

Certification Test Report

FCC ID: R7PCONCS4

IC: 5294A-CONCS4

FCC Rule Part: 15.247

IC Radio Standards Specification: RSS-210

ACS Report Number: 10-0097.W06.12.A

Manufacturer: Cellnet Technology Inc.

Model: Series-4 Conc.

Test Begin Date: December 11, 2009

Test End Date: March 24, 2010

Report Issue Date: June 17, 2010



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.

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This report contains 27 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations for a single modular approval.

1.2 Product description

The Series-4 Conc. is two-way radio frequency device that uses Cellnet RF technology and protocol to transmit data over a mesh network in the unlicensed 902-928 MHz frequency range. The Concentrator is a device that receives one-way endpoint data from the network, processes that data, and sends it to a Collector. It also receives and passes, but does not process, 2-way data. The concentrator contains:

- a LAN radio (BLT 3) - DTS
- a WAN radio (UtiliNet IWR) - DSS
- a power supply
- a processor board (CPU)
- a battery pack in case of an AC power outage.

Note: This report covers the DSS WAN radio (Utilinet) only.

1.2.1 Technical Details

Modulation: FSK

Operating Voltage: 120 VAC

The Series-4 Conc. provides 3 distinct frequency hopping modes of operation as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Data Rates Supported (kbps)
Wide Mode	902.3 - 927.8	86	300	9.6, 19.2, 38.4, 76.8, 115.2
Narrow Mode	904.0 - 927.9	240	100	9.6, 19.2, 38.4
Full Narrow Mode	902.3 - 927.9	256	100	9.6, 19.2, 38.4

Manufacturer Information:

Cellnet Technology, Inc.
30000 Mill Creek Ave., Suite 100
Alpharetta, GA 30022

Test Sample Serial Number(s): LT-80730222

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

This Series-4 Conc. is a composite device by definition. The LAN radio (BLT) and the WAN radio (Utilinet IWR) operate under CFR 47 Part 15.247 and IC RSS-210. This report addresses the WAN radio (Utilinet IWR) only. A separate report, 10-0097.W06.22.A, will be issued to address the LAN radio (BLT).

The LAN radio (BLT) and the WAN radio (Utilinet IWR) cannot transmit simultaneously therefore radiated inter-modulation products were not evaluated.

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable. In most instances data was collected at frequencies representing the lowest and highest available for all modes 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

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. In addition, ACS is compliant to ISO/IEC 17025 as accredited by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540

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

NVLAP Lab Code: 200612-0

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:

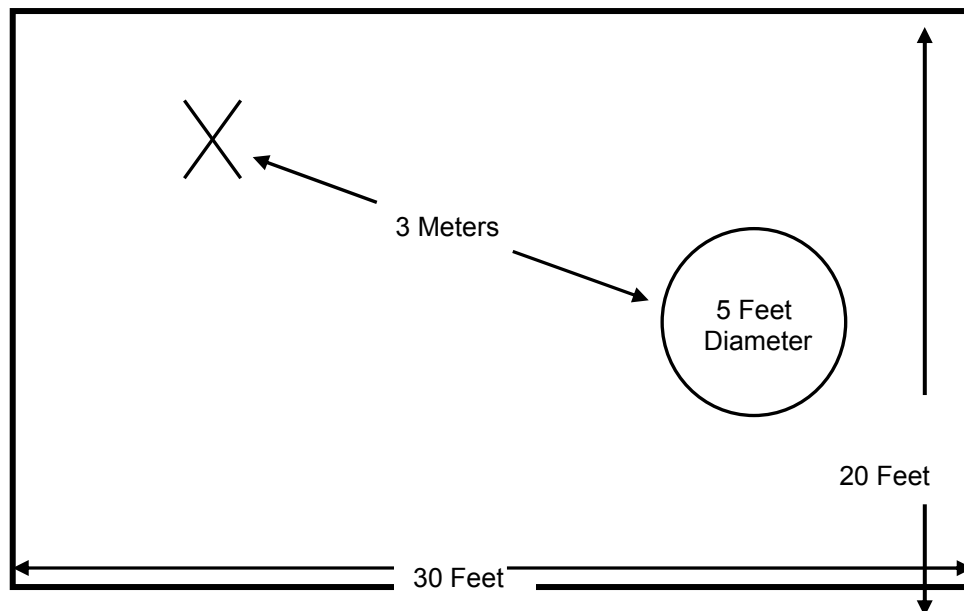


Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

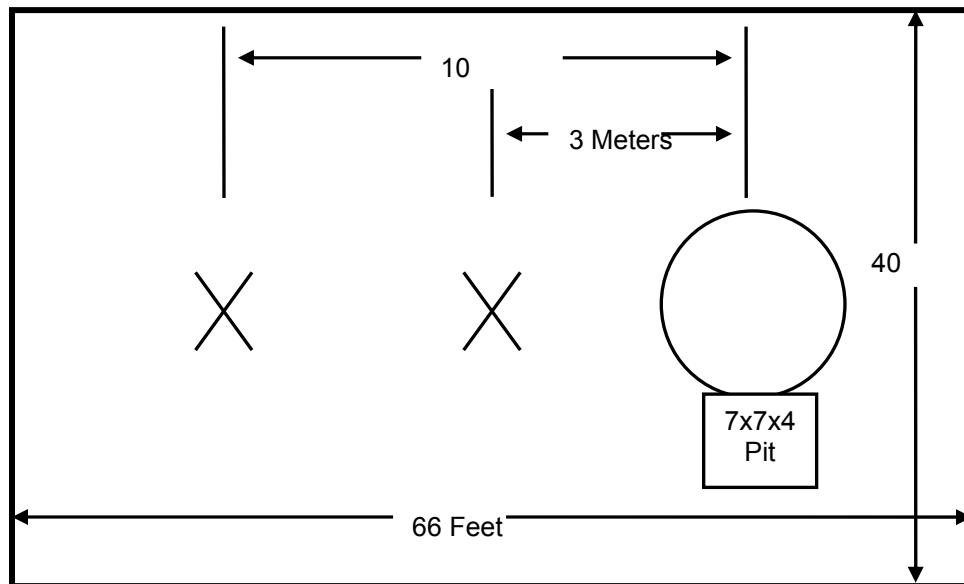


Figure 2.3-2: Open Area Test Site

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 4.1.3-1:

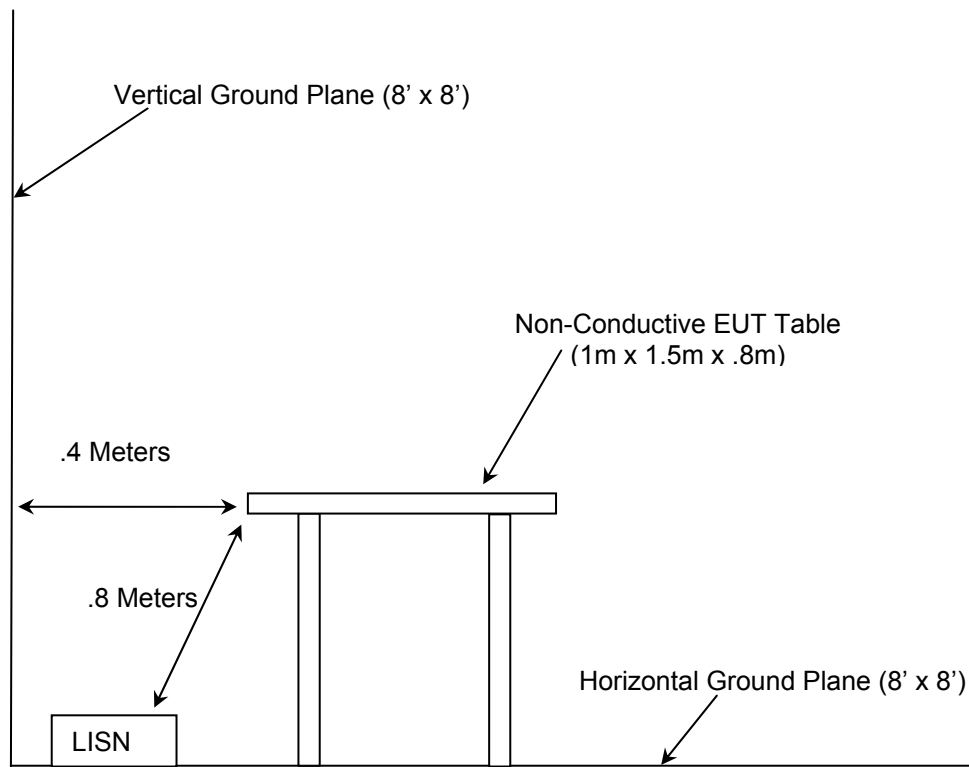


Figure 2.4-1: AC Mains Conducted EMI Site

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, 2010
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2010
- ❖ 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 7 June 2007
- ❖ Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue2, June 2007.

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

Equipment Calibration Information					
ACS#	Mfg.	Eq. type	Model	S/N	Cal. Due
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09-21-2010
2	Rohde & Schwarz	Spectrum Analyzers	ESMI - Receiver	839587/003	09-21-2010
22	Agilent	Amplifiers	8449B	3008A00526	09-21-2010
25	Chase	Antennas	CBL6111	1043	09-02-2010
73	Agilent	Amplifier	8447D	2727A05624	07-15-2010
153	EMCO	LISN	Feb-25	9411-2268	01-11-2011
167	ACS	Cable Set	Chamber EMI Cable Set	167	01-25-2011 (See Note1)
168	Hewlett Packard	Attenuators	11947A	44829	02-04-2011 (See Note2)
211	Eagle	Filters	C7RFM3NFNM	HLC-700	12-21-2010 (See Note1)
213	TEC	Amplifiers	PA 102	44927	12-21-2010
267	Agilent	Meters	N1911A	MY45100129	11-16-2010
268	Agilent	Sensors	N1921A	MY45240184	11-16-2010
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-21-2010
324	ACS	Cables	Belden	8214	07-15-2010 (See Note1)
329	A.H. Systems	Antennas	SAS-571	721	08-04-2011
337	Microwave Circuits	Filters	H1G513G1	282706	07-17-2010
339	Aeroflex/Weinschel	Attenuators	AS-18	7142	07-02-2010 (See Note2)
343	Florida RF Cables	Cables	SMRE-200W- 12.0-SMRE	N/A	05-04-2010 (See Note1)
430	RF Cables	Cables	SMS-290AW- 480-SMS	N/A	05-04-2010 (See Note1)

Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.

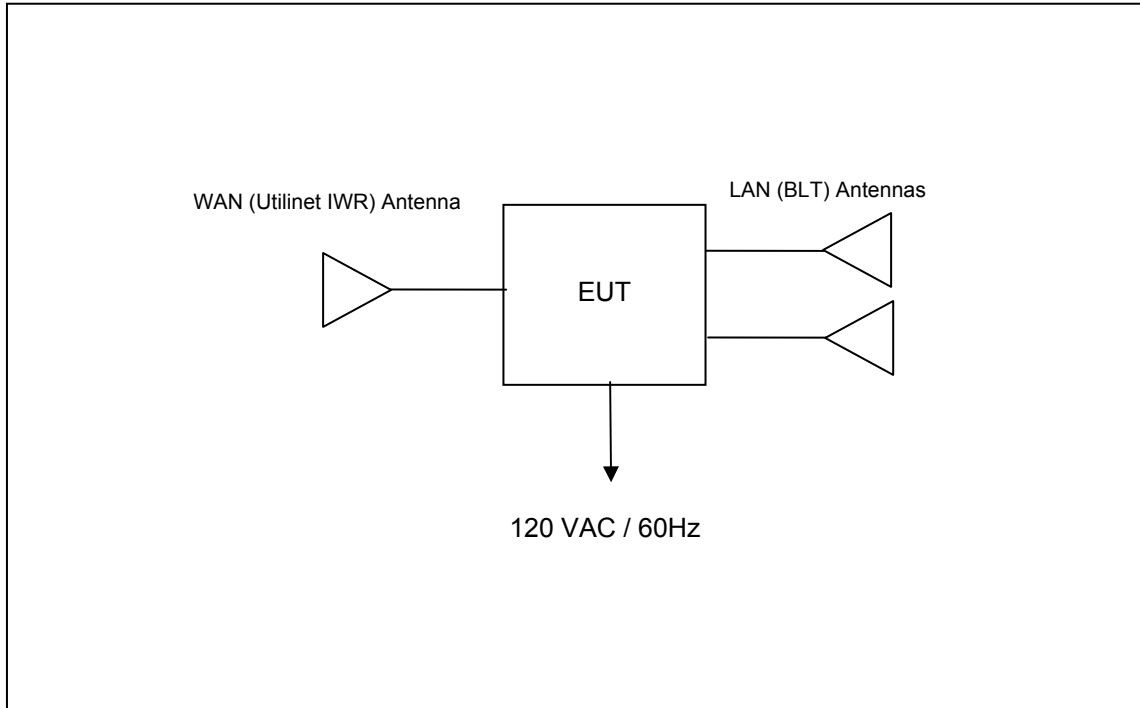
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
The EUT was tested stand-alone therefore no support equipment was utilized.				

6 EQUIPMENT UNDER 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 antenna is an omnidirectional whip antenna with a maximum gain of +5.5 dBi. The antenna coupling is N-Type therefore professional installation is required.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.2

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: Line 1 Conducted EMI Results

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.264	51.00	10.0	61	10.3	L1	FLO	QP
0.660	27.50	10.0	56	28.5	L1	FLO	QP
0.804	28.80	10.1	56	27.2	L1	FLO	QP
0.912	24.70	10.0	56	31.4	L1	FLO	QP
1.020	24.90	10.0	56	31.1	L1	FLO	QP
1.410	24.20	10.0	56	31.8	L1	FLO	QP
1.614	23.40	10.0	56	32.6	L1	FLO	QP
2.442	24.10	10.0	56	31.9	L1	FLO	QP
2.808	22.80	10.0	56	33.2	L1	FLO	QP
0.264	39.00	10.0	51	12.3	L1	FLO	AVG
0.612	21.90	10.0	46	24.1	L1	FLO	AVG
0.864	20.60	10.0	46	25.4	L1	FLO	AVG
0.978	19.90	10.0	46	26.2	L1	FLO	AVG
1.002	18.90	10.0	46	27.1	L1	FLO	AVG
1.476	18.80	10.0	46	27.2	L1	FLO	AVG
1.638	16.90	10.0	46	29.1	L1	FLO	AVG
2.466	18.70	10.0	46	27.3	L1	FLO	AVG
2.790	16.10	10.0	46	29.9	L1	FLO	AVG

Table 7.2.2-2: Line 2 Conducted EMI Results

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.168	46.90	9.9	65	18.1	L2	FLO	QP
0.264	51.40	10.0	61	9.9	L2	FLO	QP
0.618	31.00	10.0	56	25.0	L2	FLO	QP
0.828	30.20	10.0	56	25.8	L2	FLO	QP
1.014	25.60	10.0	56	30.4	L2	FLO	QP
1.176	27.60	10.0	56	28.4	L2	FLO	QP
1.236	25.20	10.0	56	30.8	L2	FLO	QP
1.302	25.10	10.0	56	30.9	L2	FLO	QP
26.976	9.90	9.4	60	50.1	L2	FLO	QP
0.228	34.10	9.9	53	18.5	L2	FLO	AVG
0.264	39.50	10.0	51	11.8	L2	FLO	AVG
0.642	17.00	10.0	46	29.0	L2	FLO	AVG
0.810	21.20	10.1	46	24.8	L2	FLO	AVG
0.990	18.80	10.0	46	27.2	L2	FLO	AVG
1.152	18.20	10.0	46	27.8	L2	FLO	AVG
1.224	18.50	10.0	46	27.5	L2	FLO	AVG
1.314	18.20	10.0	46	27.8	L2	FLO	AVG
27.264	7.00	9.4	50	43.0	L2	FLO	AVG

7.3 Radiated Emissions – FCC: Section 15.109 (Unintentional Radiation) IC: RSS-210 2.6**7.3.1 Measurement Procedure**

Radiated emissions tests were performed over the frequency range of 30MHz to 5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

7.3.2 Measurement Results

Results of the test are given in Table 7.3.2-1 below:

Table 7.3.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
30	-----	23.42	V	-6.70	-----	16.72	-----	40.0	-----	23.3
79.57	-----	45.86	H	-17.88	-----	27.98	-----	40.0	-----	12.0
121.61	-----	45.74	V	-13.50	-----	32.24	-----	43.5	-----	11.3
125.92	-----	49.82	V	-13.52	-----	36.30	-----	43.5	-----	7.2
143.16	-----	46.45	V	-14.10	-----	32.35	-----	43.5	-----	11.2
183.04	-----	52.54	H	-15.68	-----	36.86	-----	43.5	-----	6.6
386.74	-----	38.91	V	-8.50	-----	30.41	-----	46.0	-----	15.6
464.34	-----	33.55	V	-6.58	-----	26.97	-----	46.0	-----	19.0
701.45	-----	30.22	V	-1.79	-----	28.43	-----	46.0	-----	17.6
957.96	-----	20.32	H	3.26	-----	23.58	-----	46.0	-----	22.4

* Note: All emissions above 957.96 MHz were attenuated below the permissible limit.

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

7.4.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a power meter. The device employs >50 channels therefore the power is limited to 1 Watt.

7.4.2 Measurement Results

Results are shown below in Table 7.4.2-1 below:

Table 7.4.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
902.3	29.77
904.0	29.79
915.0	29.76
927.8	29.75
927.9	29.75

7.5 Channel Usage Requirements

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

7.5.1.1 Measurement Procedure

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

Carrier frequency separation was measured for all modes of operation (i.e. wide mode, narrow/full narrow mode) and data presented in section 7.5.1.2 below.

7.5.1.2 Measurement Results

The adjacent channel separation was measured to be 100 kHz for narrow (240 channels) and full narrow (256 channels) modes and 300kHz for wide mode (86 channels). Results are shown below in Figures 7.5.1.2-1 to 7.5.1.2-2.

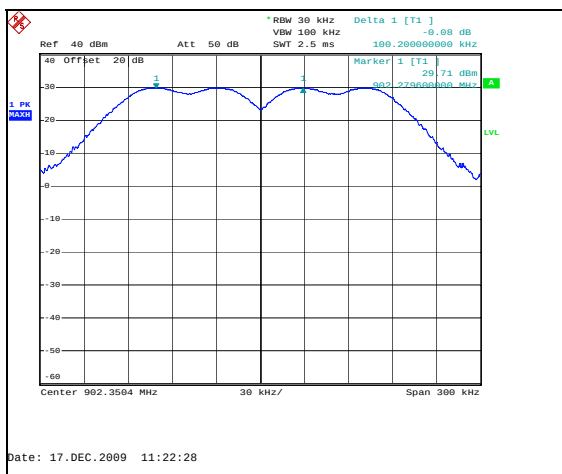


Figure 7.5.1.2-1: Narrow / Full Narrow Modes

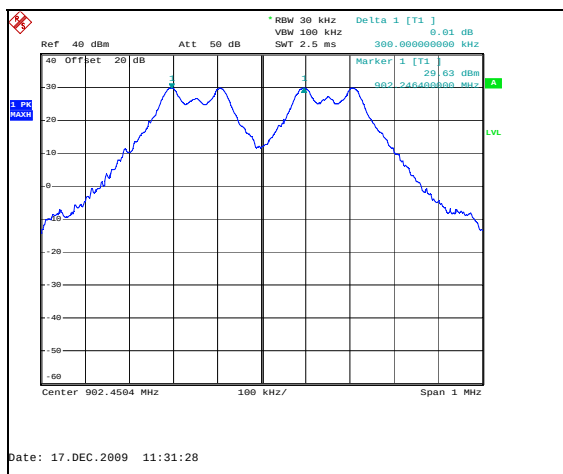


Figure 7.5.1.2-2: Wide Mode

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

The 20dB bandwidth of the device is less than 250 kHz. The device employs > 50 hopping channels as required. Results are shown below in Figures 7.5.2-1 to 7.5.2-12.

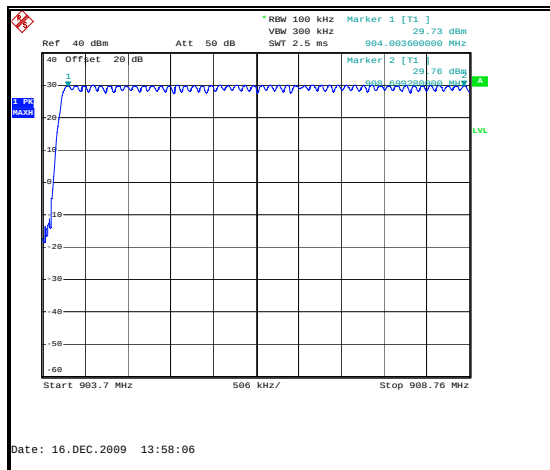


Figure 7.5.2-1: Narrow Mode (240 Channels)

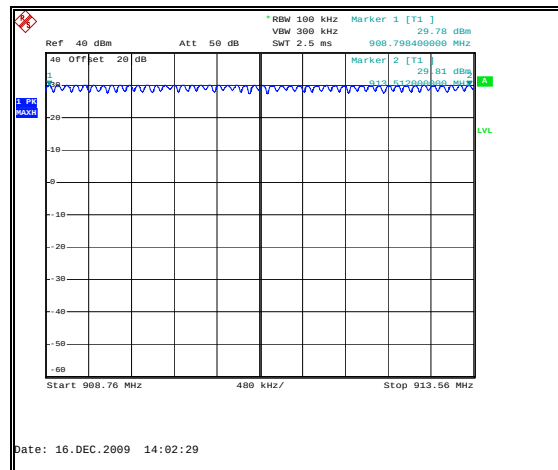


Figure 7.5.2-2: Narrow Mode (240 Channels)

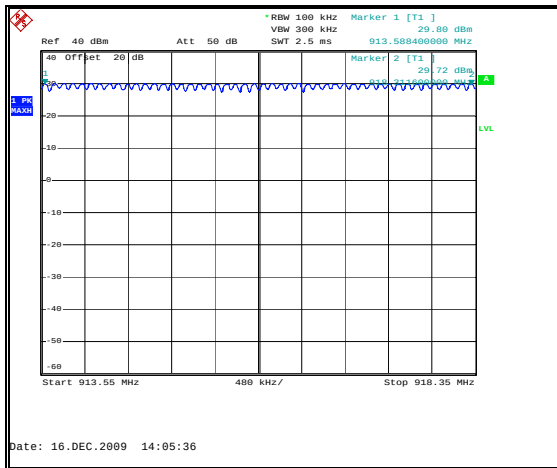


Figure 7.5.2-3: Narrow Mode (240 Channels)

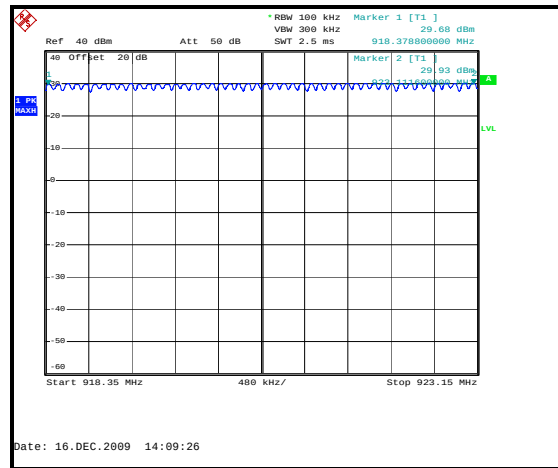


Figure 7.5.2-4: Narrow Mode (240 Channels)

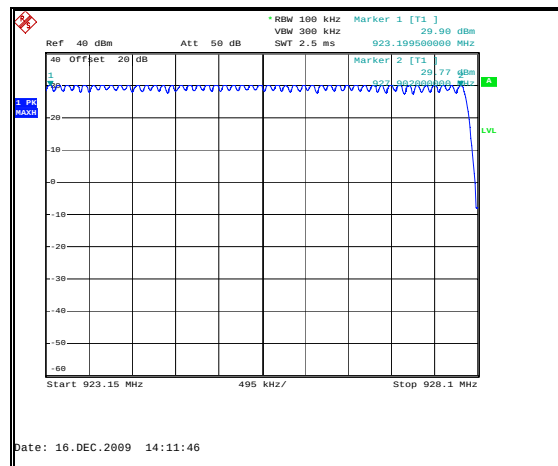


Figure 7.5.2-5: Narrow Mode (240 Channels)

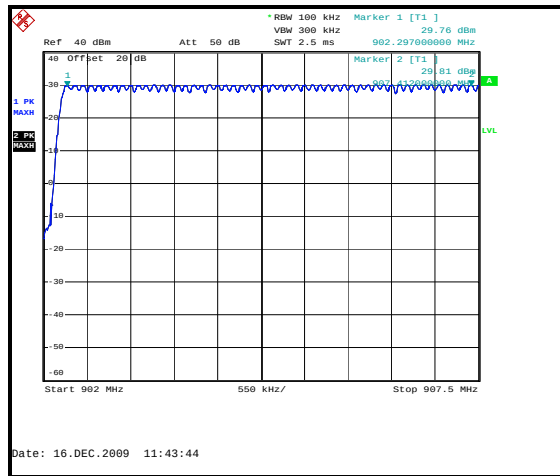


Figure 7.5.2-6: Full Narrow Mode (256 Channels)

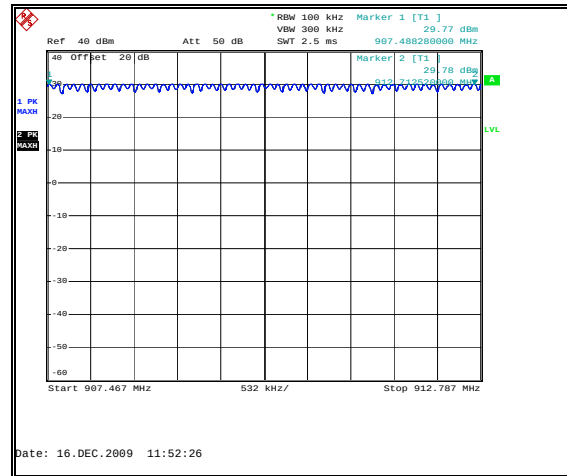


Figure 7.5.2-7: Full Narrow Mode (256 Channels)

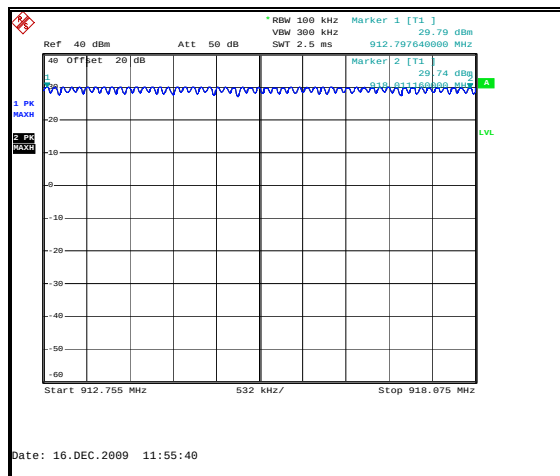


Figure 7.5.2-8: Full Narrow Mode (256 Channels)

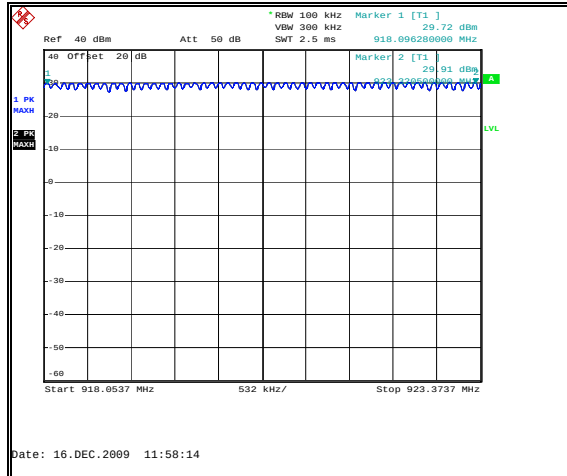


Figure 7.5.2-9: Full Narrow Mode (256 Channels)

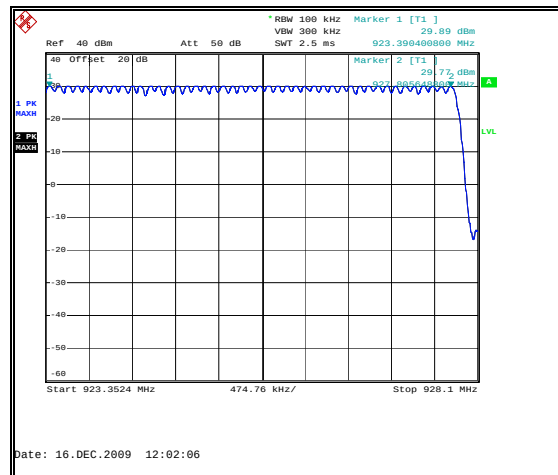


Figure 7.5.2-10: Full Narrow Mode (256 Channels)

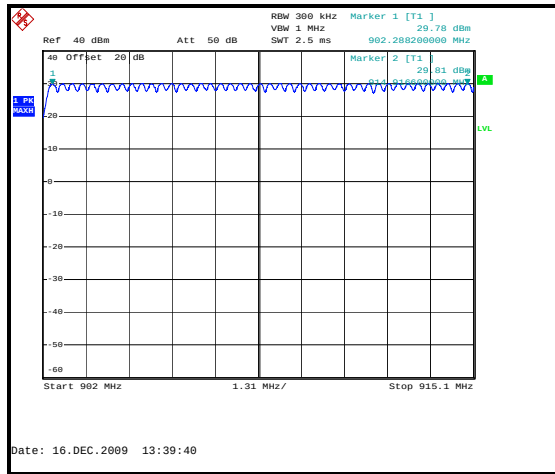


Figure 7.5.2-11: Wide Mode (86 Channels)

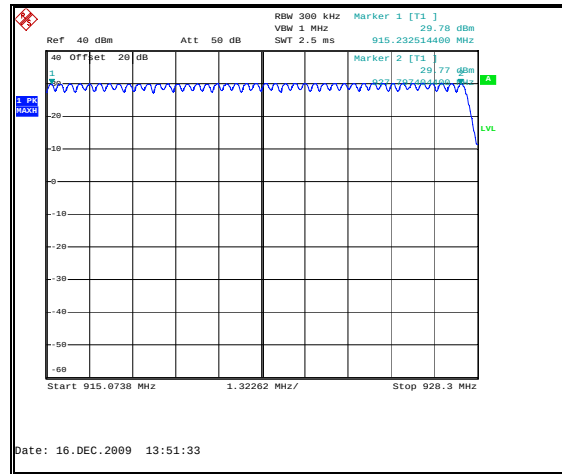


Figure 7.5.2-12: Wide Mode (86 Channels)

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

7.5.3.1 Measurement Procedure

The EUT test mode does not generate a worst case channel dwell time therefore a detailed engineering analysis is provided in the theory of operation.

As described in the theory of operation, the maximum channel transmitter dwell time is < 400ms per channel hop with the minimum period of 700ms between hops. Therefore the maximum time of occupancy on any one channel with a 20s period is <400ms for all modes of operation.

7.5.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)**7.5.4.1 Measurement Procedure**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 3 times the estimated bandwidth of the emission. The RBW was to $\geq 1\%$ of the estimated emission bandwidth. 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.

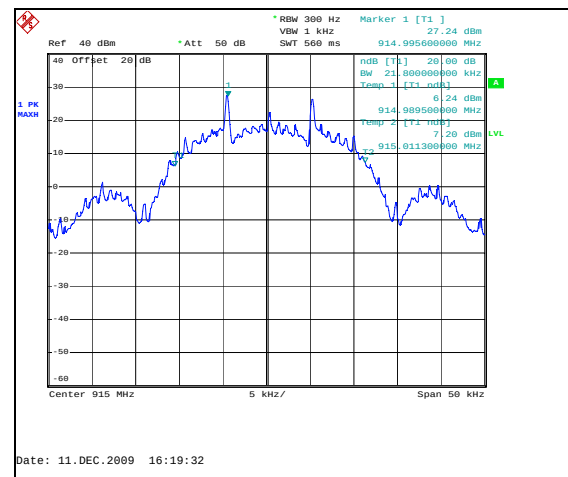
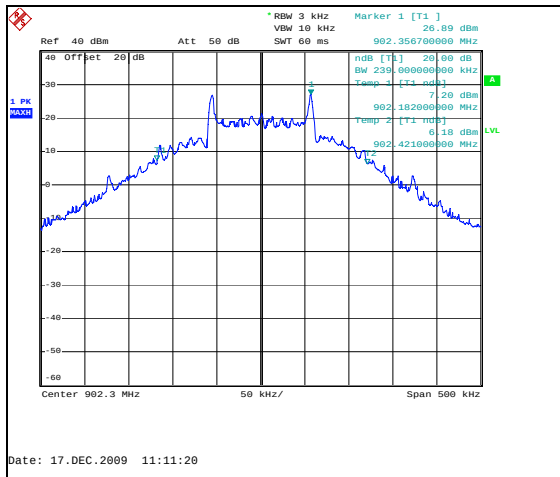
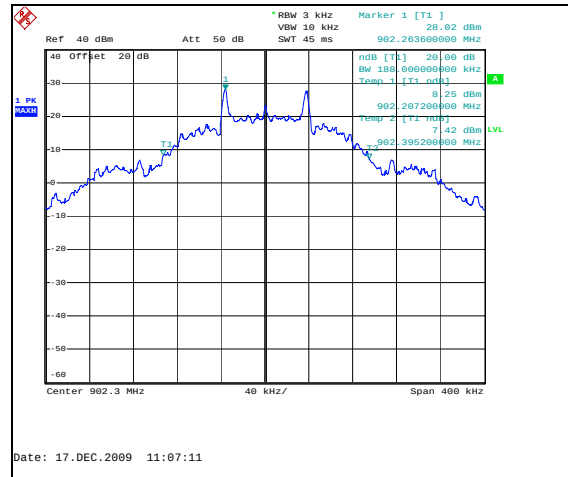
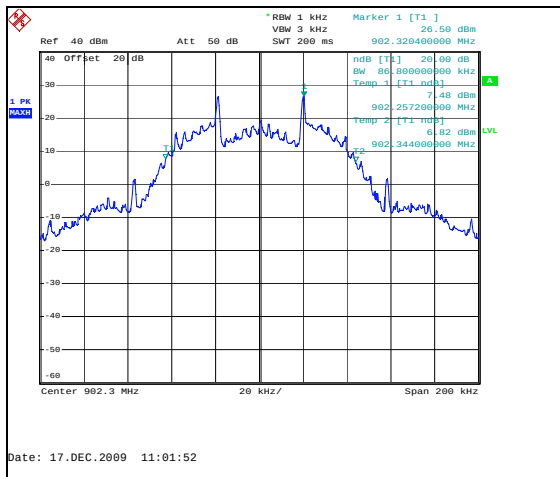
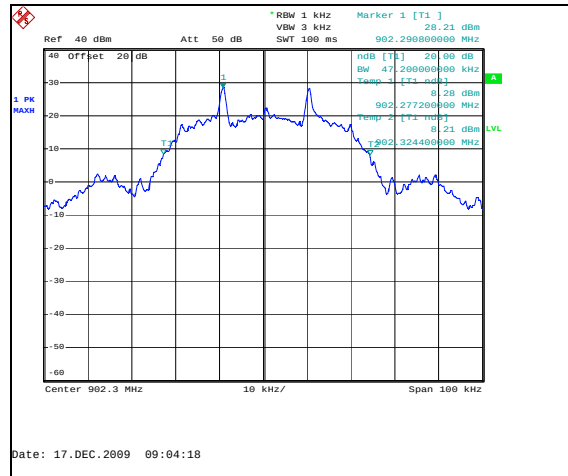
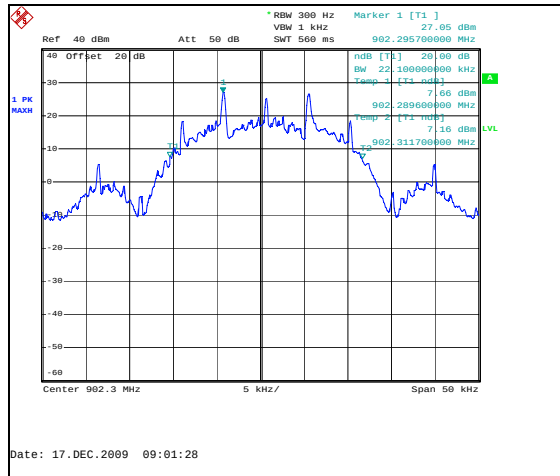
The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and approximately 20dB below the peak level. The RBW was to 1% to 3% of the approximate emission width. The trace was set to max hold with a peak detector active. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.5.4.2 Measurement Results

Results are shown below in Table 7.5.4.2-1 and Figures 7.5.4.2-1 through 7.5.4.2-30.

Table 7.5.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]	Data Rate (kbps)
902.3	22.1	21.7	9.6
902.3	47.2	44.9	19.2
902.3	86.8	85.6	38.4
902.3	188.0	183.6	76.8
902.3	239.0	261.0	115.2
915.0	21.8	21.8	9.6
915.0	47.0	45.1	19.2
915.0	86.8	85.2	38.4
915.0	176.0	179.1	76.8
915.0	239.0	241.8	115.2
927.9	21.7	21.8	9.6
927.9	46.2	44.9	19.2
927.9	87.2	88.5	38.4
927.8	182.4	185.0	76.8
927.8	241.0	247.8	115.2



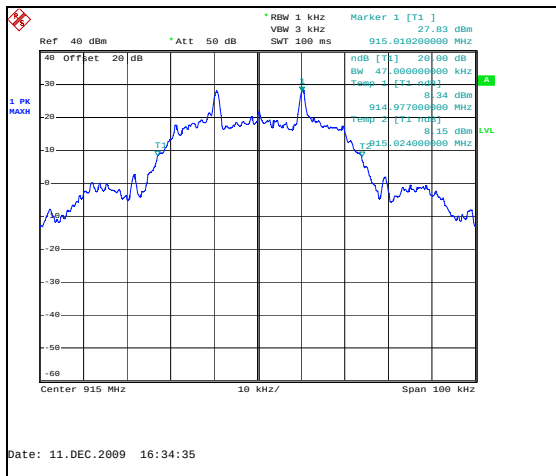


Figure 7.5.4.2-7: 20dB BW Mid Channel – 19.2kbps

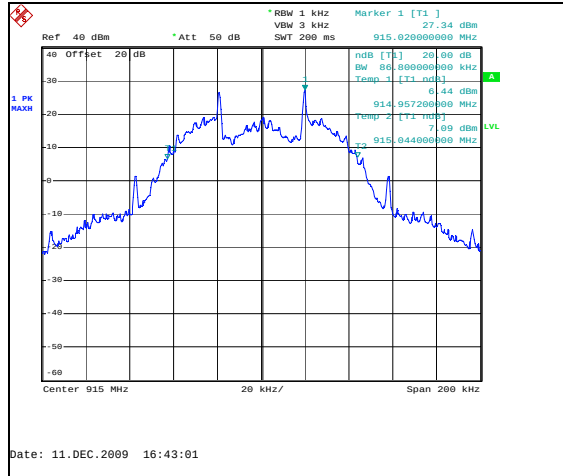


Figure 7.5.4.2-8: 20dB BW Mid Channel – 38.4kbps

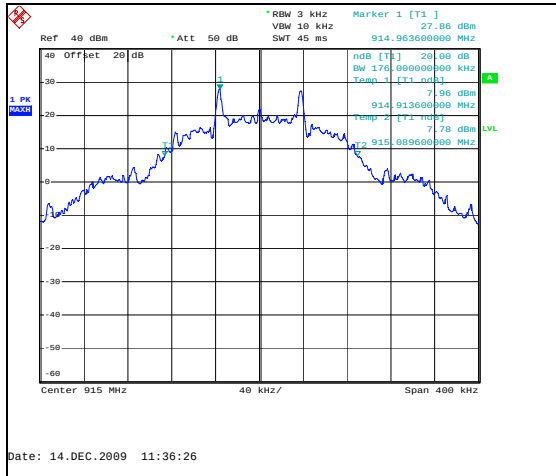


Figure 7.5.4.2-9: 20dB BW Mid Channel – 76.8kbps

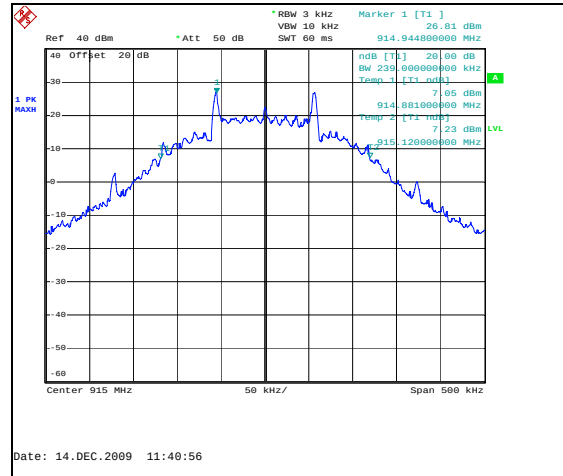


Figure 7.5.4.2-10: 20dB BW Mid Channel – 115.2kbps

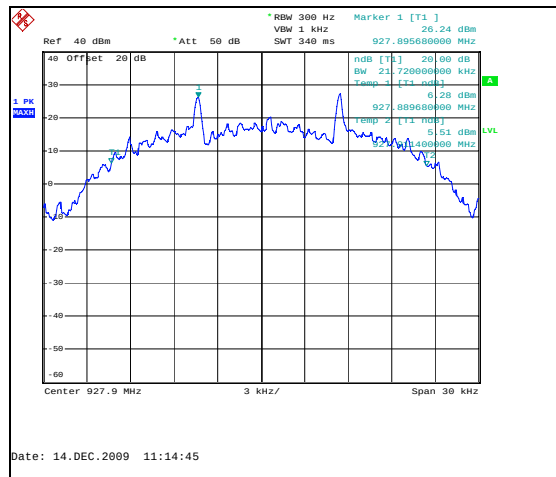


Figure 7.5.4.2-11: 20dB BW High Channel - 9.6kbps

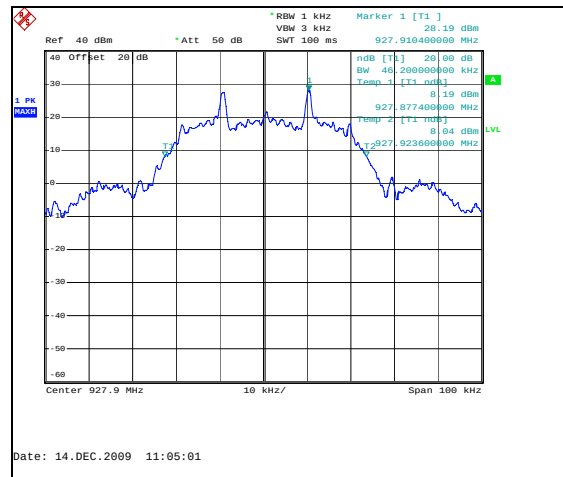


Figure 7.5.4.2-12: 20dB BW High Channel – 19.2kbps

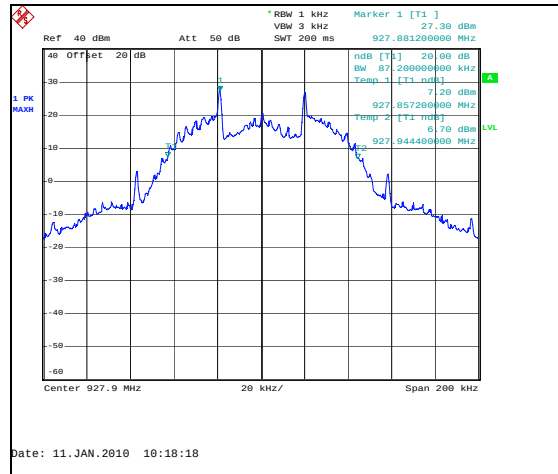


Figure 7.5.4.2-13: 20dB BW High Channel – 38.4kbps

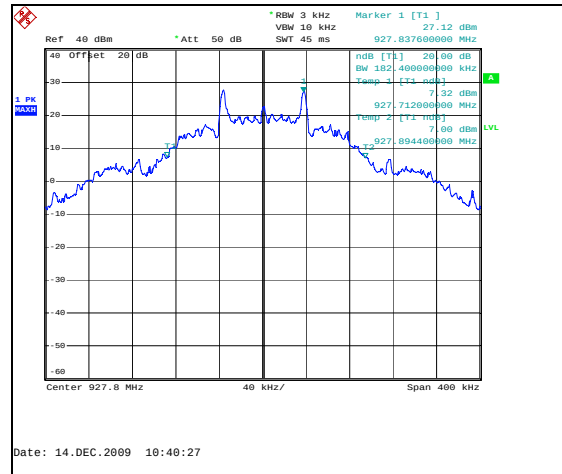


Figure 7.5.4.2-14: 20dB BW High Channel – 76.8kbps

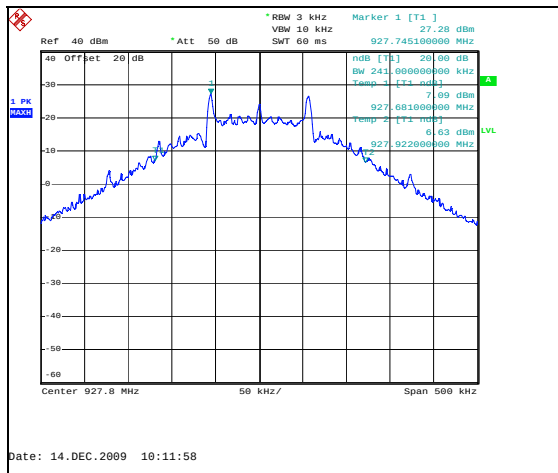


Figure 7.5.4.2-15: 20dB BW High Channel – 115.2kbps

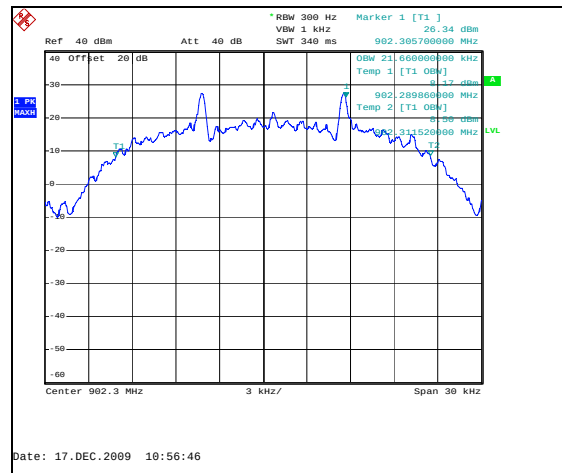


Figure 7.5.4.2-16: 99% BW Low Channel - 9.6kbps

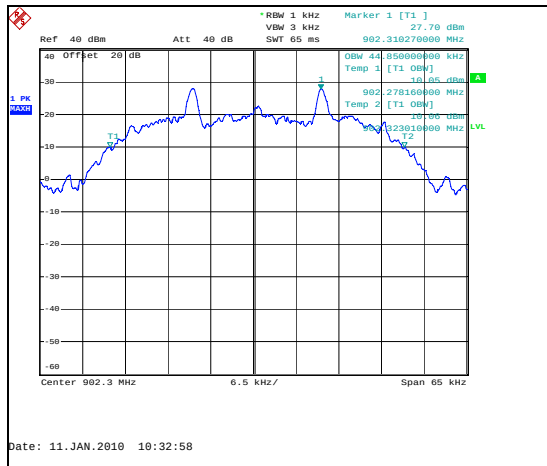


Figure 7.5.4.2-17: 99% BW Low Channel – 19.2kbps

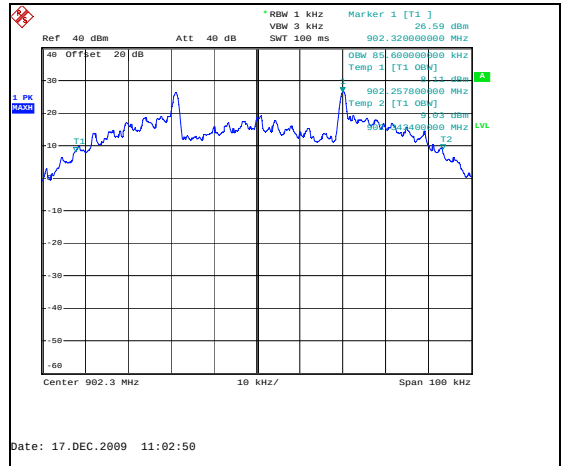


Figure 7.5.4.2-18: 99% BW Low Channel – 38.4kbps

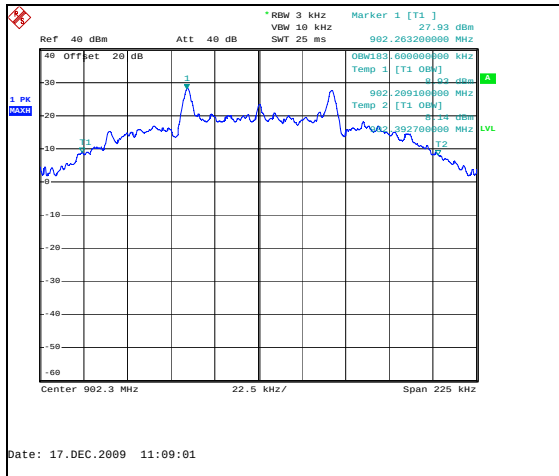


Figure 7.5.4.2-19: 99% BW Low Channel – 76.8kbps

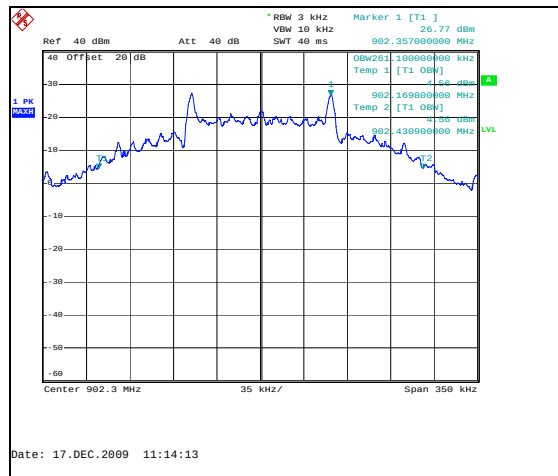


Figure 7.5.4.2-20: 99% BW Low Channel – 115.2kbps

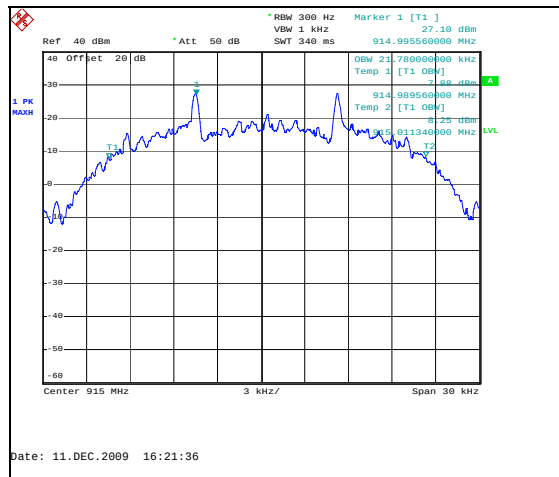


Figure 7.5.4.2-21: 99% BW Mid Channel - 9.6kbps

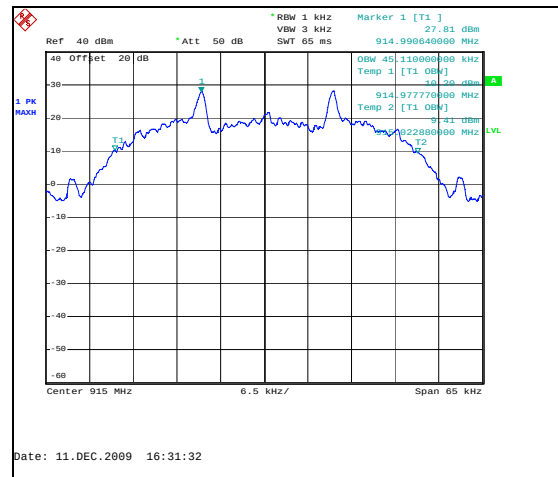


Figure 7.5.4.2-22: 99% BW Mid Channel – 19.2kbps

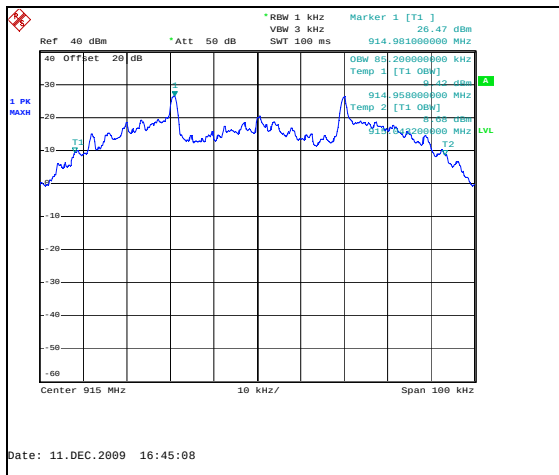


Figure 7.5.4.2-23: 99% BW Mid Channel – 38.4kbps

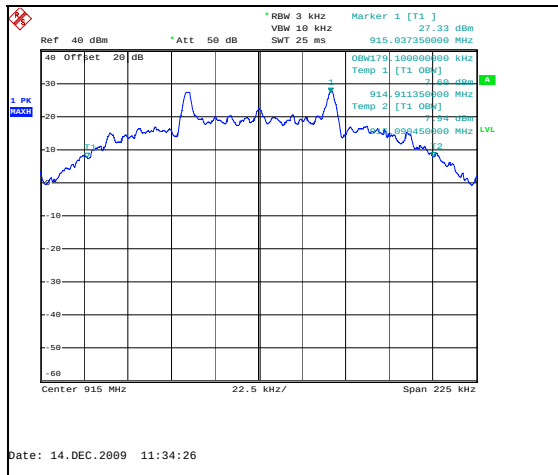


Figure 7.5.4.2-24: 99% BW Mid Channel – 76.8kbps

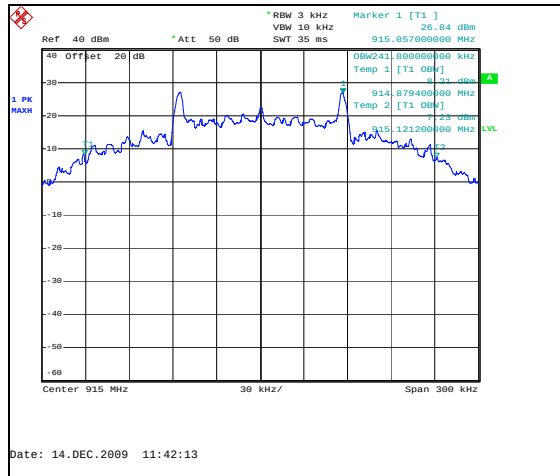


Figure 7.5.4.2-25: 99% BW Mid Channel – 115.2kbps

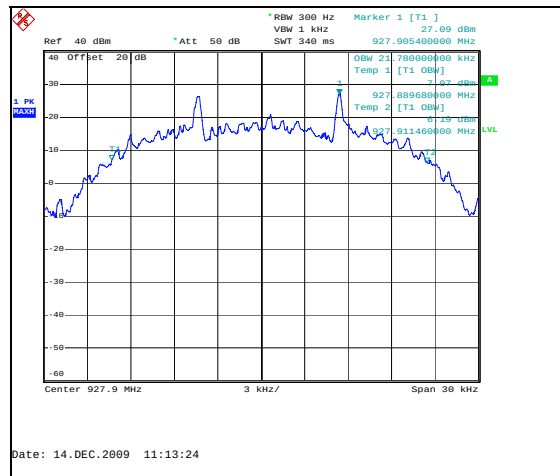


Figure 7.5.4.2-26: 99% BW High Channel – 9.6kbps

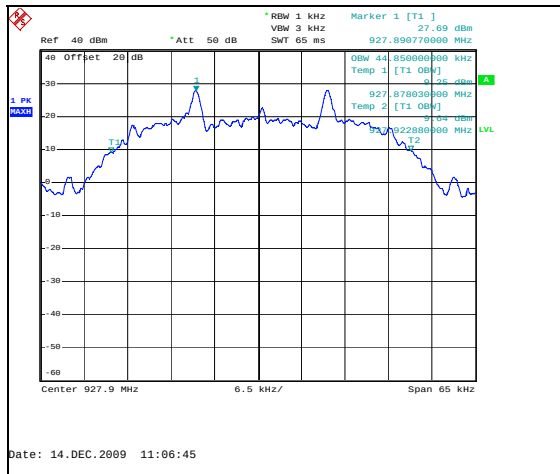


Figure 7.5.4.2-27: 99% BW High Channel – 19.2kbps

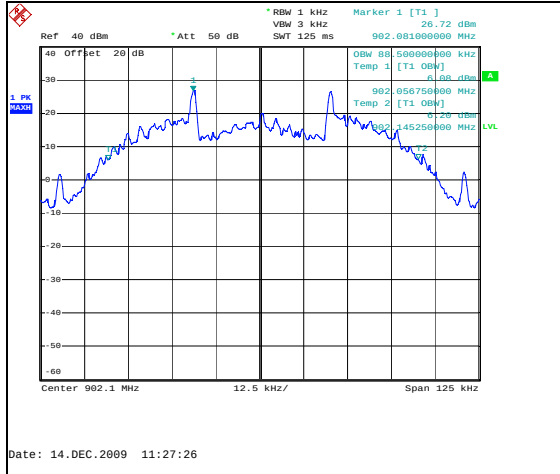


Figure 7.5.4.2-28: 99% BW High Channel – 38.4kbps

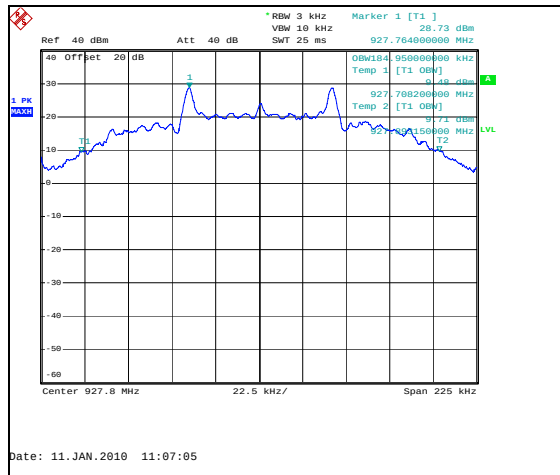


Figure 7.5.4.2-29: 99% BW High Channel – 76.8kbps

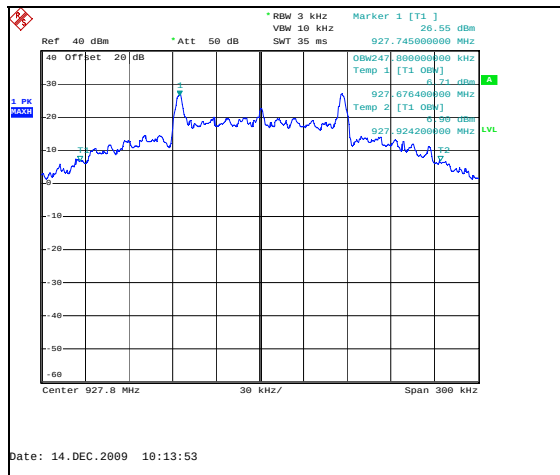


Figure 7.5.4.2-30: 99% BW High Channel – 115.2kbps

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

7.6.1 Band-Edge Compliance of RF Conducted Emissions

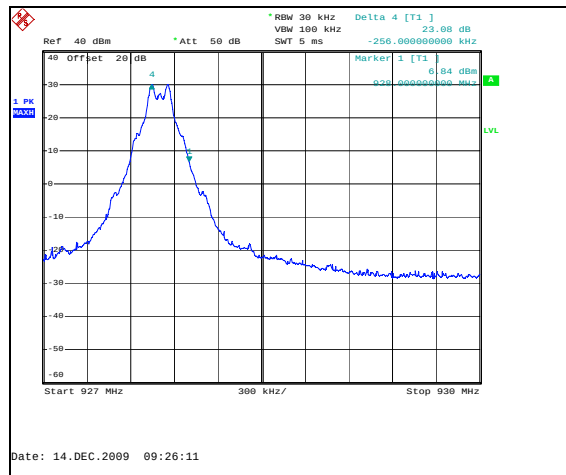
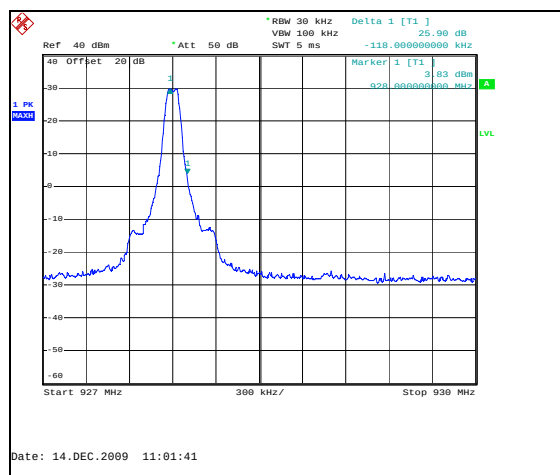
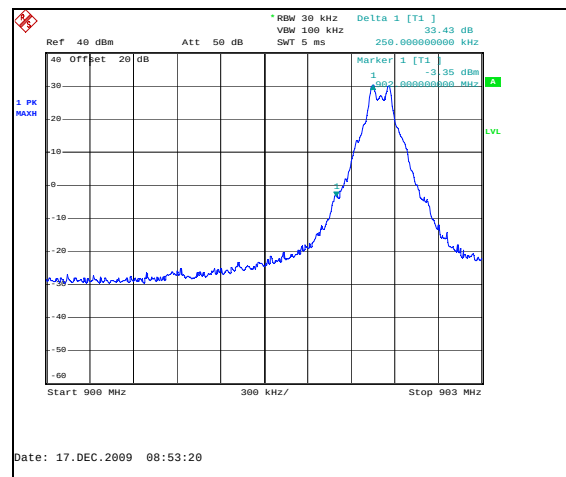
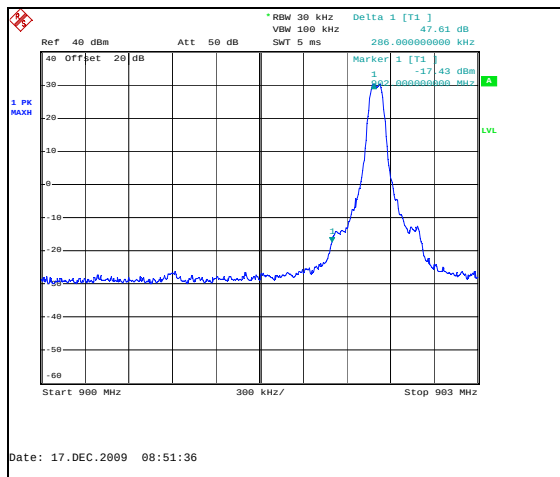
7.6.1.1 Measurement Procedure

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 30 kHz, which is $\geq 1\%$ of the span, and the VBW was set to 100kHz.

Band-edge was evaluated for all combinations of operating modes and data rates with worst case data provided. Worst case reported utilized 38.4kbps in Full Narrow Mode and 115.2kbps in Wide Mode.

7.6.1.2 Measurement Results

Results are shown in the figures 7.6.1.2-1 to 7.6.1.8 below.



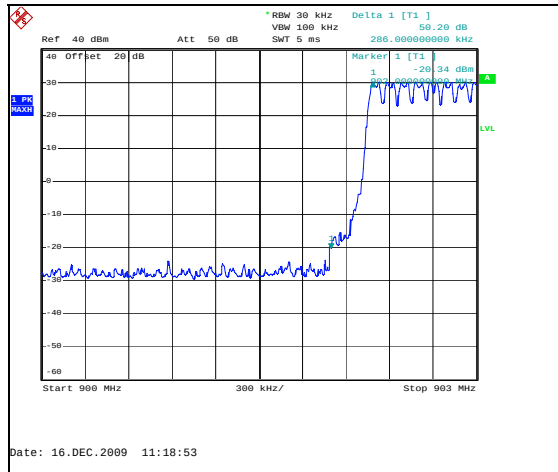
HOPPING MODE:

Figure 7.6.1.2-5: Lower Band-edge – Full Narrow Mode

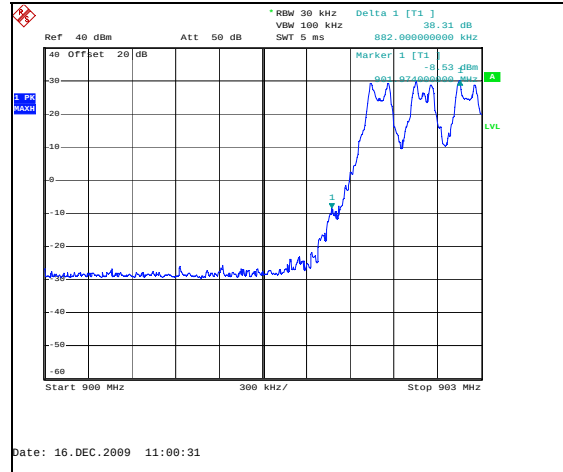


Figure 7.6.1.2-6: Lower Band-edge –Wide Mode

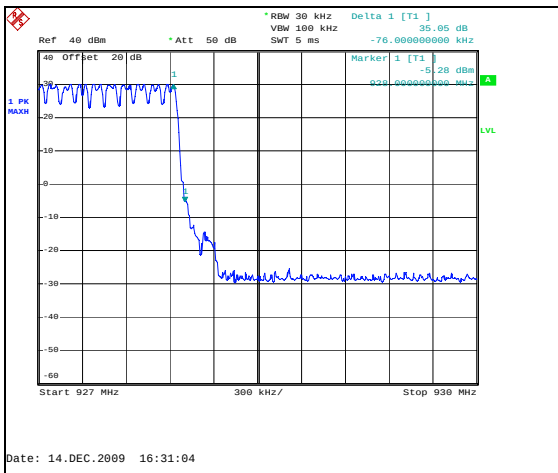


Figure 7.6.1.2-7: Upper Band-edge – Full Narrow Mode

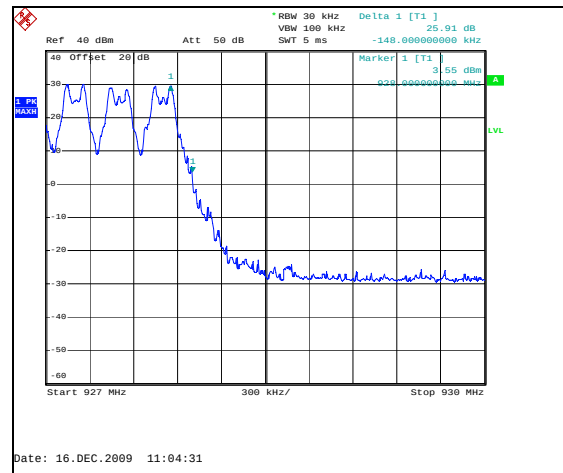


Figure 7.6.1.2-8: Upper Band-edge –Wide Mode

7.6.2 RF Conducted Spurious Emissions

7.6.2.1 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 evaluated for all combinations of operating modes and data rates with worst case data provided. Worst case report utilized 9.6kbps in Full Narrow Mode.

7.6.2.2 Measurement Results

Results are shown below in Figures 7.6.2.2-1 to 7.6.2.2-6:

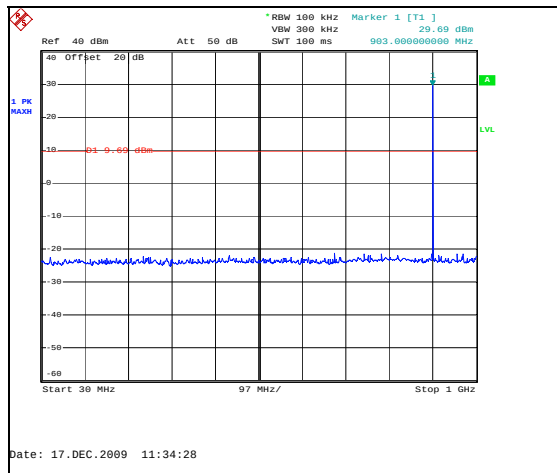


Figure 7.6.2.2-1: 30 MHz – 1 GHz – Low Channel

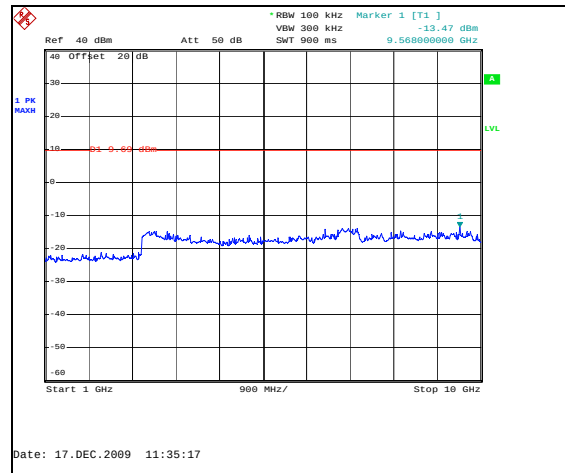


Figure 7.6.2.2-2: 1 GHz – 10 GHz – Low Channel

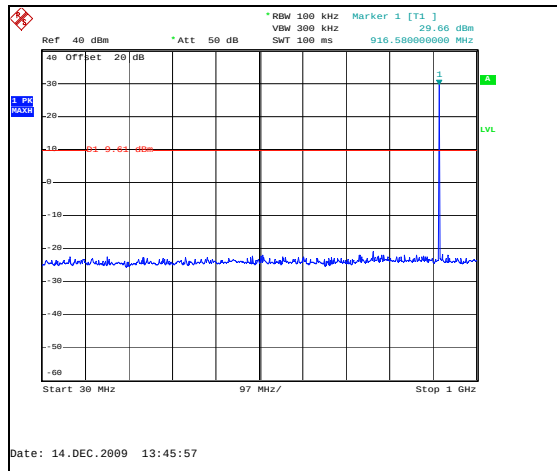


Figure 7.6.2.2-3: 30 MHz – 1 GHz –Mid Channel

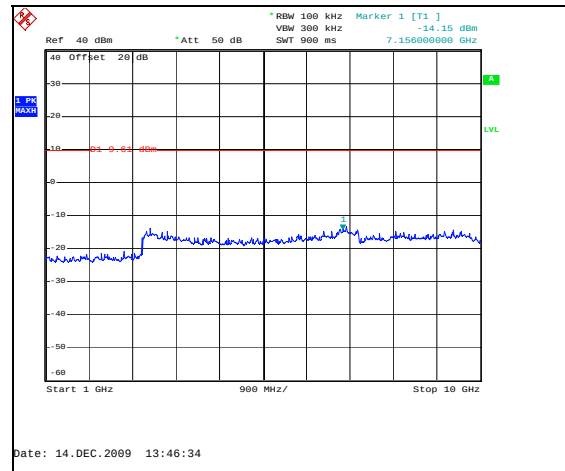


Figure 7.6.2.2-4: 1 GHz – 10 GHz – Mid Channel

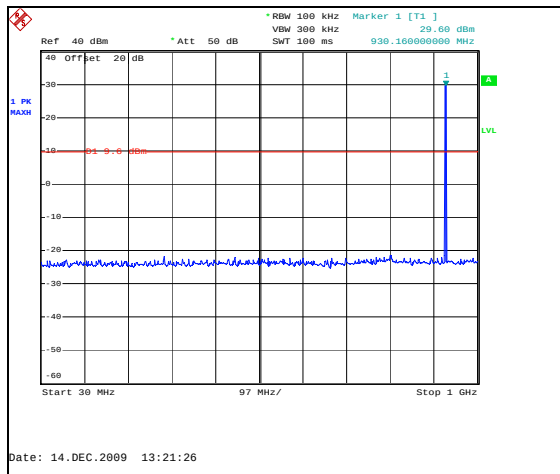


Figure 7.6.2.2-5: 30 MHz – 1 GHz – High Channel

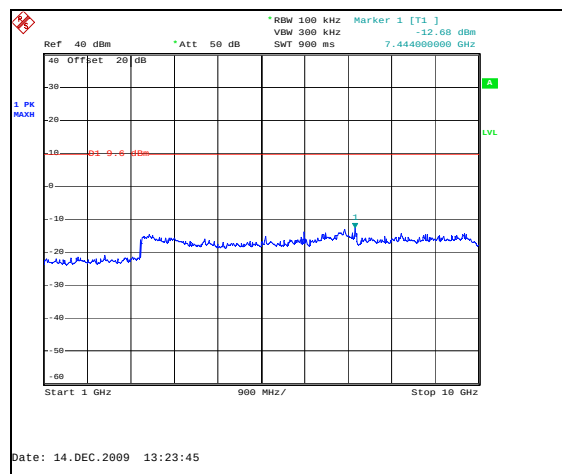


Figure 7.6.2.2-6: 1 GHz – 10 GHz – High Channel

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

7.6.3.1 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 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.

Radiated spurious emissions were evaluated for all combinations of operating modes and data rates with worst case data provided. Worst case report utilized 9.6kbps in Full Narrow Mode.

The EUT was evaluated in multiple orientations with the worst case data presented.

7.6.3.2 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in the Table 7.6.3.2-1 below.

Table 7.6.3.2-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2706.9	46.35	36.52	H	1.14	47.49	37.66	74.0	54.0	26.5	16.3
2706.9	45.98	35.59	V	1.14	47.12	36.73	74.0	54.0	26.9	17.3
3609.2	48.48	38.58	H	3.16	51.64	41.74	74.0	54.0	22.4	12.3
3609.2	48.20	37.44	V	3.16	51.36	40.60	74.0	54.0	22.6	13.4
Middle Channel										
2745	45.93	36.77	H	1.16	47.09	37.93	74.0	54.0	26.9	16.1
2745	45.43	35.16	V	1.16	46.59	36.32	74.0	54.0	27.4	17.7

* Note: All emissions not reported were attenuated below the noise floor of the receiver.

7.6.3.3 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: $46.35 + 1.14 = 47.49\text{dBuV/m}$

Margin: $74\text{dBuV/m} - 47.49\text{dBuV/m} = 26.5\text{dB}$

Example Calculation: Average

Corrected Level: $36.52 + 1.14 - 0 = 37.66\text{dBuV}$

Margin: $54\text{dBuV} - 37.66\text{dBuV} = 16.3\text{dB}$

8 CONCLUSION

In the opinion of ACS, Inc. Series-4 Conc., manufactured by Cellnet Technology Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT