Excellence in Compliance Testing

Certification Test Report

FCC ID: QZC-REXU
IC: 4557A-REXU

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 12-0259.W06.1A

Manufacturer: Elster Solutions, LLC
Model: REXU

Test Begin Date: July 16, 2012
Test End Date: July 24, 2012

Report Issue Date: August 9, 2012

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

Reviewed by: _____
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

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 Industry Canada's Radio Standards Specification RSS-210 for Certification.

1.2 Product description

The REXU module is a Printed Circuit Board Assembly (PCBA) that forms a complete electricity meter when installed in a housing and meter base.

The REXU contains (1) 900 MHz LAN frequency hopping spread spectrum radio and (1) 2.4 GHz direct sequence spread spectrum Zigbee radio. This report addresses the 900 MHz LAN radio only.

Technical Details:
The REXU utilizes multiple frequency hopping modes of operation as detailed below.

Mode	Frequency Range (MHz)	Modulation	Number of Channels	Channel Separation (kHz)	Data Rates Supported (kbps)	Rated Power (dBm)
1	902.4 - 927.6	FSK	64	400	50, 200	30
2	902.4 - 927.6	FSK	25	400	35.5, 142	24
3	902.3 - 927.8	FSK	86	300	9.6, 19.2, 38.4, 115.2	30
4	904.0 - 927.9	FSK	240	100	9.6, 19.2, 38.4	30

Operating Voltage: 18Vdc
Antenna Type / Gain: Embedded Slot Antenna; 4.07dBi gain
RF Connector: MCX

Manufacturer Information:
Elster Solutions, LLC
208 S. Rogers Lane
Raleigh, NC 27610

Test Sample Serial Numbers: 0079 (conducted), 0009 (radiated)

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 where applicable. The data presented in this report represents the worst case.

For radiated and AC power line conducted emissions, the EUT was placed on the test table in an orientation representative of final installation.

Both the 900 MHz LAN radio and the 2.4 GHz Zigbee radio can transmit simultaneously therefore radiated inter-modulation products were evaluated and found to be in compliance.

Preliminary testing was performed to determine worst-case with respect to mode of operation and data rate. The following table details the parameters used for final testing. Low, Mid and High channels in the Table 1.3-1 below indicates the lowest, middle and highest available channel within each mode.

Table 1.3-1: Test Parameters

Test Requirement	Mode	Data Rate (kbps)	Channels Evaluated
Power Line Conducted Emissions	2	35.5	Mid
Peak Output Power	1	50	Low, Mid, High
	2	35.5	Low, Mid, High
	3	9.6	Low, Mid
	4	9.6	High
Carrier Frequency Separation	1	50	NA
	2	142	
	3	9.6	
	4	9.6	
Number of Hopping Channels	1	50	NA
	2	142	
	3	9.6	
	4	9.6	
Channel Dwell Time	1	50, 200	Low
	2	35.5, 142	
	3	9.6, 19.2, 38.4, 115.2	NA*
20dB / 99% Bandwidth	1	50, 200	Low, Mid, High
	2	35.5, 142	
	3	9.6, 19.2, 38.4, 115.2	
Band-Edge (Conducted)	1	200	Low, High
	2	35.5	
	3	115.2	
	4	38.4	
RF Conducted Spurious Emissions	1	50	Low, Mid, High
	2	35.5	
	3	9.6	Low, Mid
	4	9.6	High
Radiated Spurious Emissions	1	50	Low, Mid, High
	2	35.5	
	3	9.6	Low, Mid
	4	9.6	High

* Note: Test mode firmware does not produce worst case channel dwell time for modes 3 and 4 therefore no data is provided. A detailed technical description of channel dwell time is provided in the theory of operation.

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 National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. 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, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A-1
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:

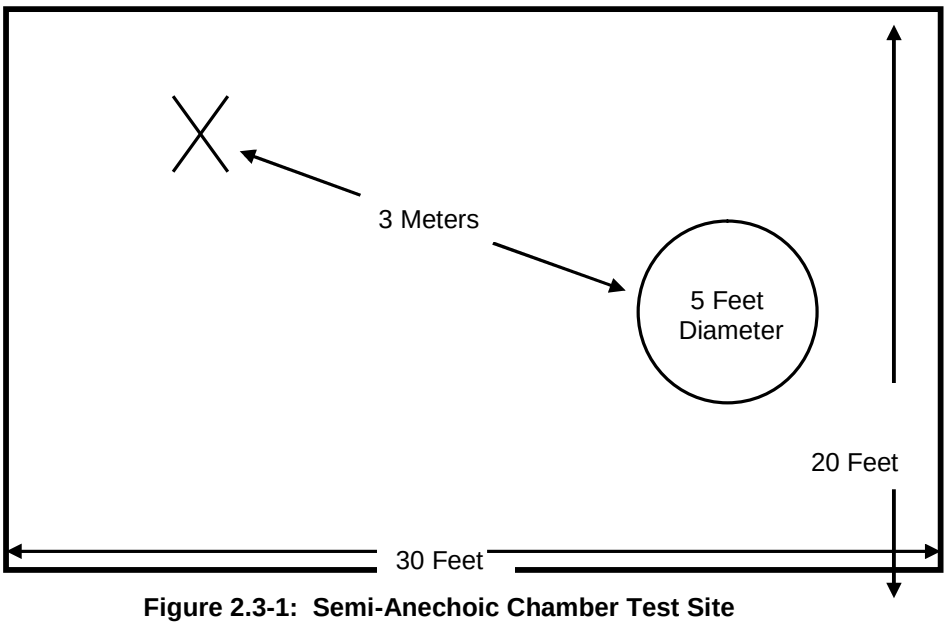

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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 C63.4.

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

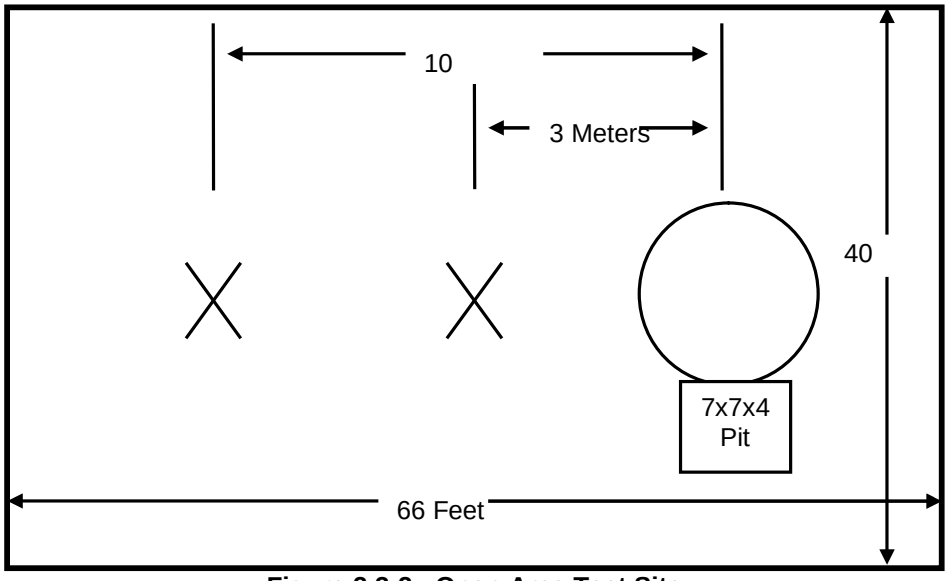

Figure 2.3-2: Open Area Test Site

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 C63.4.

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

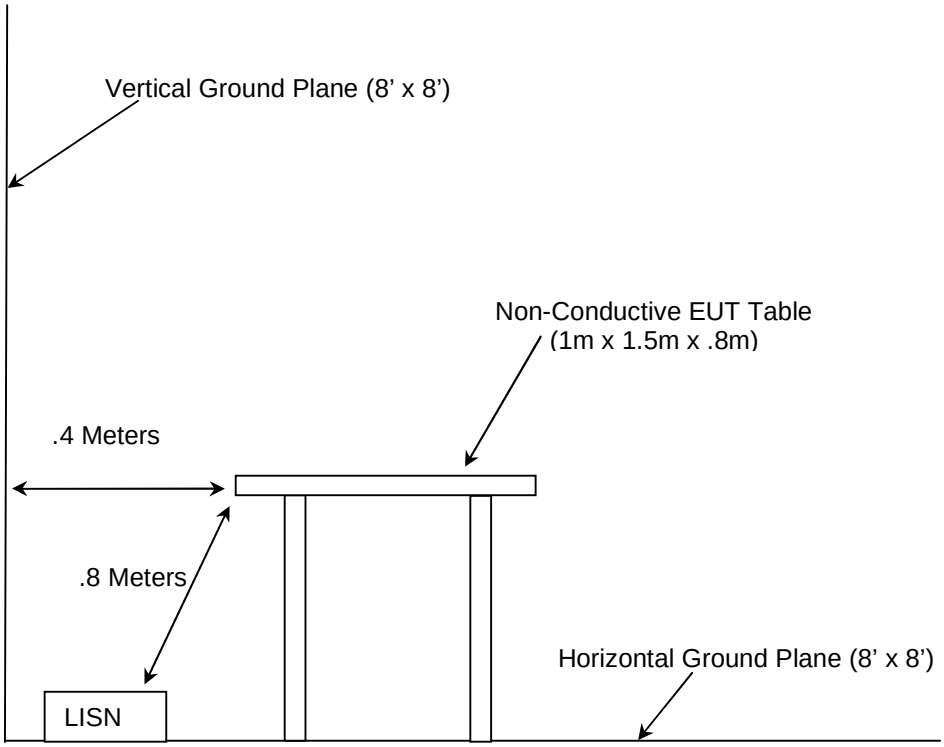

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2012
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2012
- FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000
- Industry Canada Radio Standards Specification: RSS-210 – Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, December 2010
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

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	9/23/2011	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2011	9/23/2012
3	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	839379/011	5/26/2011	5/26/2013
4	Rohde & Schwarz	ESMI - Receiver	Spectrum Analyzers	833827/003	5/26/2011	5/26/2013
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/27/2011	4/27/2013
40	EMCO	3104	Antennas	3211	2/11/2011	2/11/2013
73	Agilent	8447D	Amplifiers	2727A05624	9/30/2011	9/30/2012
153	EMCO	3825/2	LISN	9411-2268	1/13/2011	1/13/2013
167	ACS	Chamber EMI Cable Set	Cable Set	167	12/21/2011	12/21/2012
168	Hewlett Packard	11947A	Attenuators	44829	2/1/2012	2/1/2013
267	Agilent	N1911A	Meters	MY45100129	1/23/2012	1/23/2014
268	Agilent	N1921A	Sensors	MY45240184	1/17/2012	1/17/2014
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/2/2011	12/2/2012
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	4/2/2012	4/2/2013
324	ACS	Belden	Cables	8214	6/26/2012	6/26/2013
331	Microwave Circuits	H1G513G1	Filters	31417	7/2/2012	7/2/2013
338	Hewlett Packard	8449B	Amplifiers	3008A01111	3/1/2012	8/31/2012
339	Aeroflex/Weinschel	AS-18	Attenuators	7142	6/4/2012	6/4/2013
412	Electro Metrics	LPA-25	Antennas	1241	7/28/2010	7/28/2012
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	12/2/2011	12/2/2012

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	Power Supply	Agilent	E3630A	MY40015581

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

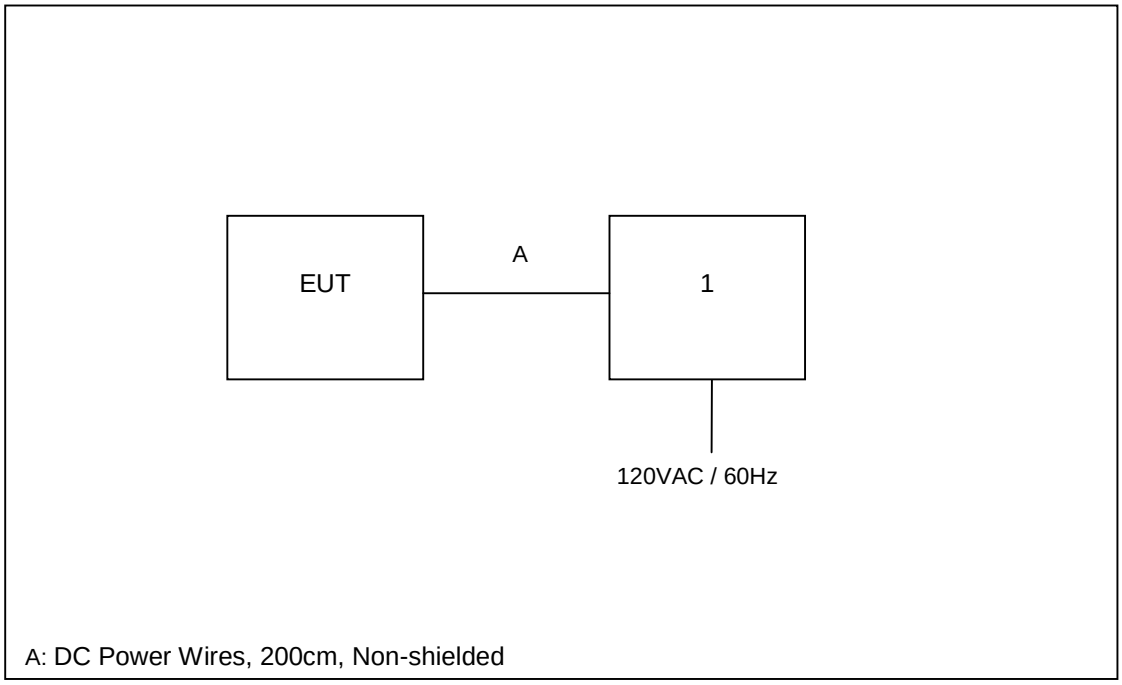

Figure 6-1: System Block Diagram

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 antenna is an embedded slot antenna with a maximum gain of +4.07 dBi. The EUT provides an on board MCX connector but no external antennas are utilized.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents 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

Results of the test are shown below in and Tables 7.2.2-1 to 7.2.2-2.

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	PE	Detector
0.192000	46.00	9.9	64	18.0	FLO	QP
0.336000	43.10	10.0	59	16.2	FLO	QP
0.534000	42.90	10.0	56	13.1	FLO	QP
0.774000	28.50	10.1	56	27.5	FLO	QP
1.068000	39.40	10.0	56	16.6	FLO	QP
1.602000	38.50	10.0	56	17.5	FLO	QP
13.890000	35.10	9.9	60	24.9	FLO	QP
14.424000	36.50	9.8	60	23.5	FLO	QP
14.958000	33.70	9.8	60	26.3	FLO	QP
27.144000	15.10	9.4	60	44.9	FLO	QP
0.192000	32.20	9.9	54	21.7	FLO	AVG
0.372000	25.30	10.0	49	23.2	FLO	AVG
0.534000	42.30	10.0	46	3.7	FLO	AVG
0.792000	19.10	10.1	46	26.9	FLO	AVG
1.068000	39.30	10.0	46	6.7	FLO	AVG
1.602000	38.10	10.0	46	7.9	FLO	AVG
13.890000	34.00	9.9	50	16.0	FLO	AVG
14.424000	35.60	9.8	50	14.4	FLO	AVG
14.958000	32.80	9.8	50	17.2	FLO	AVG
26.988000	9.40	9.4	50	40.6	FLO	AVG

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	PE	Detector
0.186000	46.80	10.0	64	17.4	FLO	QP
0.342000	43.30	10.0	59	15.9	FLO	QP
0.534000	42.40	10.0	56	13.6	FLO	QP
0.690000	26.80	10.1	56	29.2	FLO	QP
0.744000	29.00	10.1	56	27.0	FLO	QP
1.068000	38.80	10.0	56	17.2	FLO	QP
1.602000	36.10	10.0	56	19.9	FLO	QP
13.890000	34.40	9.9	60	25.6	FLO	QP
14.424000	35.50	9.8	60	24.5	FLO	QP
0.228000	26.60	9.9	53	25.9	FLO	AVG
0.360000	26.70	10.0	49	22.0	FLO	AVG
0.534000	41.50	10.0	46	4.5	FLO	AVG
0.672000	16.90	10.0	46	29.1	FLO	AVG
0.756000	19.60	10.1	46	26.4	FLO	AVG
1.068000	38.50	10.0	46	7.5	FLO	AVG
1.602000	35.70	10.0	46	10.3	FLO	AVG
13.896000	22.10	9.9	50	27.9	FLO	AVG
14.424000	31.90	9.8	50	18.1	FLO	AVG

7.3 Peak Output Power - FCC Section 15.247(b)(2) IC: RSS-210 A8.4(1)

7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a wideband peak power meter with suitable attenuation.

7.3.2 Measurement Results

Results are shown below in Table 7.3.2-1 below:

Table 7.3.2-1: RF Output Power

Mode	Frequency [MHz]	Level [dBm]
1	902.4	29.35
1	914.8	29.62
1	927.6	29.67
2	902.4	23.95
2	914.8	23.97
2	927.6	23.99
3	902.3	28.92
3	915.0	29.68
4	927.9	29.94

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-210 A8.1(b)

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to ≥ 1% of the span.

Carrier frequency separation was measured for the modes of operation identified in section 1.3 and data presented in section 7.4.1.2 below.

7.4.1.2 Measurement Results

Results are shown below in Figures 7.4.1.2-1 to 7.4.1.2-4.

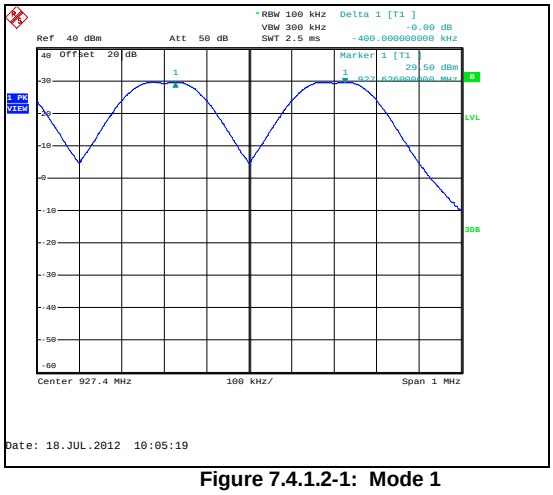

Figure 7.4.1.2-1: Mode 1

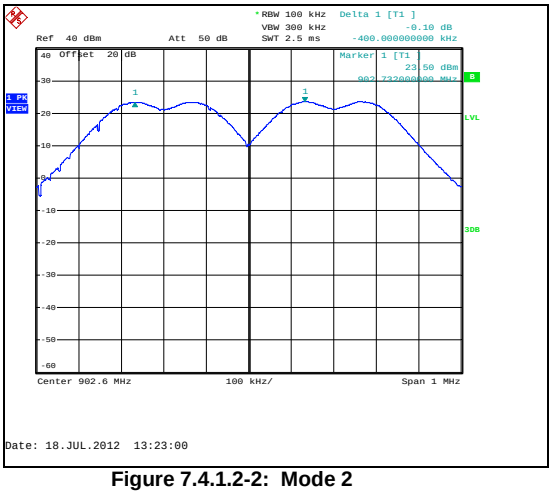

Figure 7.4.1.2-2: Mode 2

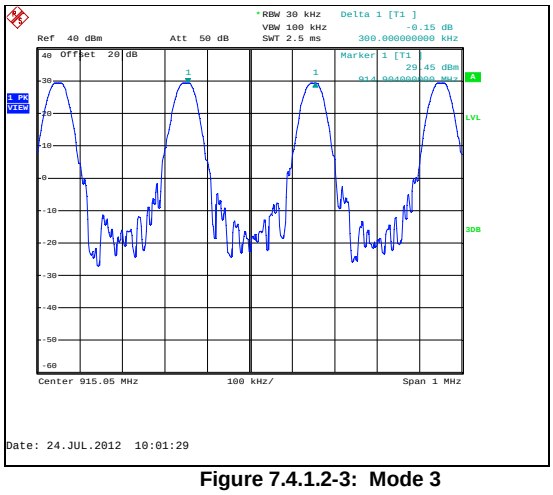

Figure 7.4.1.2-3: Mode 3

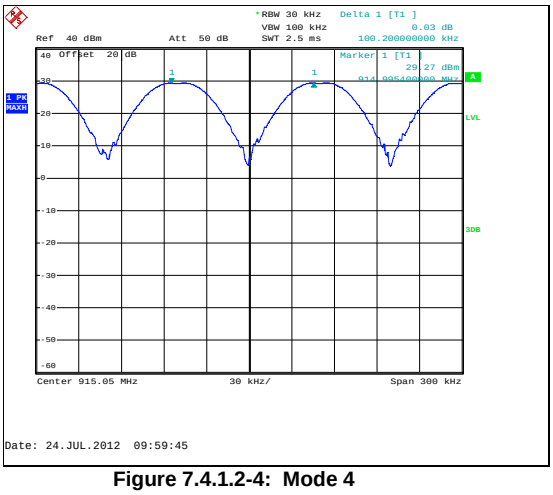

Figure 7.4.1.2-4: Mode 4

7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the entire frequency band of operation. The RBW was set to ≥ 1% of the span and VBW set to ≥ RBW.

The number of hopping channels was measured for the modes of operation identified in section 1.3 and data presented in section 7.4.2.2 below.

7.4.2.2 Measurement Results

Results are shown below in Figures 7.4.2.2-1 to 7.4.2.2-9.

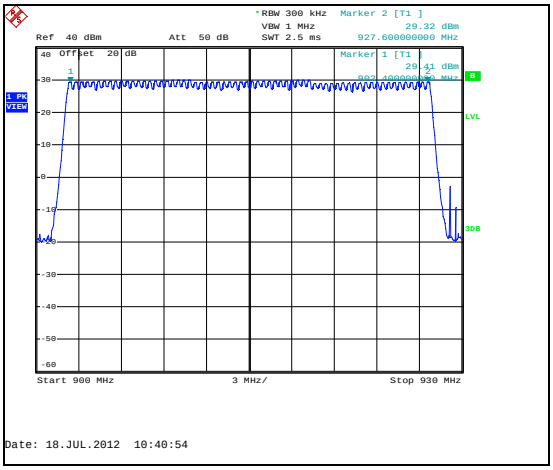

Figure 7.4.2.2-1: Mode 1 (64 Channels)

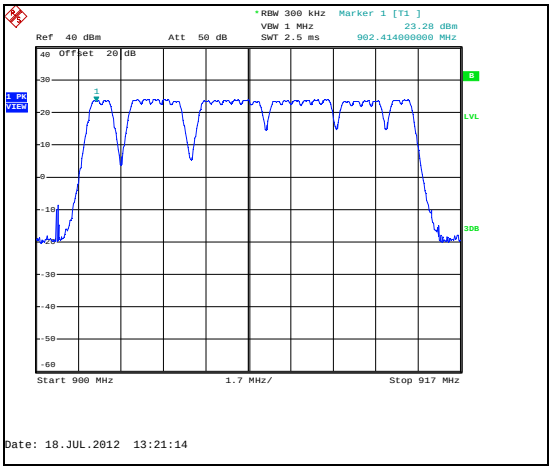

Figure 7.4.2.2-2: Mode 2 (25 Channels)

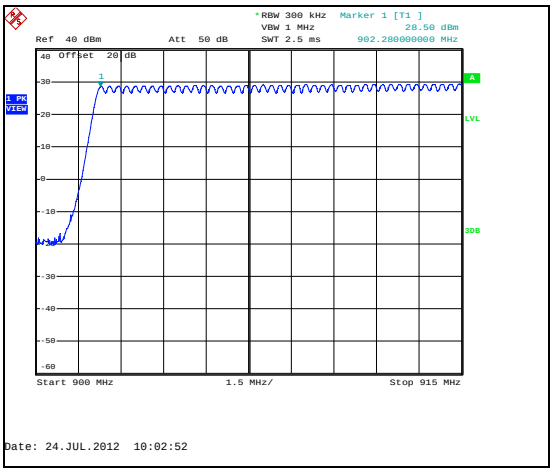

Figure 7.4.2.2-3: Mode 3 (86 Channels)

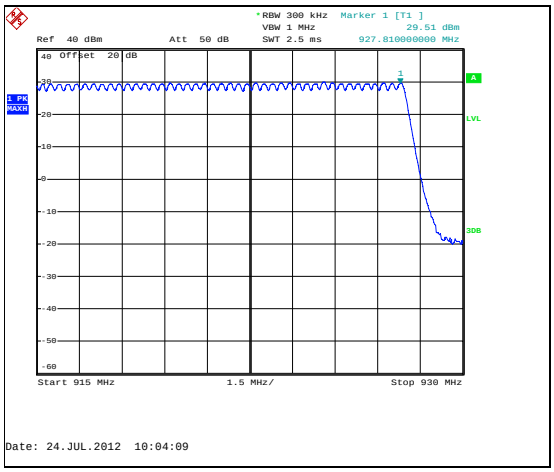

Figure 7.4.2.2-4: Mode 3 (86 Channels)

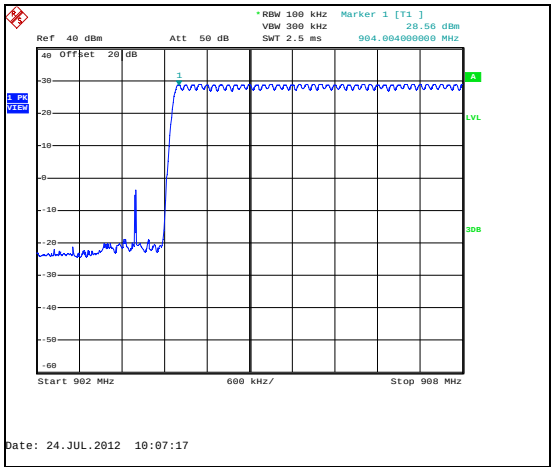

Figure 7.4.2.2-5: Mode 4 (240 Channels)

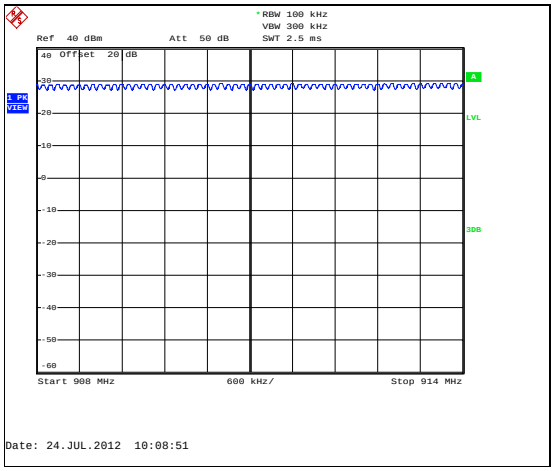

Figure 7.4.2.2-6: Mode 4 (240 Channels)

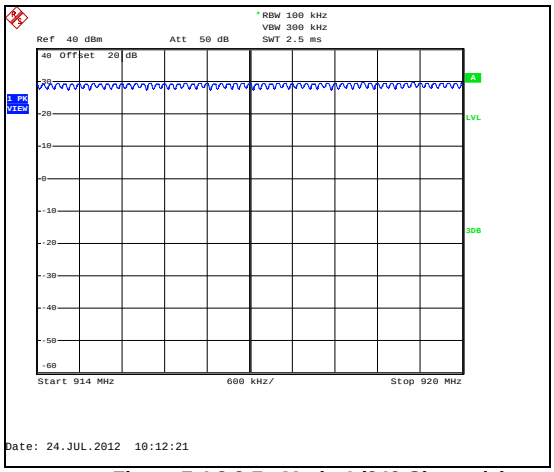

Figure 7.4.2.2-7: Mode 4 (240 Channels)

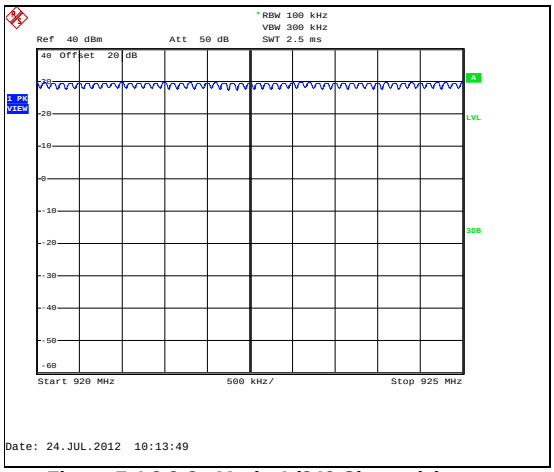

Figure 7.4.2.2-8: Mode 4 (240 Channels)

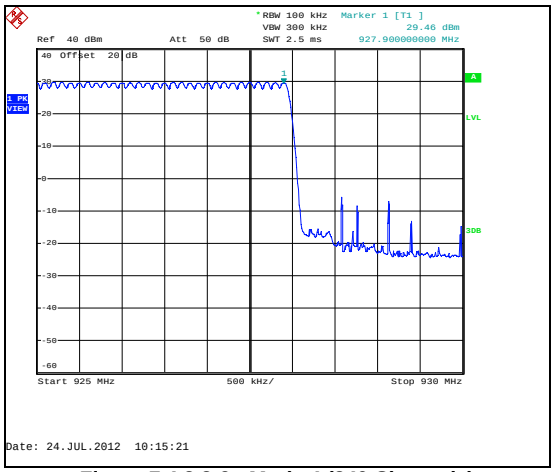

Figure 7.4.2.2-9: Mode 4 (240 Channels)

7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.4.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer display was set 0 Hz centered on a hopping channel. The RBW of the spectrum analyzer was set to approximately 1 MHz and VBW set to ≥ RBW. The Marker Delta function of the analyzer was utilized to determine the dwell time.

The dwell time was measured for the modes of operation identified in section 1.3 and data presented in section 7.4.3.2 below.

7.4.3.2 Measurement Results

Results are shown below in Table 7.4.3.2-1 and Figures 7.4.3.2-1 through 7.4.3.2-8.

Table 7.4.3.2-1: Channel Dwell Time

Mode	Data Rate (kbps)	Single Occurrence	Number of Occurrences	Total Dwell Time (ms)
1	50	36.7	2 / 20s	73.4
1	200	9.18	1 /10s	9.18
2	35.5	103.2	2 /10s	206.4
2	142	72.4	3 /10s	217.2

Note: Test mode firmware does not produce worst case channel dwell time for modes 3 and 4 therefore no data is provided. A detailed technical description of channel dwell time is provided in the theory of operation.

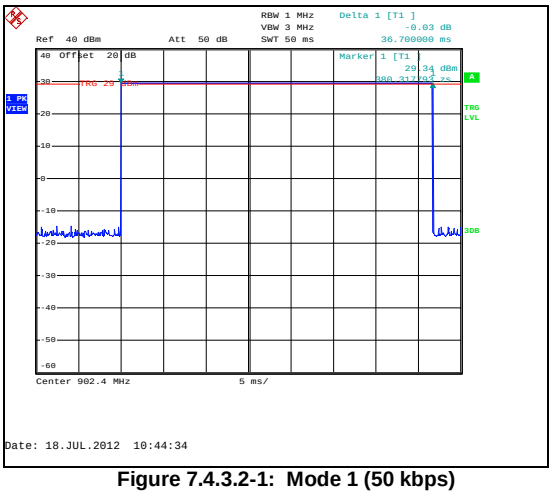

Figure 7.4.3.2-1: Mode 1 (50 kbps)

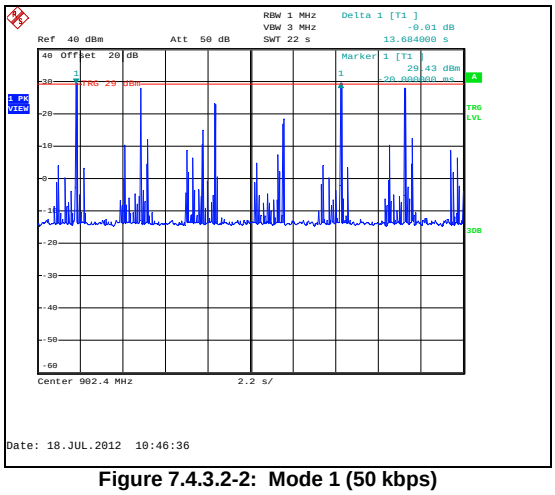

Figure 7.4.3.2-2: Mode 1 (50 kbps)

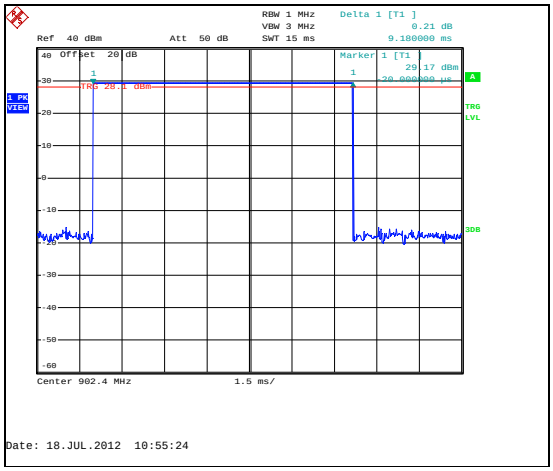

Figure 7.4.3.2-3: Mode 1 (200 kbps)

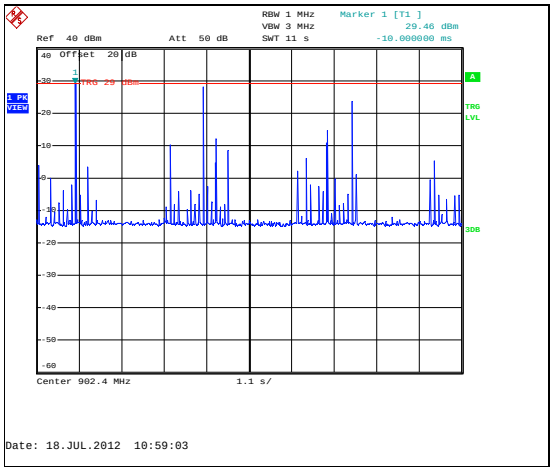

Figure 7.4.3.2-4: Mode 1 (200 kbps)

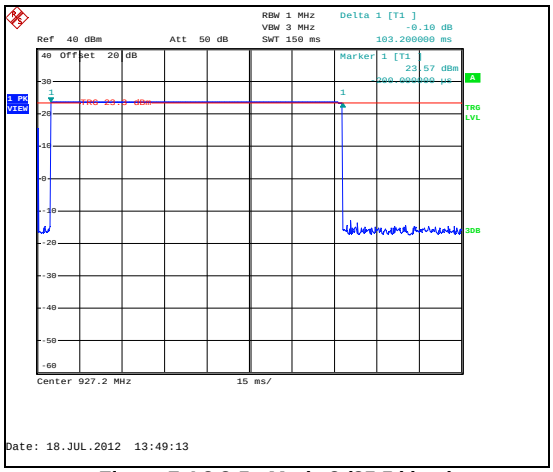

Figure 7.4.3.2-5: Mode 2 (35.5 kbps)

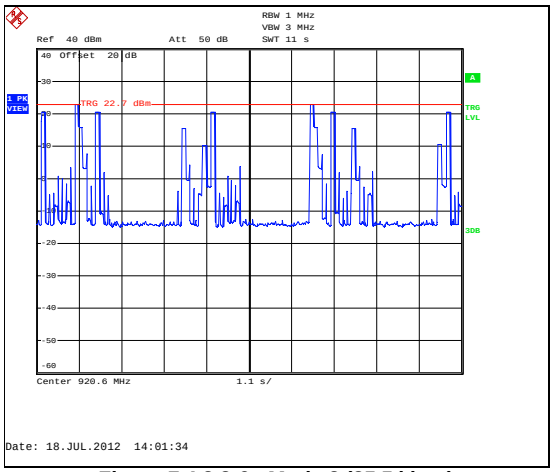

Figure 7.4.3.2-6: Mode 2 (35.5 kbps)

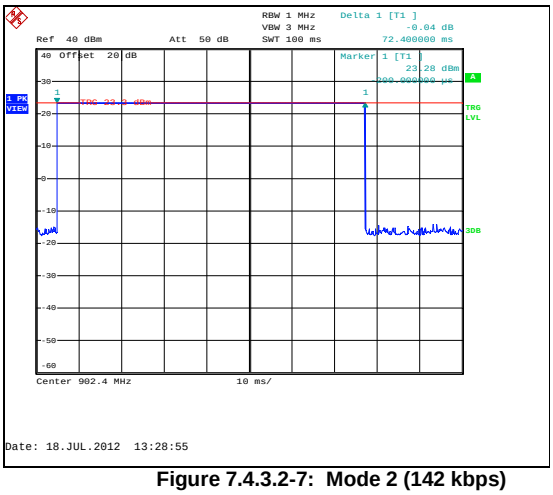

Figure 7.4.3.2-7: Mode 2 (142 kbps)

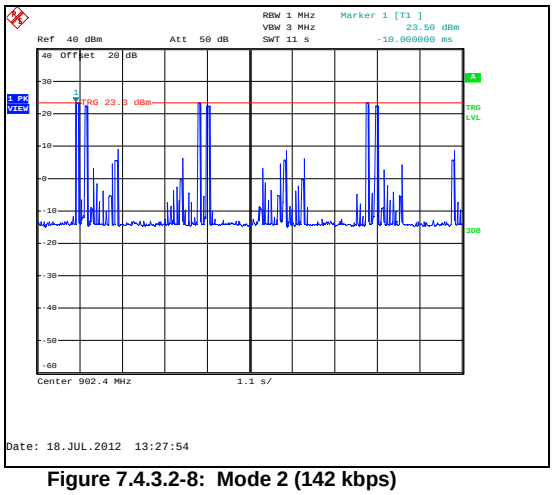

Figure 7.4.3.2-8: Mode 2 (142 kbps)

7.4.4 20 dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.4.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. 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 Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and side bands. The RBW was to ~ 1% of the span. The trace was set to max hold with a sample detector. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

The 20 dB and 99% bandwidths were measured for the modes of operation identified in section 1.3 and data presented in section 7.4.4.2 below.

7.4.4.2 Measurement Results

Results are shown below in Table 7.4.4.2-1 and Figures 7.4.4.2-1 through 7.4.4.2-48.

Table 7.4.4.2-1: 20dB / 99% Bandwidth

Mode	Frequency [MHz]	Data Rate (kbps)	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
1	902.4	50	117.6	119.4
1	914.8	50	118.8	118.8
1	927.6	50	117.6	118.8
1	902.4	200	267.0	255.0
1	914.8	200	270.0	255.0
1	927.6	200	267.0	255.0
2	902.4	35.5	384.0	390.0
2	914.8	35.5	384.0	390.0
2	927.6	35.5	384.0	388.0
2	902.4	142	330.0	318.0
2	914.8	142	336.0	320.0
2	927.6	142	330.0	320.0
3	902.3	9.6	21.8	21.0
3	915.0	9.6	21.7	21.0
3	927.8	9.6	22.2	21.0
3	902.3	19.2	43.8	44.2
3	915.0	19.2	44.2	44.0
3	927.8	19.2	44.4	43.8
3	902.3	38.4	90.8	90.0
3	915.0	38.4	90.4	89.2
3	927.8	38.4	91.6	89.2
3	902.3	115.2	279.6	270.0
3	915.0	115.2	277.2	270.0
3	927.8	115.2	278.4	268.8

MODE 1:

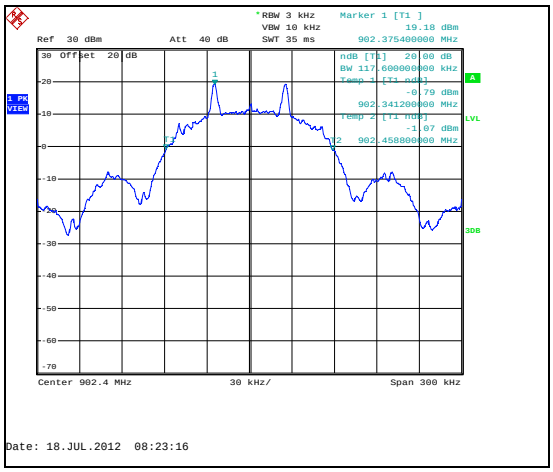

Figure 7.4.4.2-1: 20dB BW - 902.4 MHz – 50 kbps

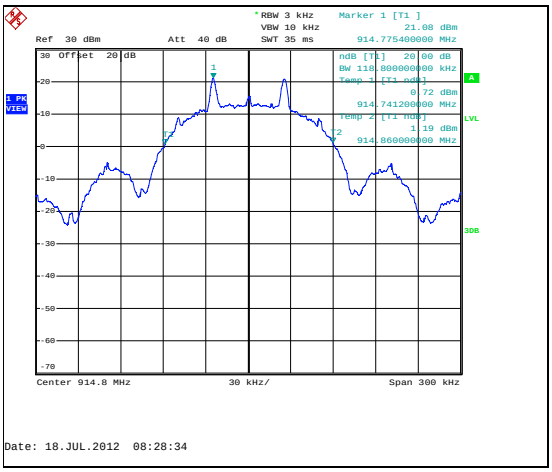

Figure 7.4.4.2-2: 20dB BW - 914.8 MHz – 50 kbps

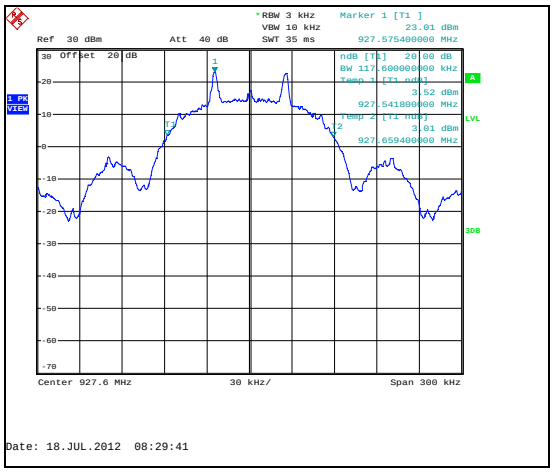

Figure 7.4.4.2-3: 20dB BW – 927.6 MHz – 50 kbps

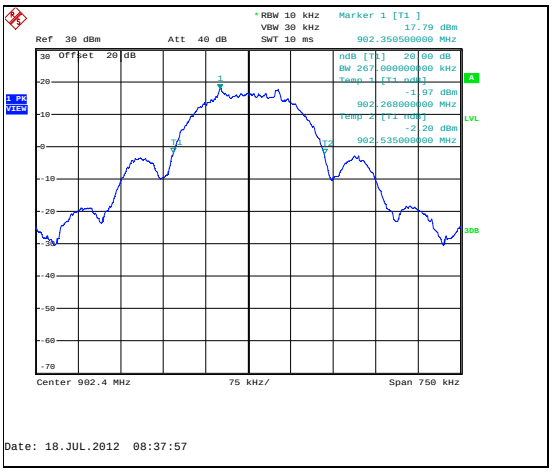

Figure 7.4.4.2-4: 20dB BW - 902.4 MHz – 200 kbps

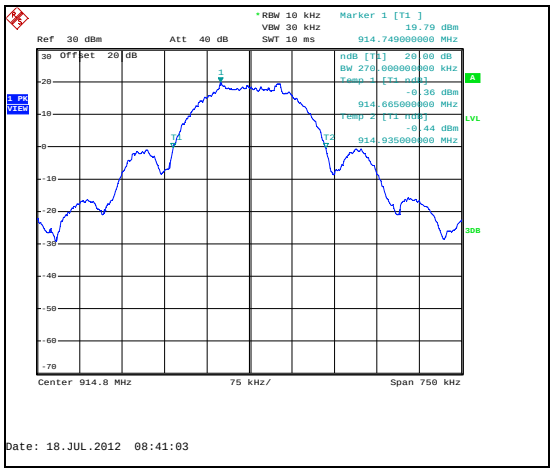

Figure 7.4.4.2-5: 20dB BW – 914.8 MHz – 200 kbps

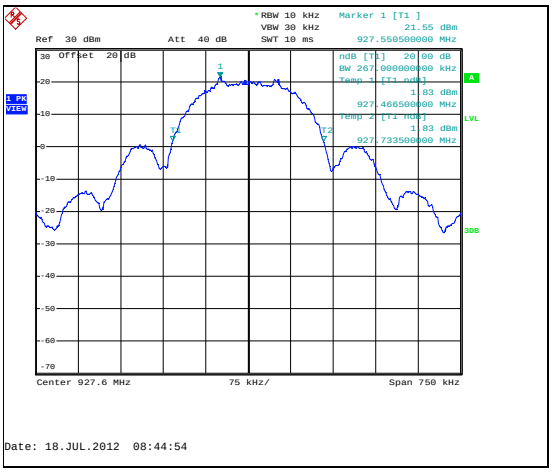

Figure 7.4.4.2-6: 20dB BW – 927.6 MHz – 200 kbps

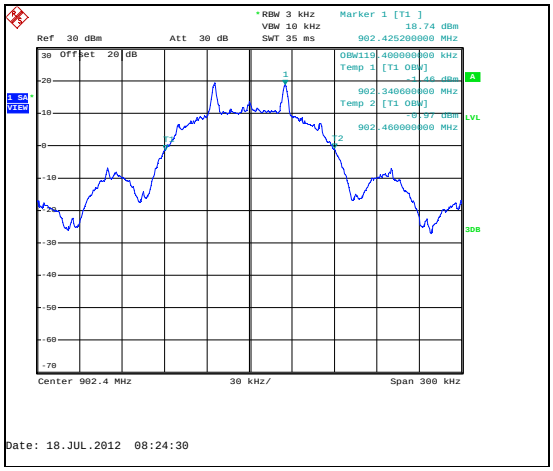

Figure 7.4.4.2-7: 99% BW - 902.4 MHz – 50 kbps

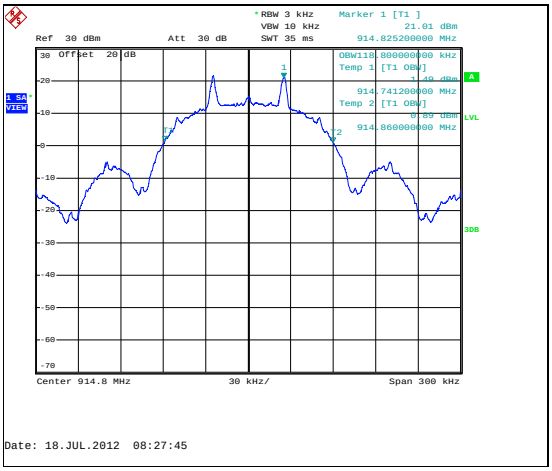

Figure 7.4.4.2-8: 99% BW - 914.8 MHz – 50 kbps

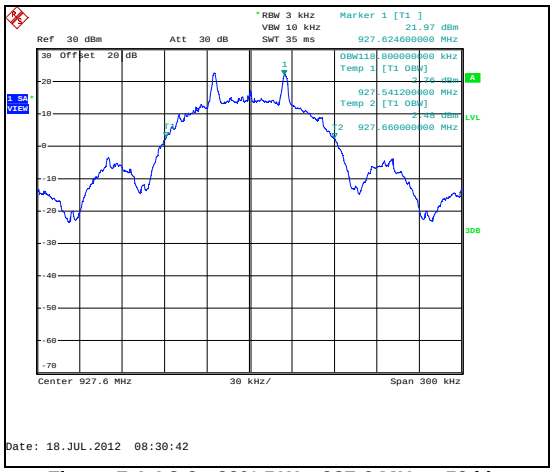

Figure 7.4.4.2-9: 99% BW – 927.6 MHz – 50 kbps

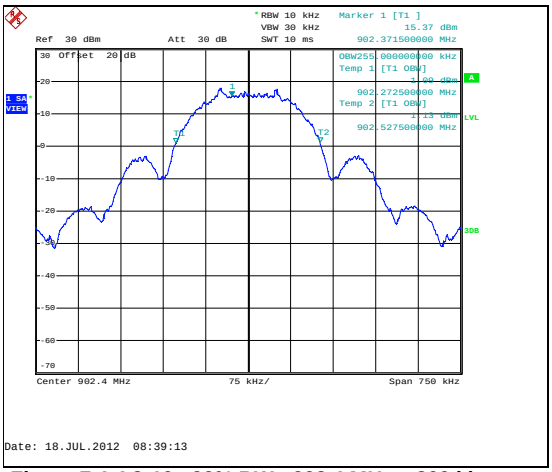

Figure 7.4.4.2-10: 99% BW - 902.4 MHz – 200 kbps

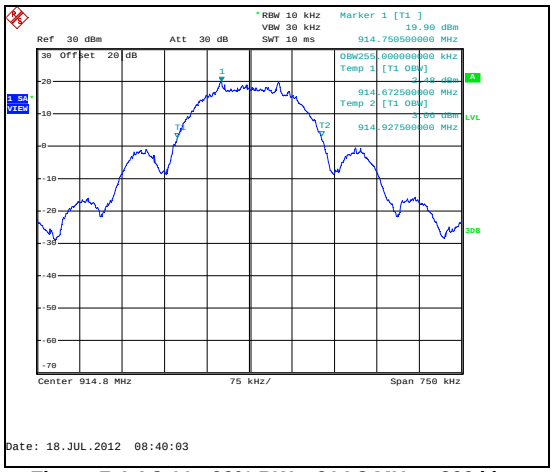

Figure 7.4.4.2-11: 99% BW – 914.8 MHz – 200 kbps

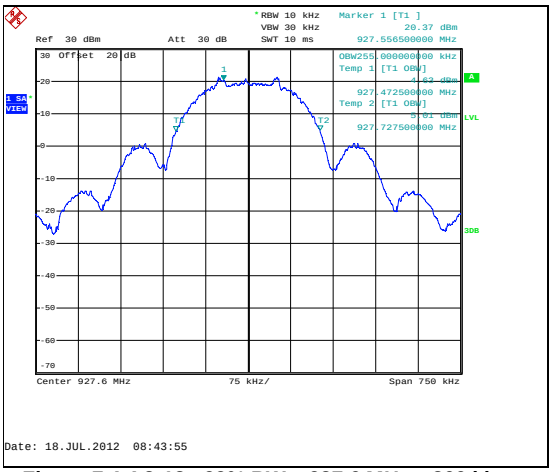

Figure 7.4.4.2-12: 99% BW – 927.6 MHz – 200 kbps

MODE 2:

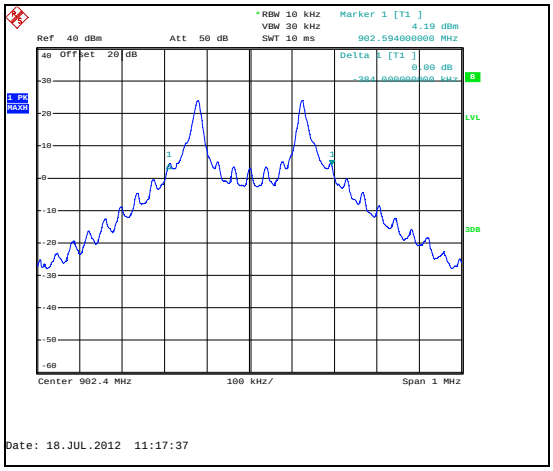

Figure 7.4.4.2-13: 20dB BW - 902.4 MHz – 35.5 kbps

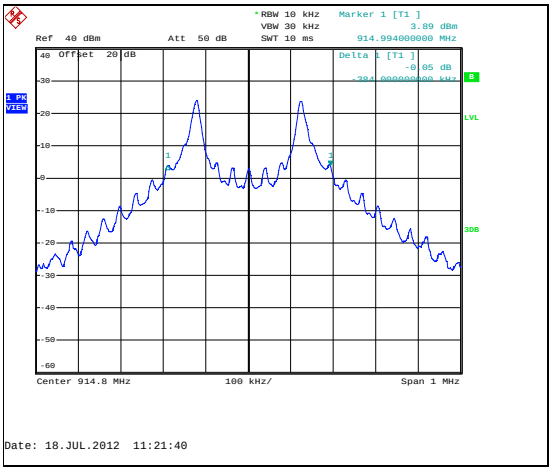

Figure 7.4.4.2-14: 20dB BW - 914.8 MHz – 35.5 kbps

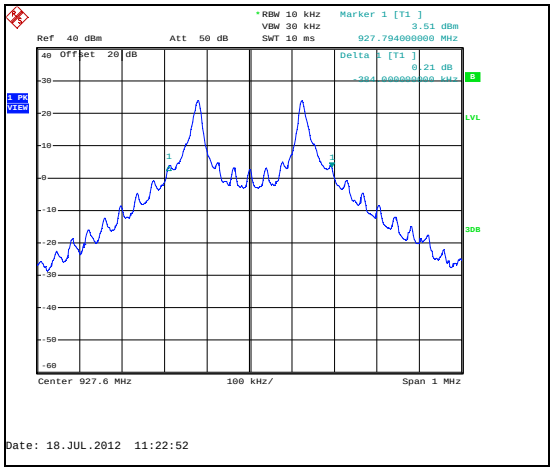

Figure 7.4.4.2-15: 20dB BW – 927.6 MHz – 35.5 kbps

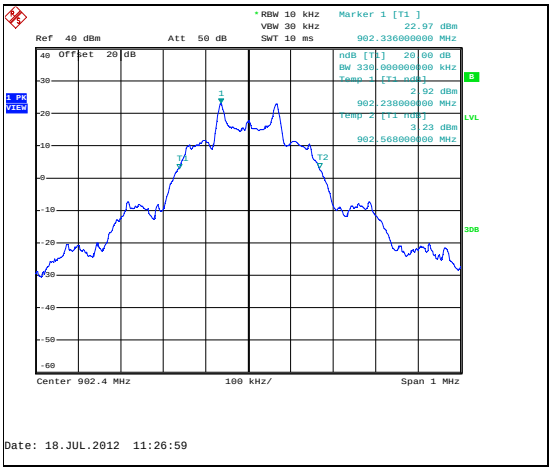

Figure 7.4.4.2-16: 20dB BW - 902.4 MHz – 142 kbps

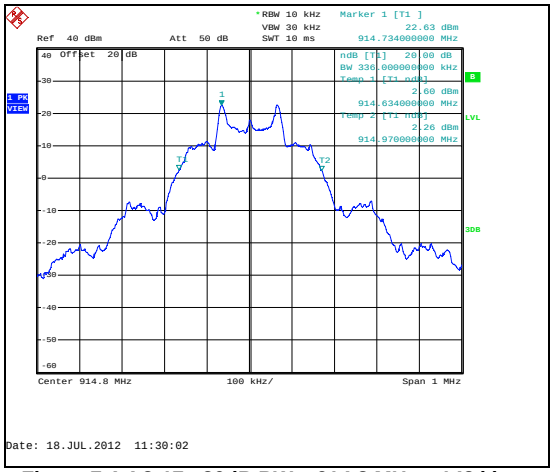

Figure 7.4.4.2-17: 20dB BW – 914.8 MHz – 142 kbps

Figure 7.4.4.2-18: 20dB BW – 927.6 MHz – 142 kbps

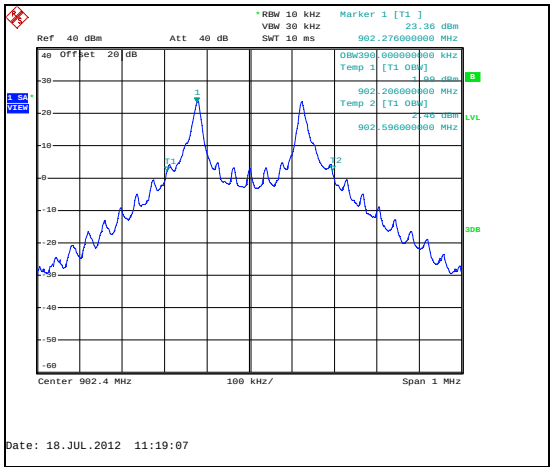

Figure 7.4.4.2-19: 99% BW - 902.4 MHz – 35.5 kbps

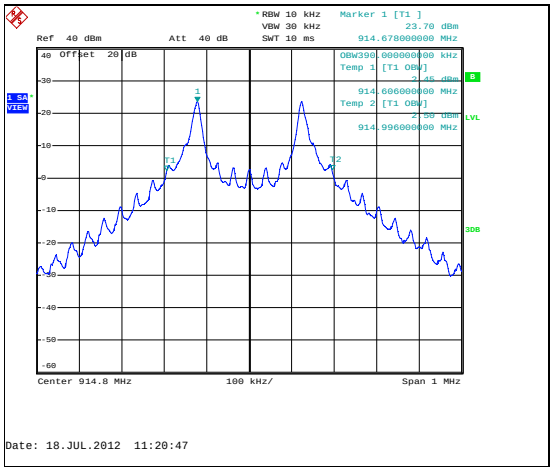

Figure 7.4.4.2-20: 99% BW - 914.8 MHz – 35.5 kbps

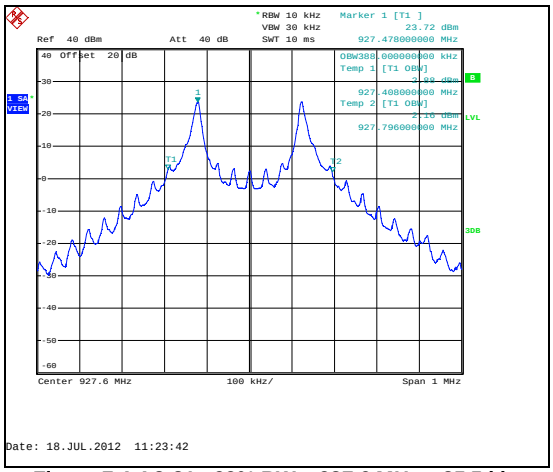

Figure 7.4.4.2-21: 99% BW – 927.6 MHz – 35.5 kbps

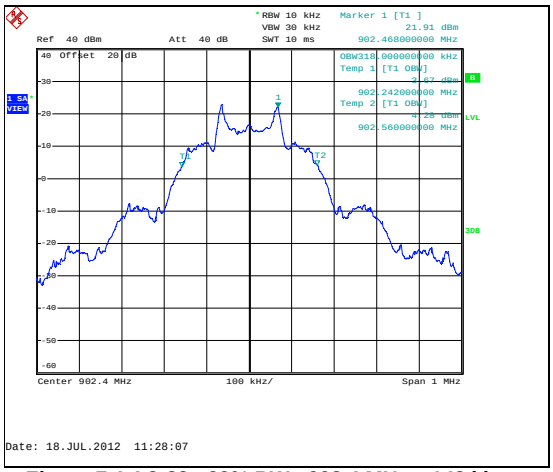

Figure 7.4.4.2-22: 99% BW - 902.4 MHz – 142 kbps

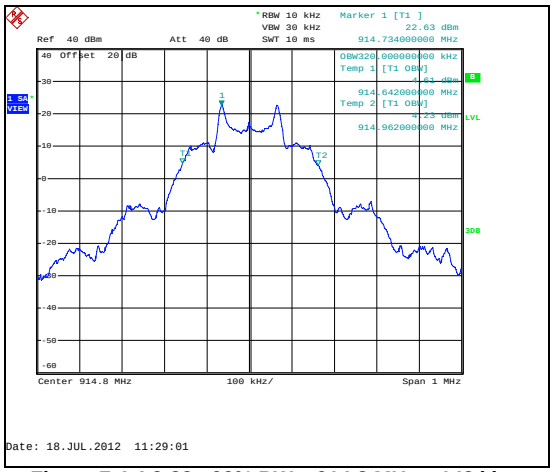

Figure 7.4.4.2-23: 99% BW – 914.8 MHz – 142 kbps

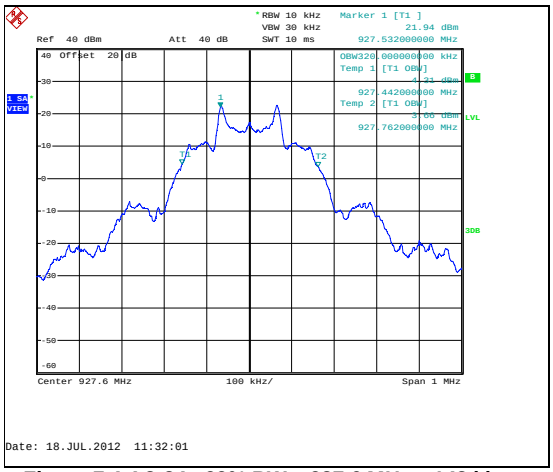

Figure 7.4.4.2-24: 99% BW – 927.6 MHz – 142 kbps

MODE 3:

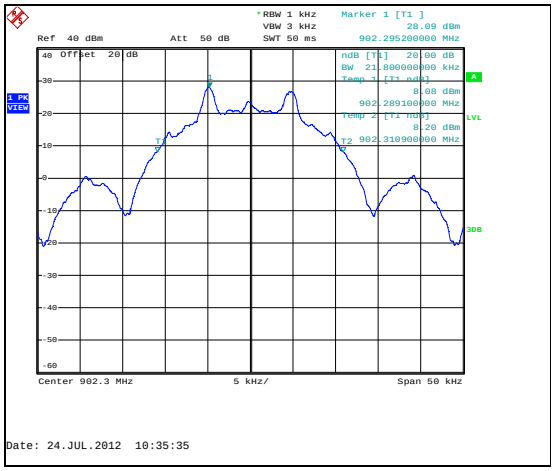

Figure 7.4.4.2-25: 20dB BW - 902.3 MHz – 9.6 kbps

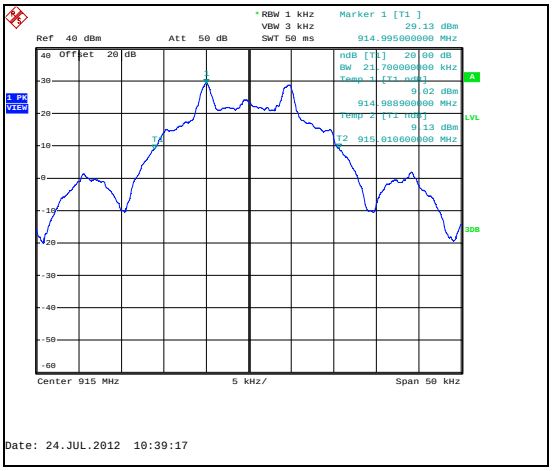

Figure 7.4.4.2-26: 20dB BW - 915.0 MHz – 9.6 kbps

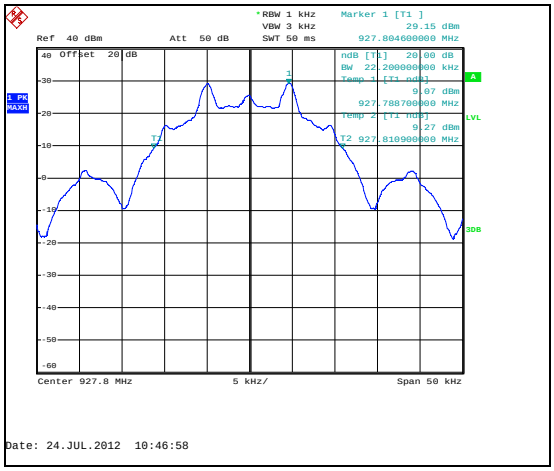

Figure 7.4.4.2-27: 20dB BW – 927.8 MHz – 9.6 kbps

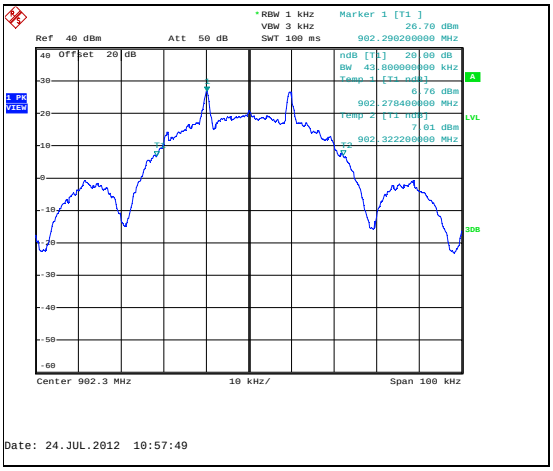

Figure 7.4.4.2-28: 20dB BW - 902.3 MHz – 19.2 kbps

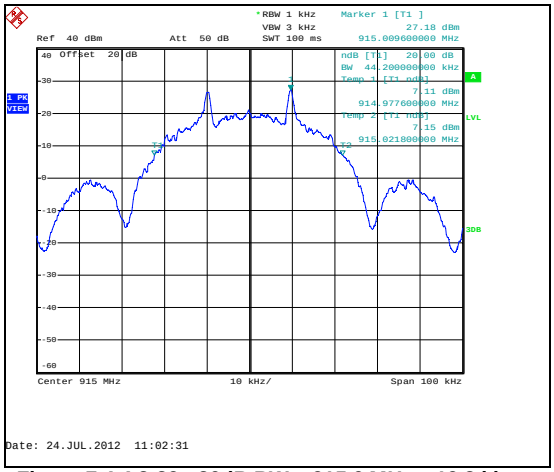

Figure 7.4.4.2-29: 20dB BW – 915.0 MHz – 19.2 kbps

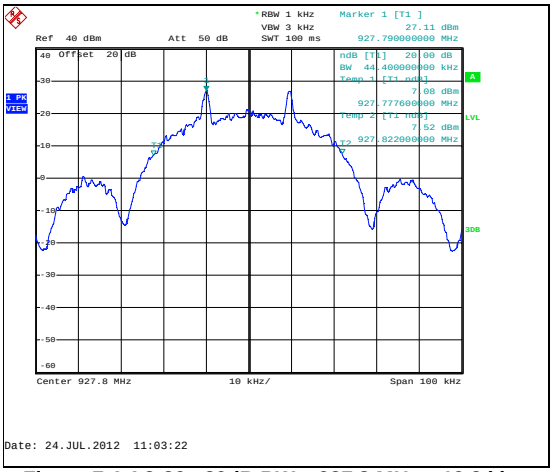

Figure 7.4.4.2-30: 20dB BW – 927.8 MHz – 19.2 kbps

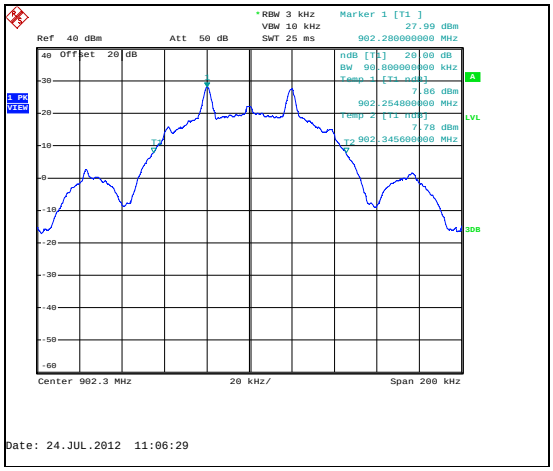

Figure 7.4.4.2-31: 20dB BW - 902.3 MHz – 38.4 kbps

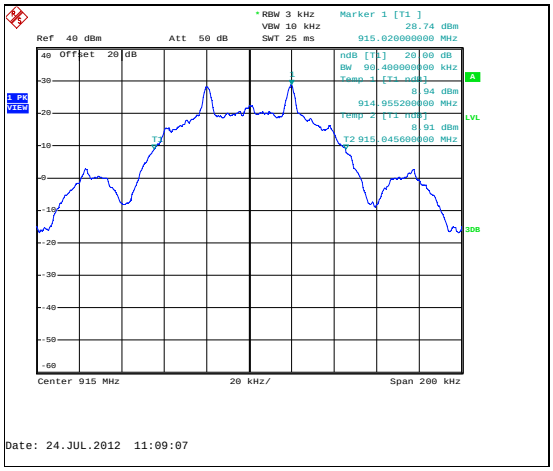

Figure 7.4.4.2-32: 20dB BW - 915.0 MHz – 38.4 kbps

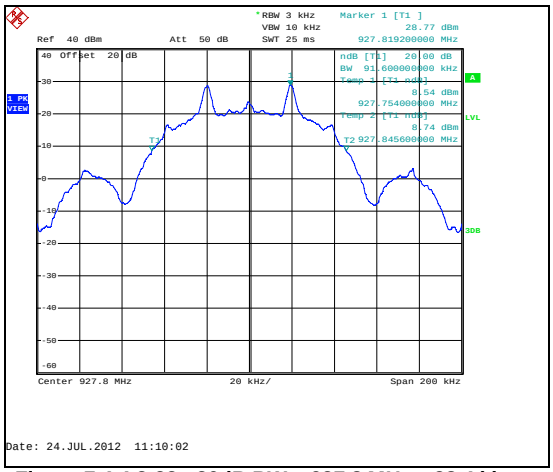

Figure 7.4.4.2-33: 20dB BW – 927.8 MHz – 38.4 kbps

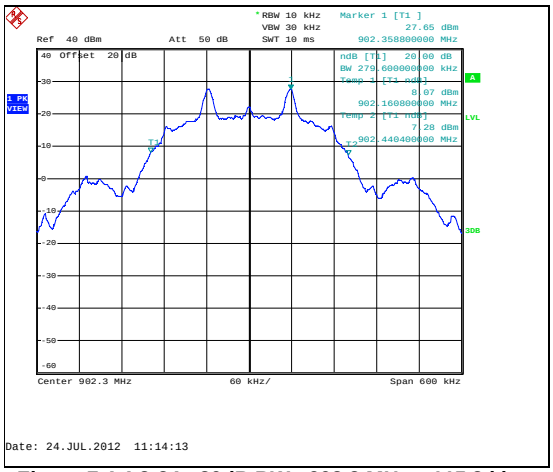

Figure 7.4.4.2-34: 20dB BW - 902.3 MHz – 115.2 kbps

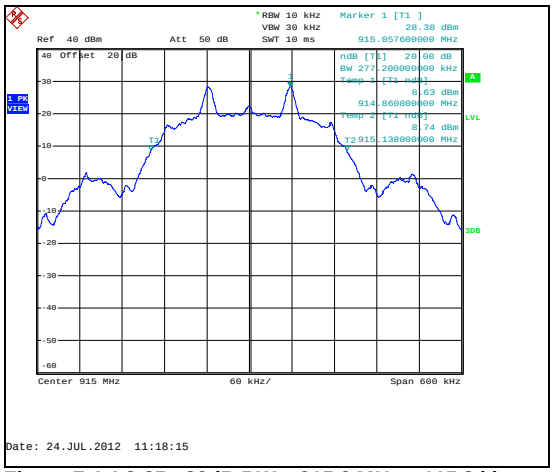

Figure 7.4.4.2-35: 20dB BW – 915.0 MHz – 115.2 kbps

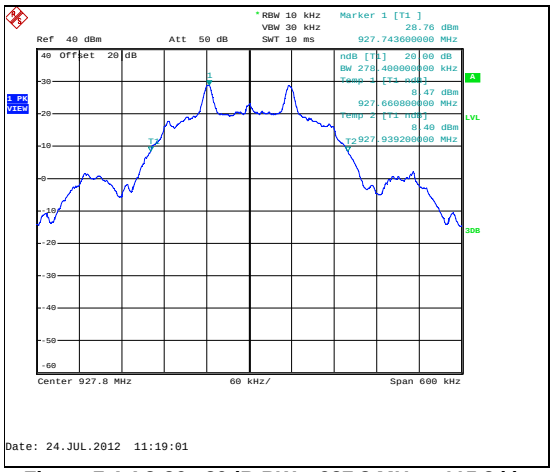

Figure 7.4.4.2-36: 20dB BW – 927.8 MHz – 115.2 kbps

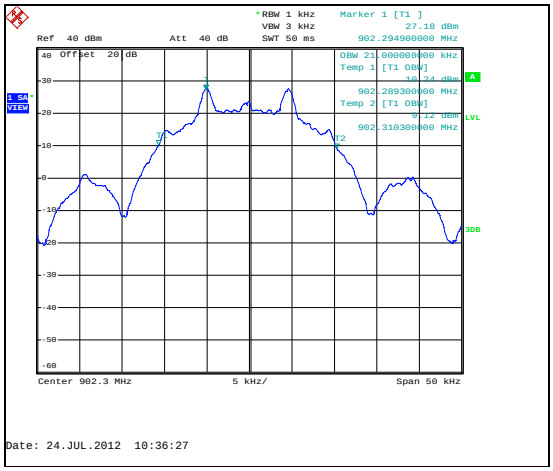

Figure 7.4.4.2-37: 99% BW - 902.3 MHz – 9.6 kbps

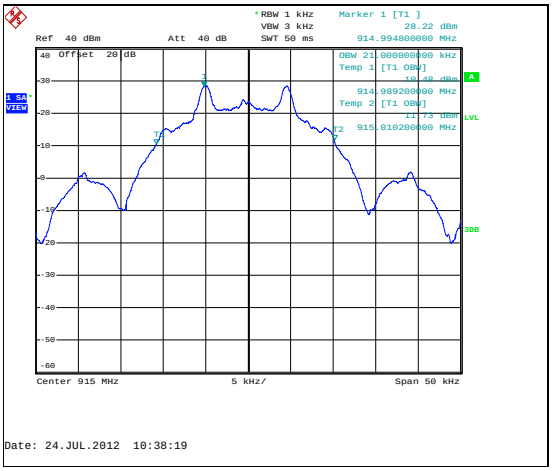

Figure 7.4.4.2-38: 99% BW - 915.0 MHz – 9.6 kbps

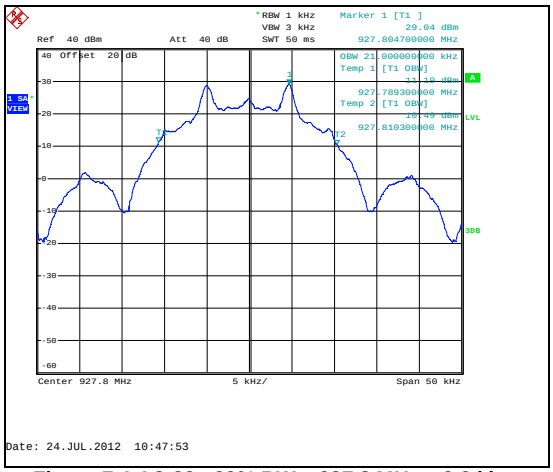

Figure 7.4.4.2-39: 99% BW – 927.8 MHz – 9.6 kbps

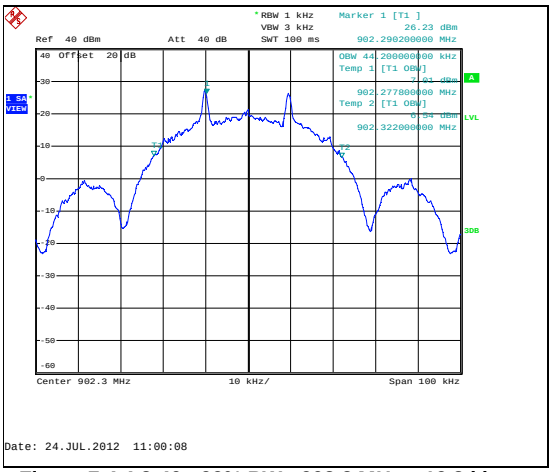

Figure 7.4.4.2-40: 99% BW - 902.3 MHz – 19.2 kbps

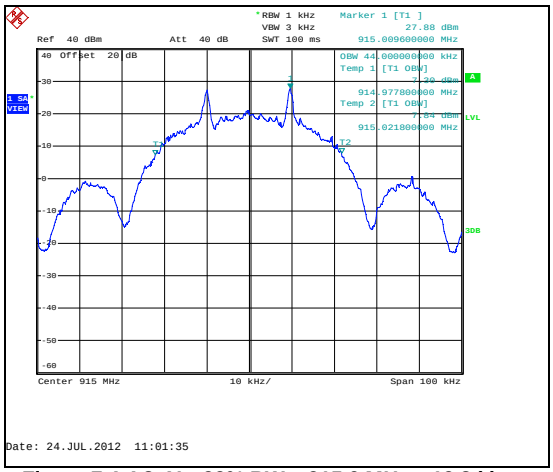

Figure 7.4.4.2-41: 99% BW – 915.0 MHz – 19.2 kbps

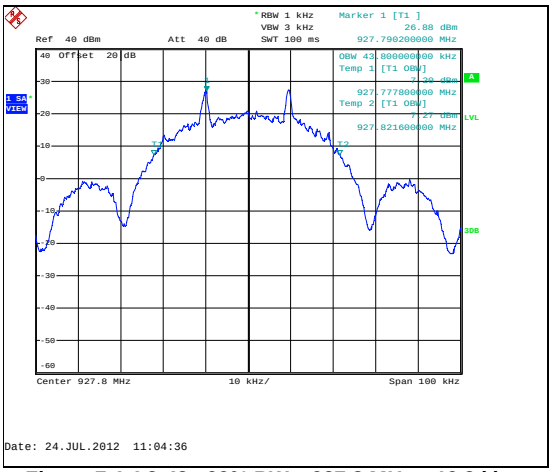

Figure 7.4.4.2-42: 99% BW – 927.8 MHz – 19.2 kbps

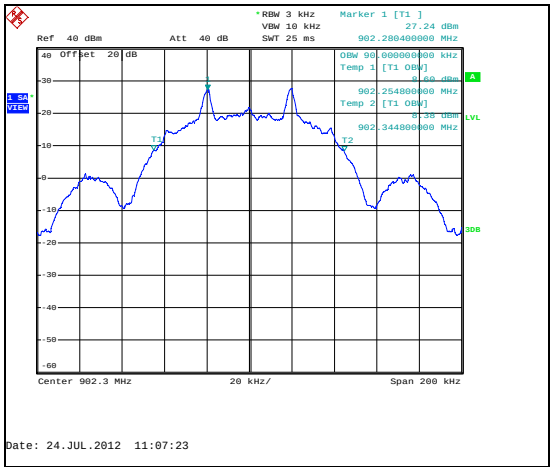

Figure 7.4.4.2-43: 99% BW - 902.3 MHz – 38.4 kbps

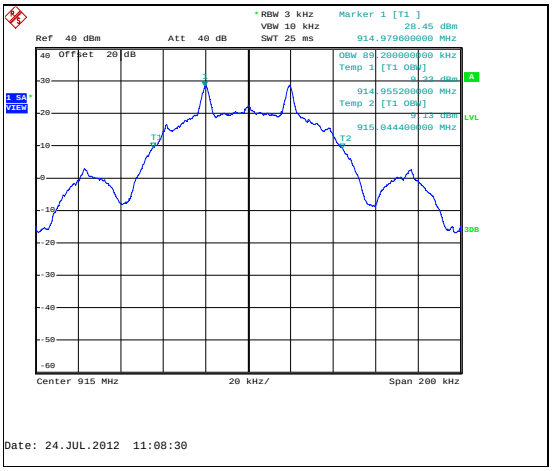

Figure 7.4.4.2-44: 99% BW - 915.0 MHz – 38.4 kbps

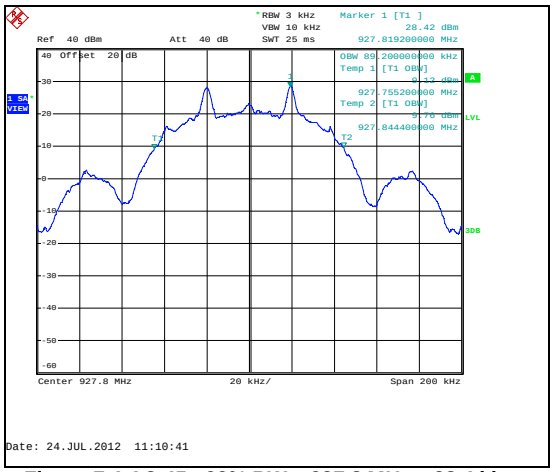

Figure 7.4.4.2-45: 99% BW – 927.8 MHz – 38.4 kbps

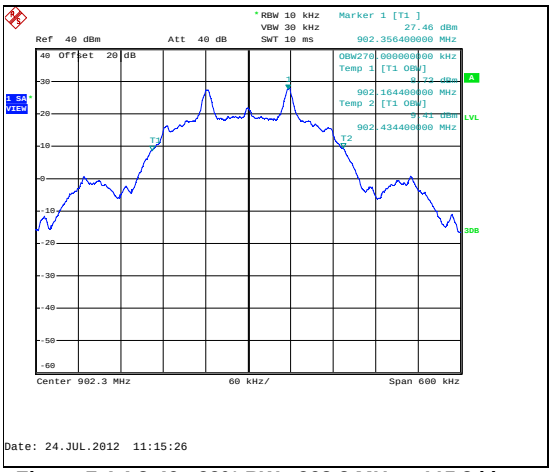

Figure 7.4.4.2-46: 99% BW - 902.3 MHz – 115.2 kbps

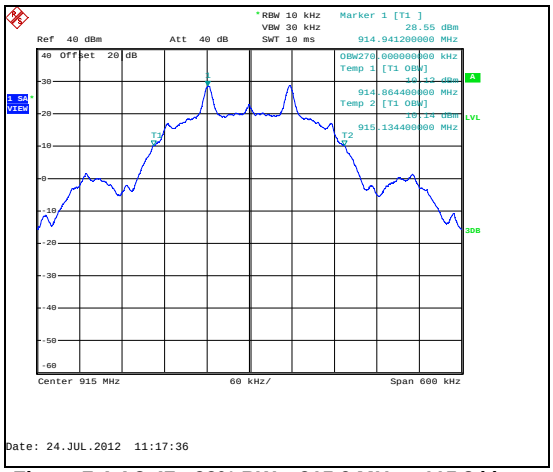

Figure 7.4.4.2-47: 99% BW – 915.0 MHz – 115.2 kbps

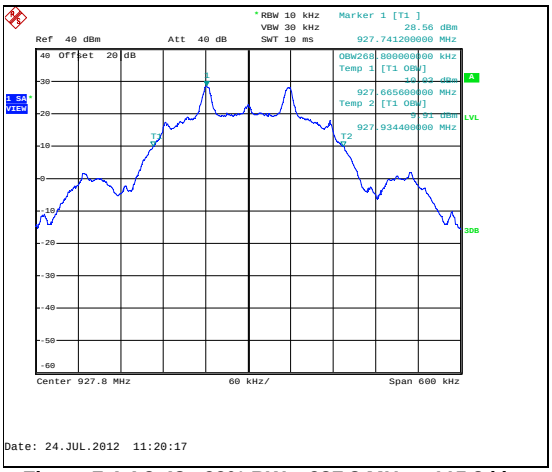

Figure 7.4.4.2-48: 99% BW – 927.8 MHz – 115.2 kbps

7.5 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 A8.5

7.5.1 Band-Edge Compliance of RF Conducted Emissions

7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. 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 ≥ 1% of the span, and the VBW set to ≥ 3x RBW.

The band-edges were measured for the modes of operation identified in section 1.3 and data presented in section 7.5.1.2 below.

7.5.1.2 Measurement Results

Results are shown in the figures 7.5.1.2-1 to 7.5.1.2-16 below.

NON-HOPPING MODE:

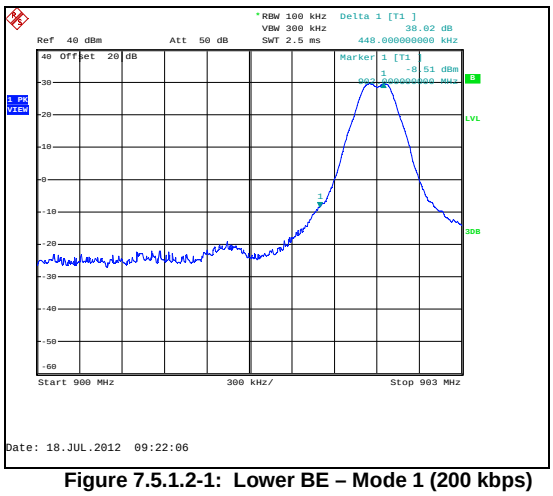

Figure 7.5.1.2-1: Lower BE – Mode 1 (200 kbps)

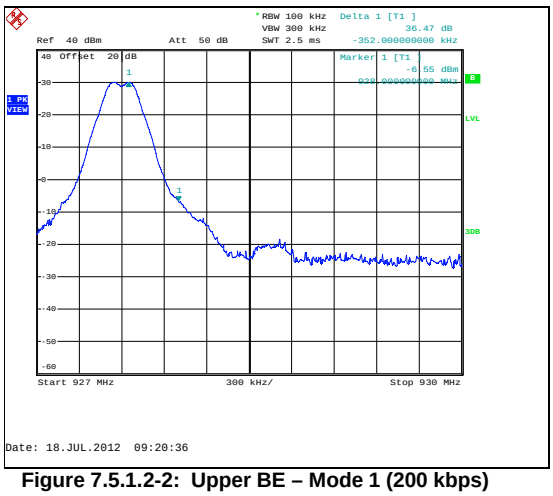

Figure 7.5.1.2-2: Upper BE – Mode 1 (200 kbps)

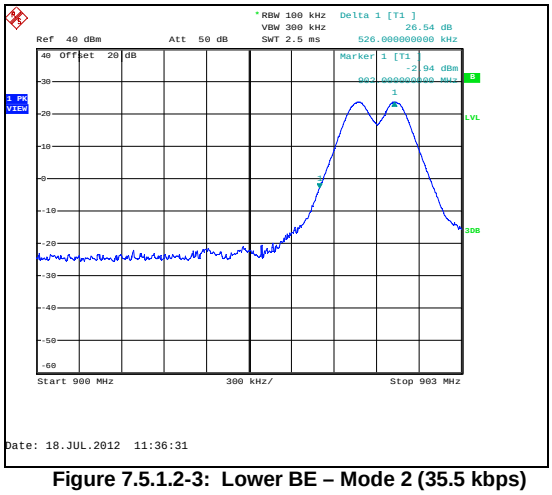

Figure 7.5.1.2-3: Lower BE – Mode 2 (35.5 kbps)

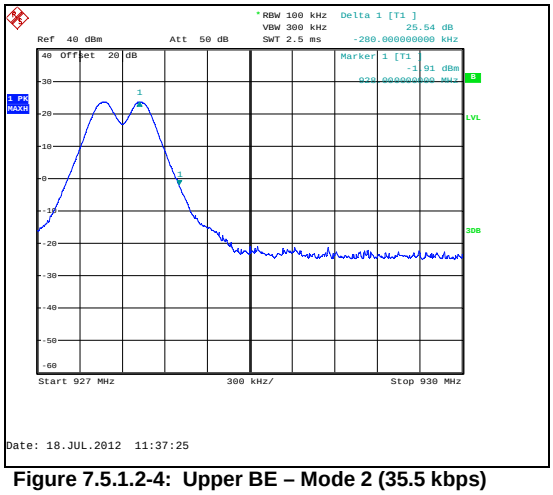

Figure 7.5.1.2-4: Upper BE – Mode 2 (35.5 kbps)

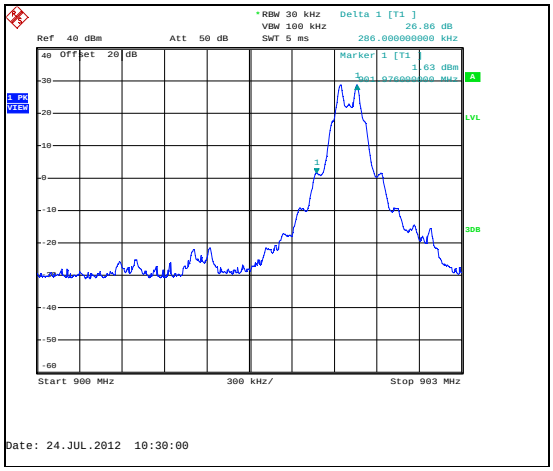

Figure 7.5.1.2-5: Lower BE – Mode 3 (115.2 kbps)

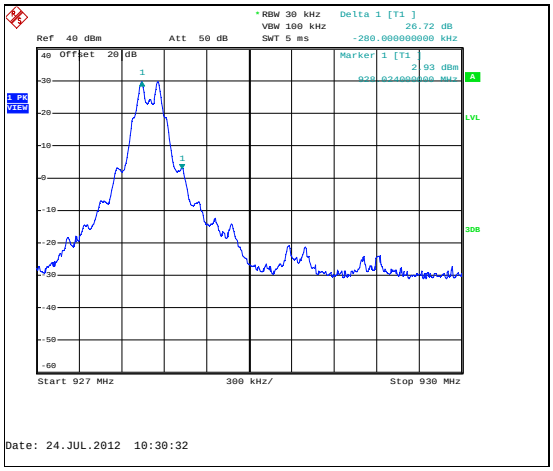

Figure 7.5.1.2-6: Upper BE – Mode 3 (115.2 kbps)

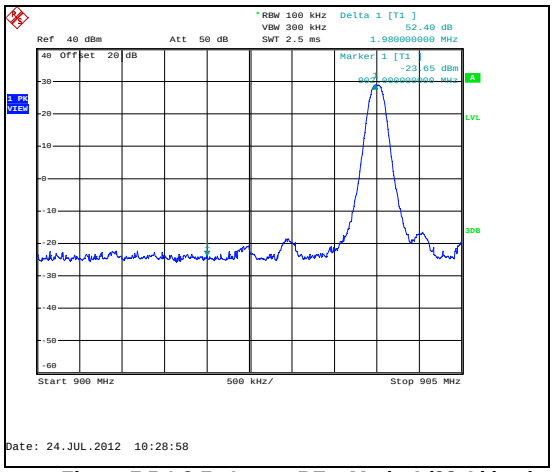

Figure 7.5.1.2-7: Lower BE – Mode 4 (38.4 kbps)

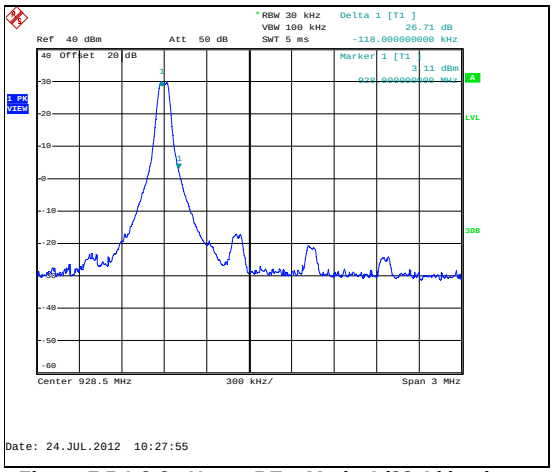

Figure 7.5.1.2-8: Upper BE – Mode 4 (38.4 kbps)

HOPPING MODE:

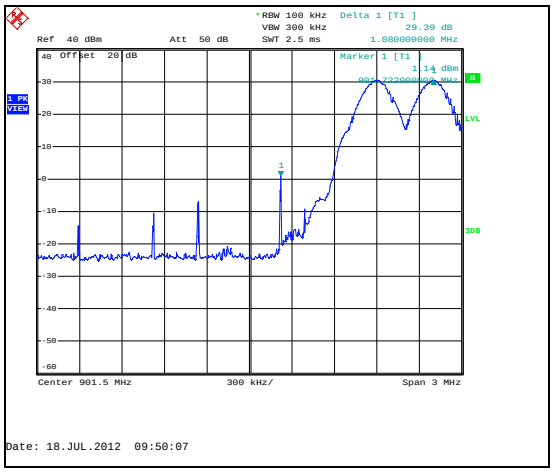

Figure 7.5.1.2-9: Lower BE – Mode 1 (200 kbps)

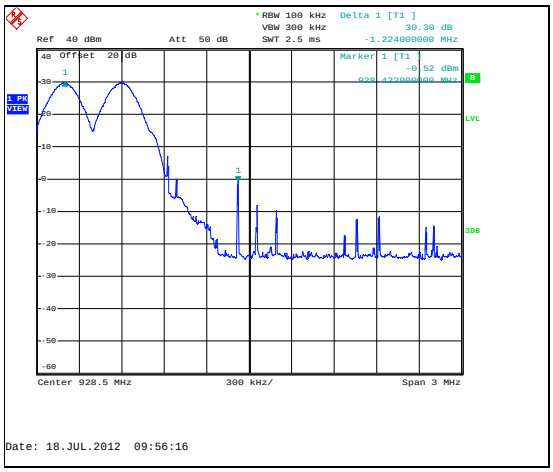

Figure 7.5.1.2-10: Upper BE – Mode 1 (200 kbps)

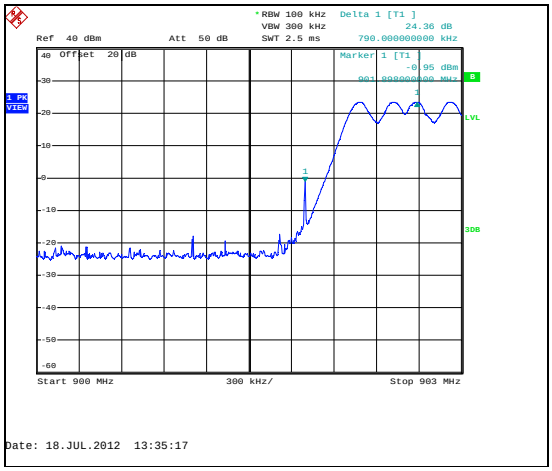

Figure 7.5.1.2-11: Lower BE – Mode 2 (35.5 kbps)

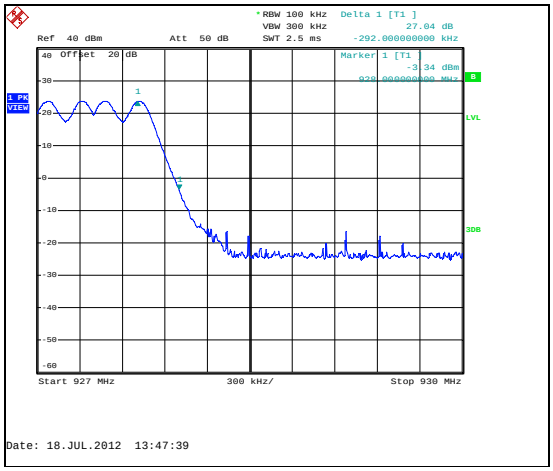

Figure 7.5.1.2-12: Upper BE – Mode 2 (35.5 kbps)

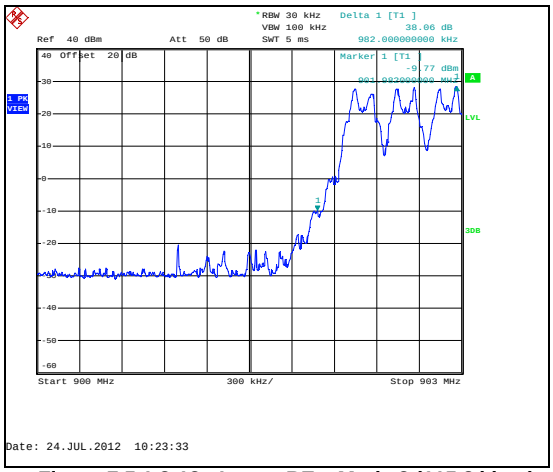

Figure 7.5.1.2-13: Lower BE – Mode 3 (115.2 kbps)

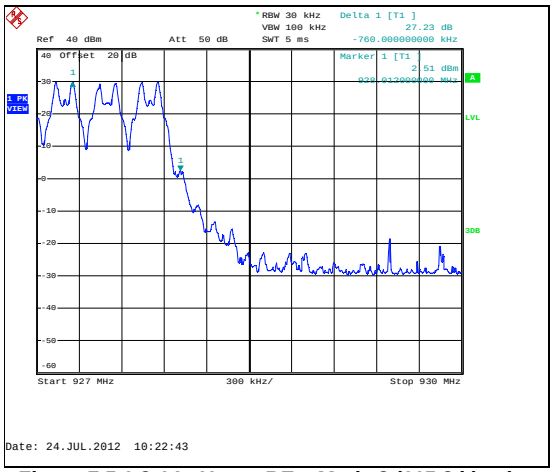

Figure 7.5.1.2-14: Upper BE – Mode 3 (115.2 kbps)

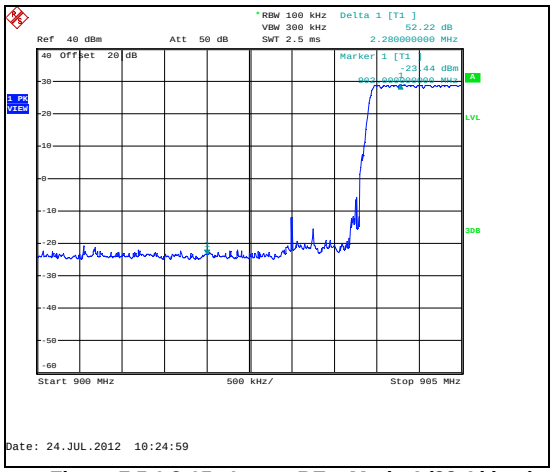

Figure 7.5.1.2-15: Lower BE – Mode 4 (38.4 kbps)

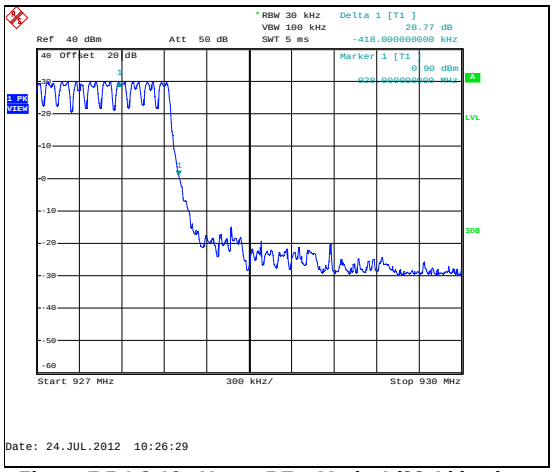

Figure 7.5.1.2-16: Upper BE – Mode 4 (38.4 kbps)

7.5.2 RF Conducted Spurious Emissions

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.

RF conducted spurious emissions were measured for the modes of operation identified in section 1.3 and data presented in section 7.5.2.2 below.

7.5.2.2 Measurement Results

Results are shown below in Figures 7.5.2.2-1 to 7.5.2.2-18:

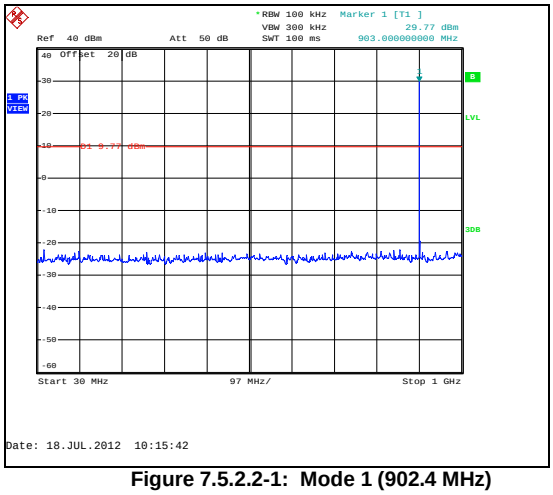

Figure 7.5.2.2-1: Mode 1 (902.4 MHz)

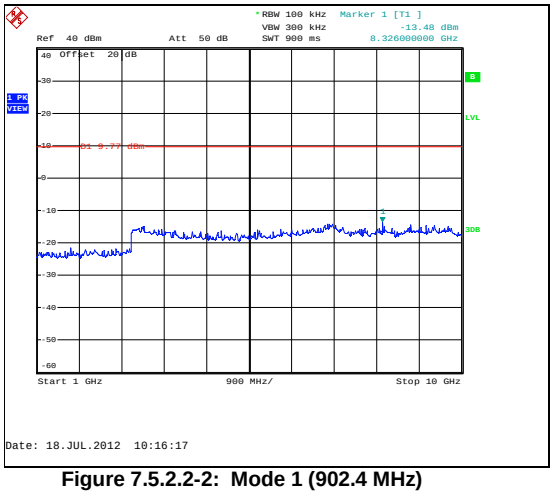

Figure 7.5.2.2-2: Mode 1 (902.4 MHz)

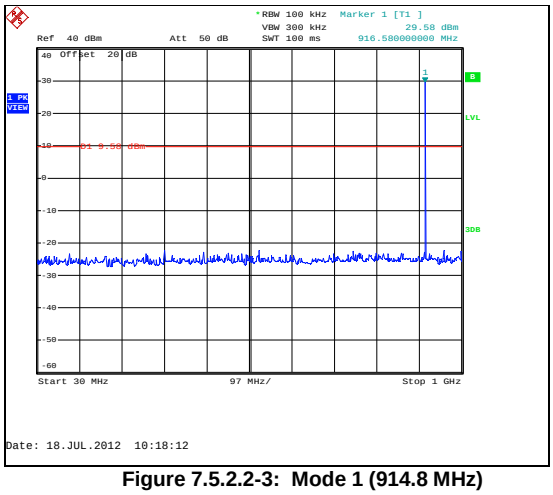

Figure 7.5.2.2-3: Mode 1 (914.8 MHz)

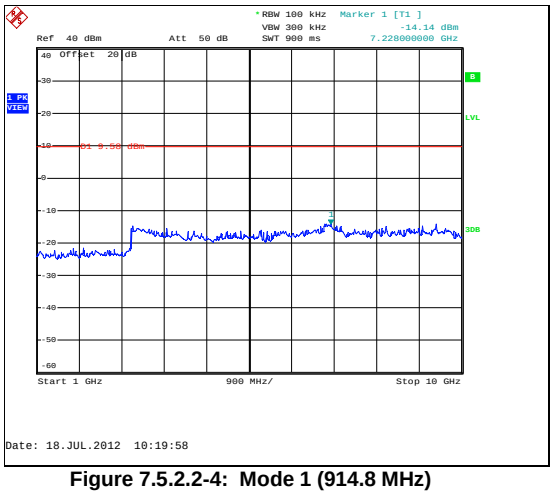

Figure 7.5.2.2-4: Mode 1 (914.8 MHz)

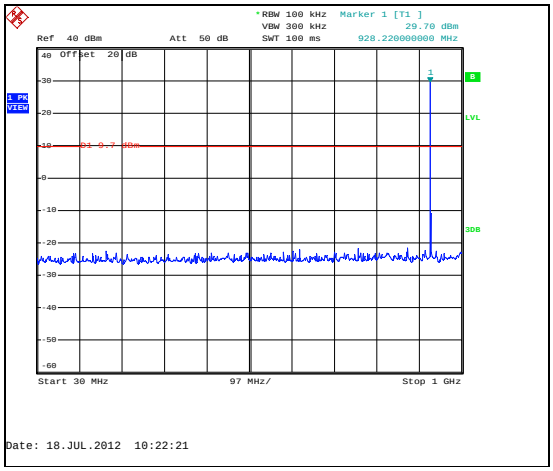

Figure 7.5.2.2-5: Mode 1 (927.6 MHz)

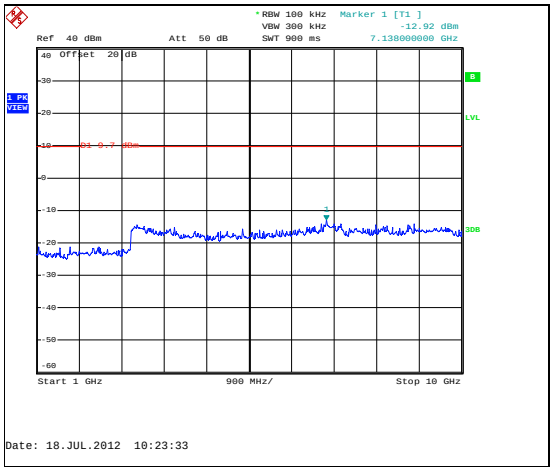

Figure 7.5.2.2-6: Mode 1 (927.6 MHz)

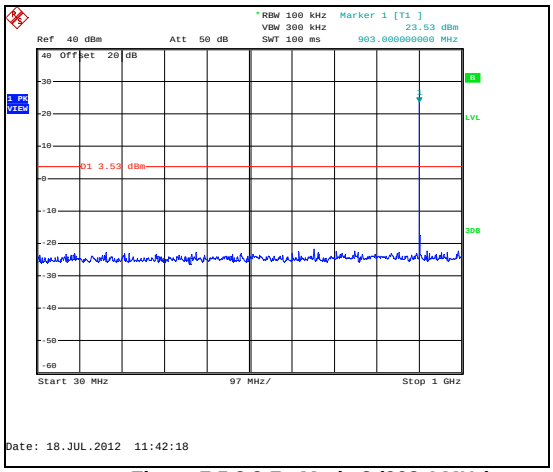

Figure 7.5.2.2-7: Mode 2 (902.4 MHz)

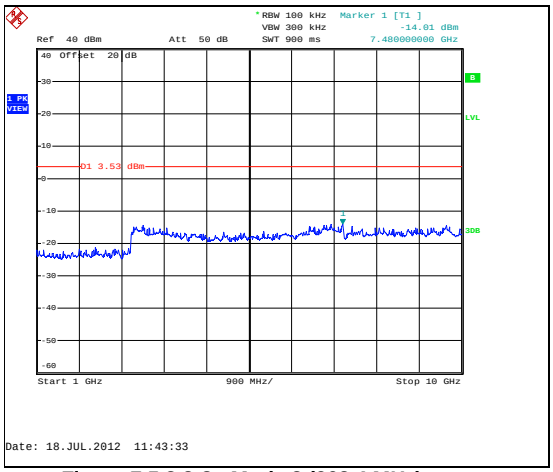

Figure 7.5.2.2-8: Mode 2 (902.4 MHz)

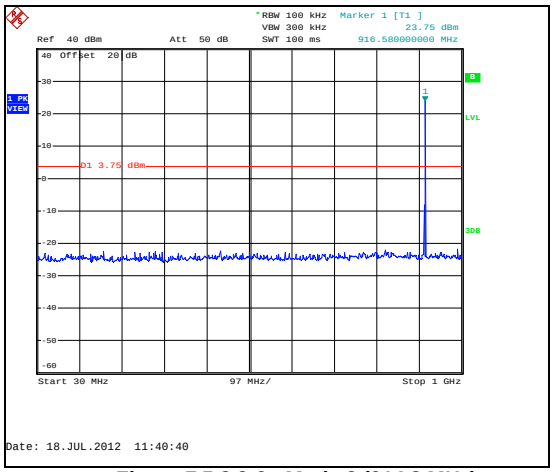

Figure 7.5.2.2-9: Mode 2 (914.8 MHz)

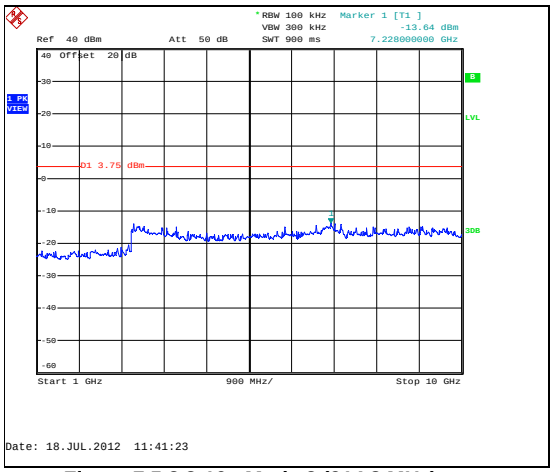

Figure 7.5.2.2-10: Mode 2 (914.8 MHz)

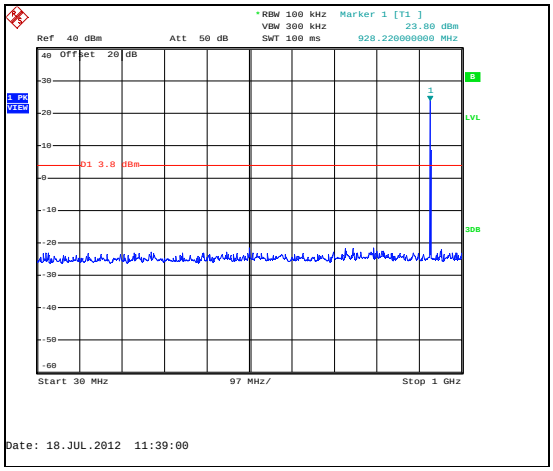

Figure 7.5.2.2-11: Mode 2 (927.6 MHz)

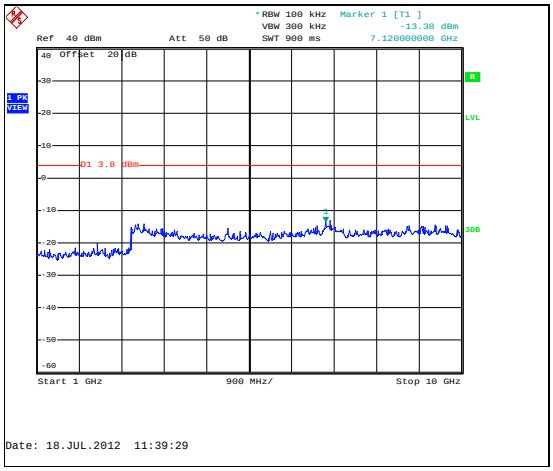

Figure 7.5.2.2-12: Mode 2 (927.6 MHz)

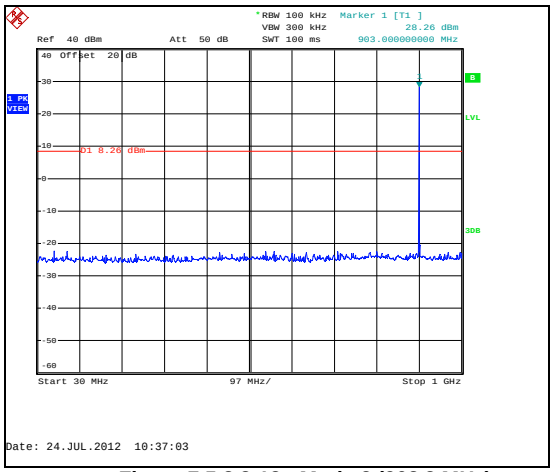

Figure 7.5.2.2-13: Mode 3 (902.3 MHz)

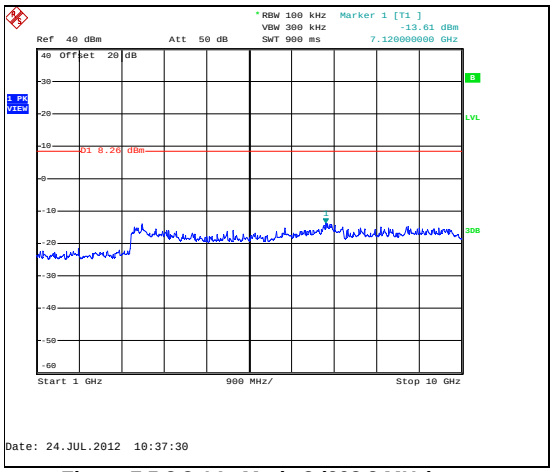

Figure 7.5.2.2-14: Mode 3 (902.3 MHz)

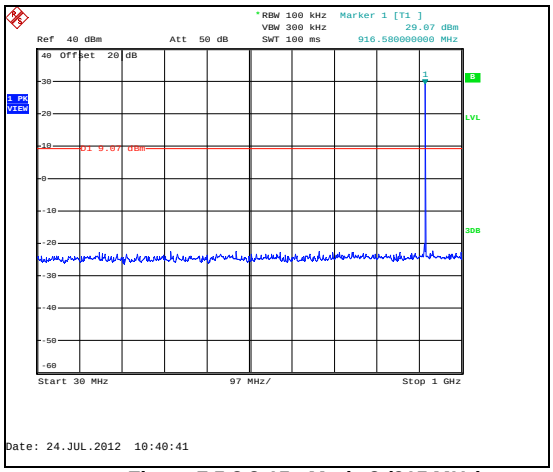

Figure 7.5.2.2-15: Mode 3 (915 MHz)

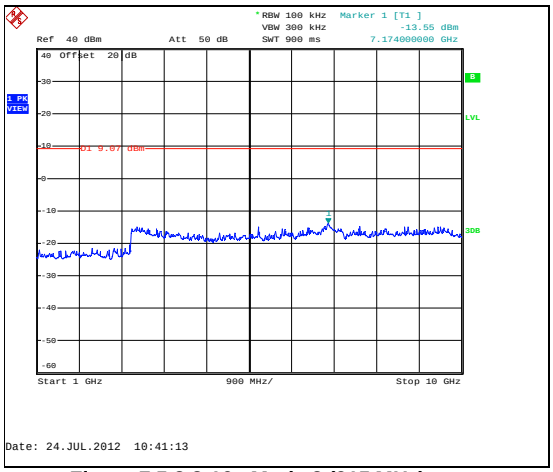

Figure 7.5.2.2-16: Mode 3 (915 MHz)

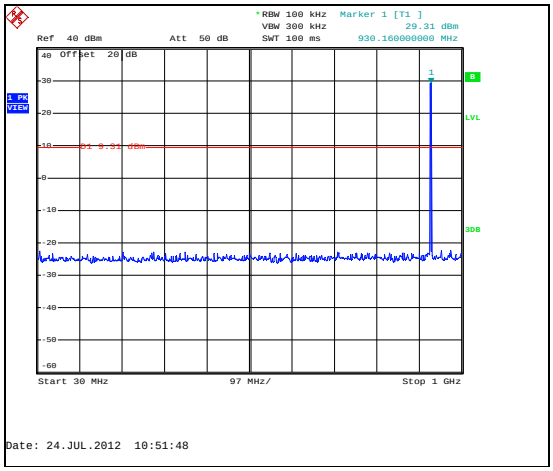

Figure 7.5.2.2-17: Mode 4 (927.9 MHz)

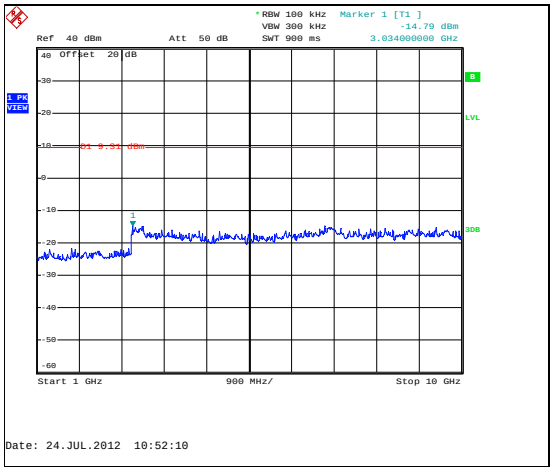

Figure 7.5.2.2-18: Mode 4 (927.9 MHz)

7.5.3 Radiated Spurious Emissions - FCC Section 15.205 IC: RSS-210 2.6

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 carrier signal on the hopping channel.

RF conducted spurious emissions were measured for the modes of operation identified in section 1.3 and data presented in section 7.5.3.2 below.

7.5.3.2 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in the Tables 7.5.3.2-1 to 7.5.3.2-3 below.

Table 7.5.3.2-1: Radiated Spurious Emissions Tabulated Data – Mode 1

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Antenna Height	Turntable Position	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(cm)	(o)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel - 902.4 MHz												
2707.2	51.49	44.91	H	145	211	-4.32	47.17	40.59	74.0	54.0	26.8	13.4
2707.2	50.66	43.38	V	123	244	-4.32	46.34	39.06	74.0	54.0	27.7	14.9
3609.6	52.63	47.04	H	165	73	-1.25	51.38	45.79	74.0	54.0	22.6	8.2
3609.6	50.02	42.29	V	103	184	-1.25	48.77	41.04	74.0	54.0	25.2	13.0
4512	50.17	41.30	H	150	263	0.61	50.78	41.91	74.0	54.0	23.2	12.1
4512	48.78	39.63	V	142	147	0.61	49.39	40.24	74.0	54.0	24.6	13.8
8121.6	47.01	36.09	H	124	210	7.59	54.60	43.68	74.0	54.0	19.4	10.3
966.38		35.65	H	100	308	1.34	---------	36.99	--------	54.0	---------	17.0
966.38		34.38	V	100	170	1.34	---------	35.72	--------	54.0	---------	18.3
Mid Channel - 916 MHz												
2744.4	50.11	42.57	H	174	193	-4.20	45.91	38.37	74.0	54.0	28.1	15.6
2744.4	49.57	41.28	V	129	242	-4.20	45.37	37.08	74.0	54.0	28.6	16.9
3659.2	49.01	39.45	H	128	195	-1.01	48.00	38.44	74.0	54.0	26.0	15.6
3659.2	50.81	43.11	V	107	177	-1.01	49.80	42.10	74.0	54.0	24.2	11.9
4574	48.15	38.47	H	177	15	0.79	48.94	39.26	74.0	54.0	25.1	14.7
4574	47.23	36.71	V	122	344	0.79	48.02	37.50	74.0	54.0	26.0	16.5
978.77		36.03	H	100	303	1.83	---------	37.86	--------	54.0	---------	16.1
978.77		31.91	V	100	47	1.83	---------	33.74	--------	54.0	---------	20.3
High Channel - 927.6 MHz												
2782.8	47.87	37.98	H	114	211	-4.07	43.80	33.91	74.0	54.0	30.2	20.1
2782.8	49.21	40.95	V	100	130	-4.07	45.14	36.88	74.0	54.0	28.9	17.1
3710.4	48.48	38.13	H	170	90	-0.76	47.72	37.37	74.0	54.0	26.3	16.6
3710.4	48.42	37.93	V	140	186	-0.76	47.66	37.17	74.0	54.0	26.3	16.8
4638	47.58	38.69	H	139	222	0.98	48.56	39.67	74.0	54.0	25.4	14.3
4638	48.65	39.58	V	130	35	0.98	49.63	40.56	74.0	54.0	24.4	13.4
960		44.56	H	100	231	1.40	---------	45.96	--------	54.0	---------	8.0
960		42.30	V	101	177	1.40	---------	43.70	--------	54.0	---------	10.3
991.61		36.81	H	100	303	2.58	---------	39.39	--------	54.0	---------	14.6
991.61		34.27	V	129	121	2.58	---------	36.85	--------	54.0	---------	17.2

Table 7.5.3.2-2: Radiated Spurious Emissions Tabulated Data – Mode 2

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Antenna Height	Turntable Position	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(cm)	(o)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel - 902.4 MHz												
2707.2	48.11	36.86	V	100	126	-4.32	43.79	32.54	74.0	54.0	30.2	21.5
3609.6	50.26	39.11	H	167	55	-1.25	49.01	37.86	74.0	54.0	25.0	16.1
3609.6	49.13	37.43	V	217	338	-1.25	47.88	36.18	74.0	54.0	26.1	17.8
4512	48.16	36.50	H	151	260	0.61	48.77	37.11	74.0	54.0	25.2	16.9
4512	47.55	35.98	V	163	327	0.61	48.16	36.59	74.0	54.0	25.8	17.4
Mid Channel - 916 MHz												
All measurements were below the instrumentation noise floor.												
High Channel - 927.6 MHz												
3710.4	50.26	38.84	H	172	67	-0.76	49.50	38.08	74.0	54.0	24.5	15.9
3710.4	48.27	36.86	V	172	29	-0.76	47.51	36.10	74.0	54.0	26.5	17.9
4638	48.17	36.48	V	132	36	0.98	49.15	37.46	74.0	54.0	24.8	16.5

Table 7.5.3.2-3: Radiated Spurious Emissions Tabulated Data – Mode 3/4

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Antenna Height	Turntable Position	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(cm)	(o)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel - 902.3 MHz												
2706.3	51.88	45.77	H	171	226	-4.05	47.83	41.72	74.0	54.0	26.2	12.3
2706.3	52.15	45.90	V	123	225	-4.05	48.10	41.85	74.0	54.0	25.9	12.1
3608.4	53.26	48.16	H	167	74	-0.95	52.31	47.21	74.0	54.0	21.7	6.8
3608.4	51.37	44.78	V	102	186	-0.95	50.42	43.83	74.0	54.0	23.6	10.2
4510.5	50.15	41.96	H	151	263	1.08	51.23	43.04	74.0	54.0	22.8	11.0
4510.5	49.88	41.94	V	133	334	1.08	50.96	43.02	74.0	54.0	23.0	11.0
966.28		36.11	H	101	135	1.34	---------	37.45	--------	54.0	---------	16.6
966.28		35.90	V	101	271	1.34	---------	37.24	--------	54.0	---------	16.8
998.28		30.04	H	100	132	3.31	---------	33.35	--------	54.0	---------	20.6
998.28		30.39	V	103	272	3.31	---------	33.70	--------	54.0	---------	20.3
Mid Channel - 915 MHz												
2745	51.44	45.36	H	175	193	-3.91	47.53	41.45	74.0	54.0	26.5	12.6
2745	50.72	44.60	V	119	31	-3.91	46.81	40.69	74.0	54.0	27.2	13.3
3660	50.21	43.43	H	165	183	-0.71	49.50	42.72	74.0	54.0	24.5	11.3
3660	52.02	45.57	V	103	177	-0.71	51.31	44.86	74.0	54.0	22.7	9.1
979		36.13	H	100	303	1.84	---------	37.97	--------	54.0	---------	16.0
979		36.92	V	114	269	1.84	---------	38.76	--------	54.0	---------	15.2
High Channel - 927.9 MHz												
2783.7	52.26	46.33	H	172	196	-3.78	48.48	42.55	74.0	54.0	25.5	11.4
2783.7	51.68	45.87	V	100	23	-3.78	47.90	42.09	74.0	54.0	26.1	11.9
3711.6	51.56	45.54	H	146	52	-0.46	51.10	45.08	74.0	54.0	22.9	8.9
3711.6	50.32	43.21	V	124	149	-0.46	49.86	42.75	74.0	54.0	24.1	11.3
4639.5	49.20	42.19	H	110	17	1.41	50.61	43.60	74.0	54.0	23.4	10.4
4639.5	51.01	44.70	V	129	326	1.41	52.42	46.11	74.0	54.0	21.6	7.9
960		40.93	H	258	213	1.40	---------	42.33	--------	54.0	---------	11.7
960		42.86	V	128	104	1.40	---------	44.26	--------	54.0	---------	9.7
991.88		35.24	H	100	300	2.61	---------	37.85	--------	54.0	---------	16.2
991.88		35.12	V	101	269	2.61	---------	37.73	--------	54.0	---------	16.3

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
Corrected Level: 51.49 - 4.32 = 47.17dBuV/m
Margin: 74dBuV/m – 47.17dBuV/m = 26.8dB

Example Calculation: Average
Corrected Level: 44.91 - 4.32 – 0 = 40.59dBuV
Margin: 54dBuV – 40.59dBuV = 13.4dB

8 CONCLUSION

In the opinion of ACS, Inc. REXU, manufactured by Elster Solutions, LLC meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT