Excellence in Compliance Testing

Certification Test Report

FCC ID: SK9ACT1
IC: 864G-ACT1

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

ACS Report Number: 16-0130.W06.1C

Manufacturer: Itron, Inc.
Models: ACT1

Test Begin Date: June 15, 2016
Test End Date: September 16, 2016

Report Issue Date: September 30, 2016

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: AT-2021

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

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This report contains 37 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 ACT1 is an electricity metering module which includes a 902.4 MHz to 927.6 MHz transmitter as well as WiFi. 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 902.4 MHz to 927.6 MHz transceiver mode of operation.

Technical Details:

Detail	Description
Frequency Range	902.4 – 927.6 MHz
Number of Channels	64
Modulation Format	FSK, OFDM, DSSS
Data Rates	FSK: 50kbps, 150kbps OFDM: 200kbps, 600kbps DSSS: 6.25kbps, 12.5kbps
Operating Voltage	24Vdc
Antenna Type(s) / Gain(s)	¼ Wave Embedded Slot Antenna / 2dBi

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

EUT Serial Numbers: Radiated/Power Line Conducted Emissions: 9840001301
RF Conducted Emissions: 9840001498, 9840001469, 9840001223

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 for each mode. The data presented in this report represents the worst case where applicable. A single test sample was not capable of supporting all modulation formats for test mode, therefore multiple samples were used to evaluate the compliance of all available modulation formats.

For radiated emissions the EUT was evaluated in three orthogonal orientations. The worst case orientation was the X-orientation. See test setup photos for more information. All data rates were evaluated for worst case operation for each modulation format. The worst case data rates evaluated were FSK 150kbps, OFDM 200kbps, and DSSS 6.25kbps.

For AC power line conducted emissions the EUT was evaluated with a commercially available wall wart power supply.

For RF conducted emissions, the EUT was modified with a temporary u.fl connector for coupling to the measurement equipment.

Radiated inter-modulation testing was performed for all combinations of simultaneous transmission and found to be in compliance.

Software power settings during test: FSK Modulation: -3
OFDM Modulation: -5
DSSS Modulation: -2

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Innovation, Science, and Economic Development Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 391271
Innovation, Science, and Economic Development Canada Lab Code: IC 4175A
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

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' 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 150cm in diameter and is located 160cm 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 table 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 chases from the turntable to the pit that allow 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.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

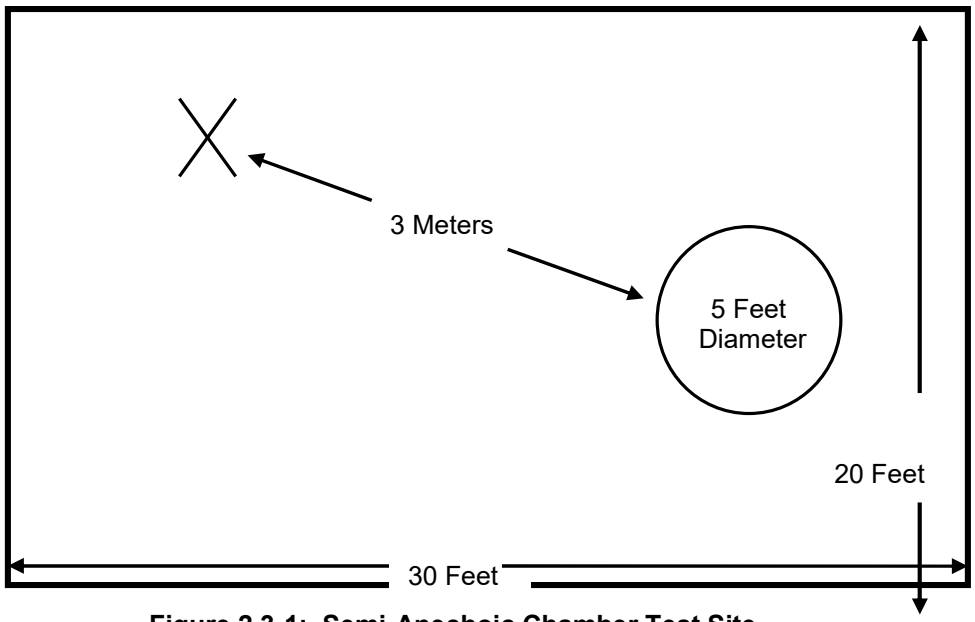

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 – 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' 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.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 – 4" PVC chases from the pit to the control room that allow 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 pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.10.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

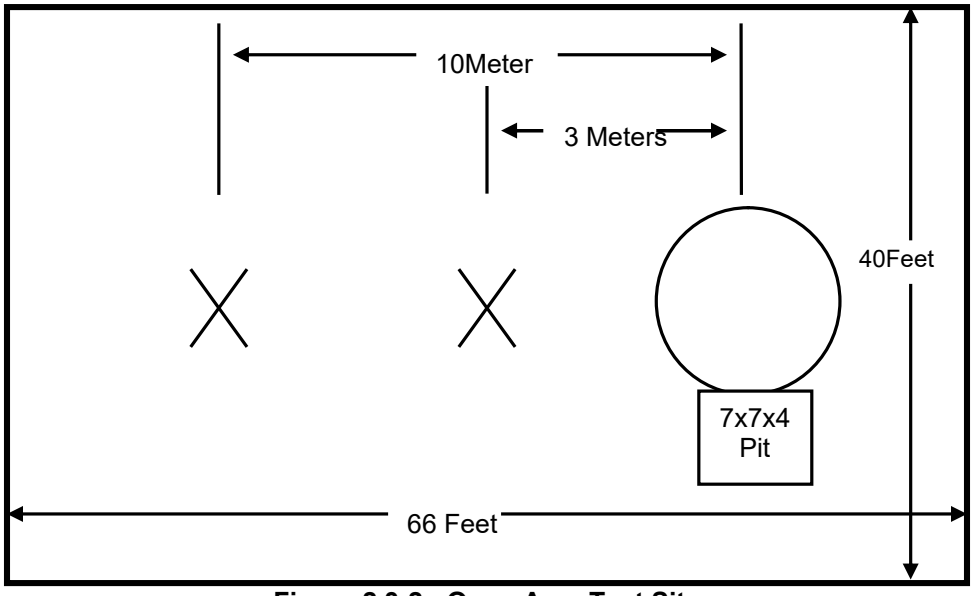

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

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.

A diagram of the room is shown below in figure 2.4-1:

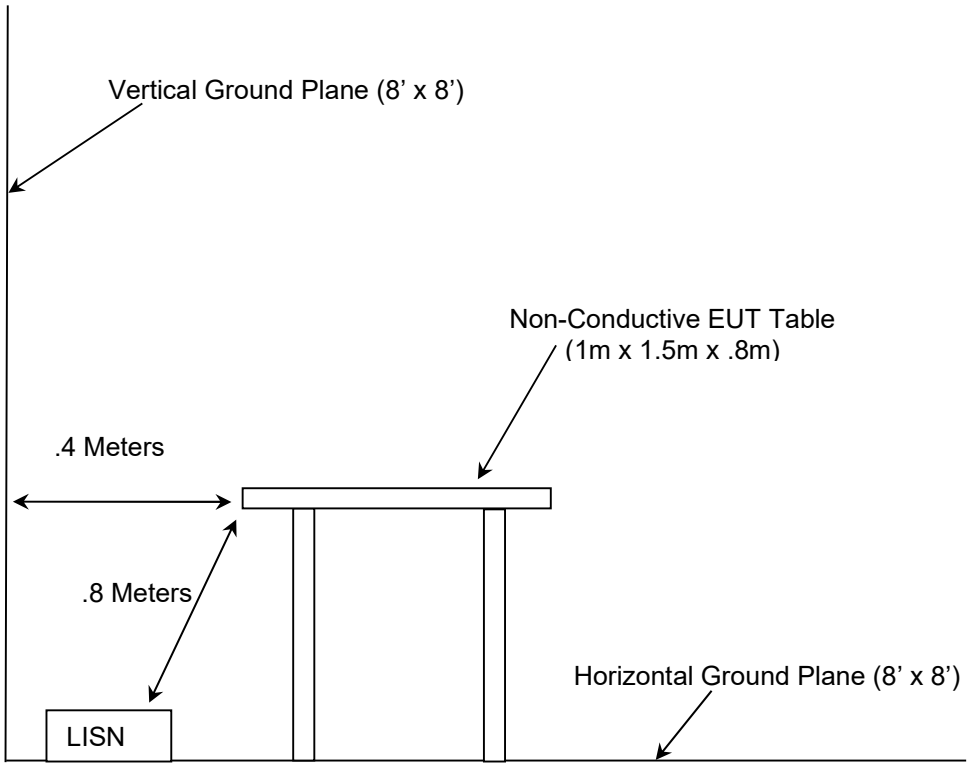

Figure 2.4-1: AC Mains Conducted EMI Site

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, 2016
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, 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

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	7/14/2015	7/14/2016
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/14/2015	7/14/2016
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	2/10/2015	2/10/2017
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2015	7/15/2016
167	ACS	hamber EMI Cable S	Cable Set	167	10/20/2015	10/20/2016
267	Agilent	N1911A	Meters	MY45100129	8/24/2015	8/24/2017
268	Agilent	N1911A	Meters	MY45100129	8/24/2015	8/24/2017
324	ACS	Belden	Cables	8214	5/2/2016	5/2/2017
337	Microwave Circuits	H1G513G1	Filters	282706	5/13/2016	5/13/2017
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/13/2015	7/13/2016
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/12/2016	7/12/2017
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	10/30/2015	10/30/2016
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/3/2015	9/3/2016
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/15/2015	7/15/2016
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/15/2016	7/15/2018
676	Florida RF Labs	SMS-290AW-480.0-SMS	Cables	MFR2Y194	9/3/2015	9/3/2016
3010	Rohde & Schwarz	ENV216	LISN	3010	7/10/2015	7/10/2016
3010	Rohde & Schwarz	ENV216	LISN	3010	7/11/2016	7/11/2017
RE112	Rohde & Schwarz	ESIB26	Receiver	836119/012	7/16/2015	7/16/2016

NCR = No Calibration Required

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

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	DC Power Supply	Volgen	KTPS24-24010WA	N/A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

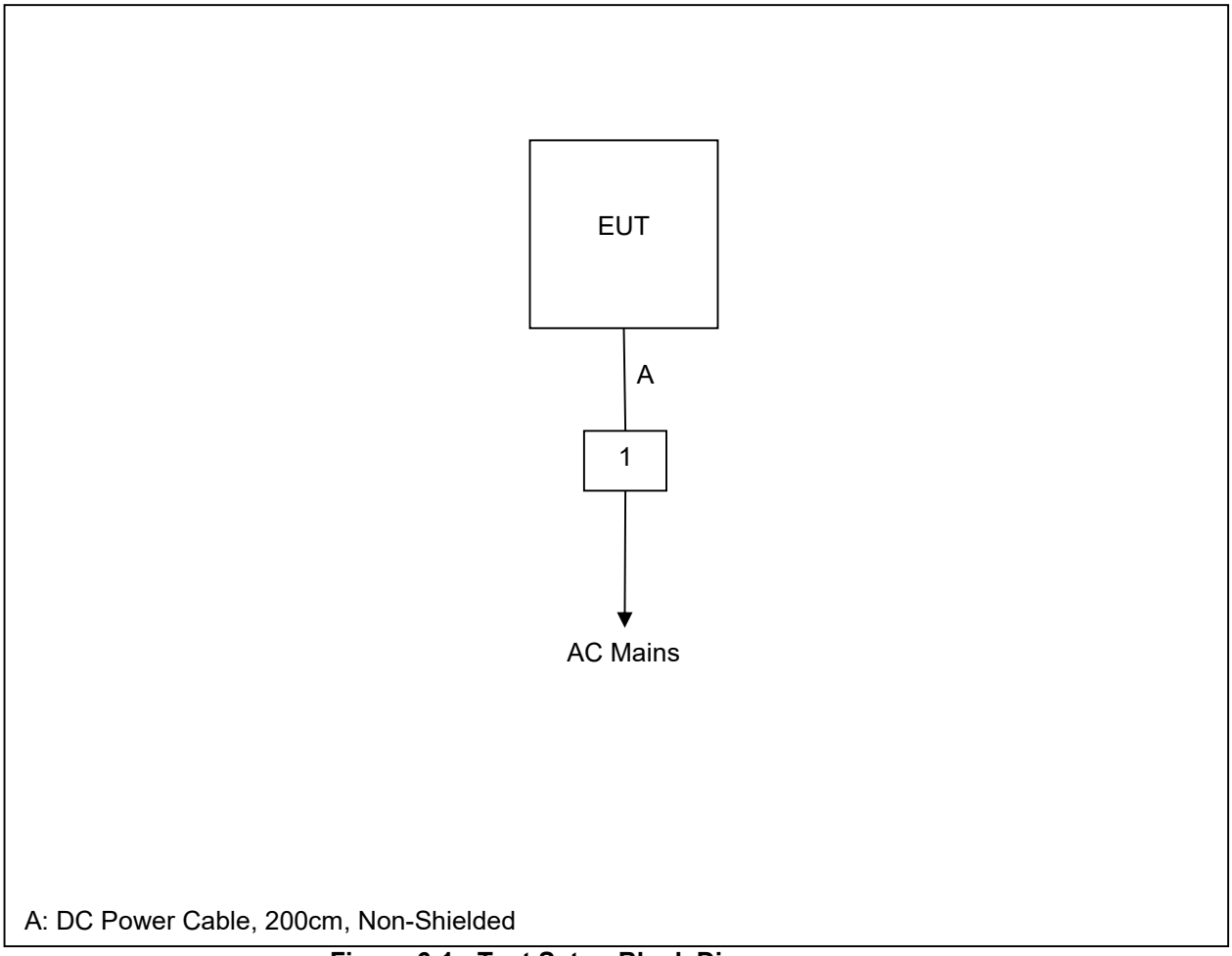

Figure 6-1: Test Setup Block Diagram

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 ACT1 utilizes a ¼ wave embedded slot antenna with 2dBi gain. The antenna is integral to the device and cannot be removed or replaced by the end user, therefore satisfying the requirements of Section 15.203.

7.2 Power Line Conducted Emissions – FCC 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

Table 7.2.2-1: Conducted EMI Results Line 1

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.475451	---	23.16	46.38	23.22	L1	9.7
0.475451	37.84	---	56.39	18.55	L1	9.7
1.302705	---	12.68	46.00	33.32	L1	9.8
1.302705	26.06	---	56.00	29.94	L1	9.8
4.965231	---	10.74	46.00	35.26	L1	9.9
4.965231	21.33	---	56.00	34.67	L1	9.9
10.593888	---	9.11	50.00	40.89	L1	10.0
10.593888	21.70	---	60.00	38.30	L1	10.0
10.622345	---	6.53	50.00	43.47	L1	10.0
10.622345	17.19	---	60.00	42.81	L1	10.0
10.622946	---	6.76	50.00	43.24	L1	10.0
10.622946	15.91	---	60.00	44.09	L1	10.0

Table 7.2.2-2: Conducted EMI Results Line 2

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.480361	---	18.85	46.30	27.45	N	9.7
0.480361	31.82	---	56.31	24.49	N	9.7
0.616533	---	10.01	46.00	35.99	N	9.7
0.616533	22.98	---	56.00	33.02	N	9.7
3.936080	---	8.58	46.00	37.42	N	9.8
3.936080	20.38	---	56.00	35.62	N	9.8
4.109318	---	8.56	46.00	37.44	N	9.8
4.109318	19.44	---	56.00	36.56	N	9.8
4.198898	---	7.17	46.00	38.83	N	9.9
4.198898	18.37	---	56.00	37.63	N	9.9
10.094088	---	6.76	50.00	43.24	N	10.0
10.094088	17.19	---	60.00	42.81	N	10.0

7.3 Peak Output Power - FCC 15.247(b)(2) ISED Canada: RSS-247 5.4(1)

7.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of a 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

Table 7.3.2-1: Maximum Conducted Peak Output Power

Frequency [MHz]	Level [dBm]	Modulation Format	Data Rate [kbps]
902.4	28.81	FSK	50
915.2	29.48	FSK	50
927.6	29.25	FSK	50
902.4	29.30	FSK	150
915.2	29.87	FSK	150
927.6	29.60	FSK	150
902.4	29.36	OFDM	200
915.2	29.82	OFDM	200
927.6	29.61	OFDM	200
902.4	29.08	OFDM	600
915.2	29.88	OFDM	600
927.6	29.69	OFDM	600
902.4	29.28	DSSS	6.25
915.2	29.74	DSSS	6.25
927.6	29.48	DSSS	6.25
902.4	29.31	DSSS	12.5
915.2	29.68	DSSS	12.5
927.6	29.65	DSSS	12.5

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC 15.247(a)(1) ISED Canada: RSS-247 5.1(2)

7.4.1.1 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.

7.4.1.2 Measurement Results

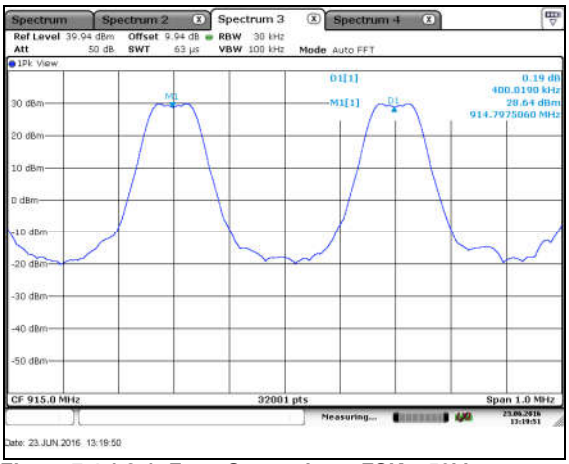

Figure 7.4.1.2-1: Freq. Separation – FSK – 50kbps

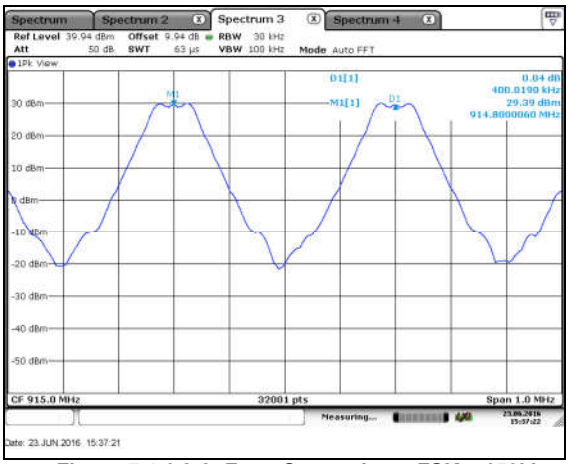

Figure 7.4.1.2-2: Freq. Separation – FSK – 150kbps

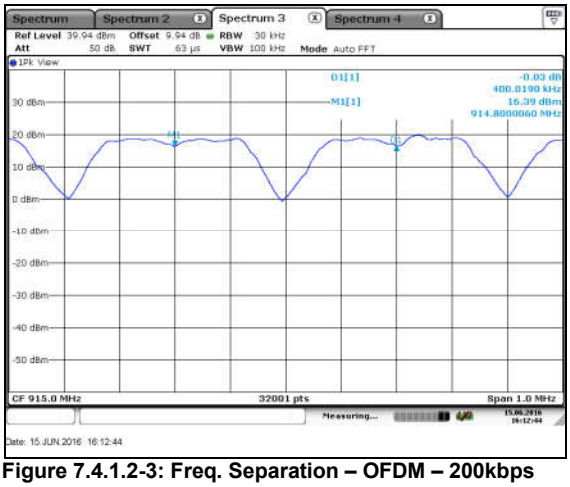

Figure 7.4.1.2-3: Freq. Separation – OFDM – 200kbps

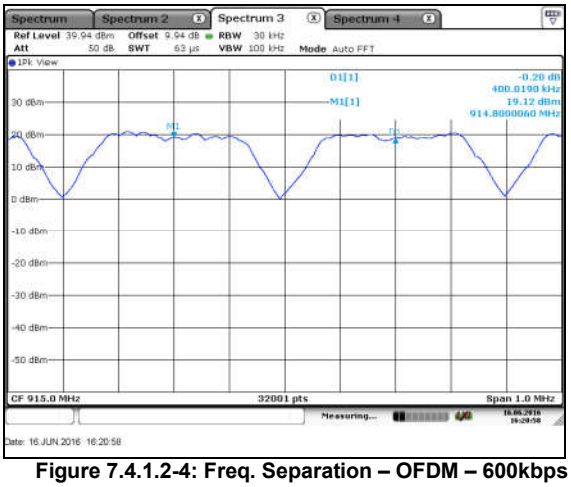

Figure 7.4.1.2-4: Freq. Separation – OFDM – 600kbps

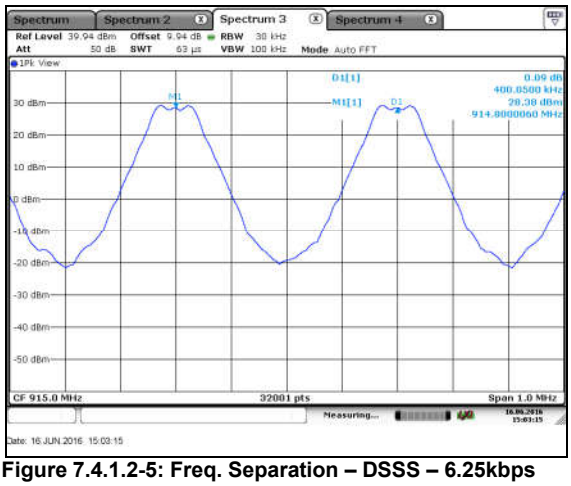

Figure 7.4.1.2-5: Freq. Separation – DSSS – 6.25kbps

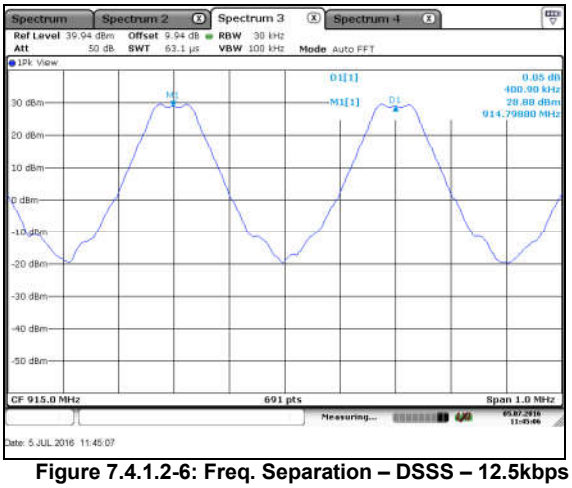

Figure 7.4.1.2-6: Freq. Separation – DSSS – 12.5kbps

7.4.2 Number of Hopping Channels – FCC 15.247(a)(1)(i) ISED Canada: RSS-247 5.1(3)

7.4.2.1 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 the frequency band of operation. The RBW was set to < 30% of the channel spacing and VBW set to ≥ RBW.

7.4.2.2 Measurement Results

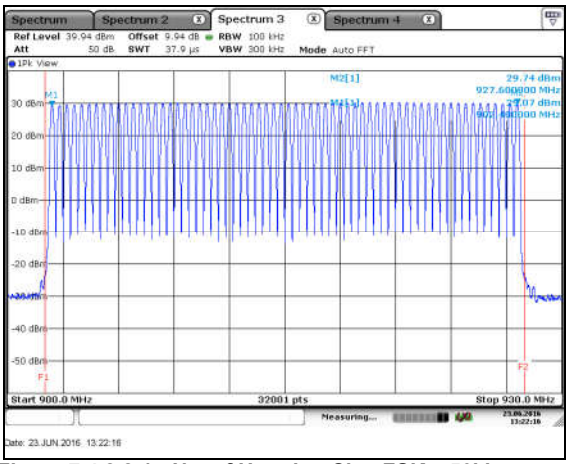

Figure 7.4.2.2-1: No. of Hopping Ch – FSK – 50kbps

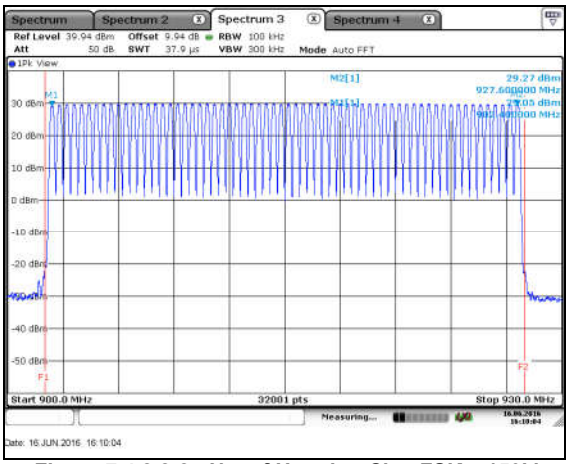

Figure 7.4.2.2-2: No. of Hopping Ch – FSK – 150kbps

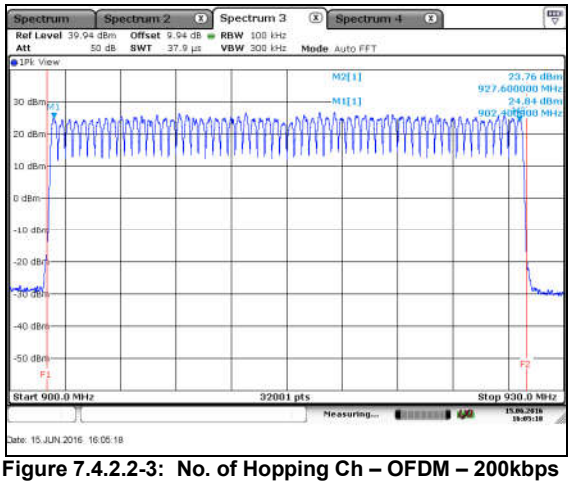

Figure 7.4.2.2-3: No. of Hopping Ch – OFDM – 200kbps

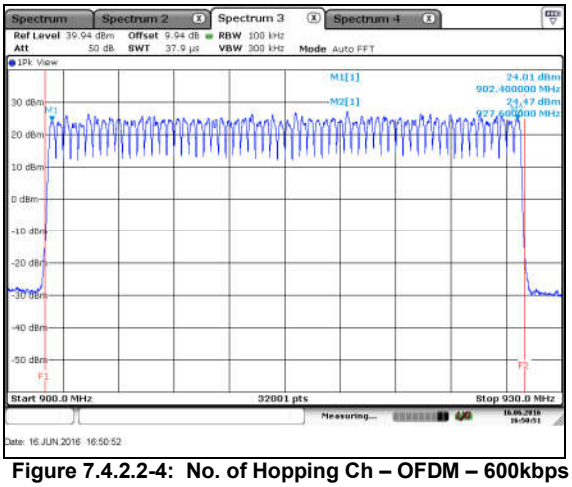

Figure 7.4.2.2-4: No. of Hopping Ch – OFDM – 600kbps

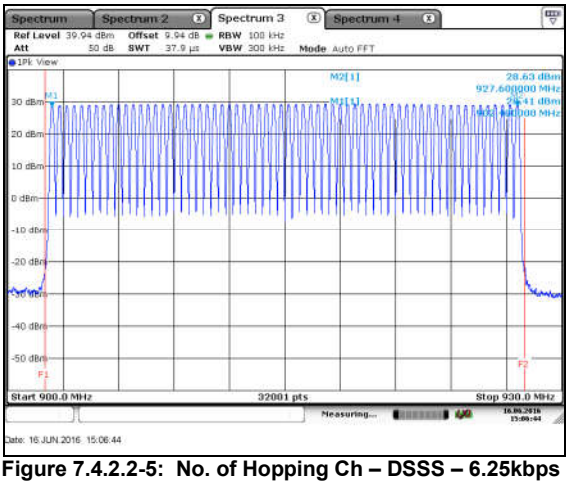

Figure 7.4.2.2-5: No. of Hopping Ch – DSSS – 6.25kbps

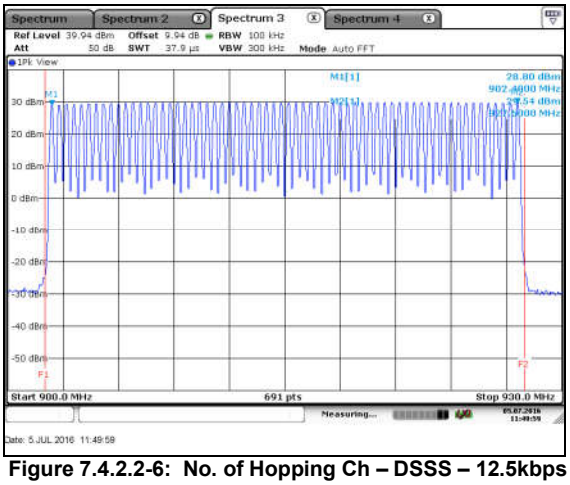

Figure 7.4.2.2-6: No. of Hopping Ch – DSSS – 12.5kbps

7.4.3 Channel Dwell Time – FCC 15.247(a)(1)(i) ISED Canada: RSS-247 5.1(3)

7.4.3.1 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.

7.4.4 20dB / 99% Bandwidth - FCC 15.247(a)(1)(i) ISED Canada: RSS-247 5.1(3)

7.4.4.1 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 marker delta and 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 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

Table 7.4.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]	Modulation Format	Data Rate [kbps]
902.4	96.344	85.554	FSK	50
915.2	91.544	85.722	FSK	50
927.6	91.235	85.769	FSK	50
902.4	176.385	154.511	FSK	150
915.2	176.151	155.464	FSK	150
927.6	174.776	155.026	FSK	150
902.4	363.520	303.459	OFDM	200
915.2	371.770	303.991	OFDM	200
927.6	368.832	301.584	OFDM	200
902.4	362.239	304.803	OFDM	600
915.2	360.239	301.459	OFDM	600
927.6	361.645	307.647	OFDM	600
902.4	126.902	110.793	DSSS	6.25
915.2	126.668	110.840	DSSS	6.25
927.6	126.746	110.653	DSSS	6.25
902.4	129.012	112.809	DSSS	12.5
915.2	128.793	112.653	DSSS	12.5
927.6	128.590	112.746	DSSS	12.5

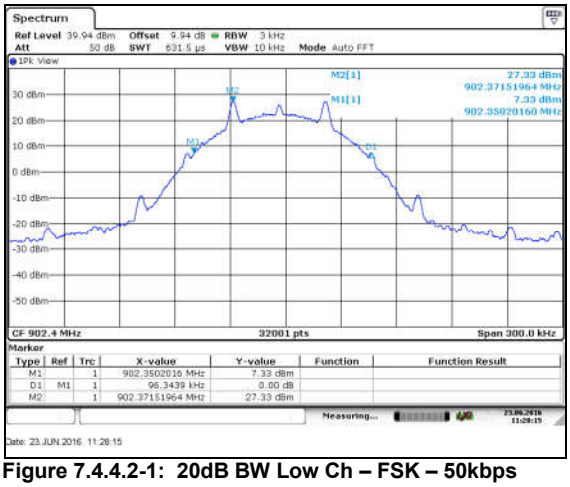

Figure 7.4.4.2-1: 20dB BW Low Ch – FSK – 50kbps

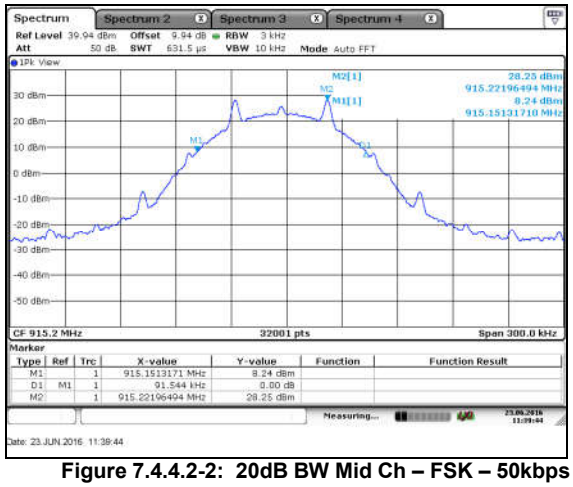

Figure 7.4.4.2-2: 20dB BW Mid Ch – FSK – 50kbps

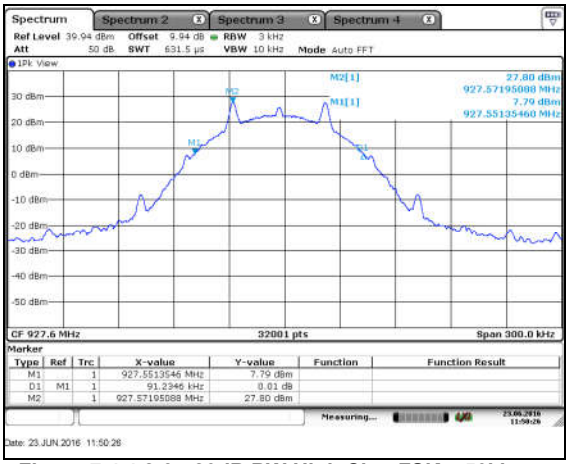

Figure 7.4.4.2-3: 20dB BW High Ch – FSK – 50kbps

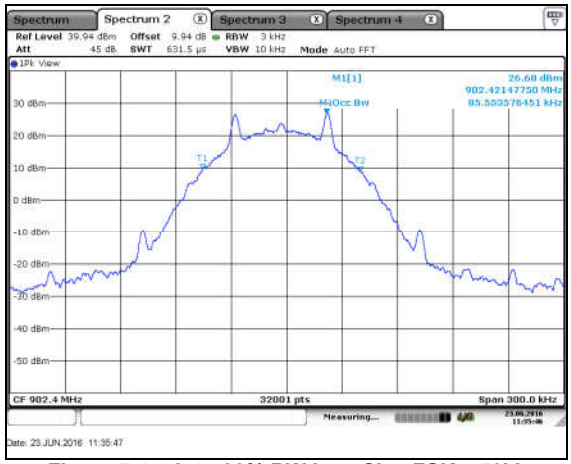

Figure 7.4.4.2-4: 99% BW Low Ch – FSK – 50kbps

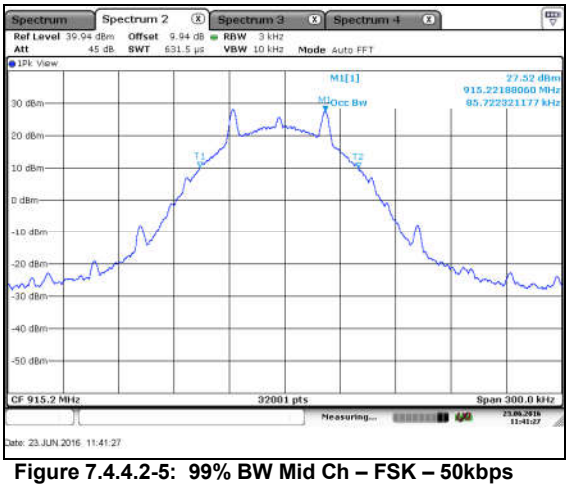

Figure 7.4.4.2-5: 99% BW Mid Ch – FSK – 50kbps

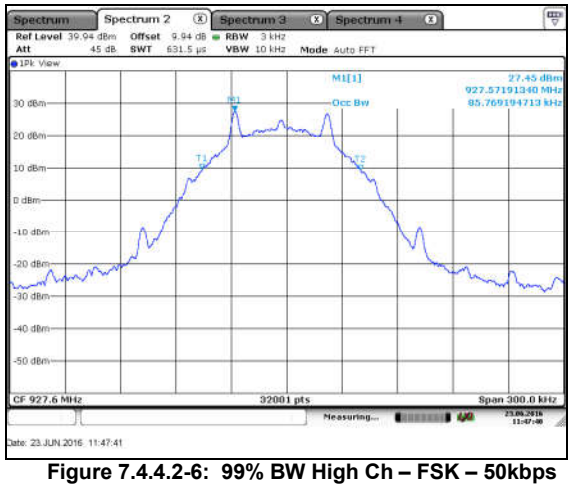

Figure 7.4.4.2-6: 99% BW High Ch – FSK – 50kbps

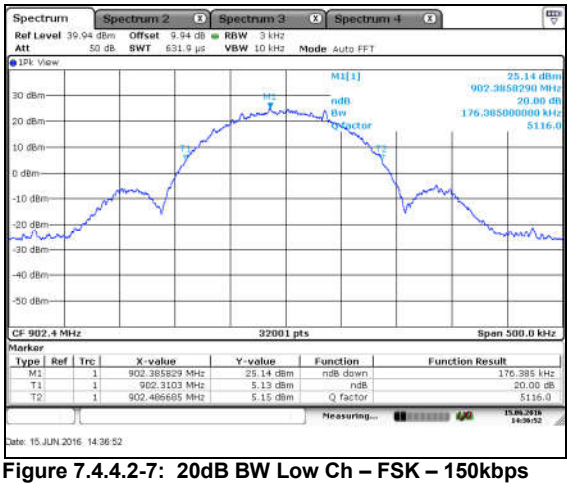

Figure 7.4.4.2-7: 20dB BW Low Ch – FSK – 150kbps

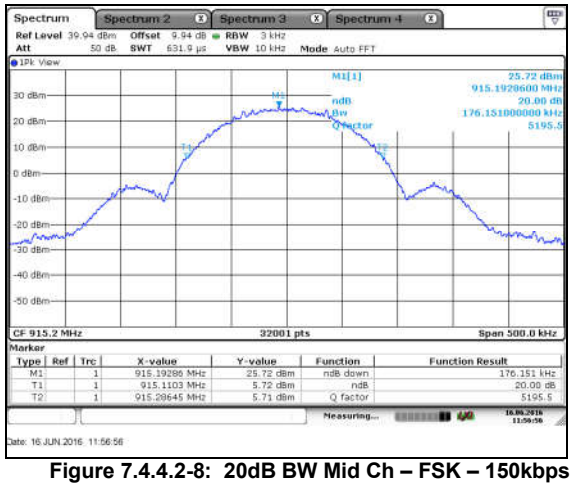

Figure 7.4.4.2-8: 20dB BW Mid Ch – FSK – 150kbps

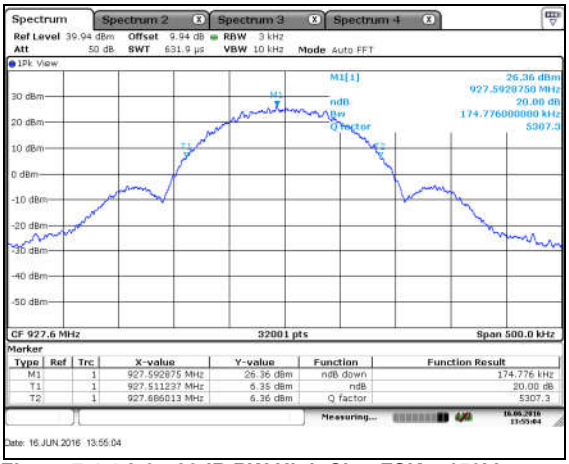

Figure 7.4.4.2-9: 20dB BW High Ch – FSK – 150kbps

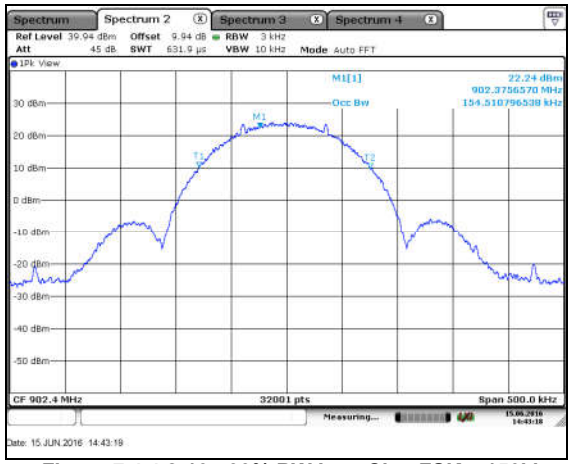

Figure 7.4.4.2-10: 99% BW Low Ch – FSK – 150kbps

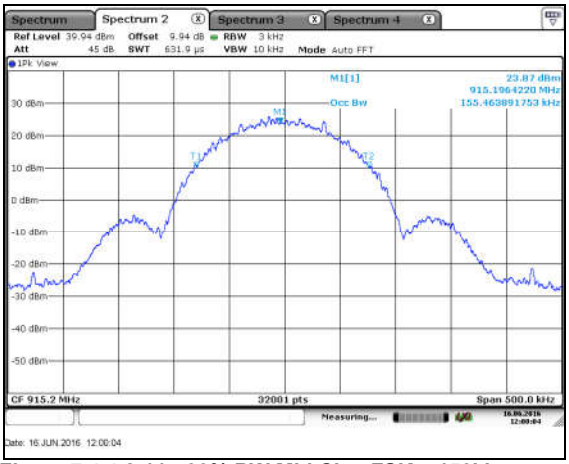

Figure 7.4.4.2-11: 99% BW Mid Ch – FSK – 150kbps

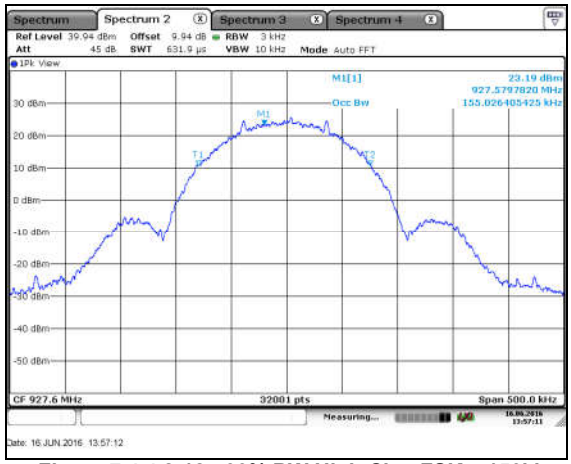

Figure 7.4.4.2-12: 99% BW High Ch – FSK – 150kbps

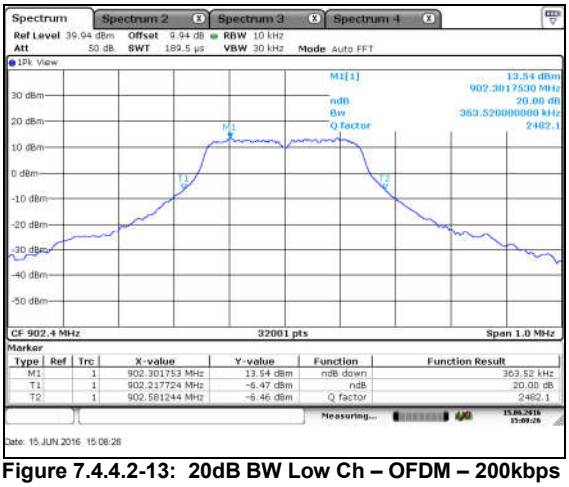

Figure 7.4.4.2-13: 20dB BW Low Ch – OFDM – 200kbps

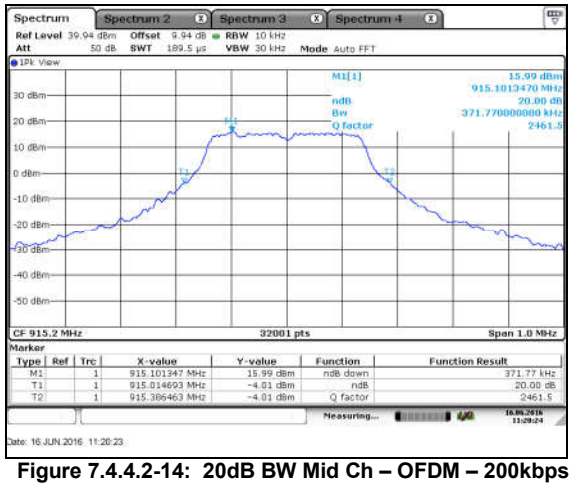

Figure 7.4.4.2-14: 20dB BW Mid Ch – OFDM – 200kbps

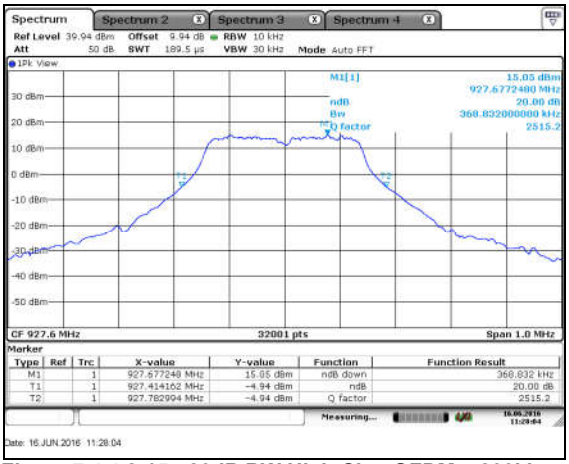

Figure 7.4.4.2-15: 20dB BW High Ch – OFDM – 200kbps

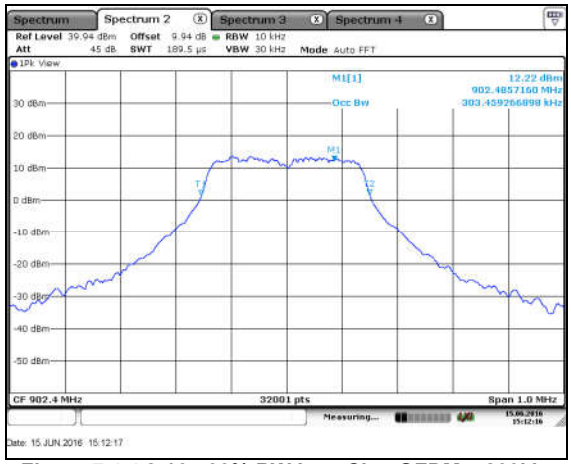

Figure 7.4.4.2-16: 99% BW Low Ch – OFDM – 200kbps

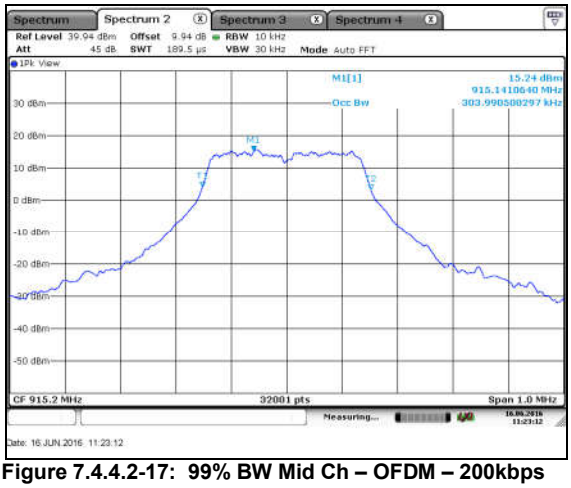

Figure 7.4.4.2-17: 99% BW Mid Ch – OFDM – 200kbps

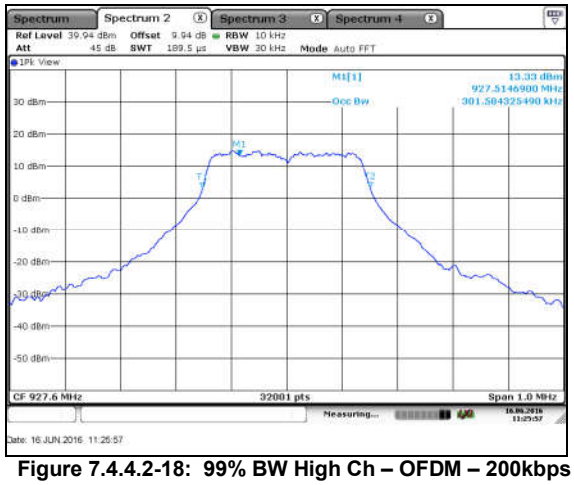

Figure 7.4.4.2-18: 99% BW High Ch – OFDM – 200kbps

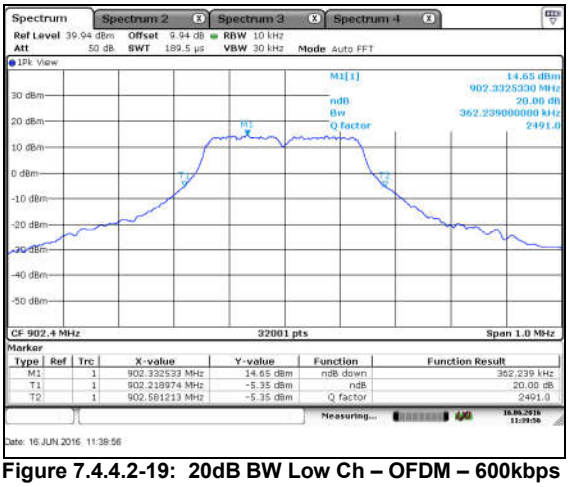

Figure 7.4.4.2-19: 20dB BW Low Ch – OFDM – 600kbps

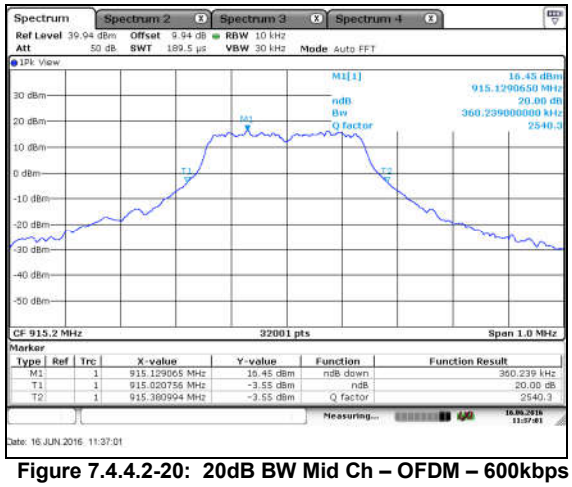

Figure 7.4.4.2-20: 20dB BW Mid Ch – OFDM – 600kbps

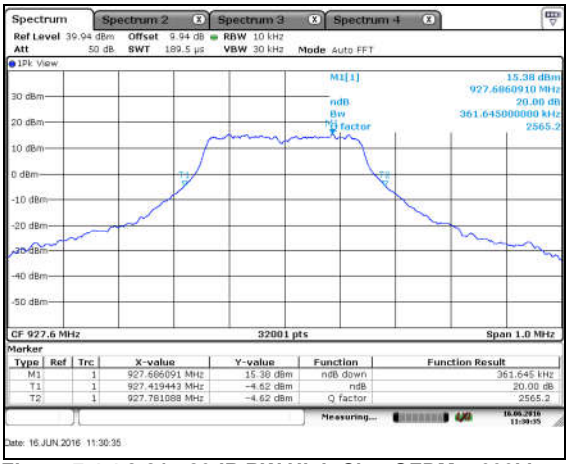

Figure 7.4.4.2-21: 20dB BW High Ch – OFDM – 600kbps

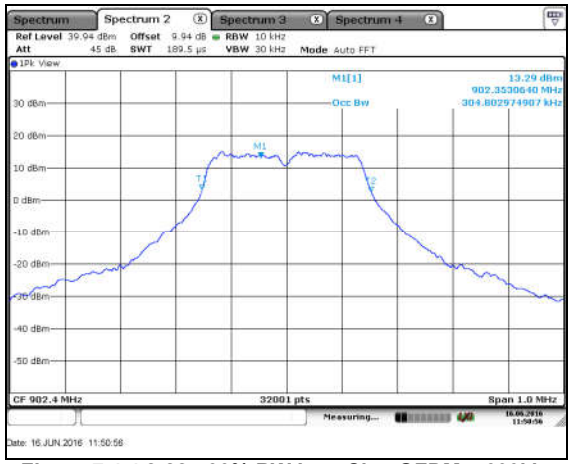

Figure 7.4.4.2-22: 99% BW Low Ch – OFDM – 600kbps

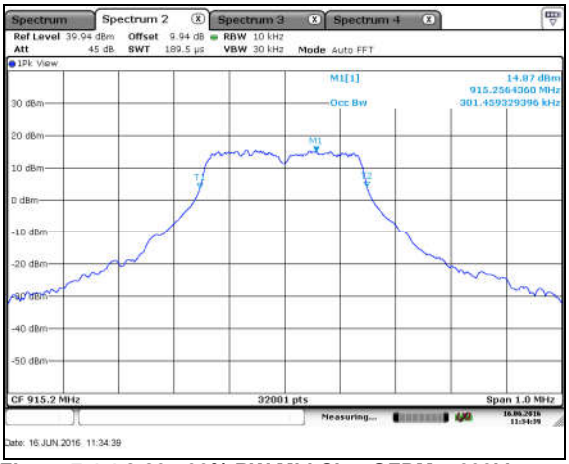

Figure 7.4.4.2-23: 99% BW Mid Ch – OFDM – 600kbps

Figure 7.4.4.2-24: 99% BW High Ch – OFDM – 600kbps

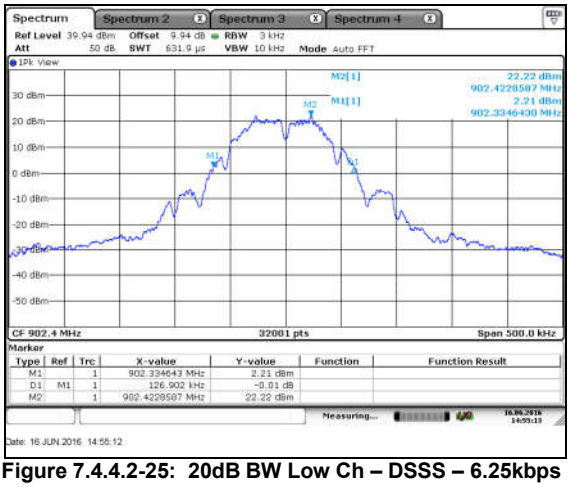

Figure 7.4.4.2-25: 20dB BW Low Ch – DSSS – 6.25kbps

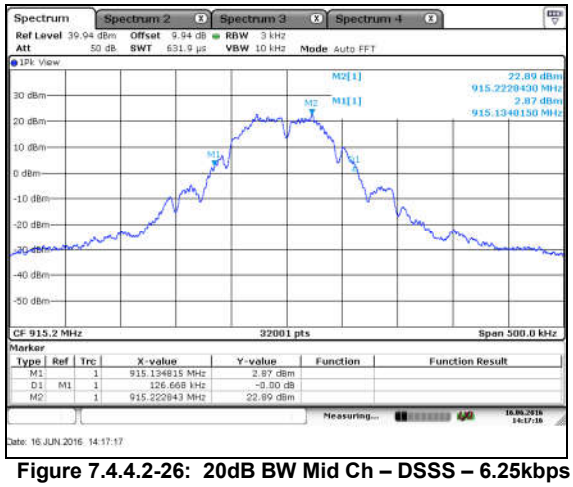

Figure 7.4.4.2-26: 20dB BW Mid Ch – DSSS – 6.25kbps

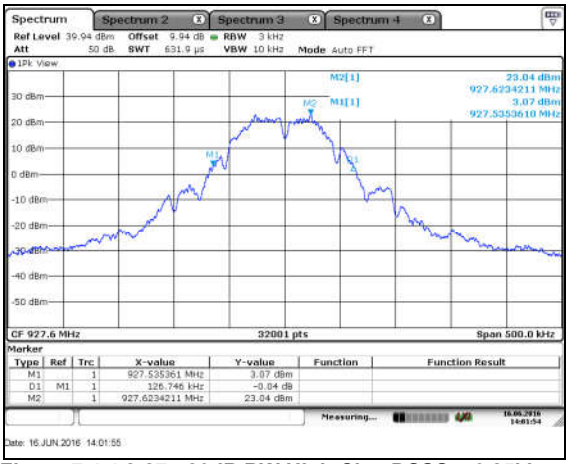

Figure 7.4.4.2-27: 20dB BW High Ch – DSSS – 6.25kbps

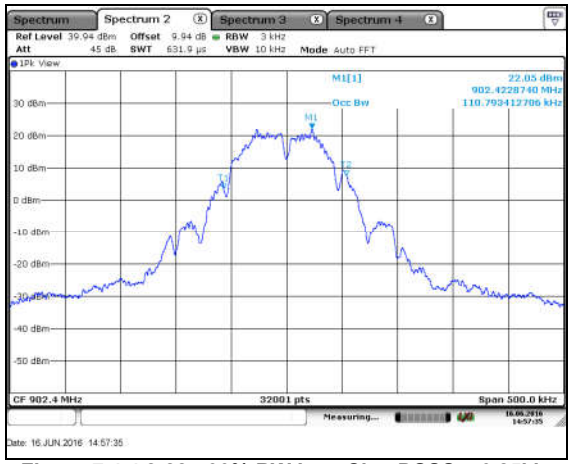

Figure 7.4.4.2-28: 99% BW Low Ch – DSSS – 6.25kbps

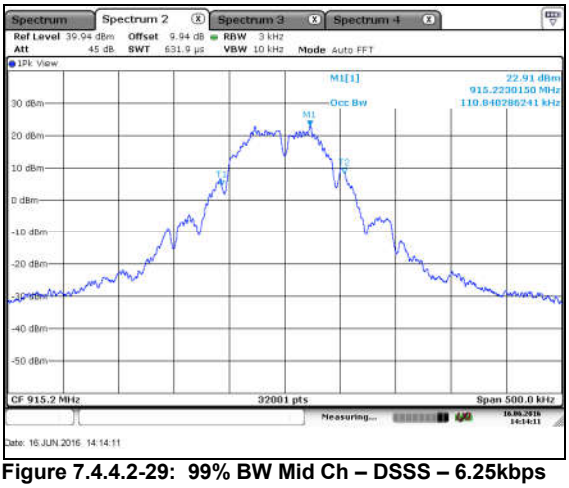

Figure 7.4.4.2-29: 99% BW Mid Ch – DSSS – 6.25kbps

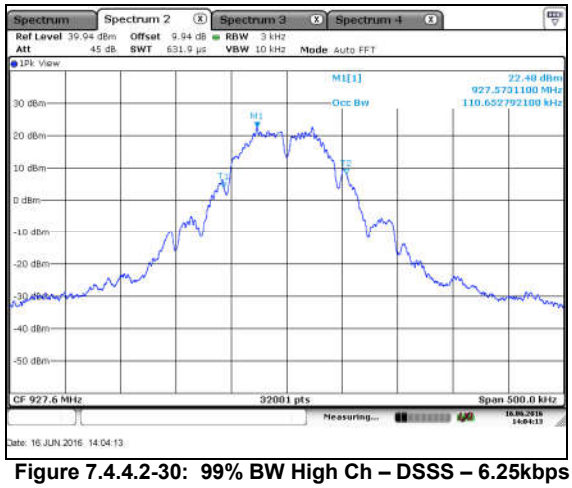

Figure 7.4.4.2-30: 99% BW High Ch – DSSS – 6.25kbps

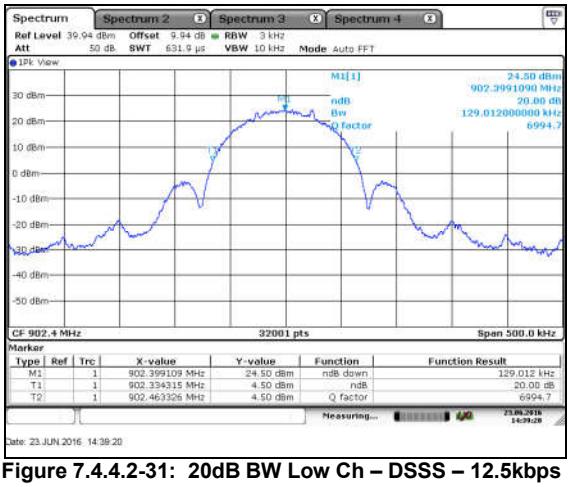

Figure 7.4.4.2-31: 20dB BW Low Ch – DSSS – 12.5kbps

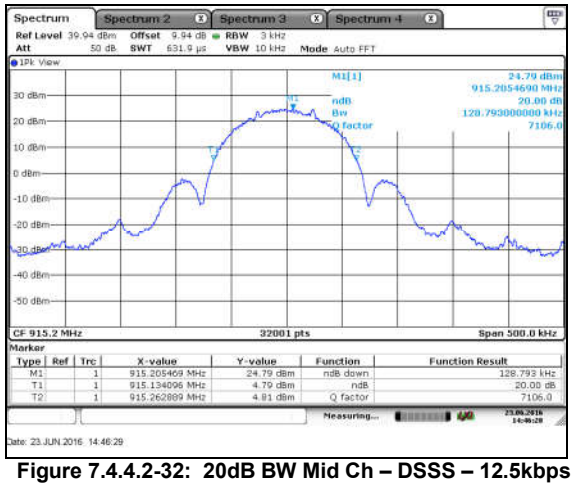

Figure 7.4.4.2-32: 20dB BW Mid Ch – DSSS – 12.5kbps

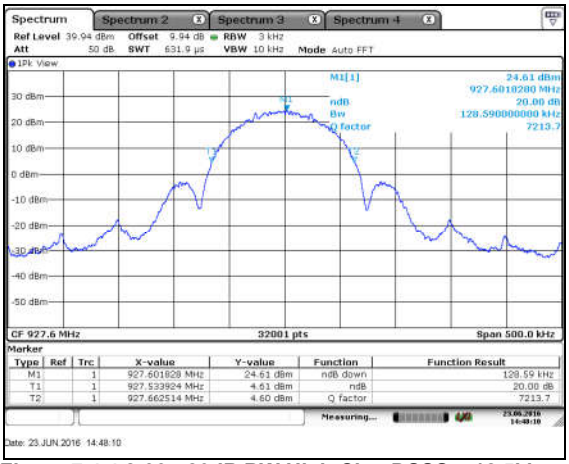

Figure 7.4.4.2-33: 20dB BW High Ch – DSSS – 12.5kbps

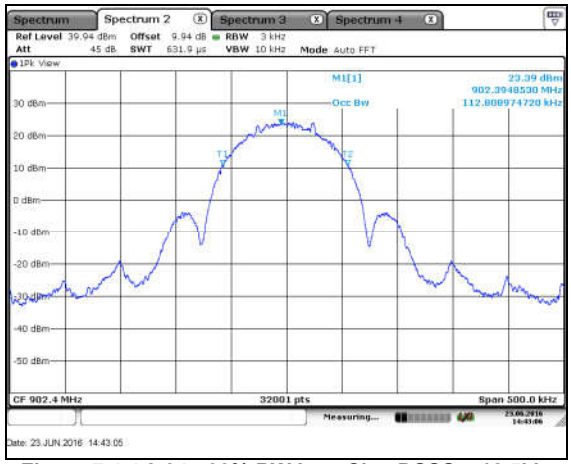

Figure 7.4.4.2-34: 99% BW Low Ch – DSSS – 12.5kbps

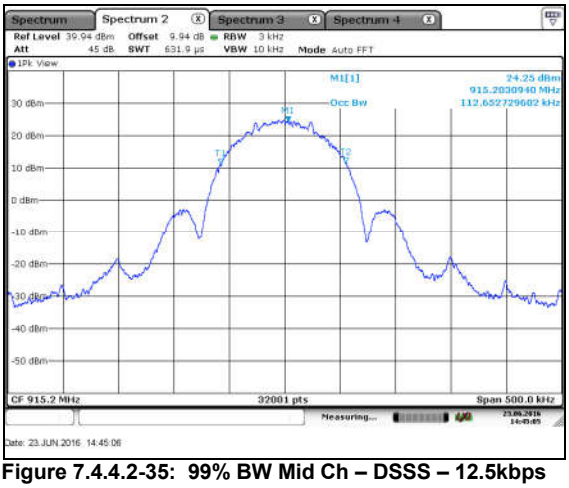

Figure 7.4.4.2-35: 99% BW Mid Ch – DSSS – 12.5kbps

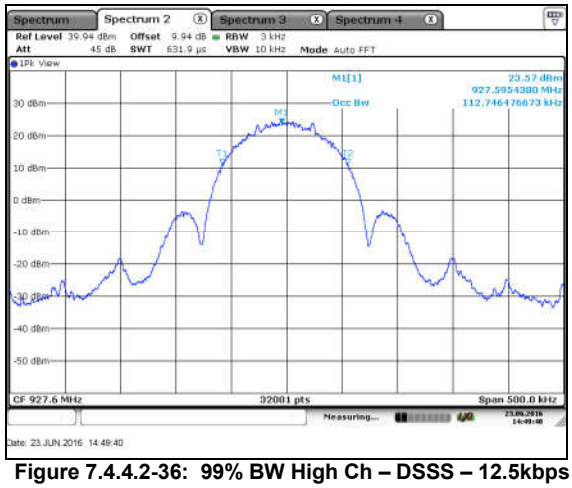

Figure 7.4.4.2-36: 99% BW High Ch – DSSS – 12.5kbps

7.5 Band-Edge Compliance and Spurious Emissions

7.5.1 Band-Edge Compliance of RF Conducted Emissions - FCC 15.247(d); IC 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 using 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 100 kHz, and the VBW was set to 300 kHz.

7.5.1.2 Measurement Results

NON-HOPPING MODE:

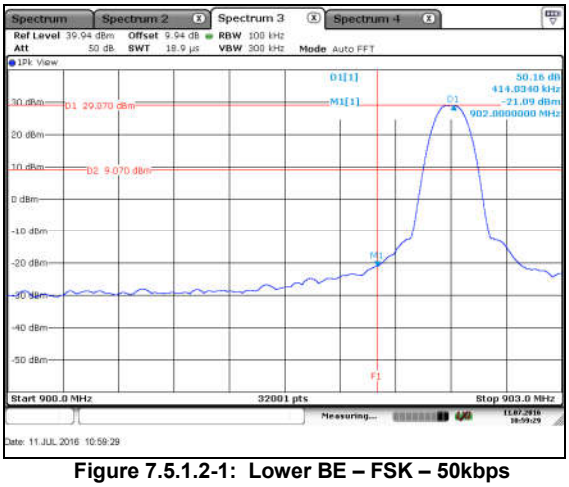

Figure 7.5.1.2-1: Lower BE – FSK – 50kbps

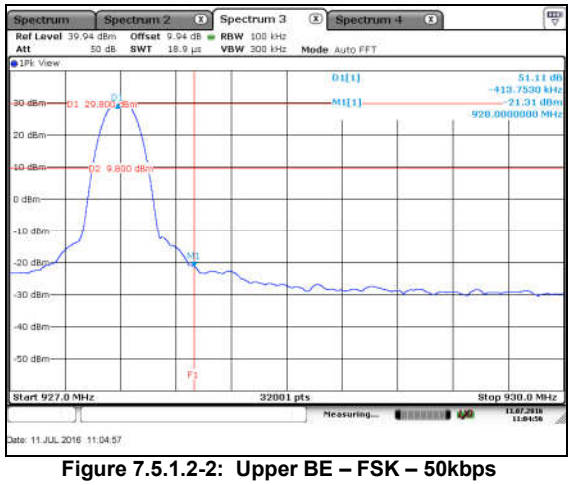

Figure 7.5.1.2-2: Upper BE – FSK – 50kbps

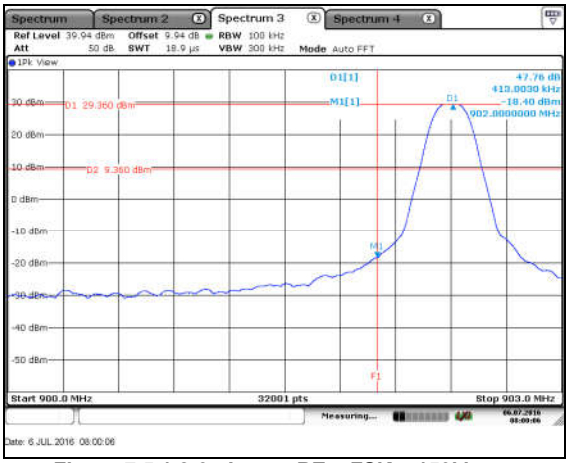

Figure 7.5.1.2-3: Lower BE – FSK – 150kbps

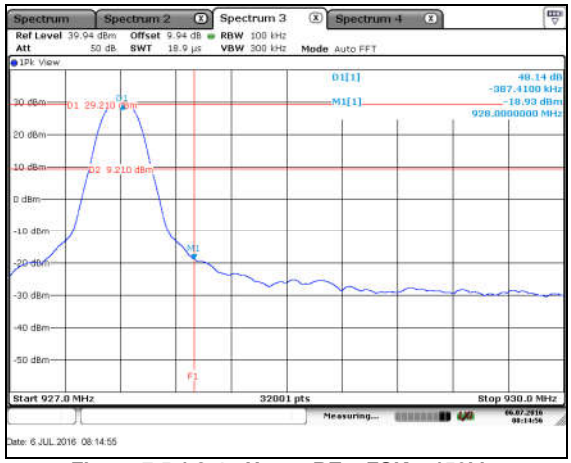

Figure 7.5.1.2-4: Upper BE – FSK – 150kbps

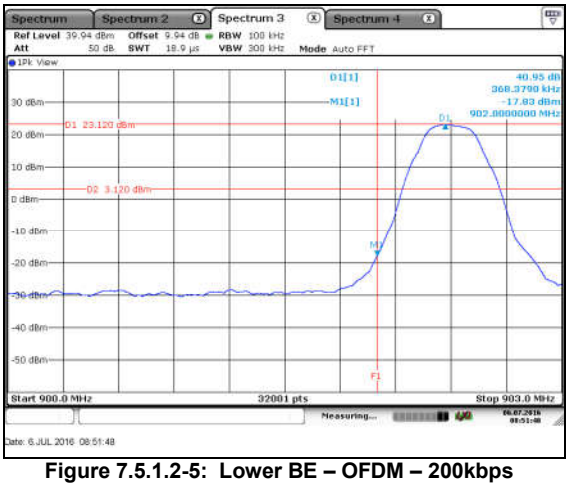

Figure 7.5.1.2-5: Lower BE – OFDM – 200kbps

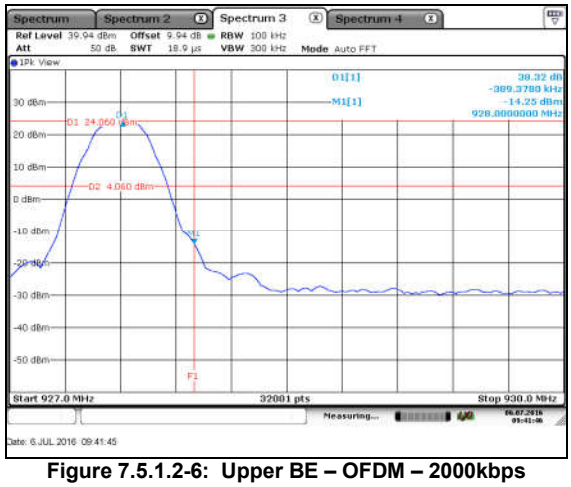

Figure 7.5.1.2-6: Upper BE – OFDM – 2000kbps

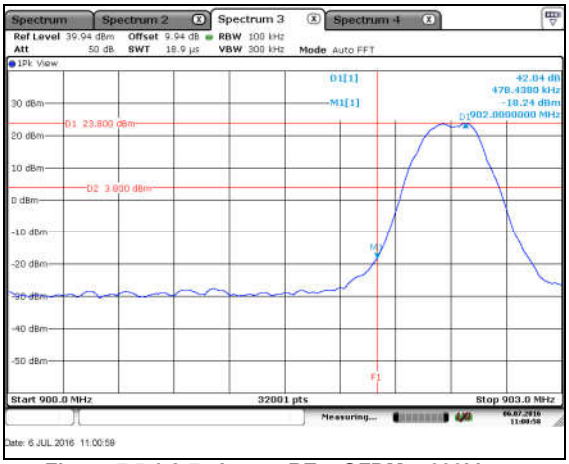

Figure 7.5.1.2-7: Lower BE – OFDM – 600kbps

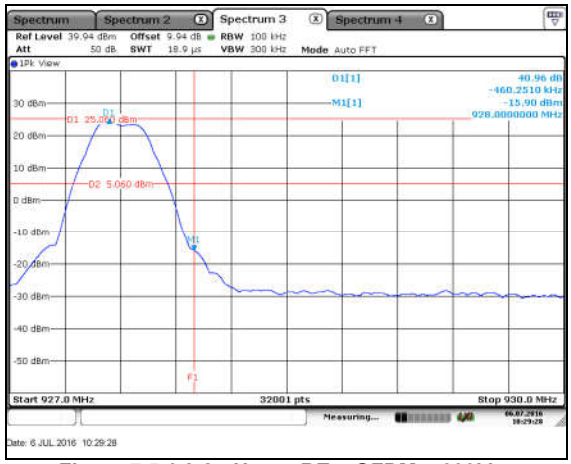

Figure 7.5.1.2-8: Upper BE – OFDM – 600kbps

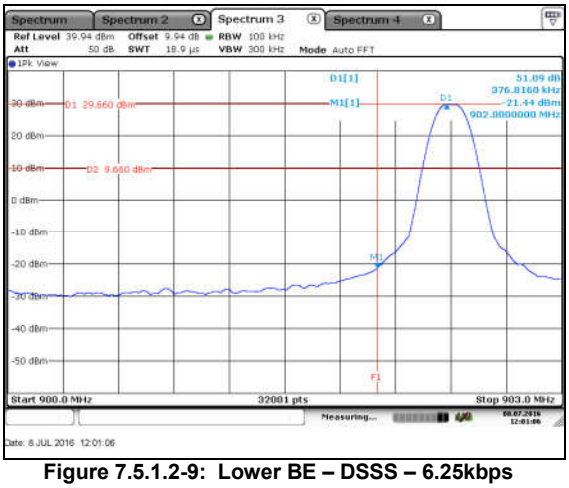

Figure 7.5.1.2-9: Lower BE – DSSS – 6.25kbps

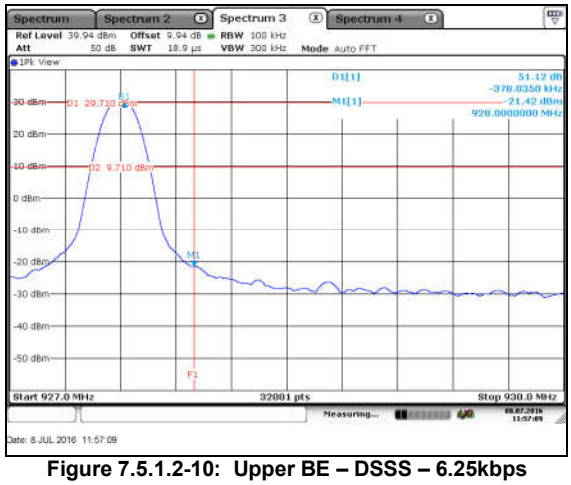

Figure 7.5.1.2-10: Upper BE – DSSS – 6.25kbps

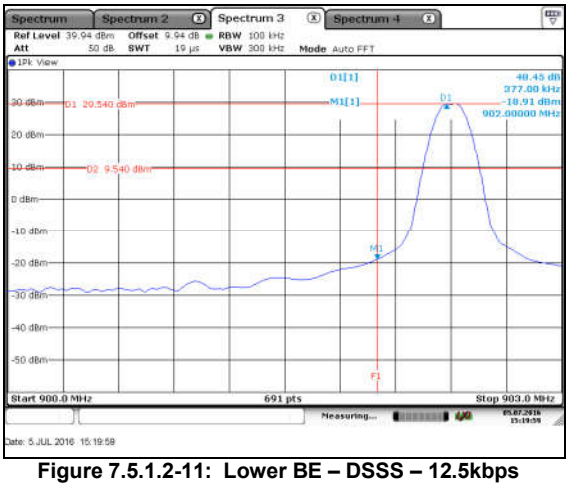

Figure 7.5.1.2-11: Lower BE – DSSS – 12.5kbps

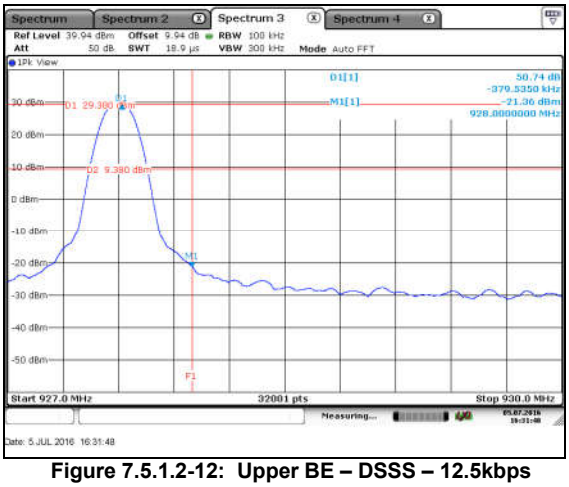

Figure 7.5.1.2-12: Upper BE – DSSS – 12.5kbps

HOPPING MODE:

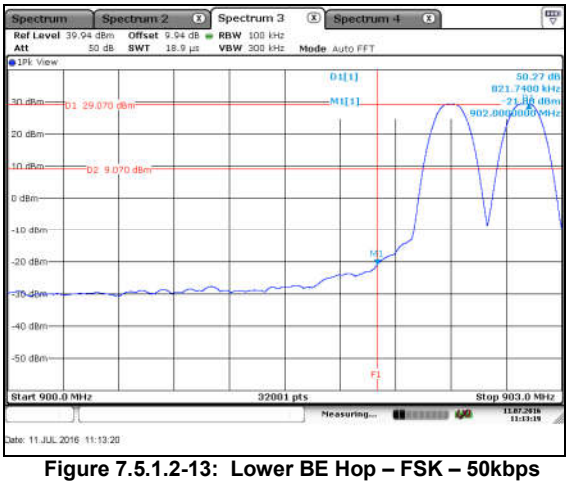

Figure 7.5.1.2-13: Lower BE Hop – FSK – 50kbps

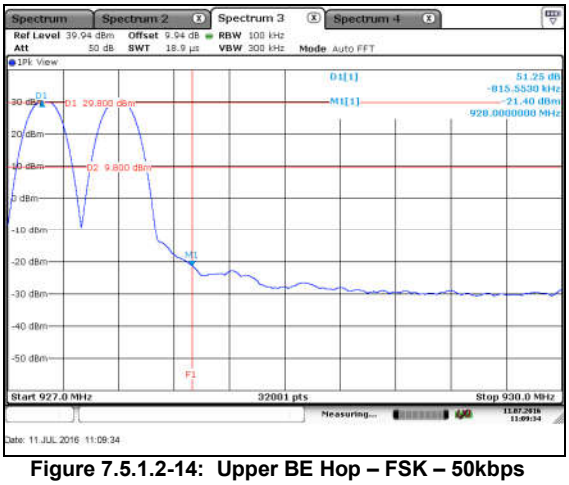

Figure 7.5.1.2-14: Upper BE Hop – FSK – 50kbps

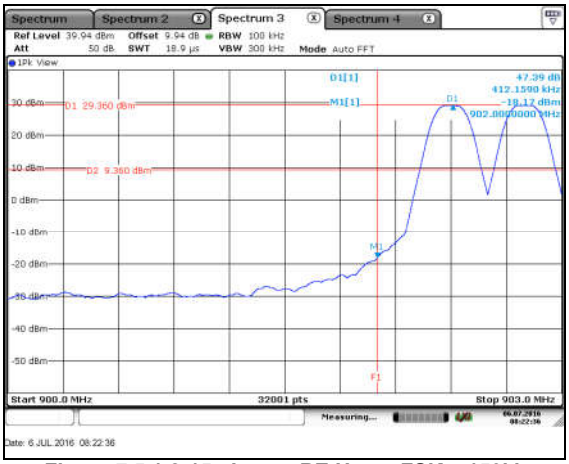

Figure 7.5.1.2-15: Lower BE Hop – FSK – 150kbps

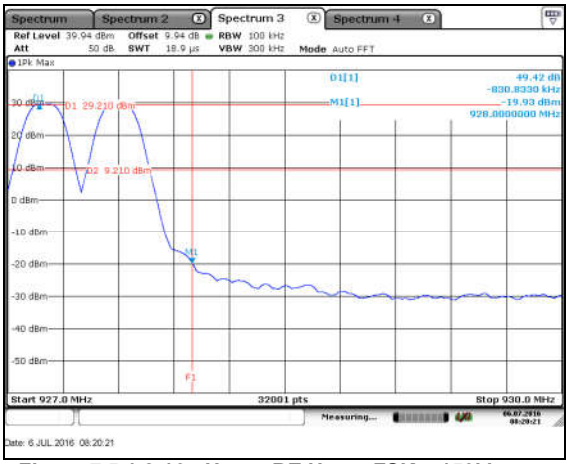

Figure 7.5.1.2-16: Upper BE Hop – FSK – 150kbps

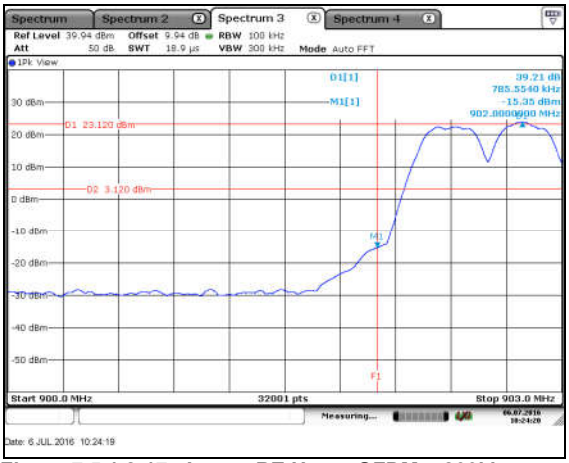

Figure 7.5.1.2-17: Lower BE Hop – OFDM – 200kbps

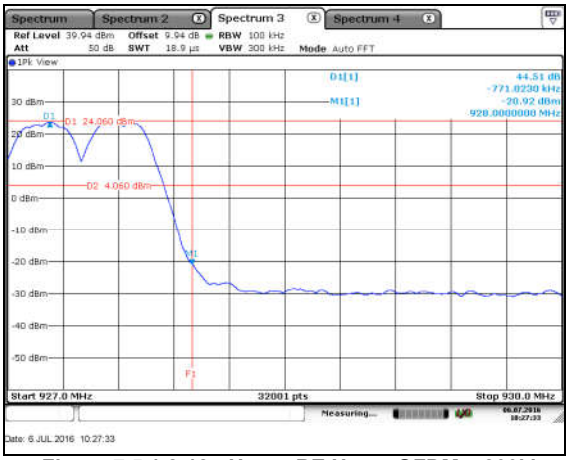

Figure 7.5.1.2-18: Upper BE Hop – OFDM – 200kbps

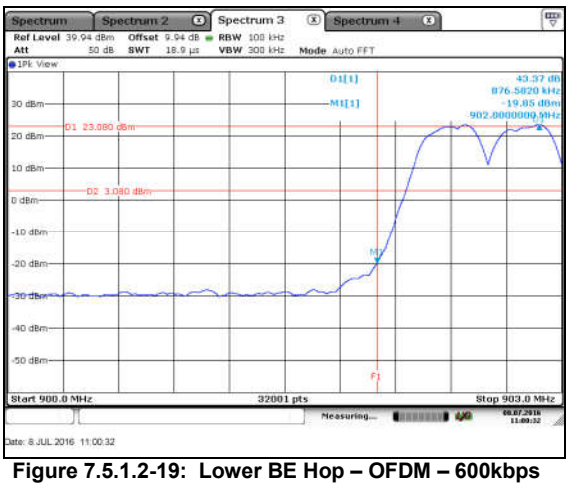

Figure 7.5.1.2-19: Lower BE Hop – OFDM – 600kbps

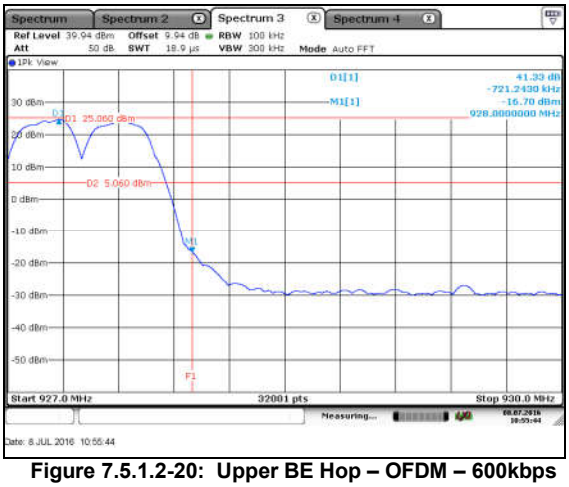

Figure 7.5.1.2-20: Upper BE Hop – OFDM – 600kbps

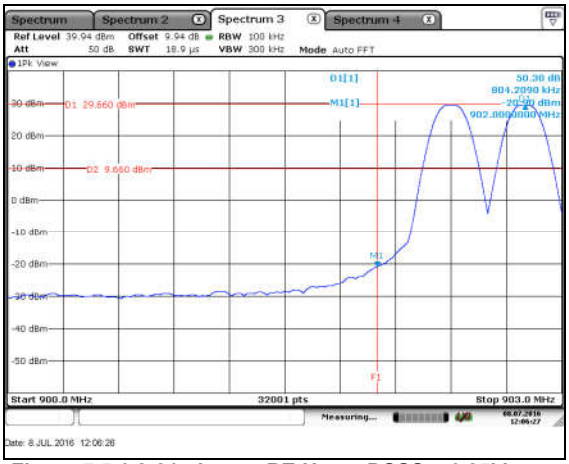

Figure 7.5.1.2-21: Lower BE Hop – DSSS – 6.25kbps

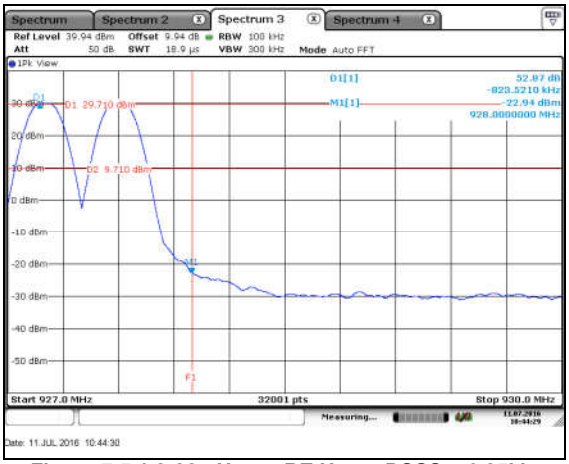

Figure 7.5.1.2-22: Upper BE Hop – DSSS – 6.25kbps

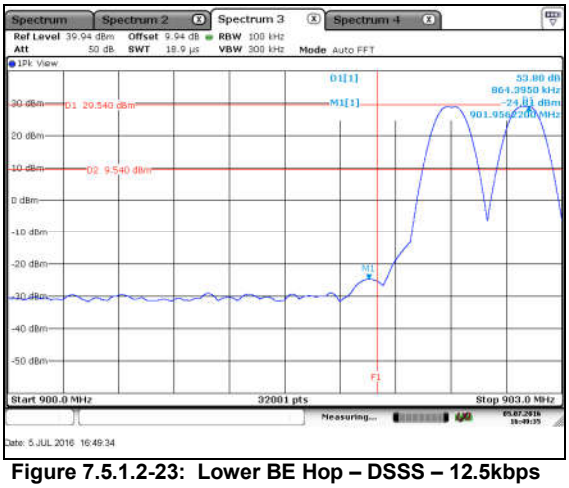

Figure 7.5.1.2-23: Lower BE Hop – DSSS – 12.5kbps

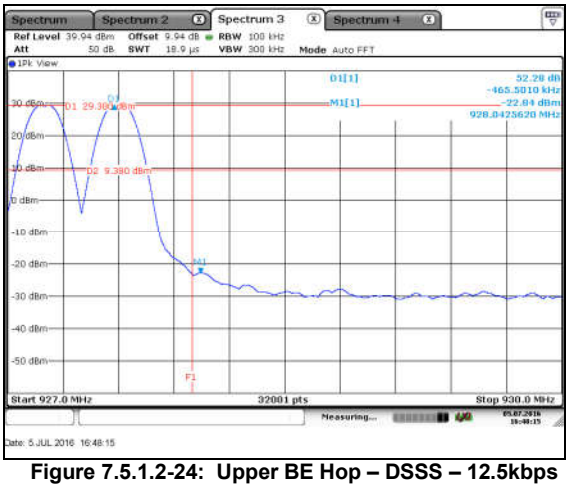

Figure 7.5.1.2-24: Upper BE Hop – DSSS – 12.5kbps

7.5.2 RF Conducted Spurious Emissions - FCC 15.247(d); IC 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 using suitable attenuation. 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.

7.5.2.2 Measurement Results

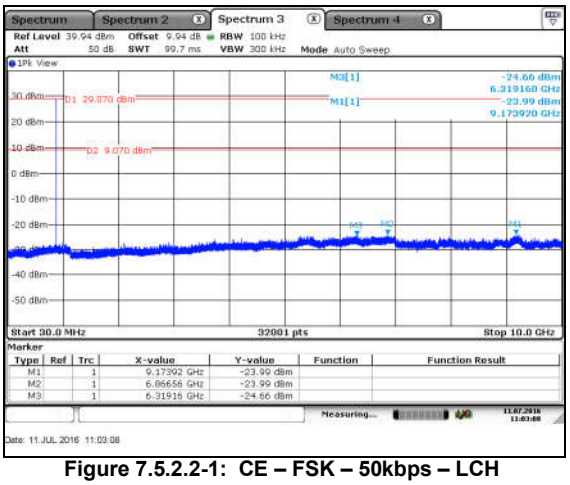

Figure 7.5.2.2-1: CE – FSK – 50kbps – LCH

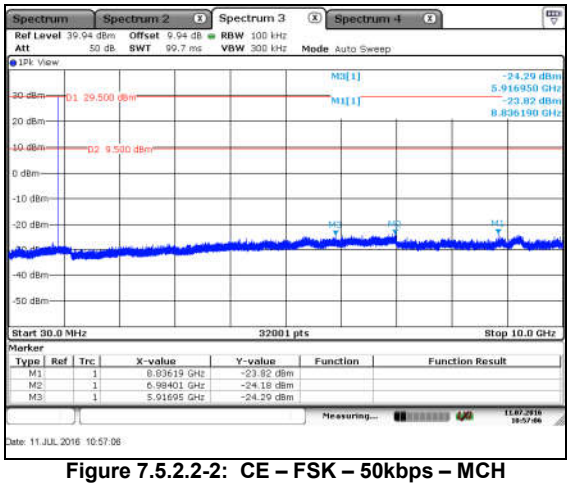

Figure 7.5.2.2-2: CE – FSK – 50kbps – MCH

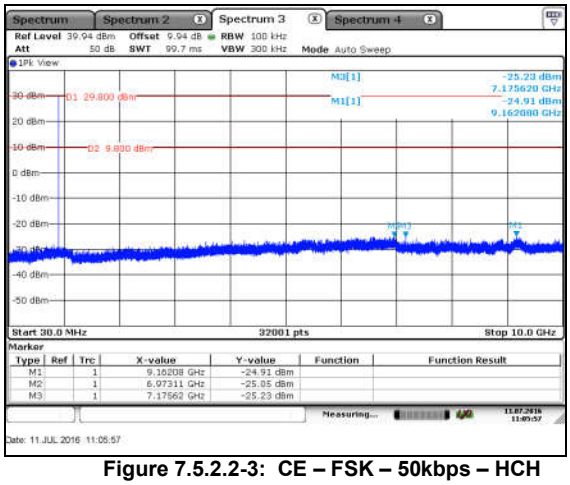

Figure 7.5.2.2-3: CE – FSK – 50kbps – HCH

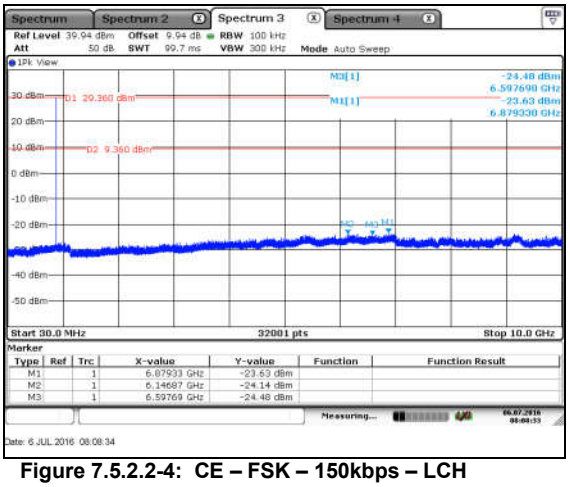

Figure 7.5.2.2-4: CE – FSK – 150kbps – LCH

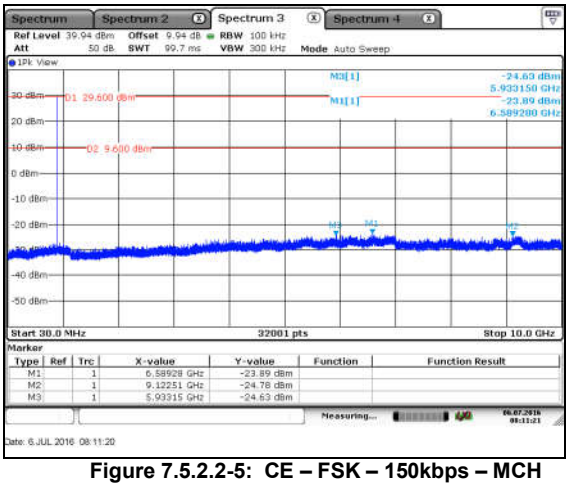

Figure 7.5.2.2-5: CE – FSK – 150kbps – MCH

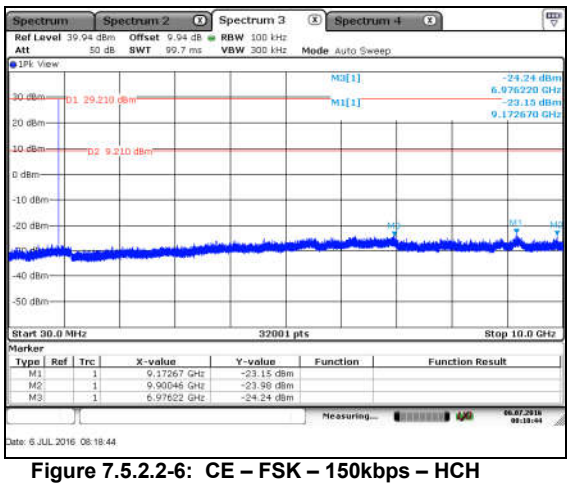

Figure 7.5.2.2-6: CE – FSK – 150kbps – HCH

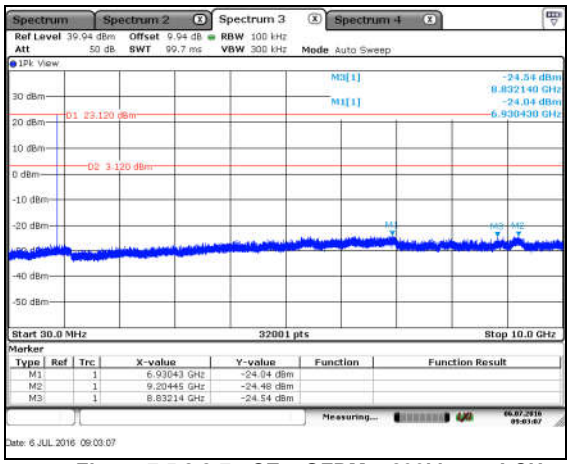

Figure 7.5.2.2-7: CE – OFDM – 200kbps – LCH

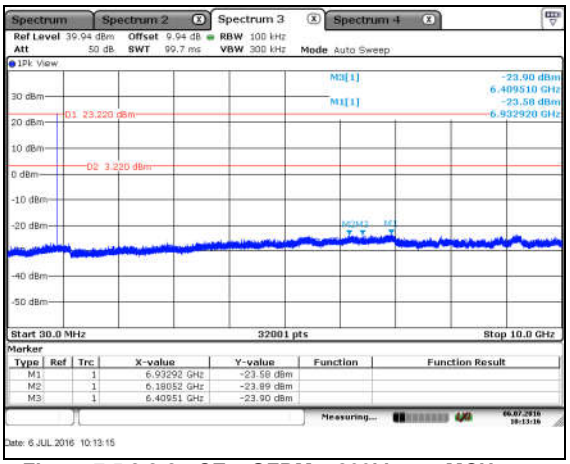

Figure 7.5.2.2-8: CE – OFDM – 200kbps – MCH

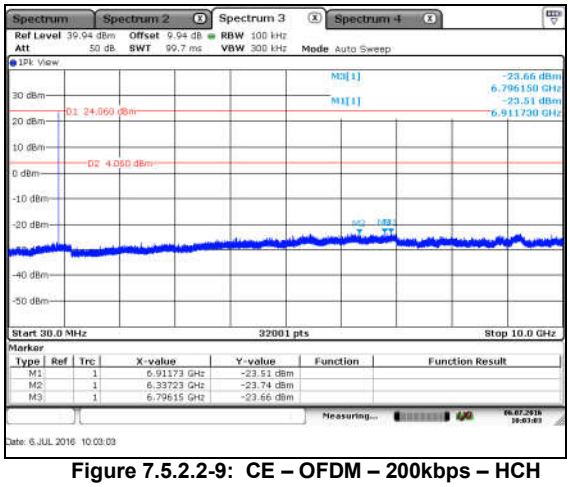

Figure 7.5.2.2-9: CE – OFDM – 200kbps – HCH

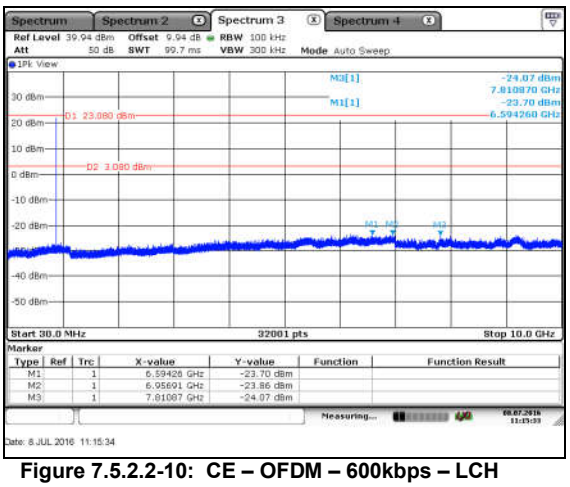

Figure 7.5.2.2-10: CE – OFDM – 600kbps – LCH

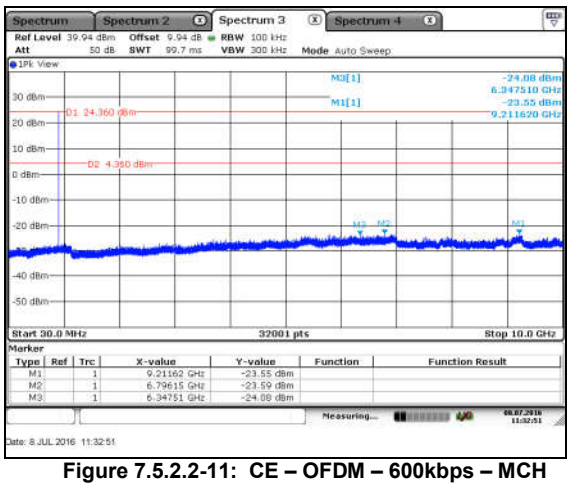

Figure 7.5.2.2-11: CE – OFDM – 600kbps – MCH

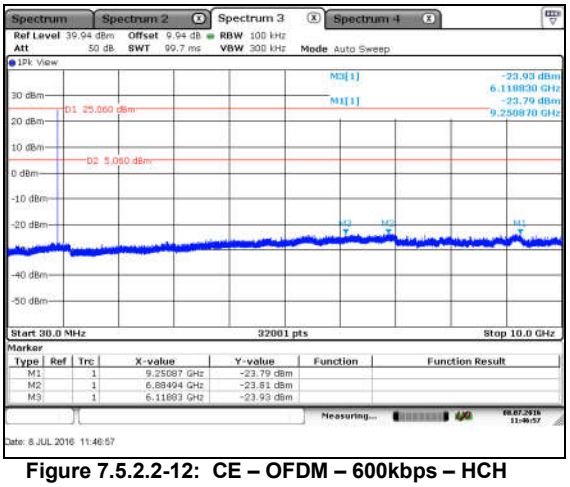

Figure 7.5.2.2-12: CE – OFDM – 600kbps – HCH

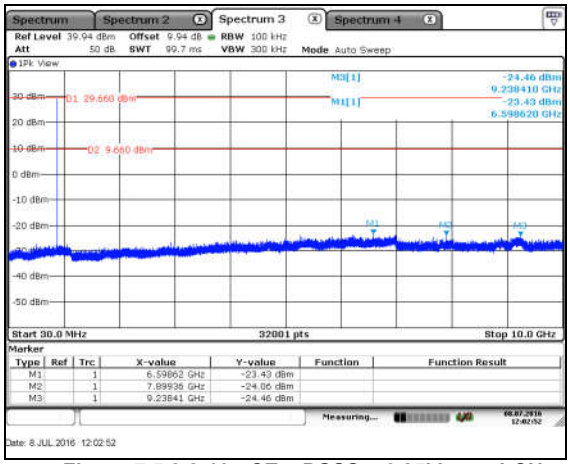

Figure 7.5.2.2-13: CE – DSSS – 6.25kbps – LCH

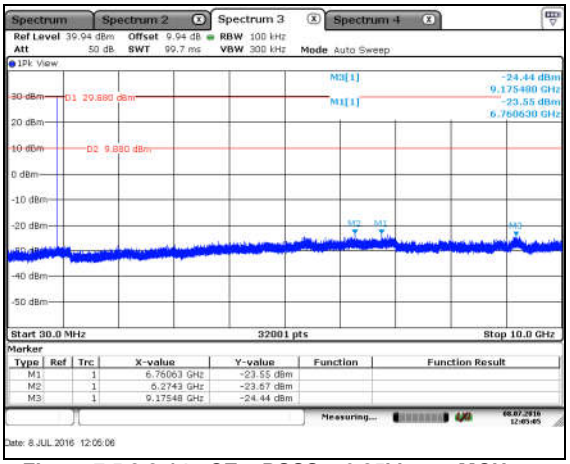

Figure 7.5.2.2-14: CE – DSSS – 6.25kbps – MCH

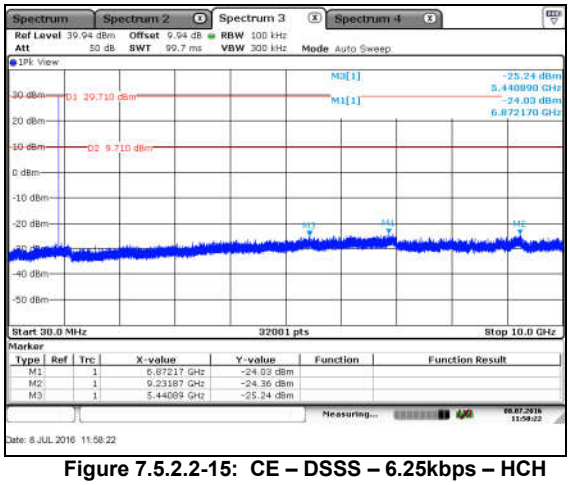

Figure 7.5.2.2-15: CE – DSSS – 6.25kbps – HCH

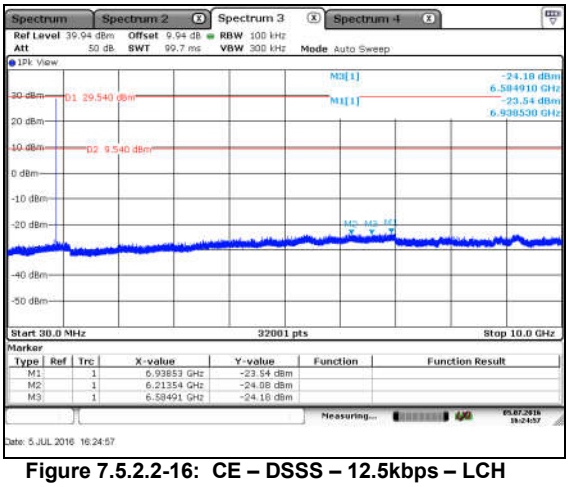

Figure 7.5.2.2-16: CE – DSSS – 12.5kbps – LCH

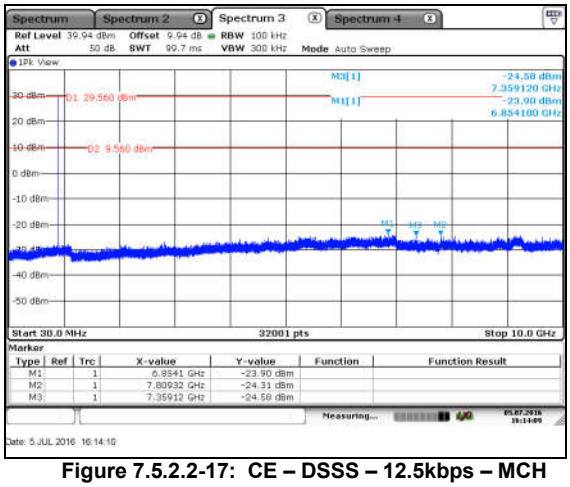

Figure 7.5.2.2-17: CE – DSSS – 12.5kbps – MCH

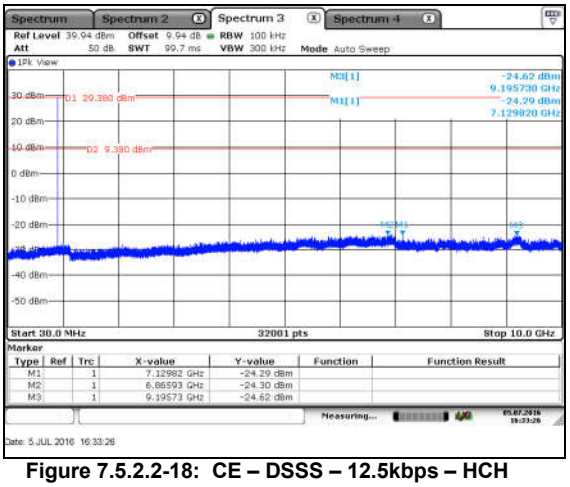

Figure 7.5.2.2-18: CE – DSSS – 12.5kbps – HCH

7.5.3 Radiated Spurious Emissions - FCC 15.205, 15.209; RSS-Gen 8.9/8.10

7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

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

7.5.3.2 Measurement Results

Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data – FSK Modulation

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										
2707.2	54.06	48.41	H	-4.26	49.80	44.15	74.0	54.0	24.2	9.8
2707.2	48.24	42.01	V	-4.26	43.98	37.75	74.0	54.0	30.0	16.2
3609.6	49.00	41.96	H	-1.41	47.59	40.55	74.0	54.0	26.4	13.5
3609.6	45.82	36.91	V	-1.41	44.41	35.50	74.0	54.0	29.6	18.5
4512	50.39	45.26	H	0.23	50.62	45.49	74.0	54.0	23.4	8.5
4512	48.46	39.45	V	0.23	48.69	39.68	74.0	54.0	25.3	14.3
Middle Channel										
1069	55.18	42.80	V	-12.84	42.34	29.96	74.0	54.0	31.7	24.0
1069	56.11	43.49	H	-12.84	43.27	30.65	74.0	54.0	30.7	23.4
2745.6	56.82	52.98	H	-4.15	52.67	48.83	74.0	54.0	21.3	5.2
2745.6	52.09	33.58	V	-4.15	47.94	29.43	74.0	54.0	26.1	24.6
3660.8	49.20	40.64	H	-1.22	47.98	39.42	74.0	54.0	26.0	14.6
4576	50.01	42.85	H	0.43	50.44	43.28	74.0	54.0	23.6	10.7
4576	47.24	37.01	V	0.43	47.67	37.44	74.0	54.0	26.3	16.6
7321.6	46.02	35.66	H	7.26	53.28	42.92	74.0	54.0	20.7	11.1
High Channel										
2782.8	54.50	50.11	H	-4.05	50.45	46.06	74.0	54.0	23.5	7.9
2782.8	48.08	44.65	V	-4.05	44.03	40.60	74.0	54.0	30.0	13.4
3710.4	47.59	41.07	H	-1.04	46.55	40.03	74.0	54.0	27.5	14.0
3710.4	44.19	35.41	V	-1.04	43.15	34.37	74.0	54.0	30.9	19.6
4638	52.16	48.77	H	0.62	52.78	49.39	74.0	54.0	21.2	4.6
4638	47.57	40.79	V	0.62	48.19	41.41	74.0	54.0	25.8	12.6

Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data – OFDM Modulation

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										
3609.6	45.77	37.57	H	-1.41	44.36	36.16	74.0	54.0	29.6	17.8
Middle Channel										
2745.6	49.22	35.66	H	-4.15	45.07	31.51	74.0	54.0	28.9	22.5
3660.8	47.60	38.13	H	-1.22	46.38	36.91	74.0	54.0	27.6	17.1
High Channel										
All emissions were attenuated below the noise floor of the instrumentation.										

Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data – DSSS Modulation

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										
2707.2	51.61	48.72	H	-4.26	47.35	44.46	74.0	54.0	26.6	9.5
2707.2	48.41	43.28	V	-4.26	44.15	39.02	74.0	54.0	29.8	15.0
3609.6	49.57	43.79	H	-1.41	48.16	42.38	74.0	54.0	25.8	11.6
3609.6	46.25	37.87	V	-1.41	44.84	36.46	74.0	54.0	29.2	17.5
4512	50.87	47.24	H	0.23	51.10	47.47	74.0	54.0	22.9	6.5
4512	46.30	38.79	V	0.23	46.53	39.02	74.0	54.0	27.5	15.0
5414.4	44.32	35.54	H	3.02	47.34	38.56	74.0	54.0	26.7	15.4
Middle Channel										
2745.6	56.35	53.11	H	-4.15	52.20	48.96	74.0	54.0	21.8	5.0
2745.6	53.03	48.11	V	-4.15	48.88	43.96	74.0	54.0	25.1	10.0
3660.8	47.75	41.28	H	-1.22	46.53	40.06	74.0	54.0	27.5	13.9
3660.8	45.21	36.12	H	-1.22	43.99	34.90	74.0	54.0	30.0	19.1
4576	50.57	47.04	H	0.43	51.00	47.47	74.0	54.0	23.0	6.5
4576	46.50	33.73	V	0.43	46.93	34.16	74.0	54.0	27.1	19.8
7321.6	44.93	33.35	H	7.26	52.19	40.61	74.0	54.0	21.8	13.4
High Channel										
2782.8	54.67	51.23	H	-4.05	50.62	47.18	74.0	54.0	23.4	6.8
2782.8	51.83	45.24	V	-4.05	47.78	41.19	74.0	54.0	26.2	12.8
3710.4	50.31	41.68	H	-1.04	49.27	40.64	74.0	54.0	24.7	13.4
3710.4	47.89	37.09	V	-1.04	46.85	36.05	74.0	54.0	27.2	18.0
4638	53.45	47.62	H	0.62	54.07	48.24	74.0	54.0	19.9	5.8
4638	50.10	38.86	V	0.62	50.72	39.48	74.0	54.0	23.3	14.5

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 Modulation

Corrected Level: 54.06 - 4.26 = 49.80dBuV/m
Margin: 74dBuV/m – 49.80dBuV/m = 24.2dB

Example Calculation: Average – FSK Modulation

Corrected Level: 48.41 - 4.26 - 0 = 44.15dBuV
Margin: 54dBuV – 44.15dBuV = 9.8dB

8 CONCLUSION

In the opinion of ACS, Inc. the ACT1, 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.

END REPORT