



**Test Item Description:**

KilnScout Wireless Moisture Meter Transmitter



**Trade Mark:**

**Manufacturer:**

**Model Numbers:**

**FCC ID :**

**IC :**

SCS Forest Products Inc.

McPro2020

SGOMcPro2020

11074A-McPro2020



## Revision History

Date	Report Number	Rev #	Details	Authors Initials
Apr 25, 2013	E10508-1301 Transmitter	0.0	Draft Test Report	DJ
Apr 29, 2013	E10508-1301 Transmitter	1.0	Original Release	DJ

**All previous versions of this Report have been superseded by the latest dated Revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.**



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## Section I: EMC Test Description

### Testing Location

**Testing Laboratory:** Quality Auditing Institute  
**Laboratory Address:** #16 – 211 Schoolhouse Street, Coquitlam, BC, V3K 4X9, Canada  
**Associated EMC Laboratory:** Quality Auditing Institute: Pitt Meadows & Maple Ridge Locations  
**Testing Location & Address:** 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada  
**Phone Number:** (604) 527-8378  
**FCC Test Site Registration Number: 10 Meter Open Air Test Site and 5 Meter Semi-Anechoic Chamber:** 226383  
**Industry Canada Site Registration Number: 5 Meter SAC:** 9543B-1  
**Industry Canada Test Site Registration Number: 10 Meter OATS:** 9543C-1

### EUT Receiving Details

**Model Number:** McPro2020  
**Company:** SCS Forest Products Inc.  
**Received Date:** February 13, 2013  
**Received By:** David Johanson  
**Test Sample Log:** QAI Product Control Log: QM 1301 -Test Sample Inventory

### Environmental Test Conditions: Indoors

Day 1: February 13, 2013	Temperature: 23°C	R.H.: 35%
Day 2: February 15, 2013	Temperature: 22°C	R.H.: 30%
Day 3: April 15, 2013	Temperature: 23°C	R.H.: 31%
Day 4: April 16, 2013	Temperature: 24°C	R.H.: 30%



## EMC Test Summary

The following tests demonstrate testimony for the FCC & IC Marks for intentional transmitter / electromagnetic compatibility testing for this unit.

Test / Requirement Description	Deviations from:		Pass / Fail	Applicable FCC Rule Parts	Applicable Industry Canada Rule Parts
	Base Standard	Test Basis			
AC Mains Power line Conducted Emissions	No	No	N/A	FCC Subpart C 15.207 (a)	RSS-Gen Issue 3 7.2.4
Digital Circuit Emission Requirement	No	No	Pass	FCC Subpart B 15.109	ICES-003 Issue 4
Antenna Requirement	No	No	Pass	FCC Subpart C 15.203	RSS Gen Issue 3 4.6.1
6 dB Bandwidth	No	No	Pass	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2(a)
Occupied Bandwidth (99% emissions bandwidth)	No	No	Pass	N/A	RSS-Gen Issue 3 4.6.1
Peak Power Output	No	No	Pass	FCC Subpart C 15.247 (b) (3)	RSS 210 Issue 8 A8.4 (4)
Power Spectral Density	No	No	Pass	FCC Subpart C 15.247 (e)	RSS 210 Issue 8 A8.2 (b)
Conducted Spurious Emissions	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 8 A8.5
Duty Cycle Correction Factor	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 3 4.5
Radiated Spurious Emissions Band Edge	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5
Radiated Spurious Emissions 9kHz – 10 GHz	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5 RSS Gen Issue 3 4.10
Antenna Gain Measurement	No	No	N/A	FCC Subpart C 15.247, 4 (b)	N/A
Maximum Field Strength Measurement	No	No	N/A	FCC Subpart C 15.249, (a)	N/A
Frequency Stability	Yes	No	Pass	FCC Subpart C 15.215 (c)	RSS Gen Issue 3 4.7 and 7.2.6

Tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with CFR 47 FCC Part 15 Subpart C Section 15.247, Industry Canada RSS 210 Issue 8: Intentional Transmitter Standards For Low-Power Licence-Exempt Radio Communication Devices & Digitally Modulated Intentional Radiators Operating in the 915MHz ISM Band. The manufacturer is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products as required.

X

Tested By & Report Written By  
David Johanson, RF/ EMC Engineer

X

Reviewed By  
Aman RF/ EMC Test Engineer



## Measurement Uncertainty

Radio Frequency:	±1.5 x 10 <sup>-5</sup>
Total RF Power: Conducted:	±1 dB
RF Power Density: Conducted	±2.75 dB
Spurious Emissions: Conducted	±3 dB
All Emissions: Radiated	±3.5 dB
Temperature	±1°C
Humidity	±5 %
DC and Low Frequency Voltages	±3 %

## Test Equipment List

### OATS Equipment List

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A042004	31-Oct-2012	31-Oct-2015
AILTECH/Eaton	94455-1	Biconical Antenna 20-200MHz	0931	10-Mar-2011	10-Mar-2014
EMCO	93146	Log Periodical Antenna 200-1000MHz	9811-5136	10-Mar-2011	10-Mar-2014
Rohde & Schwarz	ESCI	EMI Receiver	1000123	29-Mar-2011	29-Mar-2014

### Semi-Anechoic Chamber Equipment List

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
ETS Lindgren	2165	Turntable	00043677	N/A	N/A
ETS Lindgren	2125	Mast	00077487	N/A	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz-3GHz (Prescan use only)	A120106	28-Oct-2008	28-Oct-2011
Sunol Sciences	JB3	Biconilog Antenna 30MHz-3GHz (Prescan use only)	A120106	Verified: 12-Mar-2012	
Rohde & Schwarz	ESU40	EMI Receiver	100011	26-June-2012	26-Jun-2015
COM-POWER	LI-115	LISN	241036	9-Mar-2011	9-Mar-2014
A.H. Systems	PAM-0118	Preamplifier	189	N/A	N/A
COM-POWER	AHA-118	Dual Ridge Horn Antenna	711040	11-Mar-2011	11-Mar-2014
ETS Lindgren	S201	5 meter Semi- Anechoic Chamber	1030	N/A	N/A

### Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software



## Section II: Equipment Under Test Information

### Product Description

The SCS Forest Products KilnScout Moisture sensor is setup inside of the wood drying kiln and is used to monitor the moisture content of the wood. The KilnScout periodically transmits it's data to a KilnScout receiver that is specially dedicated to the KilnScout transmitter.

### Operational Description

The KilnScout Transmitter operates in the 915MHz ISM band (902 to 928MHz) and is connected to 2 metal sensor plates that are used to estimate the moisture content of the wood. It is designed to produce a momentary transmission with the data to the Receiver. The transmitter is installed with a 7.2Vdc non-rechargeable Lithium Battery.

### EUT Testing Configuration

For the purpose of compliance testing, the EUT was powered using an internal lithium battery for all tests except for the Temperature stability tests. The Temperature stability tests were done using an auxiliary +5Vdc power supply since the Lithium battery would not function for long at the elevated temperature. The Transmitter was programmed to transmit the maximum output power at the low, mid and high channels of the 915 ISM band (907, 915.2 and 923.3 MHz respectively) in a continuous transmission mode, with or without modulation. Programming was done by using a specific button program options as designed into the EMC Testing Firmware. For the purpose of testing radiated emissions, the EUT was mounted above the table top with one sensor plate sitting on the tabletop with a second sensor located on the tables shelf, approximately 40cm lower. This setup was chosen since it best represents the normal configuration of the product.

### EUT Testing Information

<b>Manufacturer</b>	SCS Forest Products Inc.
<b>Product Software/Firmware Revision</b>	RF Test FW Rev. 4.03
<b>Model Numbers</b>	McPro2020
<b>Hardware Revision</b>	3.0 Rev 2
<b>Serial Numbers</b>	N/A
<b>Voltage</b>	7.2Vdc Battery Module
<b>Current Draw</b>	N/A

### Summary of On Board Frequencies

<b>Frequency:</b>	<b>Module:</b>	<b>Signal:</b>
8MHz	Microcontroller Crystal	Reference Clock
8MHz	Impedance Sensor Chip	Reference Clock
16MHz	Radio Chip PLL	Reference Clock
200kHz	EEPROM clock	System Clock



### **Auxiliary Equipment**

<b>Description</b>	<b>Manufacturer</b>	<b>Model Number</b>	<b>Serial Number</b>
Sensor Plates	SCS Forest	N/A	N.A

### **EUT Cabling Configuration**

<b>Description</b>	<b>Number of Lines</b>	<b>Connection Type</b>	<b>Load or Termination</b>	<b>Shielded</b>	<b>Ferrites</b>
Sensor	2	Circular	Plates	No	No

### **EUT EMC Test Firmware**

The EUT has a special version of firmware loaded for stand alone radio measurements. This EMC firmware configures the radio for maximum output power and maximum transmit duty cycle. It allows the EUT to transmit in carrier mode and in modulated carrier mode with pseudo random payload at low, mid, and high channels.



## Section III: Intentional Transmitter Testing to CFR 47 FCC Part 15, Subpart C, Section 15.247 and Industry Canada RSS 210 Issue 8

### Summary of Intentional Transmitter Tests

Test / Requirement Description	Deviations from:		Pass / Fail	Applicable FCC Rule Parts	Applicable Industry Canada Rule Parts
	Base Standard	Test Basis			
Digital Circuit Emission Requirement	No	No	Pass	FCC Subpart B 15.109	ICES-003 Issue 4
Antenna Requirement	No	No	Pass	FCC Subpart C 15.203	RSS Gen Issue 3 4.6.1
6 dB Bandwidth	No	No	Pass	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2(a)
Occupied Bandwidth (99% emissions bandwidth)	No	No	Pass	N/A	RSS-Gen Issue 3 4.6.1
Peak Power Output	No	No	Pass	FCC Subpart C 15.247 (b) (3)	RSS 210 Issue 8 A8.4 (4)
Power Spectral Density	No	No	Pass	FCC Subpart C 15.247 (e)	RSS 210 Issue 8 A8.2 (b)
Conducted Spurious Emissions	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 8 A8.5
Conducted Spurious Emissions Band Edge	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 8 A8.5
Duty Cycle Correction Factor	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 3 4.5
Radiated Spurious Emissions Band Edge	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5
Radiated Spurious Emissions (TX and RX) 4 MHz – 18 GHz	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5 RSS Gen Issue 3 4.10
Antenna Gain Measurement	No	No	N/A	FCC Subpart C 15.247, 4 (b)	N/A
Maximum Field Strength Measurement	No	No	N/A	FCC Subpart C 15.249, (a)	N/A
Frequency Stability	Yes	No	Pass	FCC Subpart C 15.215 (c)	RSS Gen Issue 3 4.7 and 7.2.6

**NOTE: See Appendix A for all Intentional Transmitter Testing Data**



## Appendix A: Report of Measurement Data and Plots

### Digital Circuits Radiated Emission Testing

DATE: April 16, 2013  
TEST STANDARD: ICES-003 Issue 4; FCC Part 15B  
TEST METHOD: ANSI C63.4-2009  
TEST VOLTAGE: 7.2Vdc Battery Pack

MINIMUM STANDARD: Class A Limit:

Frequency (MHz)	Field Strength		
	$\mu\text{V/m}$ at 10-m	$\text{dB}\mu\text{V/m}$ at 10m	Calculated $\text{dB}\mu\text{V/m}$ at 3m
30 - 88	90	39.0	49.5
88 - 216	150	43.5	54.0
216 - 960	210	46.4	56.9
960 - above	300	49.5	60.0

METHOD OF MEASUREMENT: The equipment was set up in 3m Semi Anechoic Chamber for preliminary and final measurements; Radiated Emissions were performed at 3 meters for this unit. A typical application was tested.

Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength. The transmitter was OFF and power was On to operate the digital circuitry for this test.

MODIFICATIONS: The EUT did not require any modifications.

MEASUREMENT DATA: no emissions were detected 30-1000MHz. No measurements were performed.

PERFORMANCE: Complies with Standard



## **Antenna Requirements**

DATE: February 20, 2013

TEST STANDARD: IC RSS-Gen Section 7.1.2; FCC Part 15.203

APPLICABLE REGULATIONS : - "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited."... "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

RESULT : This unit meets this requirement. The Antenna is fitted with a Reverse Polarity SMA connector. This antenna is specifically designed with an additional high temperature resistant plastic sleeve for SCS Forest products and can not be substituted with any other antenna due to the high temperature environment.

Linx Technology ANT-916-CW-RH



## **6 dB Bandwidth**

DATE: April 15, 2013

BASE STANDARD: FCC Part 15.247 (a) (2) & RSS 210 Issue 8 A8.2 (a)

TEST METHOD: FCC Publication 558074 & RSS 210 Issue 8 A8.2 (a)

TEST VOLTAGE: 7.2Vdc Battery pack

MINIMUM STANDARD: 15.247 (a) (2): Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the 6 dB bandwidth measured.

METHOD OF MEASUREMENT: KDB 558074 DTS Measurements

The EUT's modulation was turned on and the trace on the spectrum analyzer was set to a maximum hold setting. The trace stabilized then a marker was put at the peak and two delta markers were put 6 dB down from the peak on either side of the peak.

### TEST RESULTS:

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)
Low	907.02	574.5
Mid	915.20	584.9
High	923.25	544.9

MEASUREMENT DATA: See below for the 6 dB Bandwidth plots.

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



Controlled by EMC32

\*RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

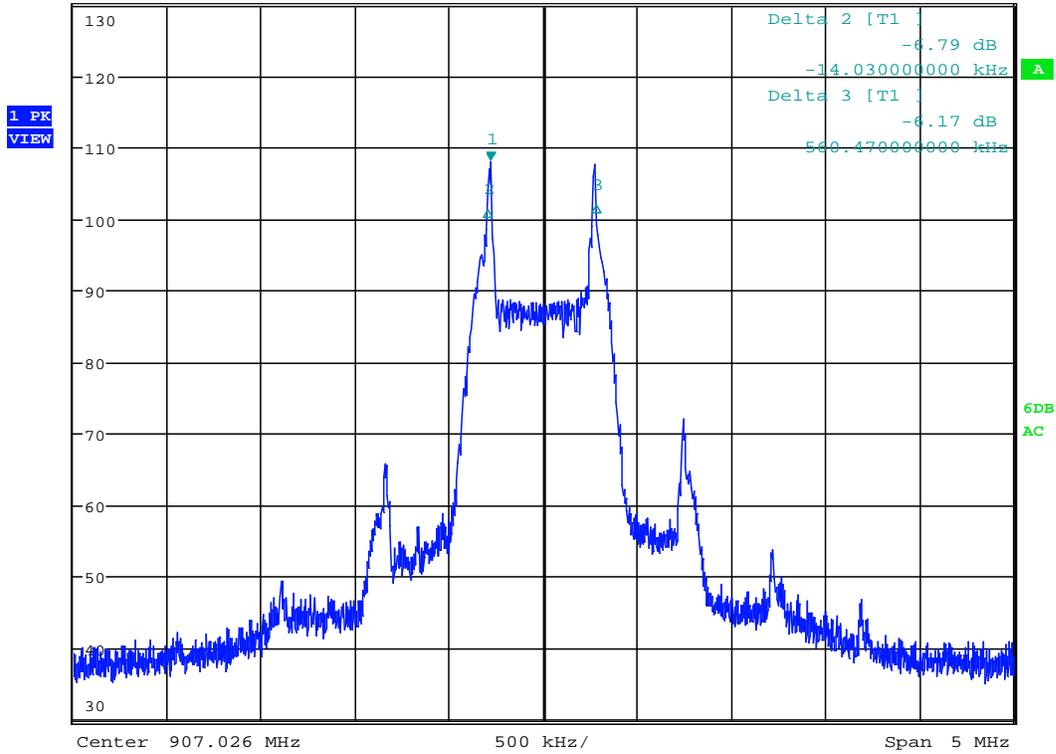
107.96 dBμV

Ref 130 dBμV

\*Att 20 dB

SWT 105 ms

906.746030000 MHz



TTTTTT

Date: 15.APR.2013 20:34:55

### Low Channel 6 dB Bandwidth



Controlled by EMC32

\*RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

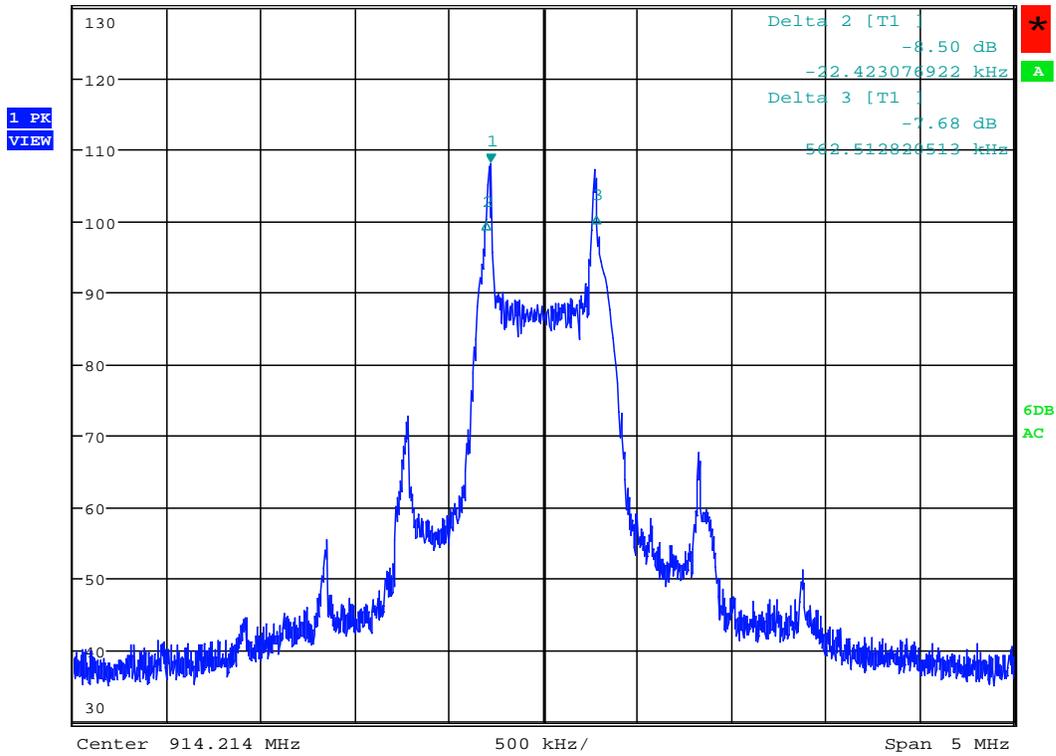
108.09 dBμV

Ref 130 dBμV

\*Att 20 dB

SWT 105 ms

913.933500000 MHz



TTTTTT

Date: 15.APR.2013 19:40:17

### Mid Channel 6 dB Bandwidth



Controlled by EMC32

\*RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

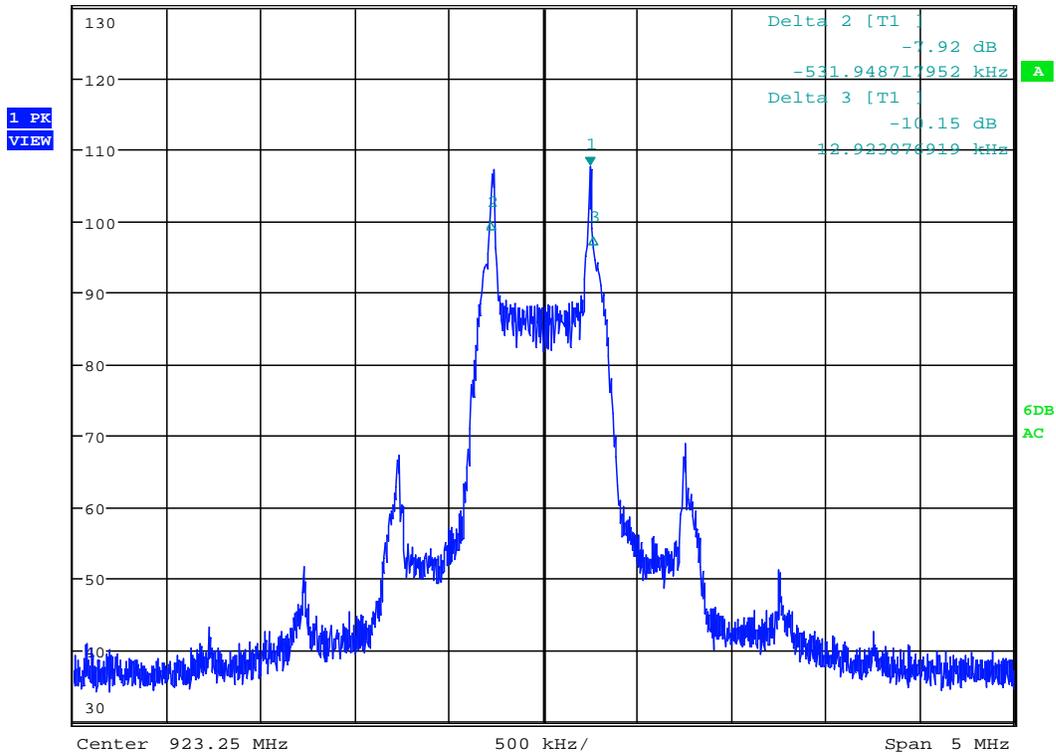
107.60 dBμV

Ref 130 dBμV

\*Att 20 dB

SWT 105 ms

923.501500000 MHz



TTTTTT

Date: 15.APR.2013 20:09:40

### High Channel 6 dB Bandwidth



## **Occupied Bandwidth**

DATE: April 15, 2013

BASE STANDARD: RSS-Gen Issue 3: 4.6.1

TEST METHOD: RSS-Gen Issue 3: 4.6.1

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the 99% occupied bandwidth measured.

### METHOD OF MEASUREMENT:

The EUT's modulation was turned on and the trace on the spectrum analyzer was set to a maximum hold setting. The trace stabilized then the occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% occupied bandwidth.

### TEST RESULTS:

Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Low	907.02	709.5
Mid	915.20	693.5
High	923.25	658.5

MEASUREMENT DATA: See below for the 99% Occupied Bandwidth plots.

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



Controlled by EMC32

\*RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

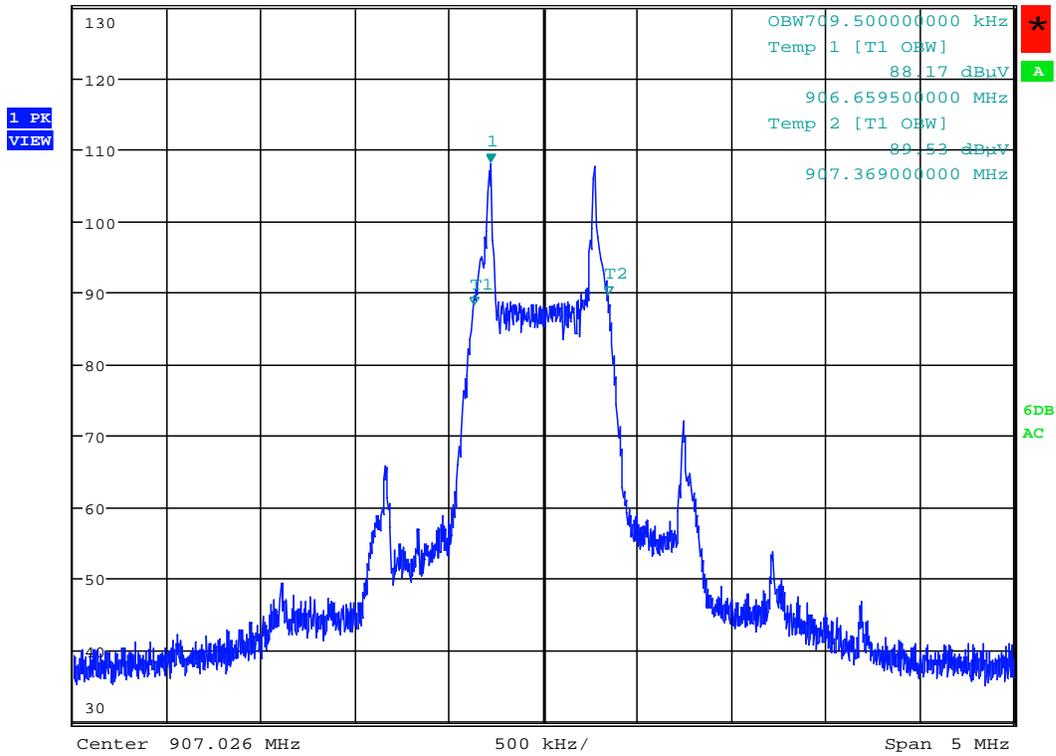
107.96 dBuV

Ref 130 dBuV

\*Att 20 dB

SWT 105 ms

906.746030000 MHz



TTTTTT

Date: 15.APR.2013 20:35:47

### Low Channel 99% Occupied Bandwidth



Controlled by EMC32

\*RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

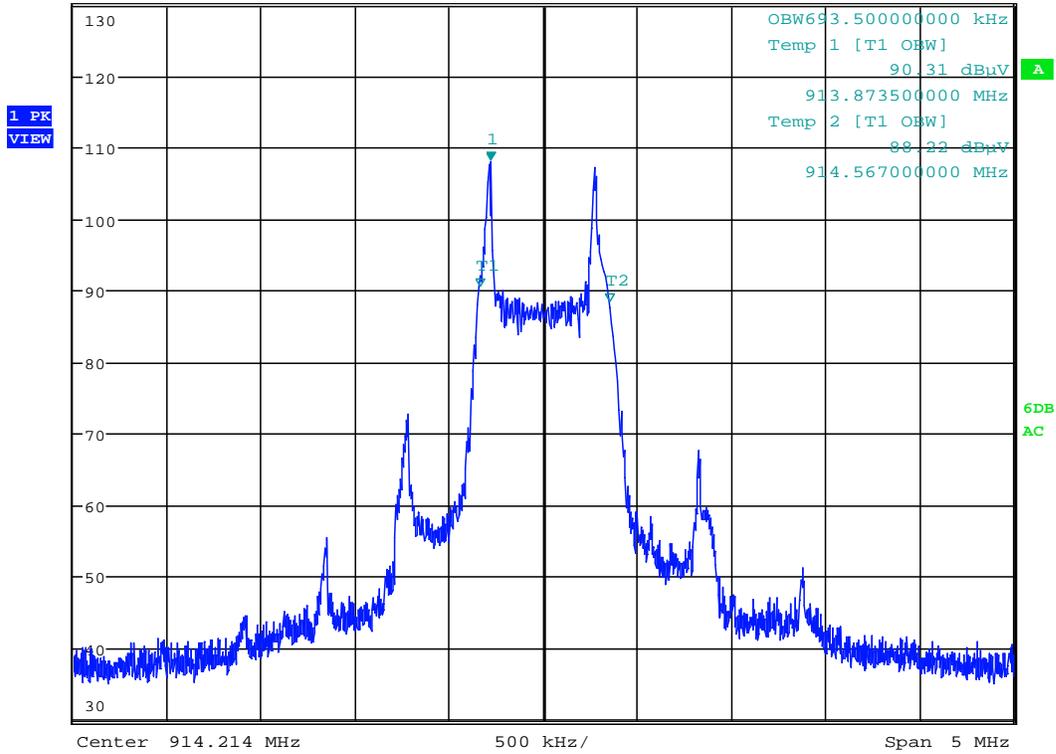
108.09 dBuV

Ref 130 dBuV

\*Att 20 dB

SWT 105 ms

913.933500000 MHz



TTTTTT

Date: 15.APR.2013 19:39:10

### Mid Channel 99% Occupied Bandwidth



Controlled by EMC32

\* RBW 10 kHz

Marker 1 [T1 ]

VBW 30 kHz

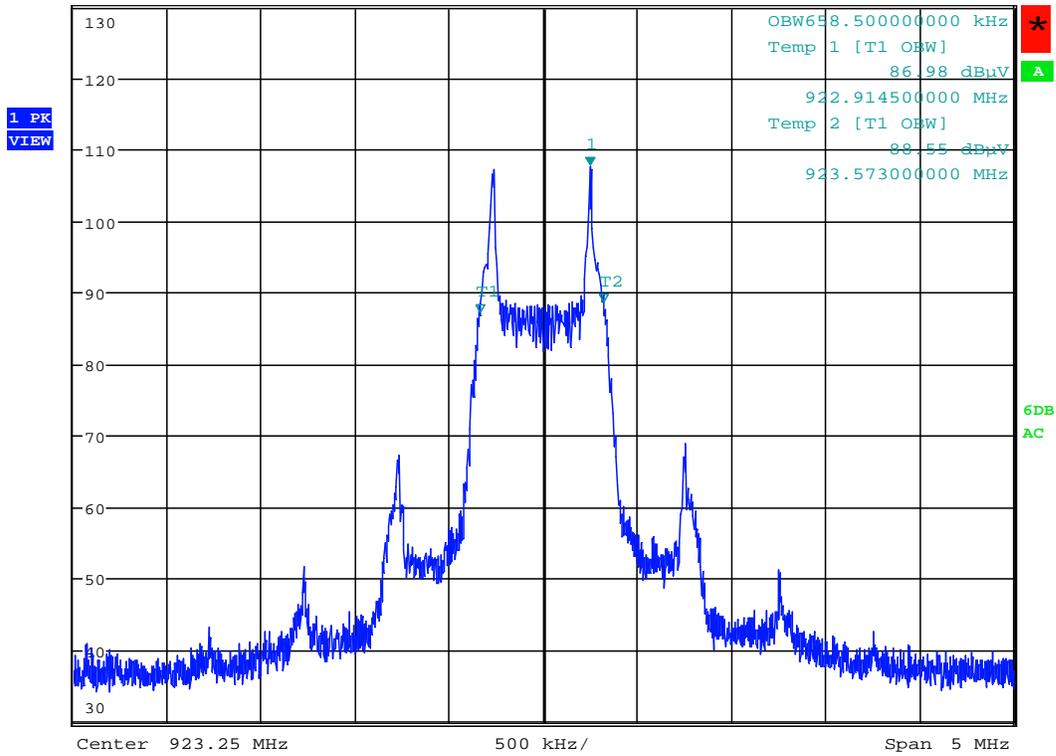
107.60 dBμV

Ref 130 dBμV

\* Att 20 dB

SWT 105 ms

923.501500000 MHz



TTTTTT

Date: 15.APR.2013 20:11:17

### High Channel 99% Occupied Bandwidth



## **Peak Power Output**

DATE: April 16, 2013

BASE STANDARD: FCC 15.247 & RSS 210 Issue 8 A8.2

TEST METHOD: FCC Publication 558074 & RSS-Gen Issue 3: 4.8

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: The maximum peak output power shall not exceed 1Watt or +30 dBm in the 902-928 MHz ISM band.

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the peak output power measured.

METHOD OF MEASUREMENT: KDB 558074 DTS Measurements

The EUT's modulation was turned on and the trace on the spectrum analyzer was set to a maximum hold setting. The trace stabilized then the peak power was measured. The RBW of the spectrum analyzer was set to 1 MHz as per measurement option #1

TEST RESULTS:

Channel	Frequency (MHz)	Peak Power (dBm)
Low	907.02	2.26
Mid	915.20	2.05
High	923.25	1.80

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



## **Power Spectral Density**

DATE: April 16, 2013

BASE STANDARD: FCC 15.247 (e) & RSS 210 Issue 8 A8.2 (b)

TEST METHOD: FCC Publication 558074 & RSS 210 Issue 8: A8.2 (b)

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: 15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the power spectral density was measured on the low, mid and high channels.

METHOD OF MEASUREMENT: KDB 558074 DTS Measurements

The EUT's modulation was turned on and the trace on the spectrum analyzer was set to a maximum hold setting. A single 700 second sweep was taken with the RBW equal to 3 kHz, the VBW equal to 10 kHz. The span was set to 2.0 MHz. The peak reading was taken off the trace and cable losses were added to it to obtain the data seen in the table below.

TEST RESULTS:

Channel	Frequency (MHz)	Power Spectral Density (dBm)
Low	907.02	2.08
Mid	915.20	1.73
High	923.25	1.49

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



## **Conducted Spurious Emissions (TX)**

DATE: April 16, 2013

BASE STANDARD: FCC 15.247 (d) & RSS 210 Issue 8 A8.5

TEST METHOD: FCC Publication 558074 & RSS 210 Issue 8: A8.5

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the conducted spurious emissions were measured on the low, mid and high channels.

TEST RESULTS: Compliant. No emissions were found 9kHz to 900MHz. Due to the products filtering, no emissions were detected from 1.9GHz to 10GHz. The worst case emission was 31.6 dB below the carrier power in the high channel at 1.830 GHz. This is a corrected value.

MEASUREMENT DATA:

Fundamental Carrier Frequency (MHz)	Frequency (MHz)	dB Below the Carrier
907.02	1813.482	32.78
907.02	2720.264	47.47
907.02	3626.974	56.10
915.20	1830.40	33.59
915.20	2745.60	51.28
915.20	3660.80	55.51
923.25	1846.50	33.97
923.25	2769.75	51.53
923.25	3693.00	56.07

No other frequencies were detected

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



## **Radiated Spurious Emissions Band Edge**

DATE: Apr 16, 2013

BASE STANDARD: FCC 15.247 (d) & RSS 210 Issue 8 A8.5

TEST METHOD: FCC Publication 558074 & RSS 210 Issue 8: A8.5

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST SETUP: The EUT was provided with a 50 Ohm reverse thread SMA connector on the transmitter output. The transmitter output was connected to a spectrum analyzer and the conducted spurious emissions band edge was measured on the low and high channels.

METHOD OF MEASUREMENT: KDB 558074 DTS Measurements

The plot was performed using conducted measurement method as outlined in KDB 558074. There were no Radiated Emissions detected from the case when the Antenna Port was terminated with a 50Ohm load. The EUT's modulation was turned on and the trace on the spectrum analyzer was set to a maximum hold setting. A 1 minute Maxhold multiple sweep was taken with the RBW equal to 100 kHz, the VBW equal to 300 kHz.

MEASUREMENT DATA: See below for the Radiated spurious emissions bandedge measurements.

MODIFICATIONS: The EUT did not require any modifications.

PERFORMANCE: PASS: Complies with the applicable standard.



Controlled by EMC32

\*RBW 100 kHz  
VBW 300 kHz  
SWT 45 ms

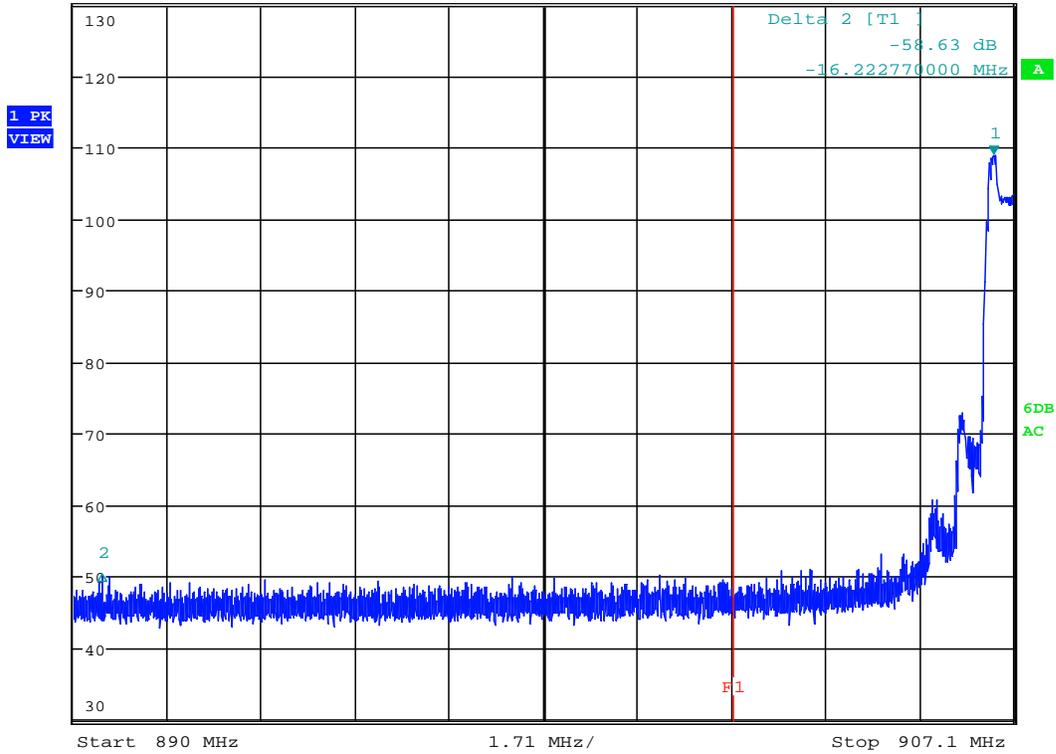
Marker 1 [T1 ]

108.86 dBμV

Ref 130 dBμV

\*Att 20 dB

906.746030000 MHz



TTTTTT

Date: 15.APR.2013 20:27:39

### Low Channel Radiated Spurious Emissions Band Edge Measurement



Controlled by EMC32

\*RBW 100 kHz  
VBW 300 kHz  
SWT 45 ms

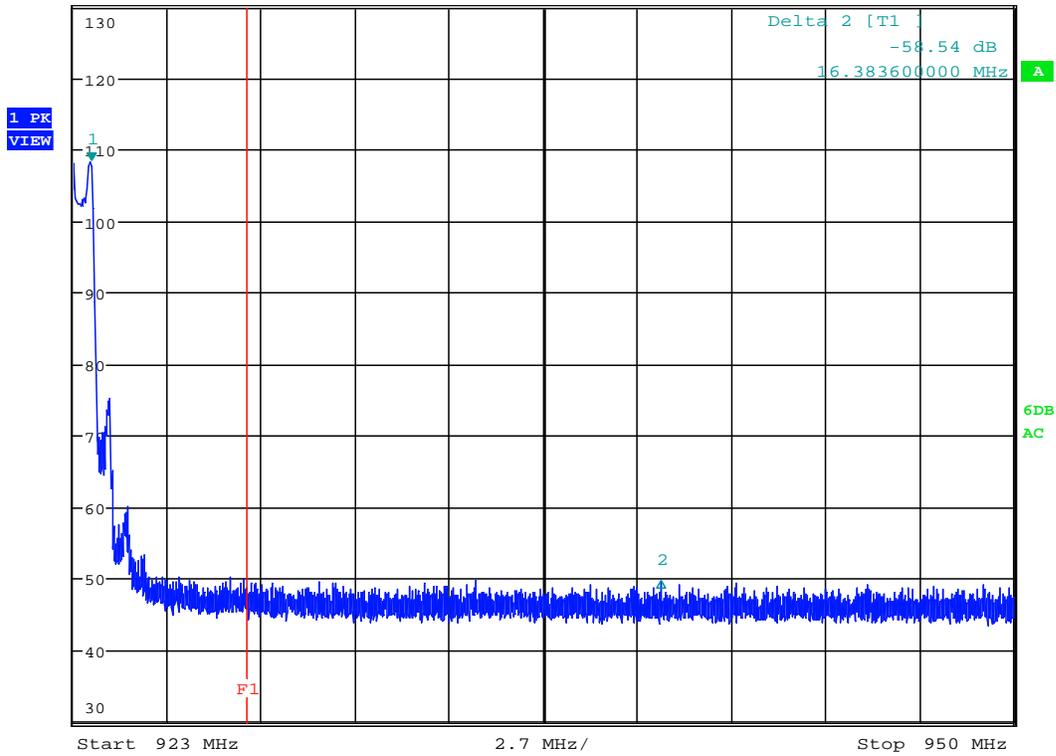
Marker 1 [T1 ]

108.27 dBµV

Ref 130 dBµV

\*Att 20 dB

923.502200000 MHz



TTTTTT

Date: 15.APR.2013 20:23:02

### High Channel Radiated Spurious Emissions Band Edge Measurement



## **Radiated Spurious Emissions**

DATE: April 16, 2013

BASE STANDARD: FCC Part 15.209 – Radio Frequency Devices  
FCC Part 15.205 – Restricted Bands of Operation  
RSS 210 Issue 8 2.5 and A8.5

TEST METHOD: ANSI C63.4-2009

TEST VOLTAGE: 120VAC, 60Hz

MINIMUM STANDARD: FCC 15.205 and RSS 210 Issue 8 2.2 Restricted Bands of Operation

(a) Only spurious emissions are permitted in any of the frequency bands listed below.

<b>MHz</b>	<b>MHz</b>	<b>MHz</b>	<b>GHz</b>
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	N/A
13.36-13.41	N/A	N/A	N/A

(b) The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.



Table 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Calculated Field Strength at 3meters (dBuV/m)
0.009–0.490	2400/F (kHz)	300	107.6/F (kHz)
0.490–1.705	24000/F (kHz)	30	107.6/F (kHz)
1.705–30.0	30	30	49.54
30–88	100**	3	40.0
88–216	150**	3	43.5
216–960	200**	3	46.02
Above 960	500	3	53.98

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76– 88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241

**TEST SETUP:** The EUT was setup in a 3 meter semi anechoic chamber. For peak measurements above 1 GHz the RBW was set to 1 MHz and the VBW set to 3 MHz. Average levels were measured with a RBW of 1 MHz and an average detector. For measurements below 1 GHz a CISPR Quasi-Peak Detector with a 120kHz bandwidth was used.

**TESTS COMPLETED:** The EUT was put into its Low, Mid and High channels and the spurious emission were measured from 1 GHz to 10 GHz using a horn antenna.

**METHOD OF MEASUREMENT:** KDB 558074 DTS Measurements

**TEST RESULTS:** Compliant

**MEASUREMENT DATA:** No spurious emissions, other then harmonics were detected 9kHz to 10GHz. No other frequencies were detected. Only Radiated Frequencies with in the restricted bands as listed in the above table were measured.

Transmitter Frequency (MHz).	Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBµV/m)
907.03	2721.09	47.52	1000.00	1000.000	158.6	H	61.3	6.48	54
907.03	3628.12	19.97	1000.00	1000.000	171.6	H	57.8	34.03	54
915.20	2745.62	47.81	1000.00	1000.000	157.8	H	58.7	6.19	54
915.20	3660.81	17.41	1000.00	1000.000	100.0	H	57.8	36.59	54
923.25	2770.25	44.24	1000.00	1000.000	155.9	H	63.2	9.76	54
923.25	3693.75	20.12	1000.00	1000.000	157.0	H	65.0	33.88	54

**MODIFICATIONS:** The EUT did not require any modifications.

**PERFORMANCE:** PASS: Complies with the applicable standard.



## **Transmitter Frequency Stability**

DATE:	February 22, 2013
TEST STANDARD:	RSS-Gen Section (4.7) and (7.2.6) and FCC Part 15.215(c)
TEST VOLTAGE:	5Vdc from power supply
MINIMUM STANDARD:	<p>Not specified.</p> <p>(4.7)With the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below:</p> <p>(a) at temperatures of -30°C, +20°C and +125°C, at the manufacturer's rated supply voltage of the battery.</p> <p>(b) at a temperature of +20°C and at ±15 percent of the manufacturer's rated supply voltage.</p> <p>(7.2.6) Transmitter frequency stability for licence-exempt radio apparatus shall be measured in accordance with Section 4.7. Also, for licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C, +20°C and +125°C instead of at the temperatures specified in Section 4.7(a). If the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standards, measurement of the frequency stability is not required provided that the occupied bandwidth of the licence-exempt radio apparatus lies entirely outside the restricted bands and the prohibited TV bands of 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz.</p> <p>(15.215(c) )</p> <p>The 20dB bandwidth must remain within the designated frequency band over the expected variations in temperature and voltage range</p>
TEST SETUP:	<p>The EUT was bench tested and in our temperature chamber. Since this is a battery operated device, there was no measurement resulting from the AC voltage variation. The temperature was varied at +125, +20, 0 and -30° Celsius. The transmitter was set for Carrier Wave (CW) mode and the lowest and highest channel Frequency was measured at each Temperature setting, after the Transmitter stabilized at the temperature. After the CW mode was measured the Modulated Mode was also measured.</p>
MEASUREMENT METHOD:	Measurements were made using a Spectrum Analyzer with 120kHz RBW Average detector using the appropriate Antennas, amplifiers and filters.
DEVICE DESCRIPTIONS:	As described in the above EUT description and setup Section.



EMISSIONS DATA:

The Occupied bandwidth lies within the 902 to 928 designated band.  
Channel 4 – 906.764MHz

Temperature (deg. Celsius)	CW Frequency	Bandwidth level at band edge (dB from peak emission)
20	906.764	-30.8
-30	906.780	-30.9
0	906.770	-30.9
125	906.764	-30.9

Channel 22 – 923.008MHz

Temperature (deg. Celsius)	CW Frequency	Bandwidth level at band edge (dB from peak emission)
20	923.008	-31.8
-30	923.020	-31.9
0	923.020	-31.9
125	923.001	-31.8

OBSERVATIONS:

The EUT performed as expected.

PERFORMANCE:

Complies.

## Appendix B: EUT Photos During EMC Testing



Radiated Emissions Setup in the Semi-Anechoic Chamber EUT mounted above sensor plates



Radiated Emissions Setup in the Semi-Anechoic Chamber with the 2 Sensor plates



Radiated Emission Test Setup in the Semi-Anechoic Chamber



Radiated Emissions Test Set-Up in the Semi-Anechoic Chamber