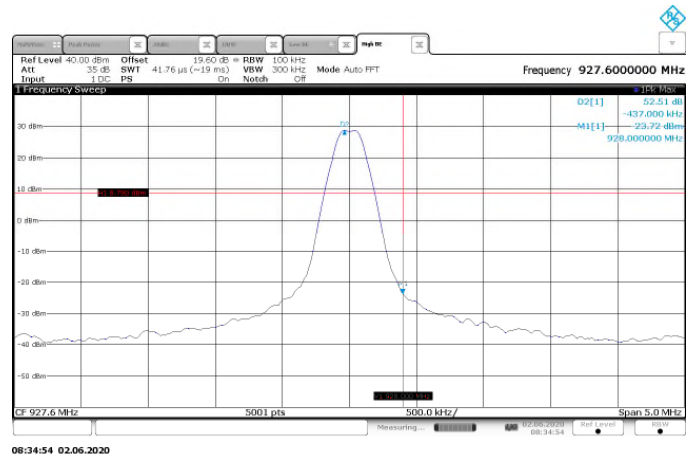


Figure 7.5.1.2-4: Upper Band-edge – FSK – 150kbps

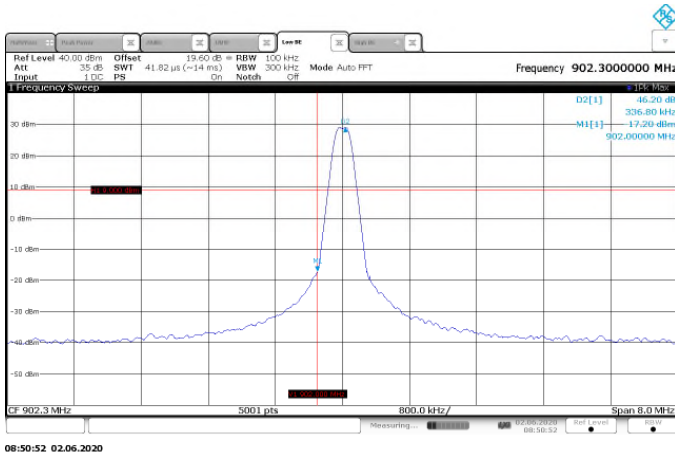


Figure 7.5.1.2-5: Lower Band-edge – GFSK – 150kbps

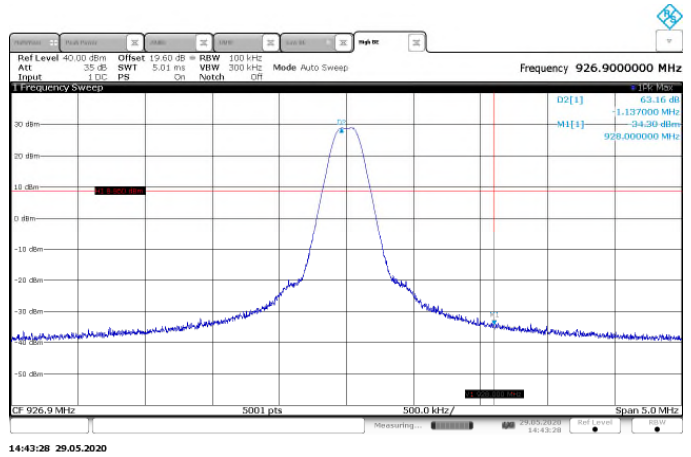


Figure 7.5.1.2-6: Upper Band-edge – GFSK – 150kbps

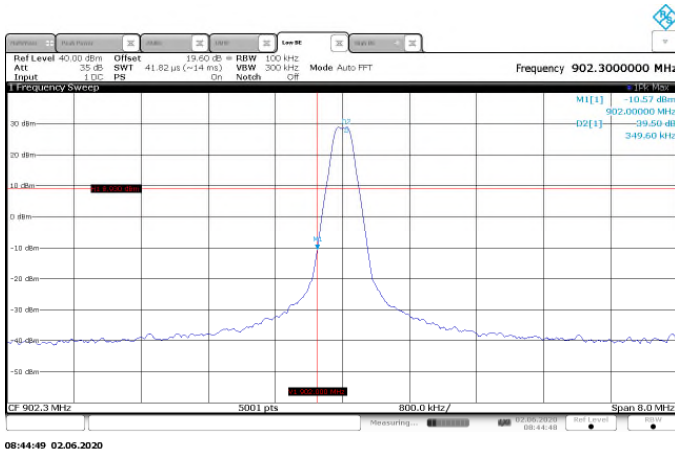


Figure 7.5.1.2-7: Lower Band-edge – GFSK – 200kbps

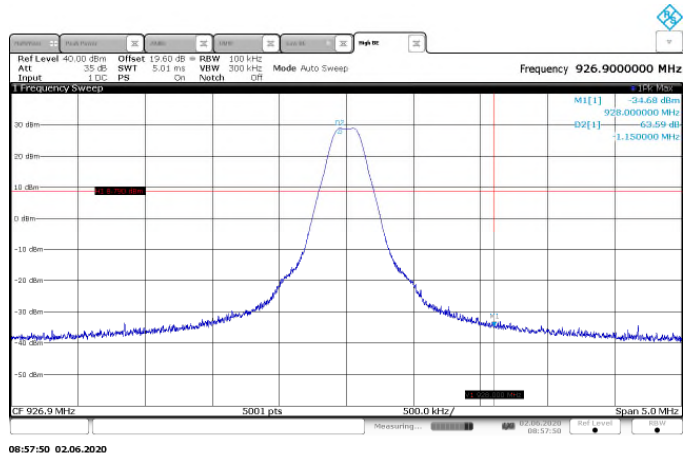


Figure 7.5.1.2-8: Upper Band-edge – GFSK – 200kbps

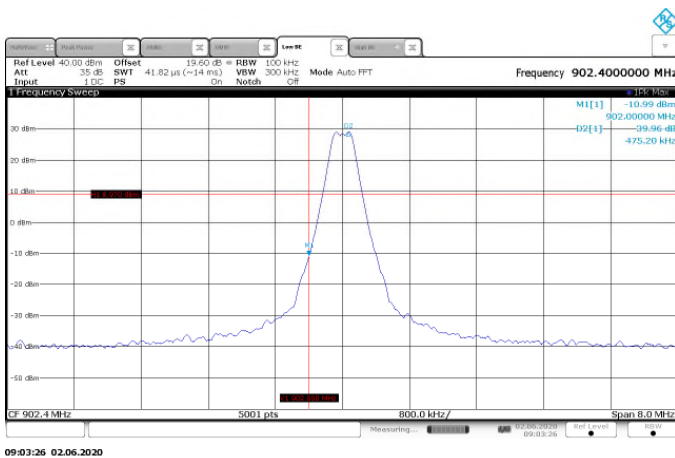


Figure 7.5.1.2-9: Lower Band-edge – GFSK – 300kbps

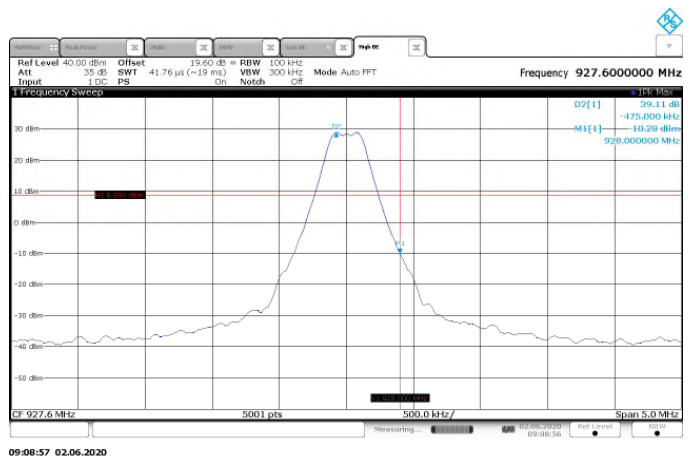


Figure 7.5.1.2-10: Upper Band-edge – GFSK – 300kbps

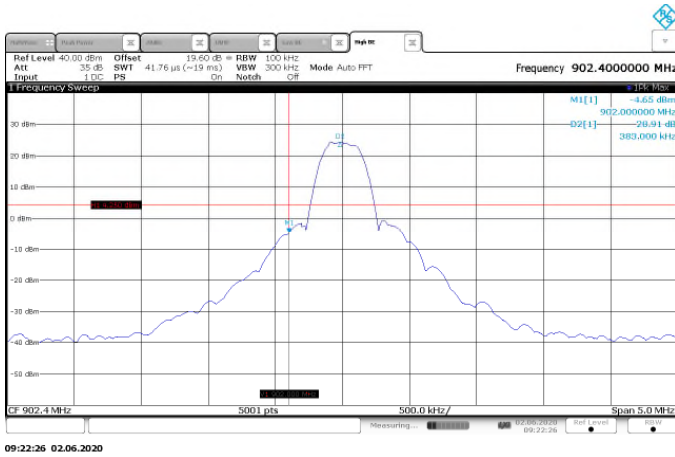


Figure 7.5.1.2-11: Lower Band-edge – OFDM – 600kbps

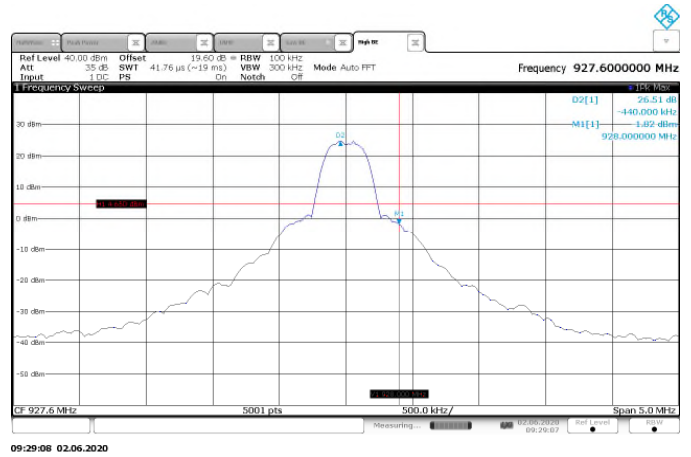


Figure 7.5.1.2-12: Upper Band-edge – OFDM – 600kbps

**HOPPING MODE:**

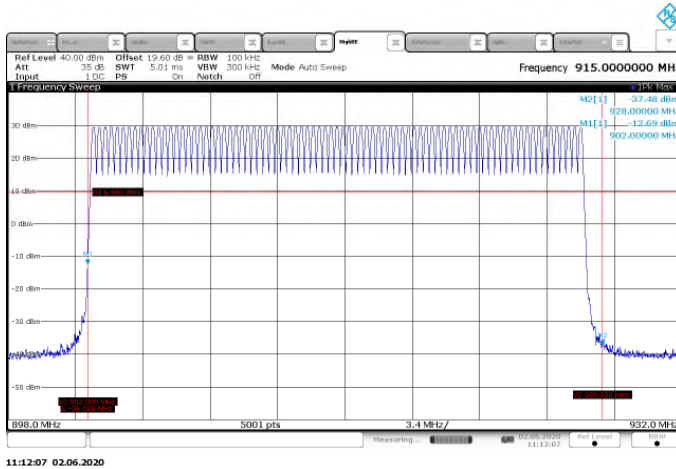


Figure 7.5.1.2-13: Band Edges – FSK – 100kbps



Figure 7.5.1.2-14: Band Edges – FSK – 150kbps

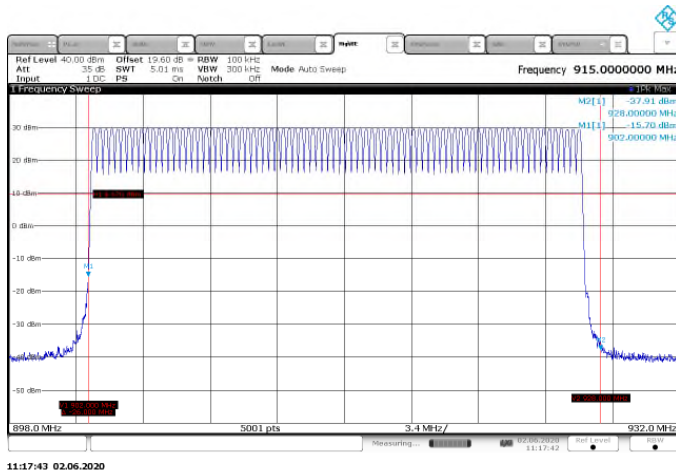


Figure 7.5.1.2-15: Band Edges – GFSK – 150kbps

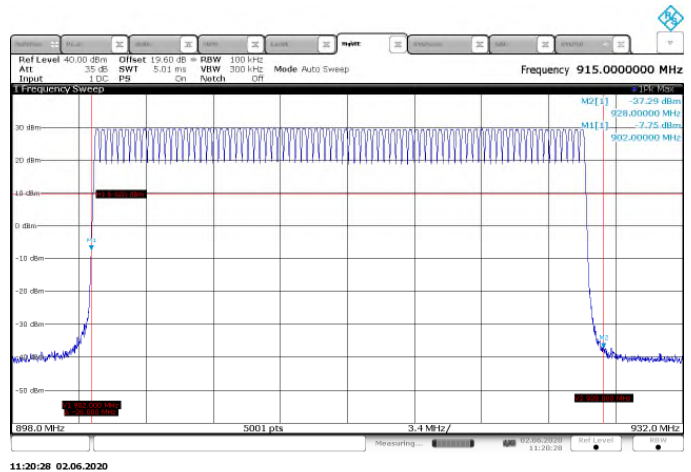


Figure 7.5.1.2-16: Band Edges – GFSK – 200kbps

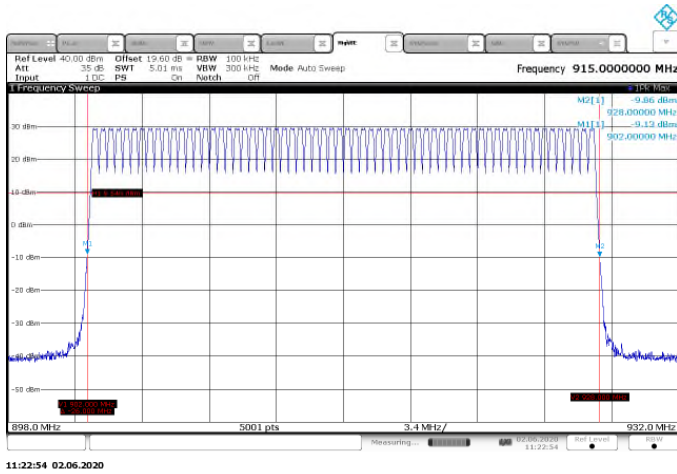


Figure 7.5.1.2-17: Band Edges – GFSK – 300kbps

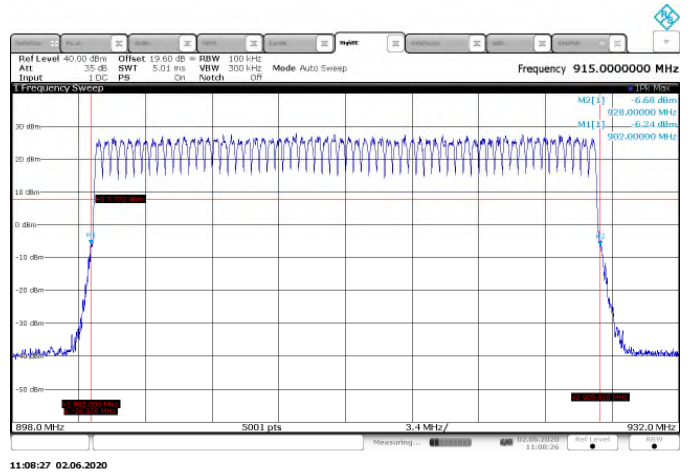


Figure 7.5.1.2-18: Band Edges – OFDM – 600kbps



**7.5.2 RF Conducted Spurious Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5**

**7.5.2.1 Measurement Procedure**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer’s RBW was set to 100kHz. A peak detector function was used with the trace set to max hold. Worst-case data presented (FSK / 100kbps)

**7.5.2.2 Measurement Results**

Performed by: Jeremy Pickens

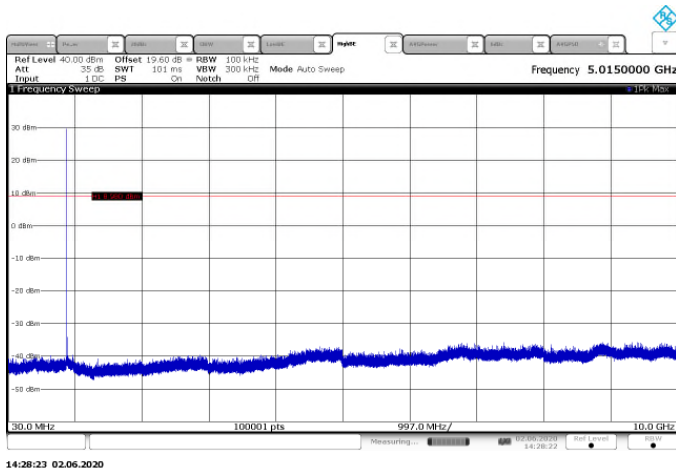


Figure 7.5.2.2-1: 30 MHz – 10 GHz – Low Channel

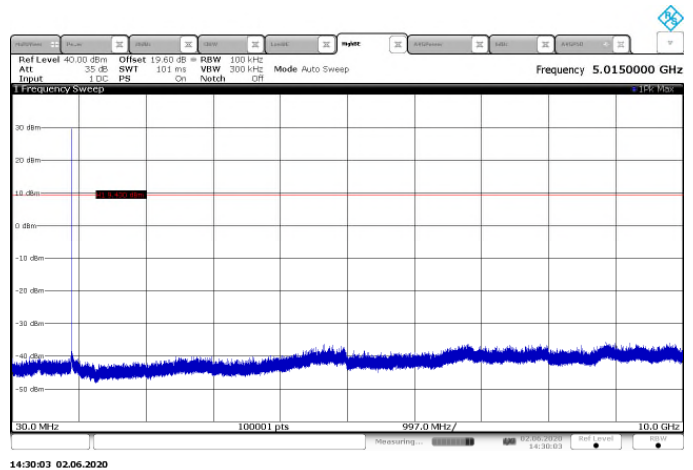


Figure 7.5.2.2-2: 30 MHz – 10 GHz – Middle Channel

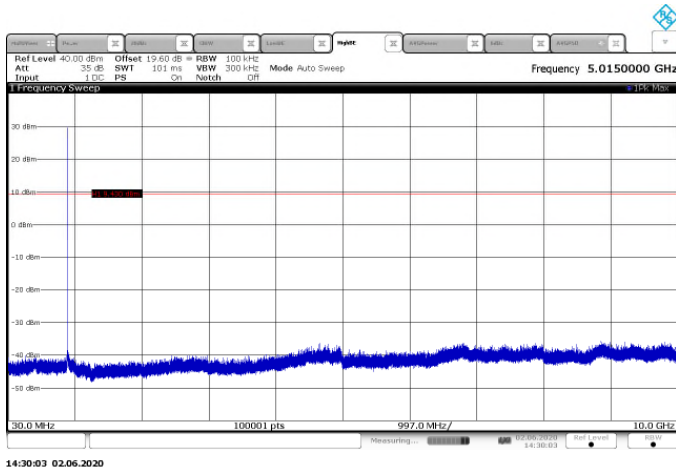


Figure 7.5.2.2-3: 30 MHz – 10 GHz –High Channel

### 7.5.3 Radiated Spurious Emissions – FCC: Section 15.205, 15.209; ISED Canada: RSS-Gen 8.9/8.10

#### 7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9kHz to 10GHz, 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.

The EUT was caused to generate a continuous modulated carrier on the hopping channel.

Each emission found to be in a restricted band was compared to the applicable radiated emission limits.

Radiated spurious emissions were evaluated for all combinations of operating modes and data rates with worst case data provided.

#### 7.5.3.2 Measurement Results

Performed by: Jeremy Pickens

**Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data (FSK 100kHz)**

Frequency (MHz)	Level (dBµV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Low Channel</b>										
2706.9	47.20	34.50	H	0.97	48.17	35.47	74.0	54.0	25.8	18.5
2706.9	46.60	34.10	V	0.97	47.57	35.07	74.0	54.0	26.4	18.9
3609.2	48.10	36.50	H	2.55	50.65	39.05	74.0	54.0	23.3	14.9
3609.2	47.10	34.80	V	2.55	49.65	37.35	74.0	54.0	24.3	16.6
<b>Middle Channel</b>										
2745.6	47.60	35.80	H	1.05	48.65	36.85	74.0	54.0	25.4	17.2
2745.6	47.3	34.9	V	1.05	48.35	35.95	74.0	54.0	25.7	18.1
3660.8	48.9	39.5	H	2.72	51.62	42.22	74.0	54.0	22.4	11.8
3660.8	47.1	35.2	V	2.72	49.82	37.92	74.0	54.0	24.2	16.1
4576	47.2	36.4	H	4.58	51.78	40.98	74.0	54.0	22.2	13.0
4576	47	35.5	V	4.58	51.58	40.08	74.0	54.0	22.4	13.9
7321.6	54.5	49.5	H	8.40	62.90	57.90	83.5	63.5	20.6	5.6
7321.6	50.9	44.1	V	8.40	59.30	52.50	83.5	63.5	14.7	11.0
8236.8	51.7	44	H	8.98	60.68	52.98	83.5	63.5	13.3	10.5
<b>High Channel</b>										
2780.7	47.3	35.2	H	1.12	48.42	36.32	74.0	54.0	25.6	17.7
2780.7	46.5	34.6	V	1.12	47.62	35.72	74.0	54.0	26.4	18.3
3707.6	49.1	38.4	H	2.87	51.97	41.27	74.0	54.0	22.0	12.7
3707.6	47.9	35.5	V	2.87	50.77	38.37	74.0	54.0	23.2	15.6
4634.5	45.8	33.8	H	4.61	50.41	38.41	74.0	54.0	23.6	15.6
4634.5	45.6	33.5	V	4.61	50.21	38.11	74.0	54.0	23.8	15.9
7415.2	53.1	46.5	H	4.61	50.21	38.11	83.5	63.5	33.3	25.4
7415.2	49.7	42	V	8.46	61.56	54.96	83.5	63.5	21.9	8.5
8342.1	48.2	39.3	H	8.46	58.16	50.46	83.5	63.5	25.3	13.0

Note: Measurements above 7GHz were recorded at 1 meter. The limits were adjusted by 9.5dB for the distance correction.

Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data (GFSK 150kHz)

Frequency (MHz)	Level (dB $\mu$ V)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dB $\mu$ V/m)		Limit (dB $\mu$ V/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Low Channel</b>										
2706.9	46.60	34.40	H	0.97	47.57	35.37	74.0	54.0	26.4	18.6
2706.9	46.40	34.40	V	0.97	47.37	35.37	74.0	54.0	26.6	18.6
3609.2	48.20	36.50	H	2.55	50.75	39.05	74.0	54.0	23.2	14.9
3609.2	46.70	34.70	V	2.55	49.25	37.25	74.0	54.0	24.7	16.7
<b>Middle Channel</b>										
2745.6	46.80	35.30	H	1.05	47.85	36.35	74.0	54.0	26.2	17.7
2745.6	47.6	35	V	1.05	48.65	36.05	74.0	54.0	25.4	18.0
3660.8	49	39	H	2.72	51.72	41.72	74.0	54.0	22.3	12.3
3660.8	47.4	35.5	V	2.72	50.12	38.22	74.0	54.0	23.9	15.8
4576	47.9	36.5	H	4.58	52.48	41.08	74.0	54.0	21.5	12.9
4576	47.7	36.1	V	4.58	52.28	40.68	74.0	54.0	21.7	13.3
7321.6	53.9	39.8	H	8.40	62.30	48.20	83.5	63.5	21.2	15.3
7321.6	50.6	43.8	V	8.40	59.00	52.20	83.5	63.5	24.5	11.3
8236.8	51	39.9	H	8.98	59.98	48.88	83.5	63.5	23.5	14.6
<b>High Channel</b>										
2780.7	47.4	35	H	1.12	48.52	36.12	74.0	54.0	25.5	17.9
2780.7	47	34.6	V	1.12	48.12	35.72	74.0	54.0	25.9	18.3
3707.6	49.5	38.8	H	2.87	52.37	41.67	74.0	54.0	21.6	12.3
3707.6	48.1	36.2	V	2.87	50.97	39.07	74.0	54.0	23.0	14.9
4634.5	46.8	34	H	4.61	51.41	38.61	74.0	54.0	22.6	15.4
4634.5	46	33.8	V	4.61	50.61	38.41	74.0	54.0	23.4	15.6
7415.2	53.2	46.5	H	8.46	61.66	54.96	83.5	63.5	21.8	8.5
7415.2	49.6	41.5	V	8.46	58.06	49.96	83.5	63.5	25.4	13.5
8342.1	47.9	38.8	H	9.09	56.99	47.89	83.5	63.5	26.5	15.6

Note: Measurements above 7GHz were recorded at 1 meter. The limits were adjusted by 9.5dB for the distance correction.

Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data (OFDM 600kHz)

Frequency (MHz)	Level (dB $\mu$ V)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dB $\mu$ V/m)		Limit (dB $\mu$ V/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
<b>Low Channel</b>										
3609.6	47.00	35.10	H	2.55	49.55	37.65	74.0	54.0	24.4	16.3
3609.6	46.80	34.50	V	2.55	49.35	37.05	74.0	54.0	24.6	16.9
<b>Middle Channel</b>										
3660.8	47.2	35.5	H	2.72	49.92	38.22	74.0	54.0	24.1	15.8
3660.8	46.7	34.4	V	2.72	49.42	37.12	74.0	54.0	24.6	16.9
<b>High Channel</b>										
3710.4	47.5	36.6	H	2.88	50.38	39.48	74.0	54.0	23.6	14.5
3710.4	47	34.7	V	2.88	49.88	37.58	74.0	54.0	24.1	16.4

**7.5.3.3 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 – FSK 100kbps - MCH**

Corrected Level:  $54.50 + 8.4 = 62.90\text{dBuV/m}$   
 Margin:  $83.5\text{dBuV/m} - 62.90\text{dBuV/m} = 20.6\text{dB}$

**Example Calculation: Average – FSK 100kbps - MCH**

Corrected Level:  $49.50 + 8.4 - 0 = 57.90\text{dBuV}$   
 Margin:  $63.5\text{dBuV} - 57.90\text{dBuV} = 5.6\text{dB}$

**8 ESTIMATION OF MEASUREMENT UNCERTAINTY**

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

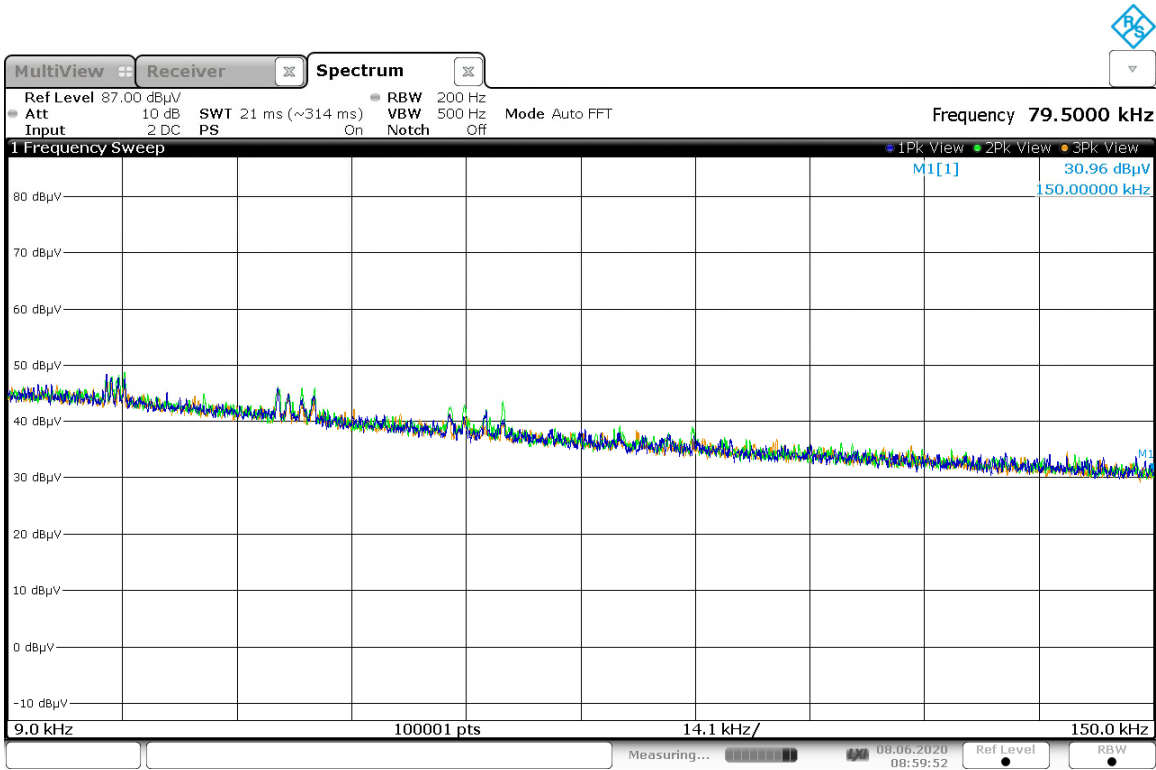
**Table 8-1: Estimation of Measurement Uncertainty**

Parameter	$U_{\text{lab}}$
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**

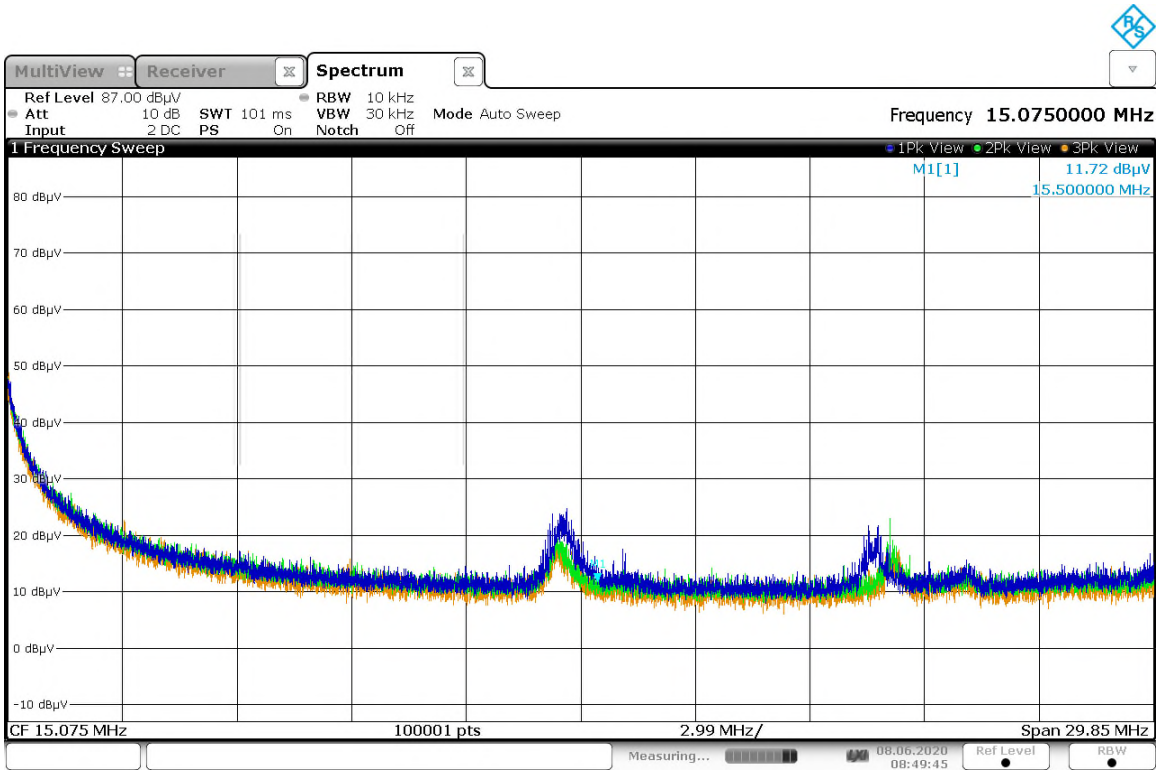
In the opinion of TÜV SÜD America, Inc. the G5R1, manufactured by Itron, Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

## 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

Full Spectrum

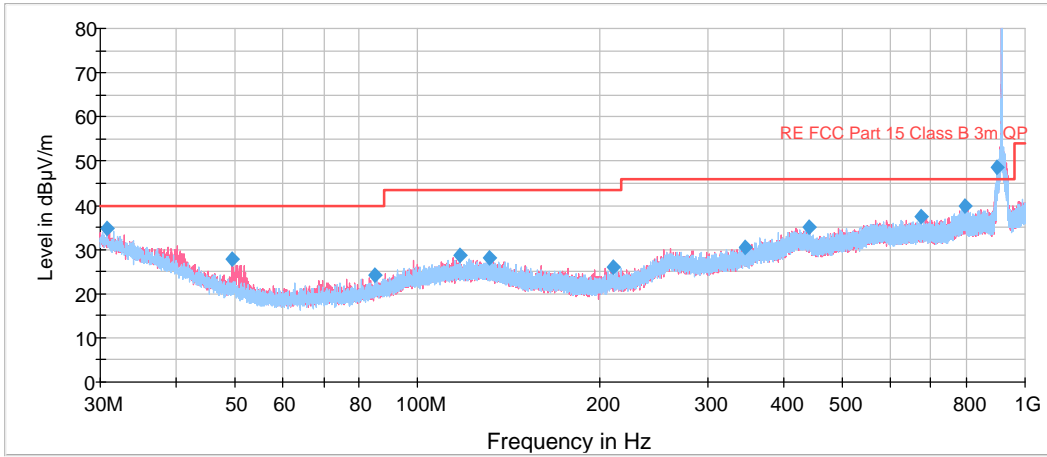
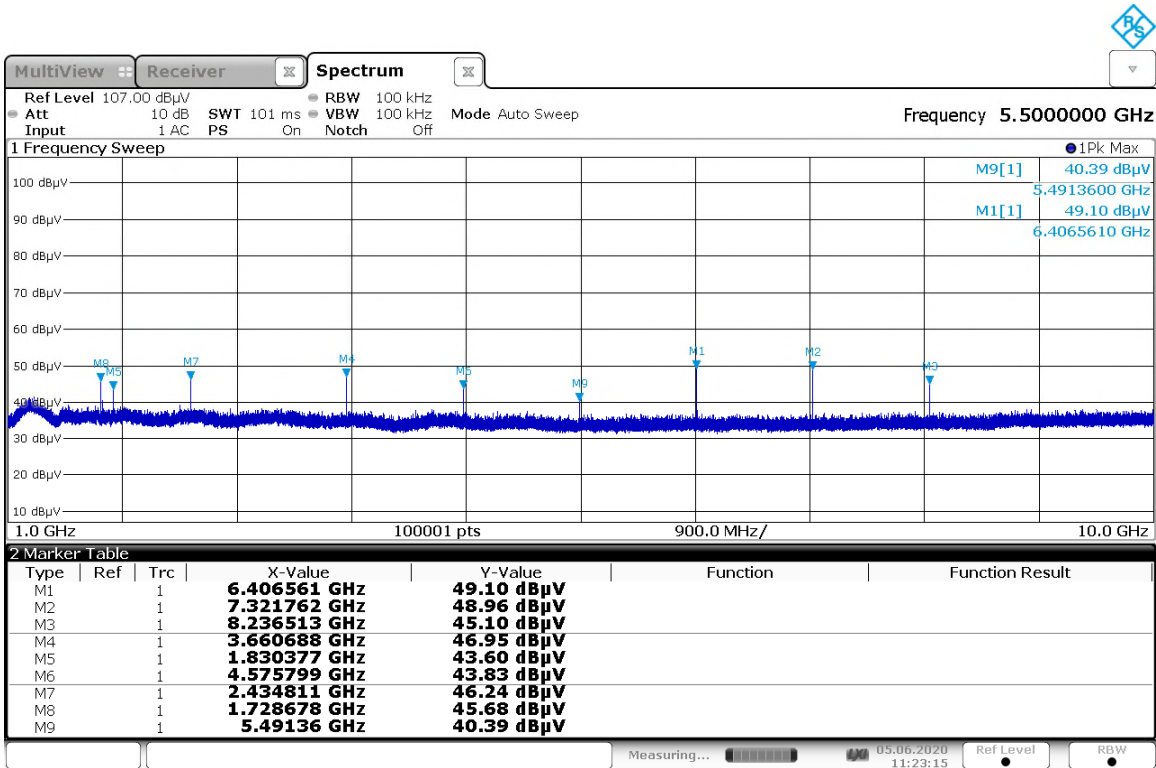


Figure A-3: Radiated Spurious Emissions – 30 MHz – 1GHz



11:23:16 05.06.2020

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



**END REPORT**