Certification Test Report

FCC ID: SK9ACT2
IC: 864G-ACT2

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

Report Number: AT72139651-3C0

Manufacturer: Itron, Inc.
Model: ACT2

Test Begin Date: May 22, 2018
Test End Date: July 9, 2018

Report Issue Date: July 27, 2018

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.

Prepared By:

Jeremy Pickens
Senior Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Ryan McGann
Senior Engineer
TÜV SÜD America Inc.

This report contains 23 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 ACT2 is an electricity metering module which includes a 902.8 MHz to 926.8 MHz transmitter as well as 2.4GHz WLAN 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 hybrid mode of operation.

Technical Information:

Detail	Description
Frequency Range	902.8 – 926.8 MHz
Number of Channels	31
Modulation Format	OFDM
Data Rates	1200kbps
Operating Voltage	24Vdc
Antenna Type / Gain	¼ Wave Embedded Slot Antenna / 2.5dBi

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

Test Sample Serial Number: Radiated Emissions: 105900002044
Power Line Conducted Emissions: 105900002044
RF Conducted Emissions: 105900002047

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.

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: RFIC Attn: 9, DMCC Scale 1586

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

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.

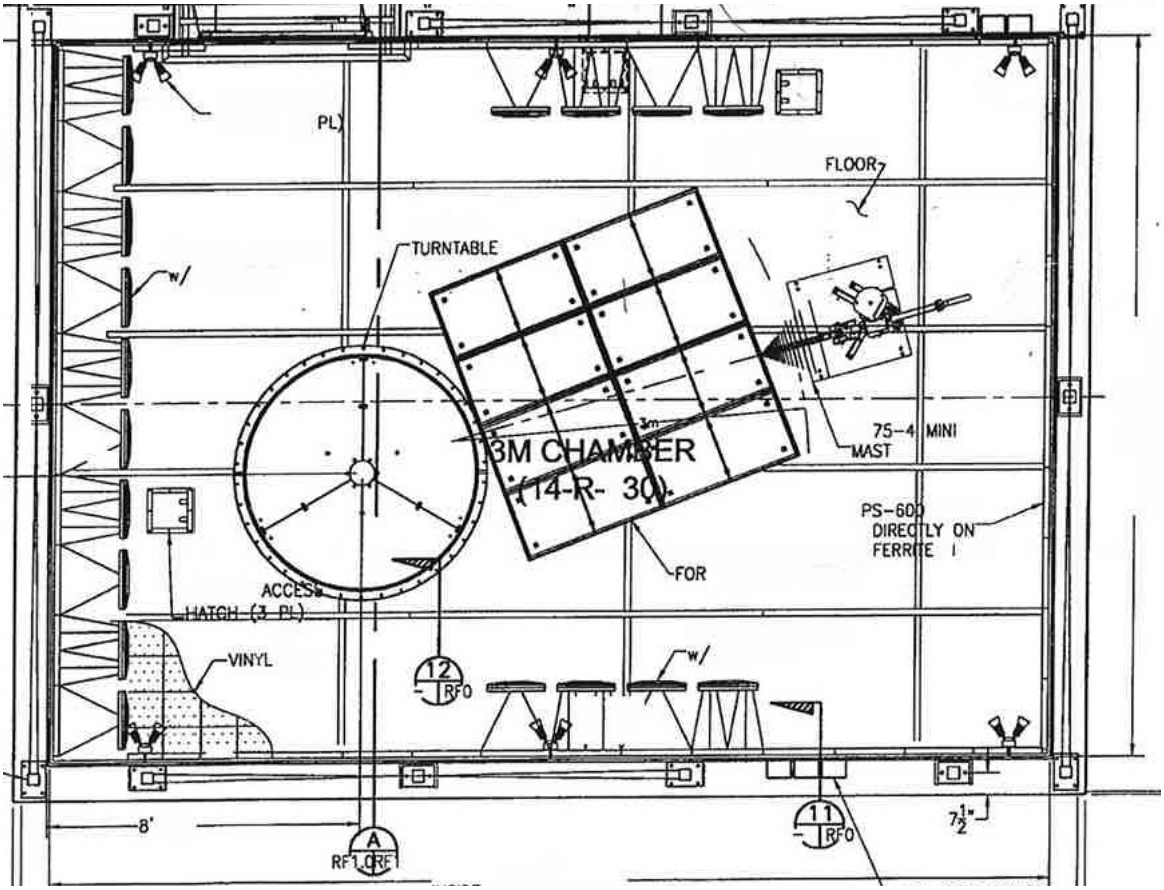


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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 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 table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

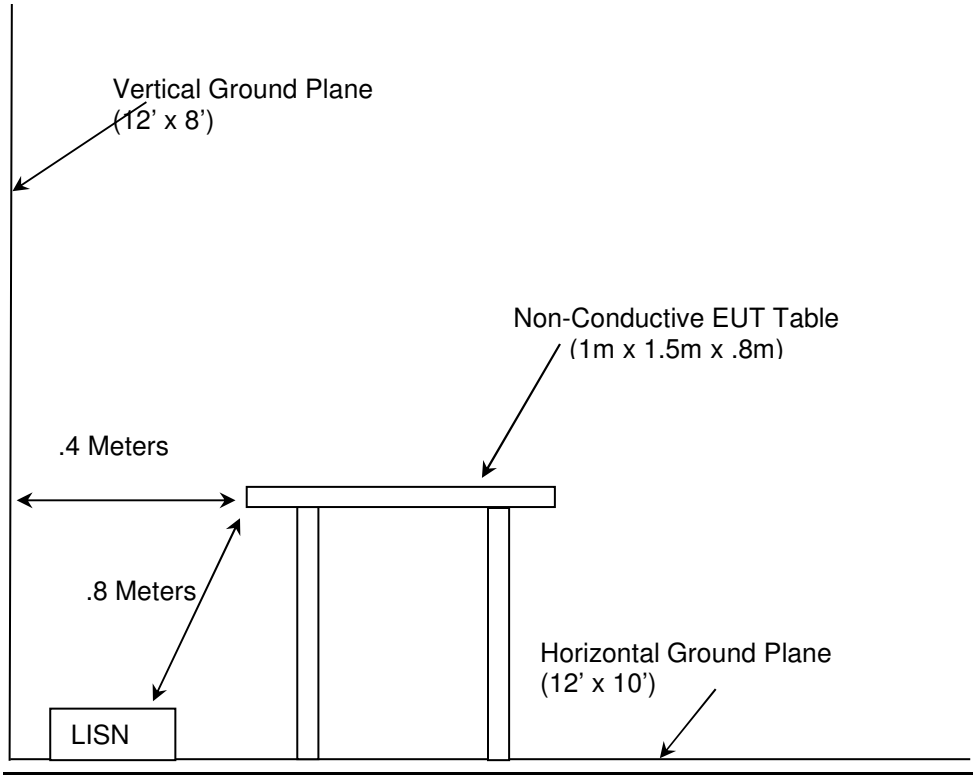


Figure 2.4.1-1: AC Mains Conducted EMI Site

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, 2018
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018
- FCC KDB 558074 D01 DTS Meas Guidance v04 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 5, 2017
- 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 4, Nov 2014.

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
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
213	TEC	PA 102	Amplifier	44927	07/24/2017	07/24/2018
324	TUV	Belden	Conducted EMI Cable	8214	04/05/2018	04/05/2019
331	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	31417	05/16/2018	05/16/2019
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
412	Electro Metrics	LPA-25	Log Periodic Antenna	1241	08/08/2016	08/08/2018
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/15/2016	07/15/2018
731	EMCO	3104	Bicon Antenna	2659	11/09/2016	11/09/2018
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	10/31/2017	10/31/2018
827	Rohde & Schwarz	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	07/28/2017	07/28/2018
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/01/2018	05/01/2019
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/11/2017	07/11/2018
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	AC/DC Adapter	Cincon Electronics	TRG1524-A	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

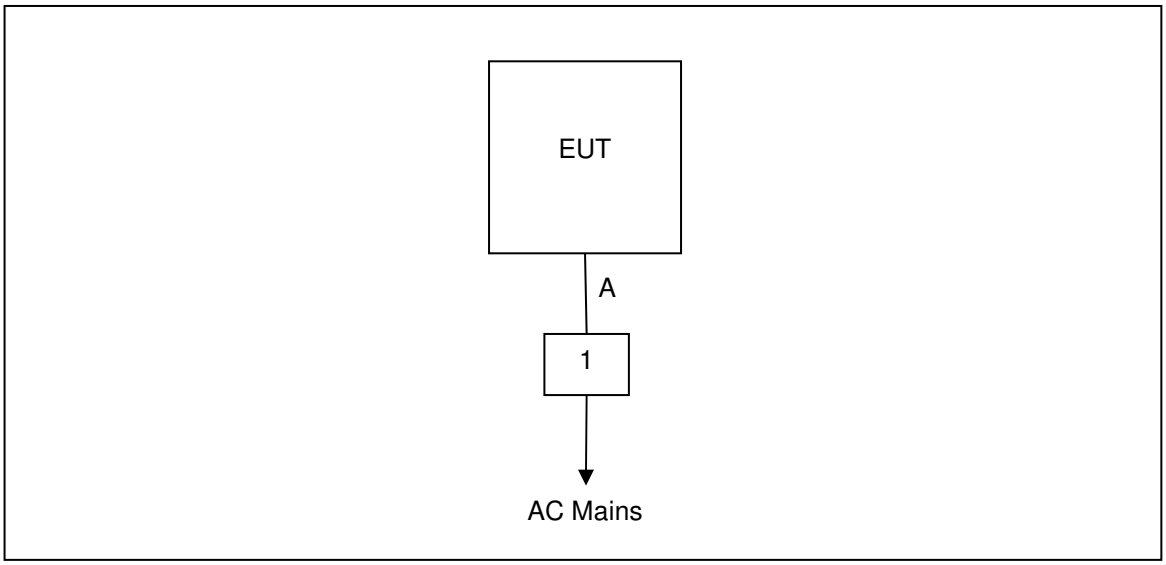


Figure 6-1: Test Setup Block Diagram

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 ¼ wave 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 2.5 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 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. 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: Tyler Leeson

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	
0.15	31.42	17.89	66	56	34.58	38.11	9.59
0.17	35.92	29.12	64.96	54.96	29.04	25.84	9.58
0.182	34.21	17.54	64.39	54.39	30.18	36.85	9.58
0.194	27.68	13.36	63.86	53.86	36.18	40.5	9.58
0.418	28.69	15.77	57.49	47.49	28.8	31.72	9.59
0.454	35.13	23.13	56.8	46.8	21.67	23.67	9.59
0.47	36.42	19.84	56.51	46.51	20.09	26.67	9.59
0.482	35.3	15.25	56.3	46.3	21	31.05	9.59
0.646	29.15	15.64	56	46	26.85	30.36	9.59
29.986	27.48	13.4	60	50	32.52	36.6	9.91

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	
0.15	26.58	17.94	66	56	39.42	38.06	9.59
0.162	26.55	20.43	65.36	55.36	38.81	34.93	9.58
0.198	25.38	13.04	63.69	53.69	38.31	40.65	9.58
0.418	25.37	14.41	57.49	47.49	32.12	33.08	9.59
0.458	34.4	24.18	56.73	46.73	22.33	22.55	9.59
0.466	34.54	22.02	56.58	46.58	22.04	24.56	9.59
0.474	34.39	16.49	56.44	46.44	22.05	29.95	9.59
2.618	25.2	10.63	56	46	30.8	35.37	9.62
2.682	24.74	10.65	56	46	31.26	35.35	9.62
29.998	28.8	13.49	60	50	31.2	36.51	10

7.3 20dB / 99% Bandwidth – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.2(a)

7.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 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 measurement functions of the analyzer were utilized to determine the 20 dB bandwidth of the emission.

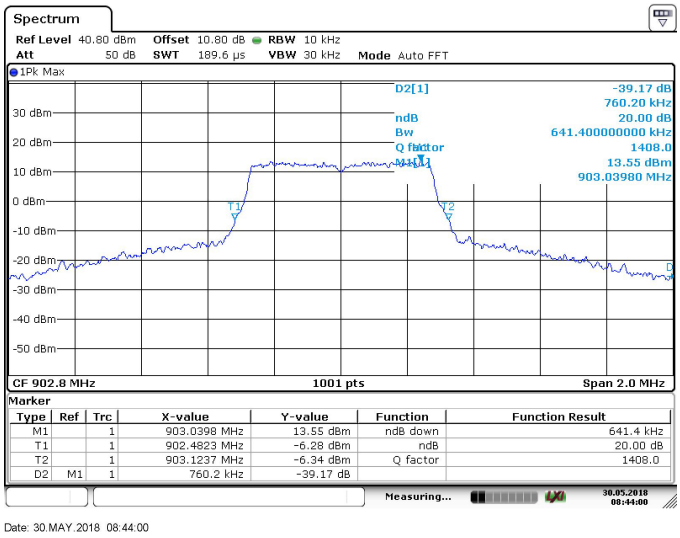
The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1% to 5% of the occupied bandwidth and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

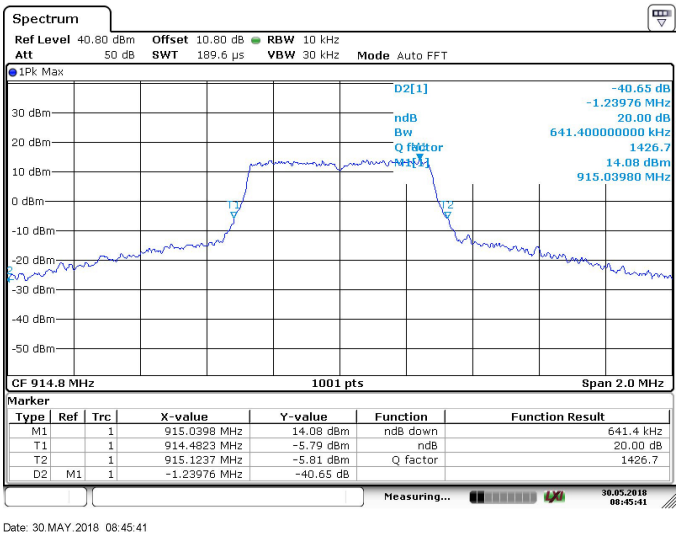
Table 7.3.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
902.8	641.40	563.49
914.8	641.40	561.11
926.8	637.40	561.54



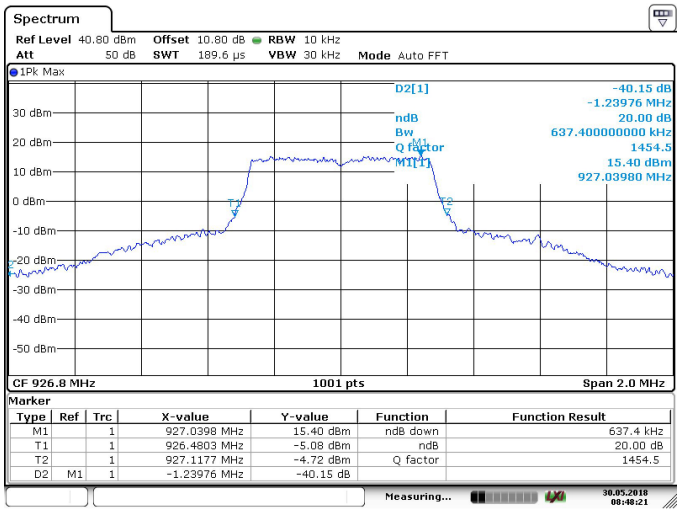
Date: 30.MAY.2018 08:44:00

Figure 7.3.2-1: 20dB Bandwidth – LCH



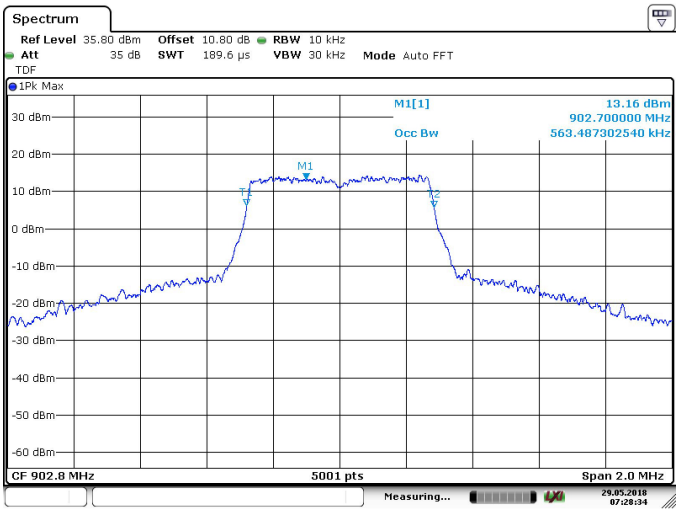
Date: 30.MAY.2018 08:45:41

Figure 7.3.2-2: 20dB Bandwidth – MCH



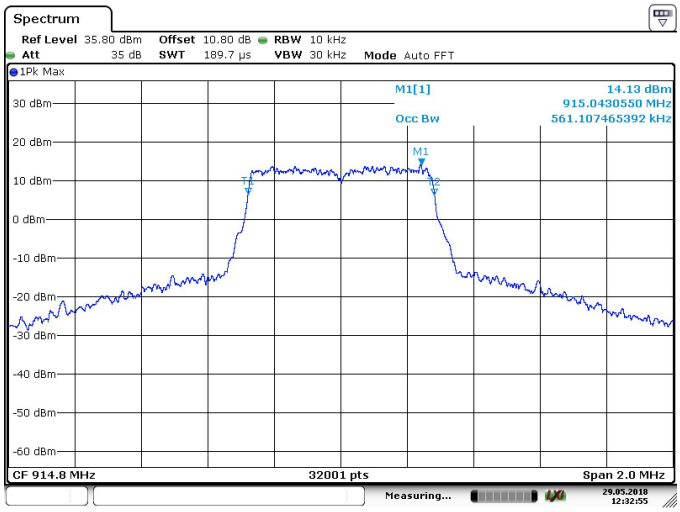
Date: 30.MAY.2018 08:48:21

Figure 7.3.2-3: 20dB Bandwidth – HCH



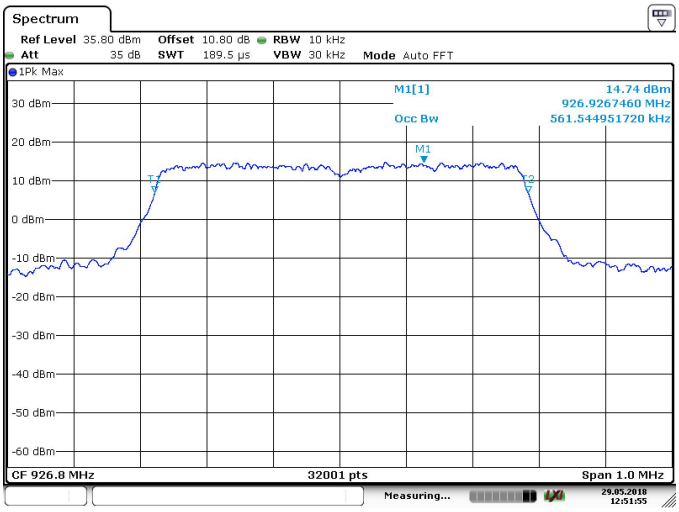
Date: 29.MAY.2018 07:28:35

Figure 7.3.2-4: 99% Occupied Bandwidth – LCH



Date: 29.MAY.2018 12:32:55

Figure 7.3.2-5: 99% Occupied Bandwidth – MCH



Date: 29.MAY.2018 12:51:55

Figure 7.3.2-6: 99% Occupied Bandwidth – HCH

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]
902.8	22.3
914.8	23.0
926.8	24.2

7.5 Channel Usage Requirements

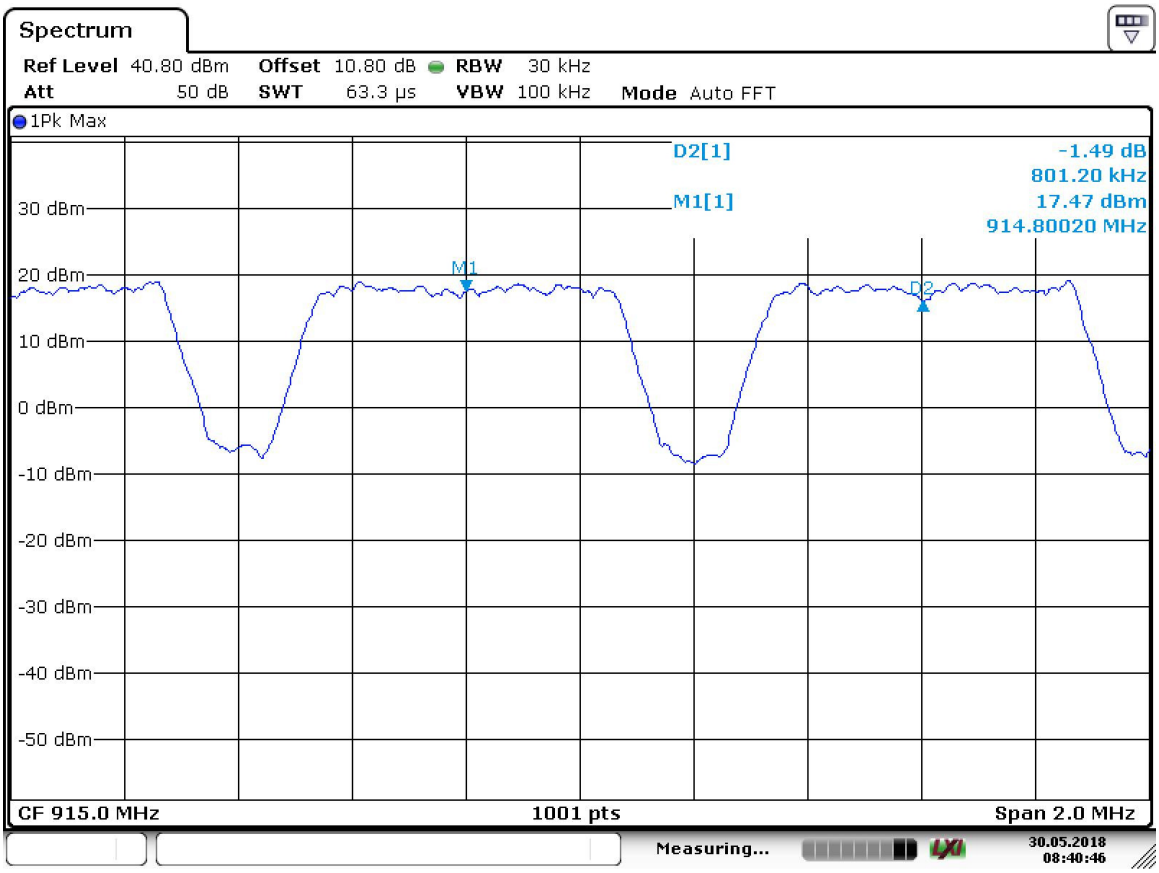
7.5.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(b)

7.5.1.1 Measurement Procedure

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

7.5.1.2 Measurement Results

Performed by: Jeremy Pickens



Date: 30.MAY.2018 08:40:46

Figure 7.5.1.2-1: Frequency Separation

7.5.2 Channel Dwell Time – FCC: Section 15.247(f); ISED Canada: RSS-247 5.3

7.5.2.1 Measurement Procedure

The EUT was not capable of producing a worst-case channel dwell time. A detailed analysis of the channel dwell time is available in the Theory of Operations accompanying this report.

7.6 Emission Levels

7.6.1 Emissions into Non-Restricted Frequency Bands – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

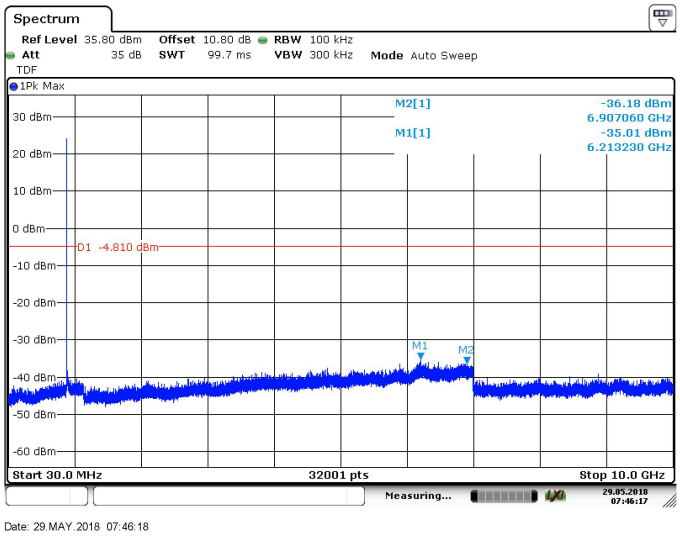
7.6.1.1 Measurement Procedure

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.

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.

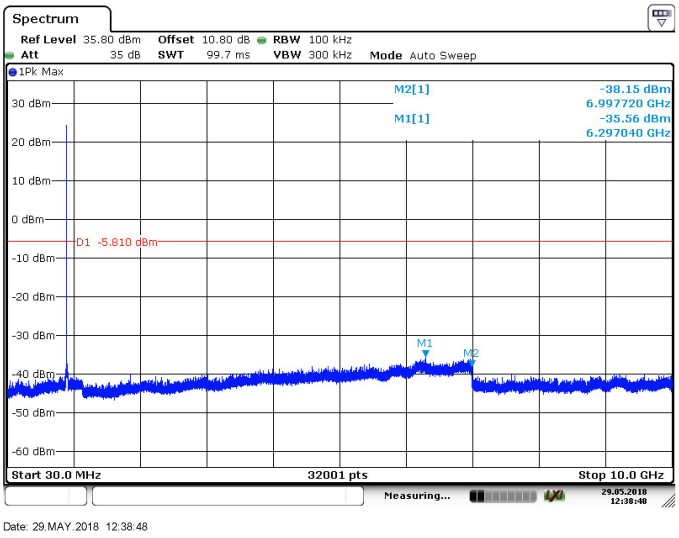
7.6.1.2 Measurement Results

Performed by: Jeremy Pickens



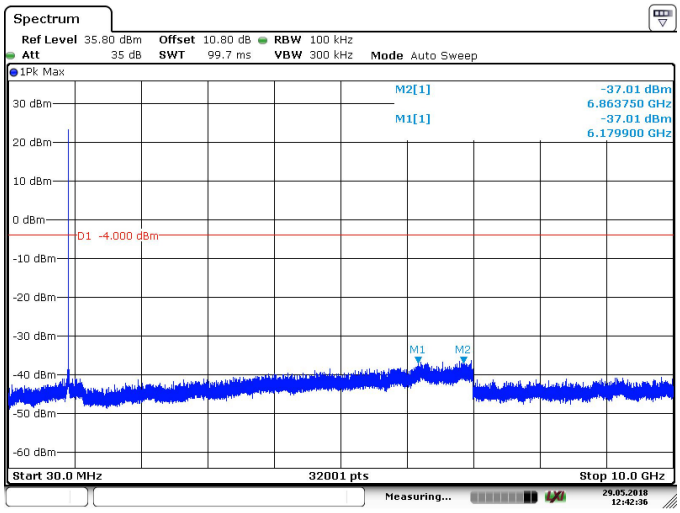
Date: 29.MAY.2018 07:46:18

Figure 7.6.1.2-1: 30 MHz – 10 GHz – Low Channel



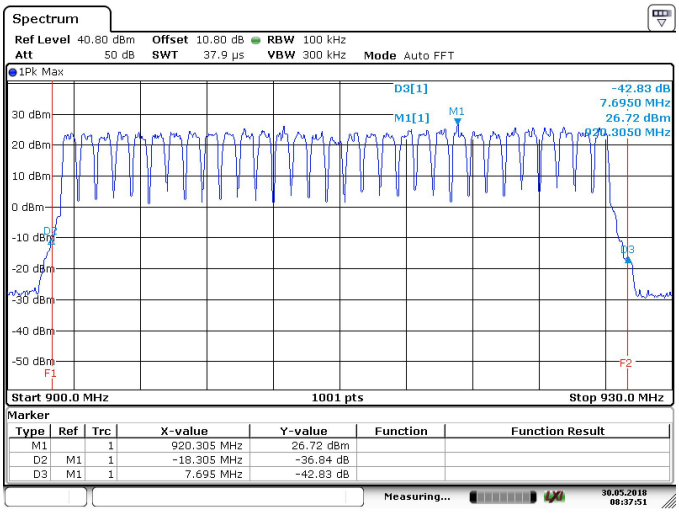
Date: 29.MAY.2018 12:38:48

Figure 7.6.1.2-2: 30 MHz – 10 GHz – Middle Channel



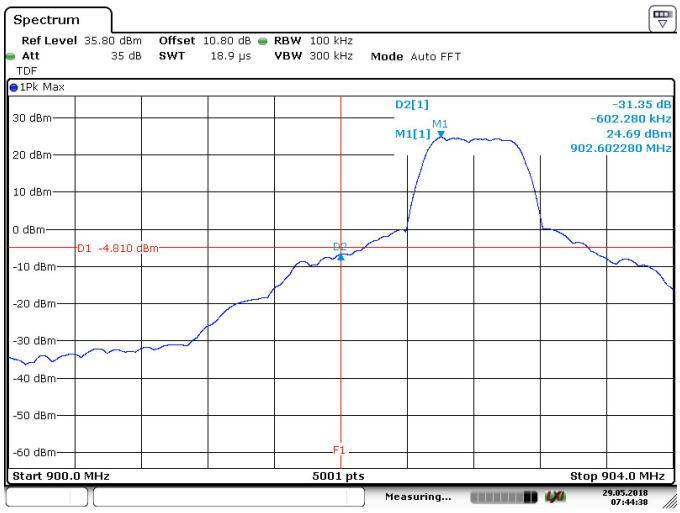
Date: 29.MAY.2018 12:42:37

Figure 7.6.1.2-3: 30 MHz – 10 GHz –High Channel



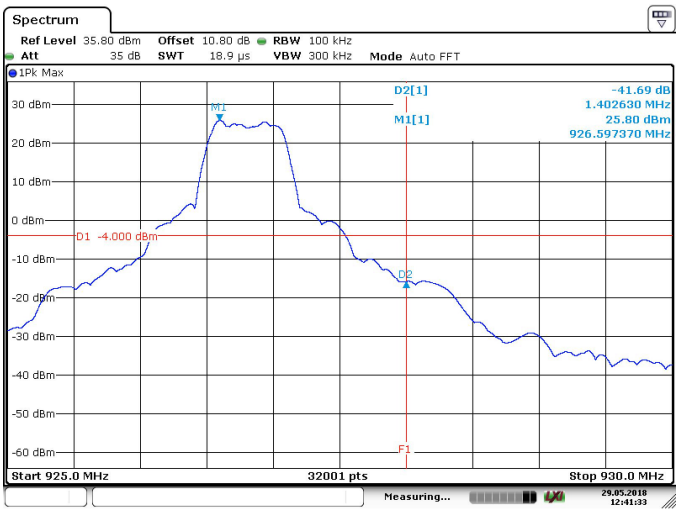
Date: 30.MAY.2018 08:37:51

Figure 7.6.1.2-4: Band-edges – Hopping



Date: 29.MAY.2018 07:44:38

Figure 7.6.1.2-5: Lower Band-edge – No Hopping



Date: 29.MAY.2018 12:41:34

Figure 7.6.1.2-6: Upper Band-edge - No Hopping

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

7.6.2.1 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.

7.6.2.2 Measurement Results

Performed by: Tyler Leeson, Jeremy Pickens

Table 7.6.2.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
* No restricted band emissions detected above the noise floor.										
Mid Channel										
* No restricted band emissions detected above the noise floor.										
High Channel										
* No restricted band emissions detected above the noise floor.										

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

7.7.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance utilizing the AVGPSD 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 1.5 times the DTS Bandwidth. 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.

7.7.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.7.2-1: Power Spectral Density

Frequency [MHz]	PSD Level [dBm]
902.8	-0.98
914.8	-0.42
926.8	0.61

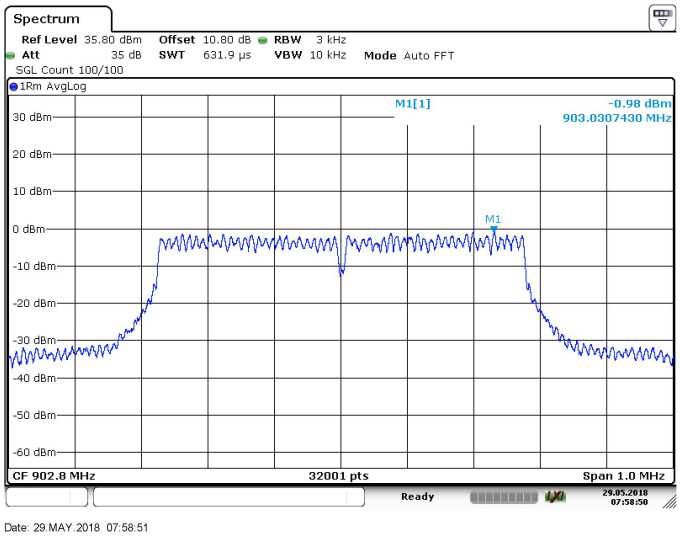


Figure 7.7.2-1: Power Spectral Density – LCH

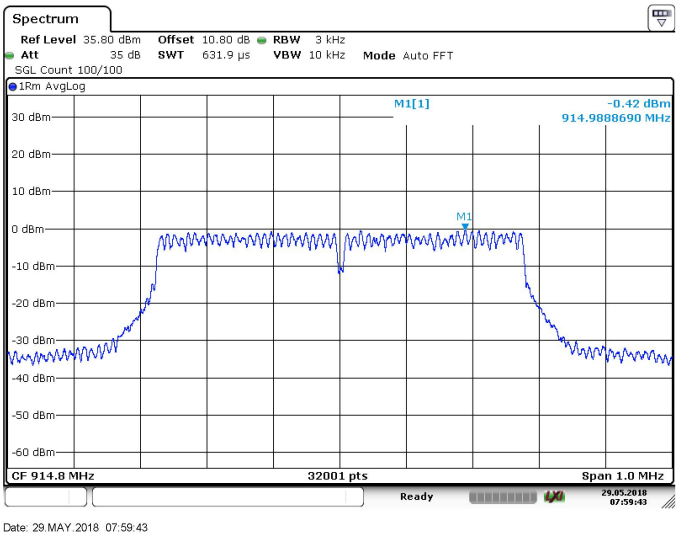


Figure 7.7.2-2: Power Spectral Density – MCH

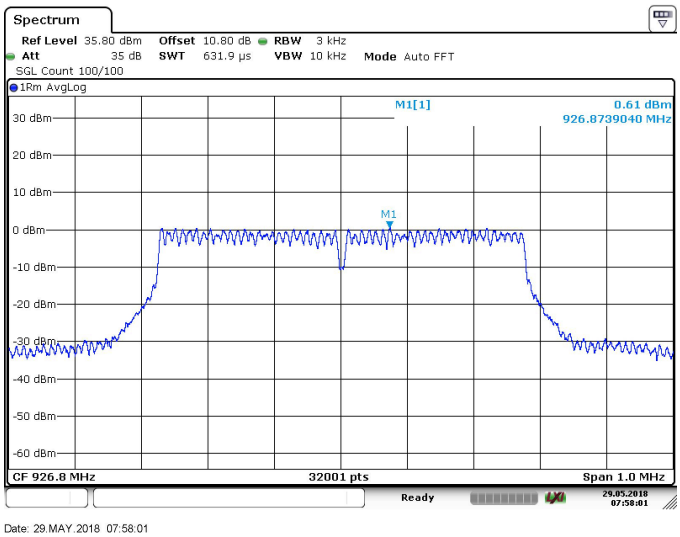


Figure 7.7.2-3: Power Spectral Density – HCH

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%.

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 ACT2, manufactured by Itron, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for the tests documented in this test report.

END REPORT