




**Nemko Test Report:** 10219979RUS1


**Applicant:** SyChip LLC  
2805 N. Dallas Parkway, Ste 400  
Plano, TX 75093  
USA

**Equipment Under Test:  
(E.U.T.)** SN2100  
  
FCC ID.: QPU2100  
IC: 4523A-SN2100

**In Accordance With:** **FCC Part 15, Subpart C, 15.247 and  
Industry Canada RSS-210, Issue 8**  
Frequency Hopping Transmitters

**Tested By:** Nemko USA Inc.  
802 N. Kealy  
Lewisville, Texas 75057-3136

**TESTED BY:**   
\_\_\_\_\_  
David Light, Senior Wireless Engineer **DATE:** 20 February 2012

**APPROVED BY:**   
\_\_\_\_\_  
Michael Cantwell **DATE:** 27-February 2012

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**Section 1. Summary of Test Results**

Manufacturer: Sychip LLC

Model No.: SN2100

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 and Industry Canada RSS-210, Issue 8 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC and Industry Canada.

- |                                     |                            |                                     |                     |
|-------------------------------------|----------------------------|-------------------------------------|---------------------|
| <input checked="" type="checkbox"/> | New Submission             | <input checked="" type="checkbox"/> | Production Unit     |
| <input type="checkbox"/>            | Class II Permissive Change | <input type="checkbox"/>            | Pre-Production Unit |

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".



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**Summary Of Test Data**

<b>NAME OF TEST</b>	<b>PARA. NO.</b>	<b>RESULT</b>
Powerline Conducted Emissions	15.207(a) / RSS-Gen 7.2.4	Complies
Channel Separation	15.247(a)(1) / RSS-210 A8.1(b)	Complies
Time of Occupancy	15.247(a)(1) / RSS-210 A8.1(d)	Complies
20 dB Occupied Bandwidth	15.247(a)(1) / RSS-210 A8.1(a)	Complies
Peak Power Output	15.247(b) / RSS-210 A8.4(2)	Complies
Spurious Emissions (Antenna Conducted)	15.247(d) / RSS-210 A8.5	Complies
Spurious Emissions (Radiated)	15.247(d) / RSS-Gen 7.2.2	Complies

**Footnotes:**

## **Section 2. Equipment Under Test (E.U.T.)**

### **General Equipment Information**

**Frequency Band:**  902 – 928 MHz  
 2400 – 2483.5 MHz  
 5725 – 5850 MHz

**Operating Frequency Range:** 2402 to 2480 MHz

**Number of Channels:** 79

**Channel Spacing:** 1 MHz

**User Frequency Adjustment:** Software controlled

### **Description of EUT**

SN2100 is a complete industrial grade high power (class 1) Bluetooth® module with on-board antenna for M2M application. It integrates Bluetooth® IC, PA, RF front end, TCXO and chip antenna into a small LGA form factor and can be simply dropped into the OEM's design.

**Section 3. Channel Separation**

NAME OF TEST: Channel Separation	PARA. NO.: FCC 15.247(a)(1) RSS-210 A8.1(b)
TESTED BY: David Light	DATE: 20 February 2012

**Test Results:** Complies.

**Measurement Data:** See 20 dB BW plot  
Measured 20 dB bandwidth: 942 kHz  
Channel Separation: 1 MHz

**Equipment Used:** 1082-1472-1036

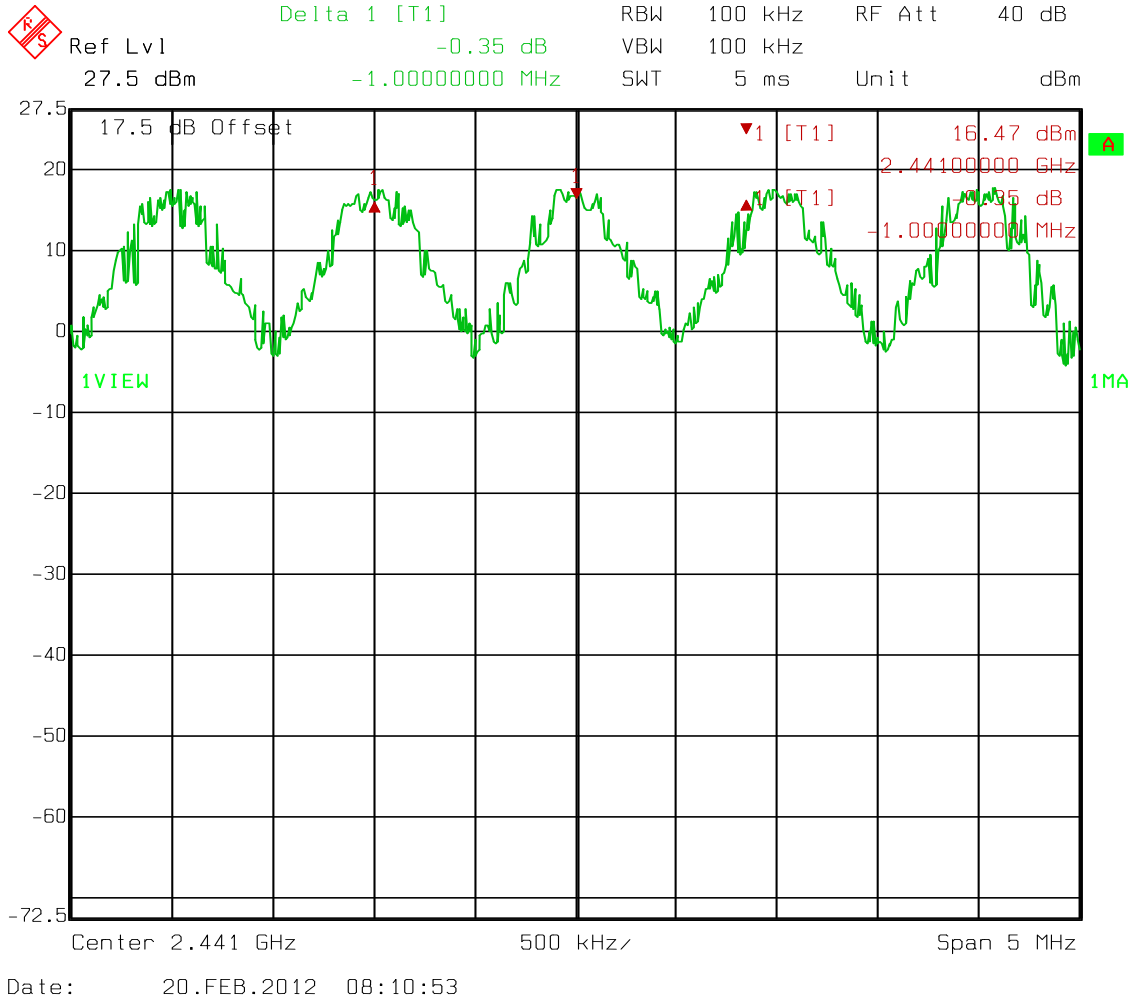
**Measurement Uncertainty:** 1X10<sup>-7</sup>ppm

**Temperature:** 23 °C

**Relative Humidity:** 49 %

EQUIPMENT: SN2100

Test Data – Channel Separation

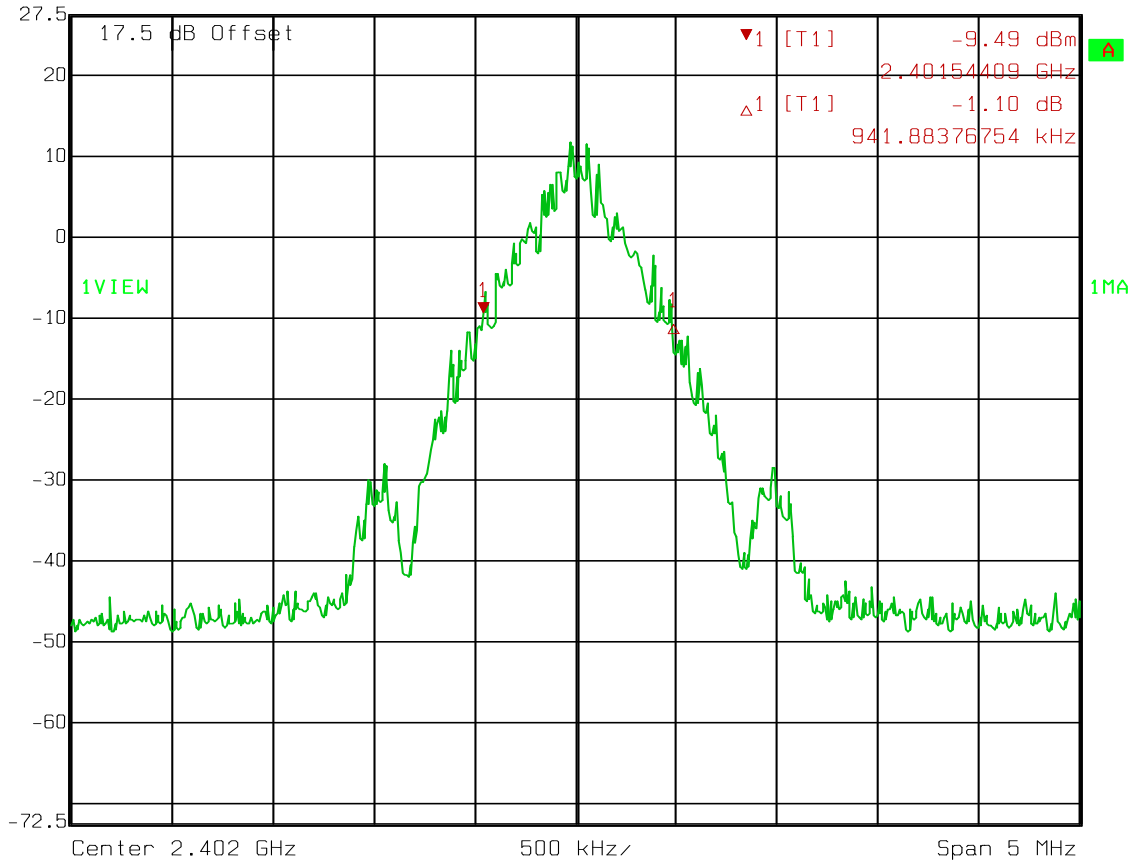


EQUIPMENT: SN2100

Test Data – 20 dB Bandwidth

Low Channel

 Ref Lvl 27.5 dBm      Marker 1 [T1] 2.40154409 GHz      RBW 10 kHz      RF Att 40 dB      VBW 10 kHz      Unit dBm      SWT 125 ms



Date: 20.FEB.2012 07:54:52

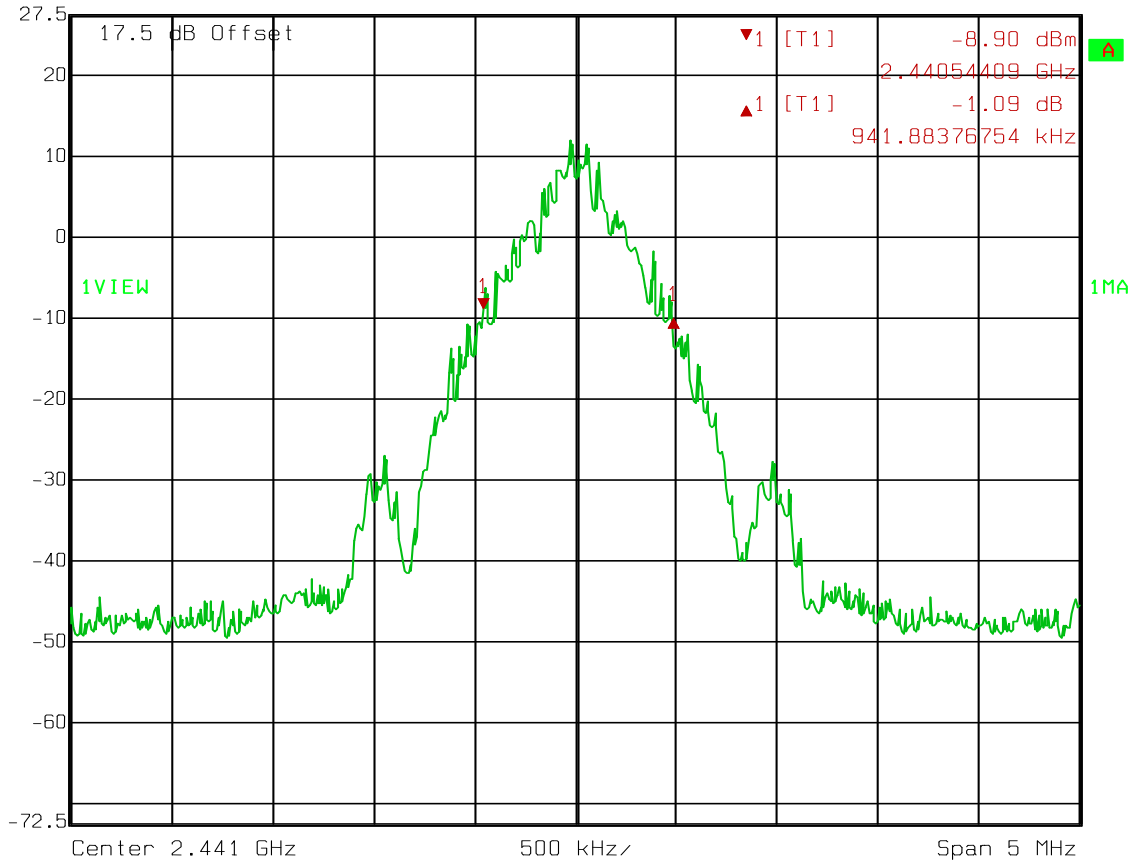


EQUIPMENT: SN2100

Test Data – 20 dB Bandwidth

Mid Channel

 Ref Lvl 27.5 dBm      Delta 1 [T1] -1.09 dB      RBW 10 kHz      RF Att 40 dB  
27.5 dBm      941.88376754 kHz      VBW 10 kHz      Unit dBm  
SWT 125 ms



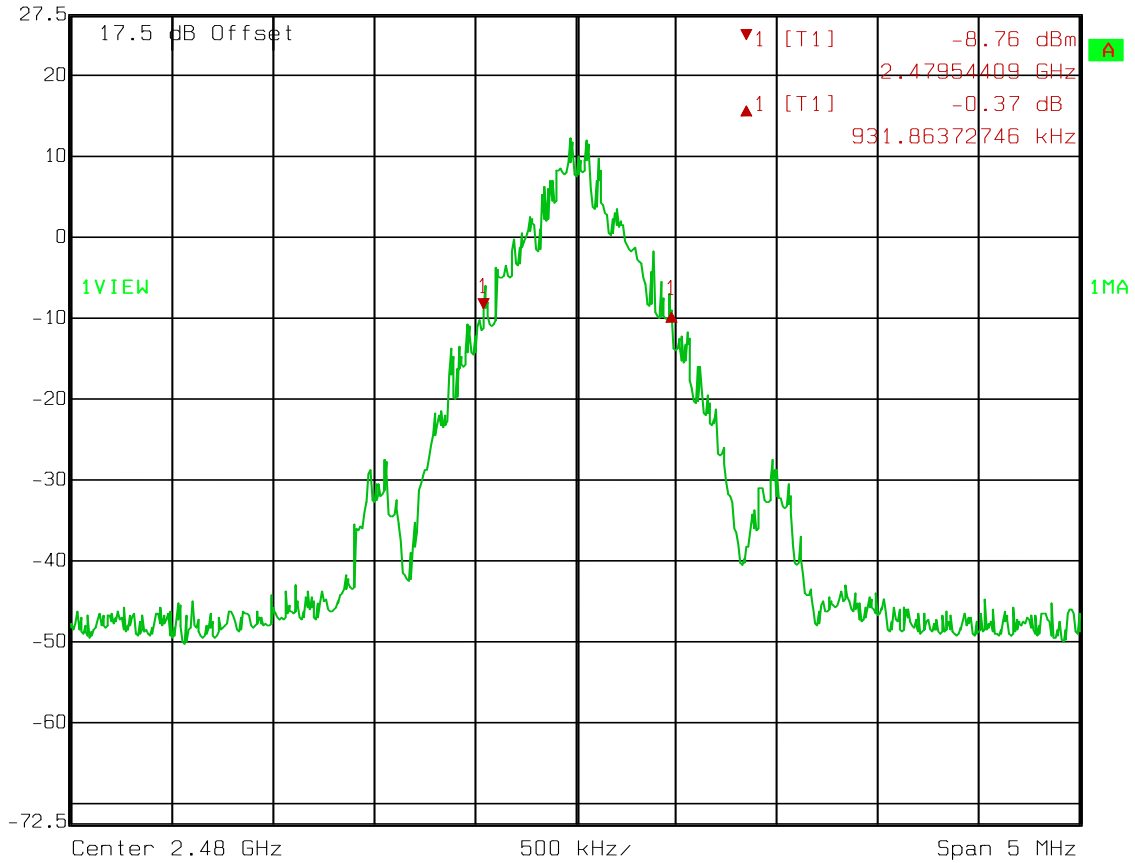
Date: 20.FEB.2012 08:04:50

EQUIPMENT: SN2100

Test Data – 20 dB Bandwidth

High Channel

 Ref Lvl 27.5 dBm      Delta 1 [T1] -0.37 dB      RBW 10 kHz      RF Att 40 dB  
27.5 dBm      931.86372746 kHz      VBW 10 kHz      Unit dBm  
SWT 125 ms



Date: 20.FEB.2012 08:07:32

**Section 4. Time of Occupancy**

NAME OF TEST: Time of Occupancy	PARA. NO.: FCC 15.247(a)(1) RSS-210 A8.1(d)
TESTED BY: David Light	DATE: 20 February 2012

**Test Results:** Complies.

**Measurement Data:**

Maximum Dwell Time On Any Channel: 0.300 seconds in 31.6 seconds

**Equipment Used:** 1082-1472-1036

**Measurement Uncertainty:** 1X10<sup>-7</sup>ppm

**Temperature:** 23 °C

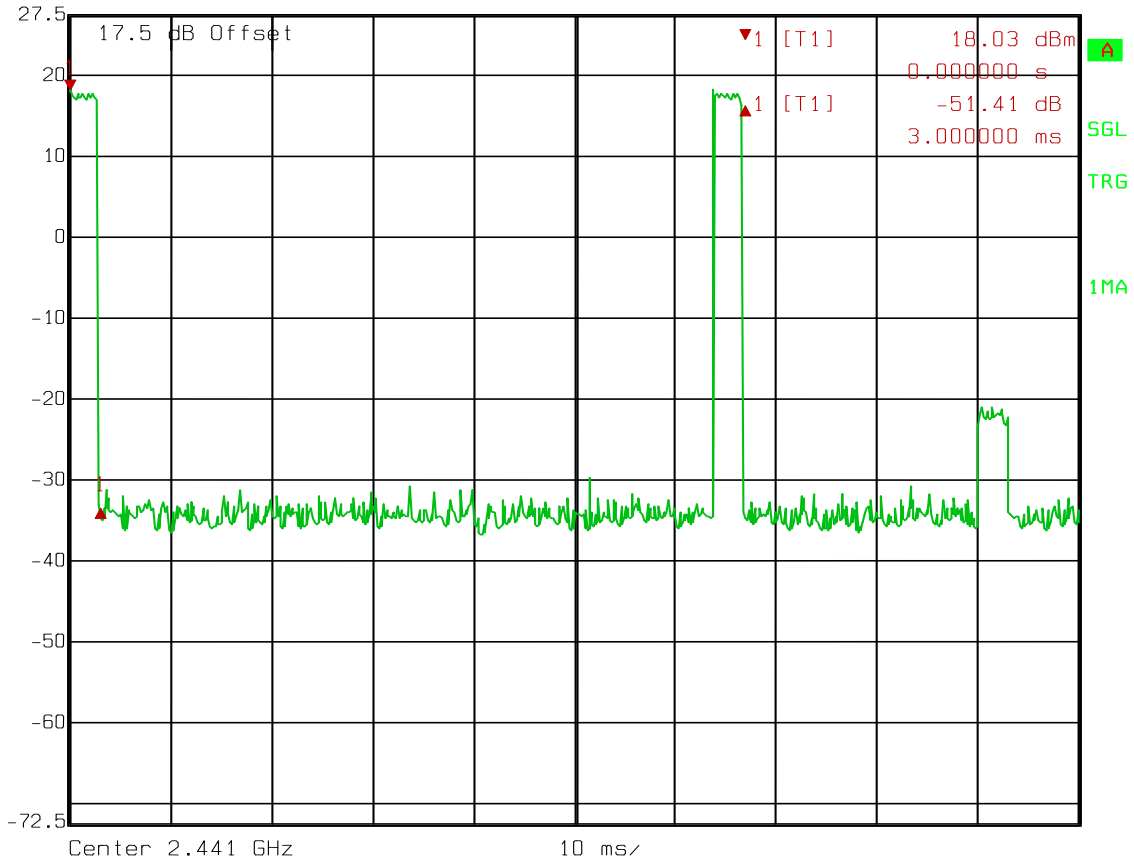
**Relative Humidity:** 49 %

EQUIPMENT: SN2100

**Test Data – Time of Occupancy**

**Pulse Width**

	Delta 1 [T1]	RBW	100 kHz	RF Att	40 dB
	Ref Lvl	-51.41 dB	VBW	100 kHz	
	27.5 dBm	3.000000 ms	SWT	100 ms	Unit dBm



Date: 20.FEB.2012 08:12:17

EQUIPMENT: SN2100

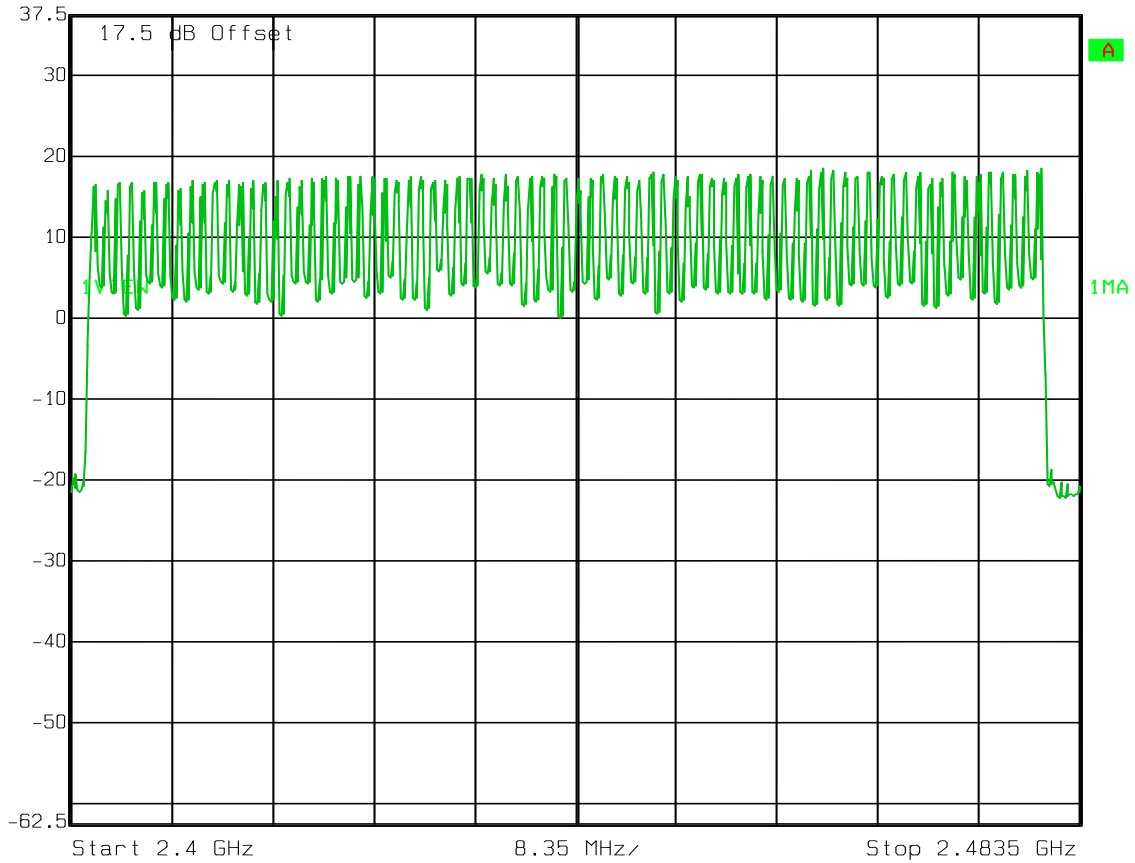
Test Data – Time of Occupancy

Hopping Channels = 79



Ref Lvl  
37.5 dBm

RBW 100 kHz RF Att 50 dB  
VBW 100 kHz  
SWT 21 ms Unit dBm



Date: 20.FEB.2012 08:14:28

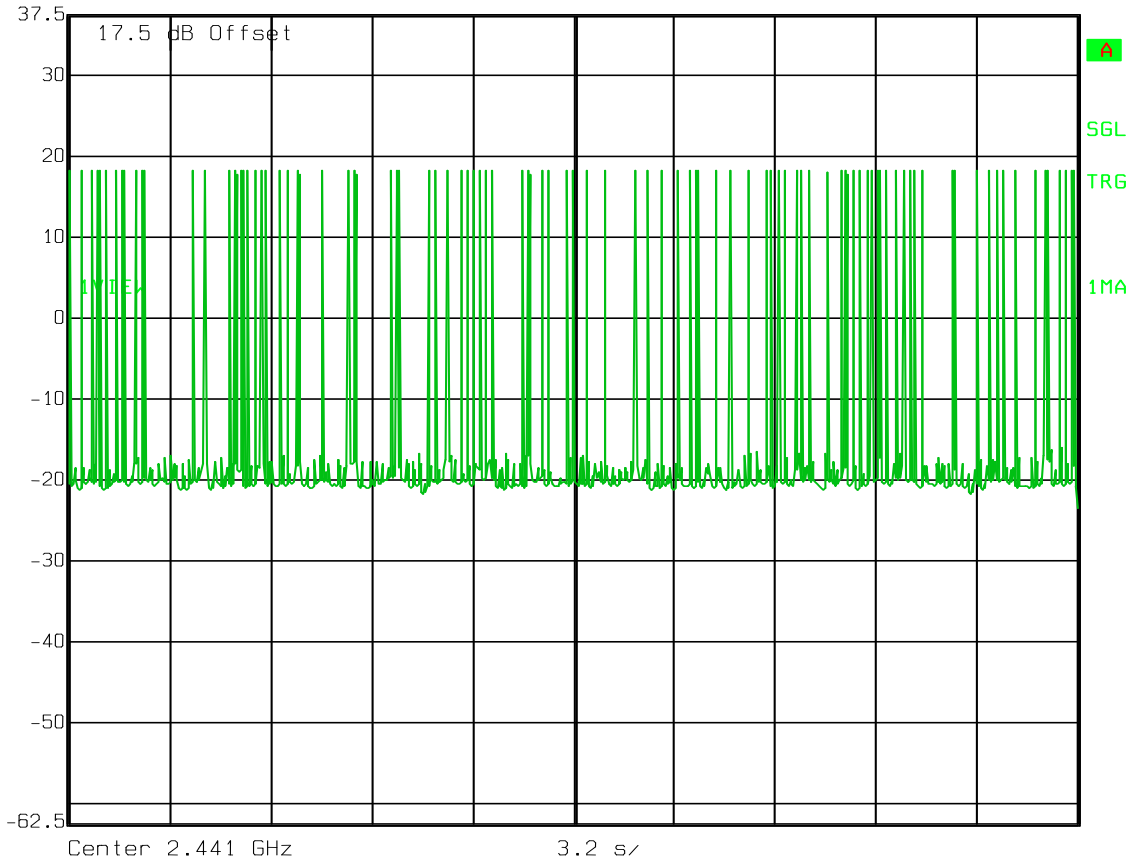
EQUIPMENT: SN2100

Test Data – Time of Occupancy



Ref Lvl  
37.5 dBm

RBW 100 kHz RF Att 50 dB  
VBW 100 kHz  
SWT 32 s Unit dBm



Date: 20.FEB.2012 08:17:10

100 Hops @ 3 ms each = 300 ms in 31.6 seconds

Limit = <400 ms

**Section 6. Peak Power Output**

NAME OF TEST: Peak Power Output	PARA. NO.: FCC 15.247 (b) RSS-210 A8.4(2)
TESTED BY: David Light	DATE: 20 February 2012

**Test Results:** Complies.

**Measurement Data:** See attached plots.

Detachable antenna?  Yes  No  
 If yes, state the type of non-standard connector used:

Frequency (MHz)	Peak Power (dBm)	Peak Power (W)	Antenna Type	Gain (dBi)	E.I.R.P. (dBm)	E.I.R.P. (W)
2402	18.0	0.063	Chip	-1.7	16.3	0.043
2441	18.6	0.072	Chip	-1.7	16.9	0.049
2480	18.9	0.078	Chip	-1.7	17.2	0.052
Maximum EIRP (W): 0.052						

- This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.
- For battery powered equipment, the device was tested with a fresh battery per 15.31(e).
- The device was tested on three channels per 15.31(l).
- This test was performed radiated.

Spectrum analyzer settings:

RBW: 10 MHz  
 VBW: 10 MHz  
 Detector: Peak

**Equipment Used:** 1036-1082-1472

**Measurement Uncertainty:** 1.7 dB

**Nemko USA, Inc.**

FCC PART 15, Subpart C and RSS-210

Frequency Hopping Transmitters

PROJECT NO.:10219979RUS1

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*EQUIPMENT:* SN2100

**Temperature:** 23 °C

**Relative Humidity:** 49 %



**Section 6. Spurious Emissions (Conducted)**

NAME OF TEST: Spurious Emissions (Conducted)	PARA. NO.: FCC 15.247(d) RSS-210 A8.5
TESTED BY: David Light	DATE: 20 February 2012

**Test Results:** Complies.

**Measurement Data:** See attached plots.

**Equipment Used:** 1036-1082-1472

**Measurement Uncertainty:** 1X10<sup>-7</sup>ppm

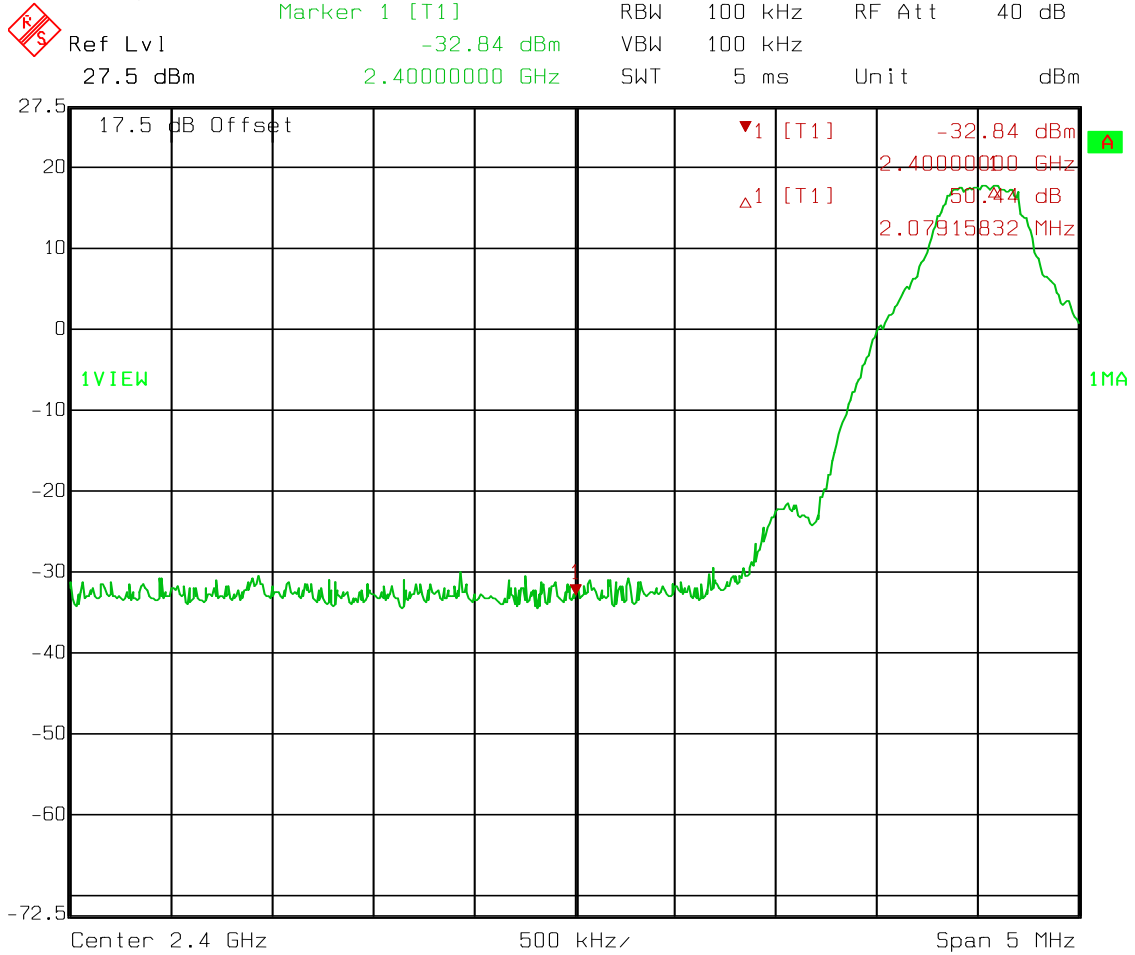
**Temperature:** 23 °C

**Relative Humidity:** 49 %

EQUIPMENT: SN2100

Test Data – Spurious Emissions at Antenna Terminals


Lower Band Edge

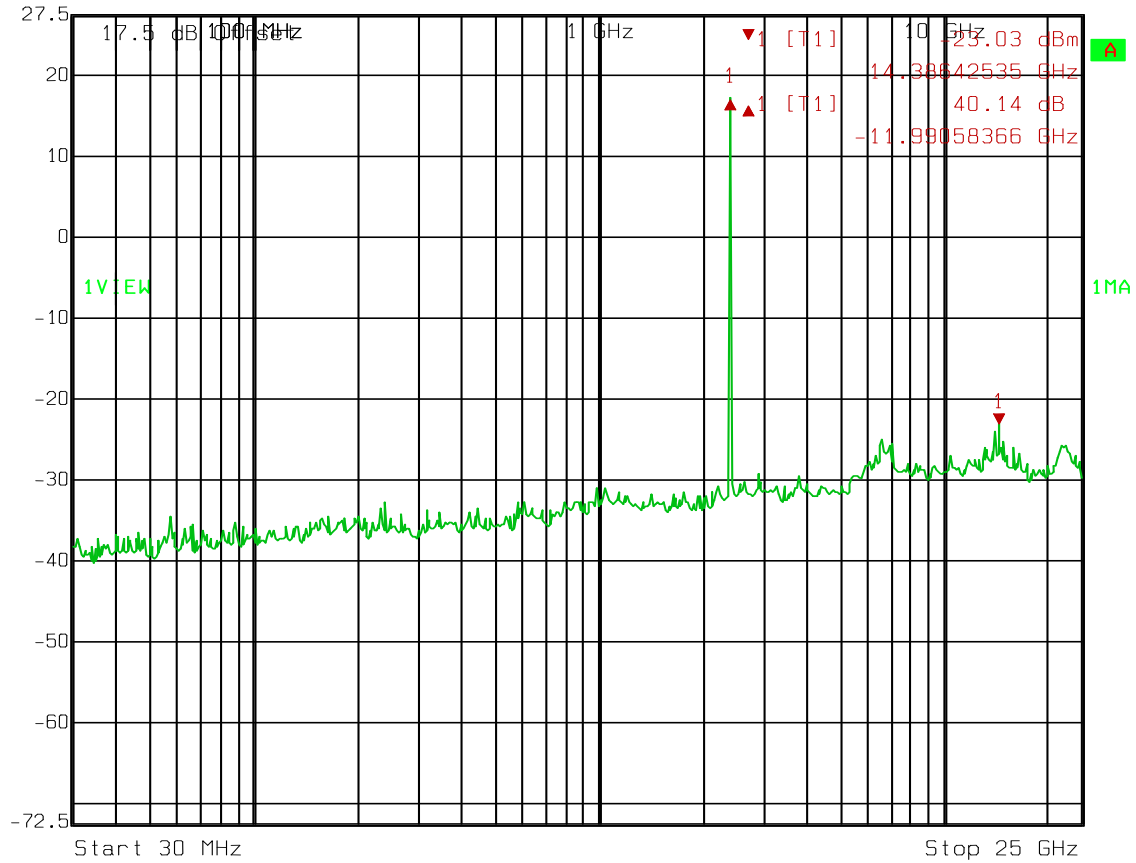


Date: 20.FEB.2012 07:48:48

Test Data – Spurious Emissions at Antenna Terminals

Spurs – Low Channel

 Delta 1 [T1] RBW 100 kHz RF Att 40 dB  
Ref Lvl 40.14 dB VBW 100 kHz  
27.5 dBm -11.99058366 GHz SWT 6.4 s Unit dBm




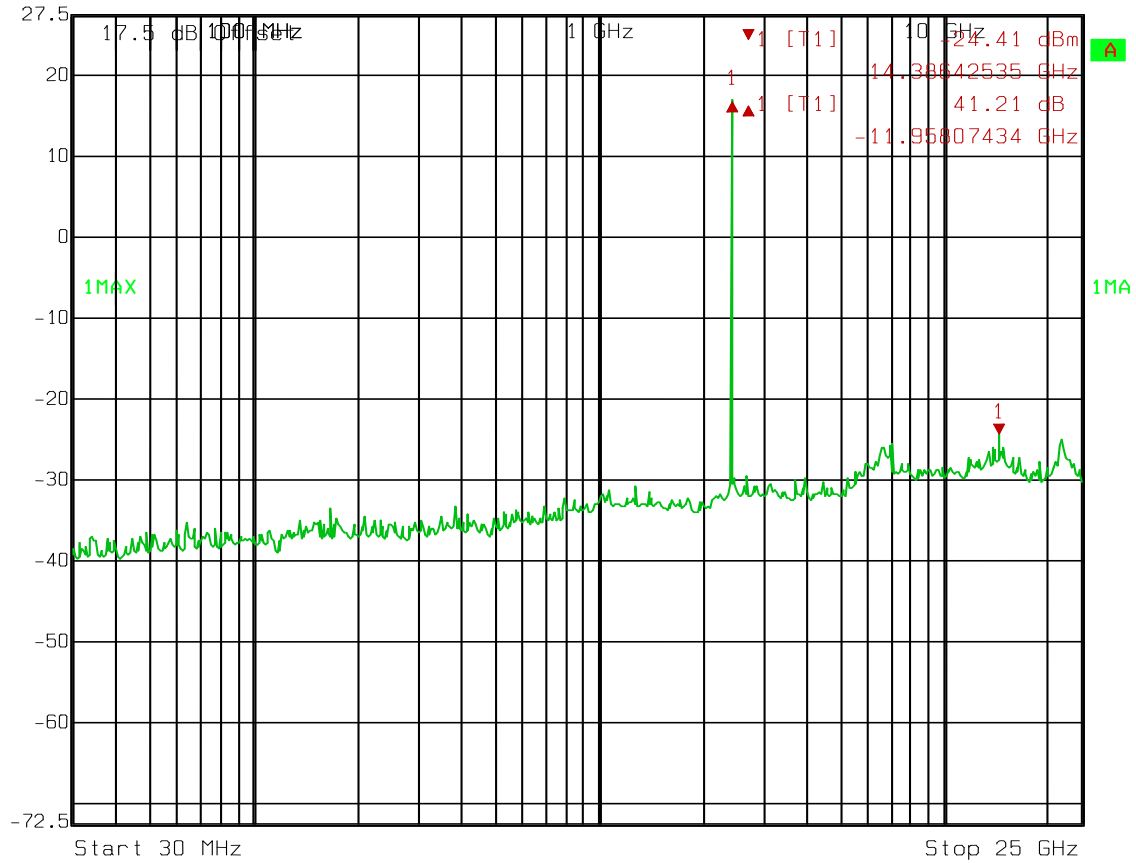
Date: 20.FEB.2012 07:49:47

EQUIPMENT: SN2100

Test Data – Spurious Emissions at Antenna Terminals

Spurs – Mid Channel

 Delta 1 [T1] RBW 100 kHz RF Att 40 dB  
Ref Lvl 41.21 dB VBW 100 kHz  
27.5 dBm -11.95807434 GHz SWT 6.4 s Unit dBm



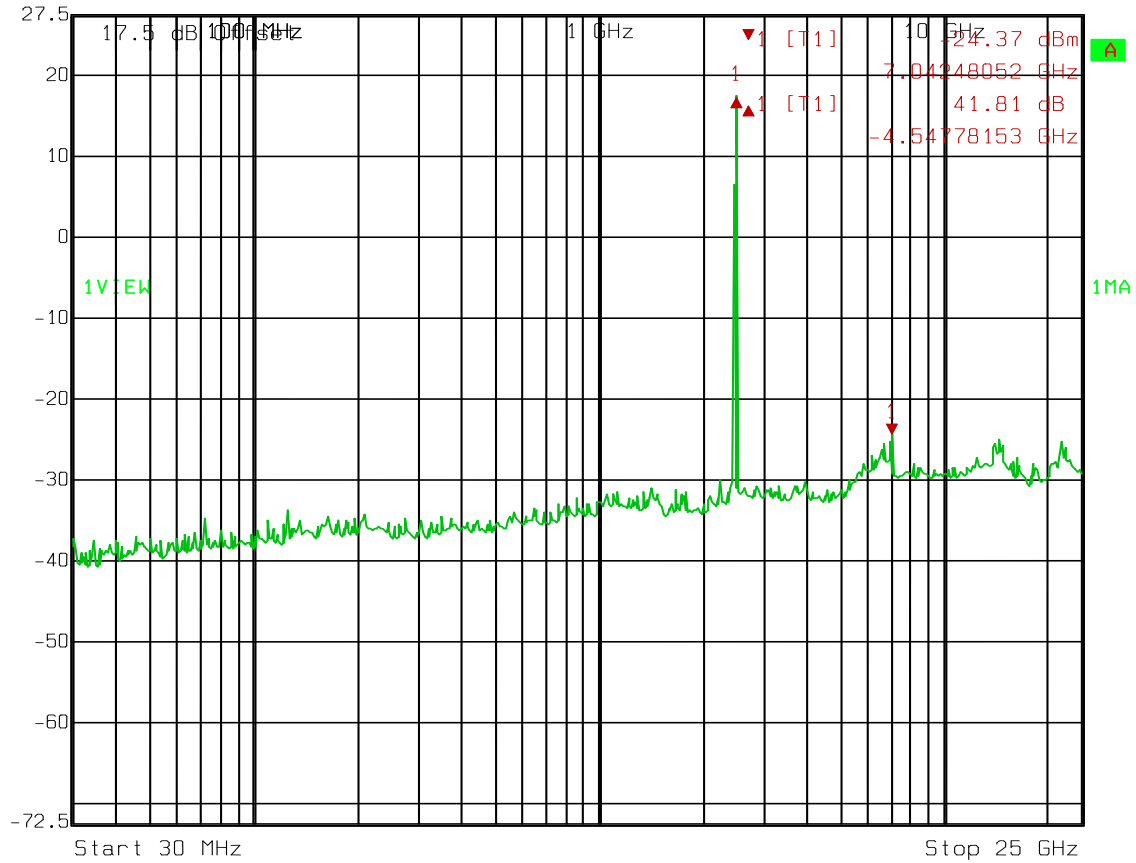
Date: 20.FEB.2012 08:03:37

EQUIPMENT: SN2100

Test Data – Spurious Emissions at Antenna Terminals

Spurs – High Channel

Ref Lvl 27.5 dBm  
Delta 1 [T1] 41.81 dB  
-4.54778153 GHz  
RBW 100 kHz  
VBW 100 kHz  
RF Att 40 dB  
SWT 6.4 s  
Unit dBm



Date: 20.FEB.2012 08:08:13

**Section 7. Spurious Emissions (Radiated)**

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: FCC 15.247(d) RSS-Gen 7.2.2
TESTED BY: David Light	DATE: 20 February 2012

**Test Results:** Complies. The worst case emission was 51.0 dBµV/m at 4882 MHz. This is 3 dB below the specification limit of 54.0 dBµV/m. This was a peak measurement.

**Measurement Data:** See attached table.

**Duty Cycle Calculation:**

Duty Cycle correction factor(dB) =  $20 \log (rf_{ON} \text{ in ms}/100\text{ms}) = 20 \log (6/100) = -24.4 \text{ dB}$

Notes:

- For handheld devices, the EUT was tested on three orthogonal axis'
- The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33
- The device was tested on three channels per 15.31(l).
- No emissions were detected within 20 dB of the specification limit therefore none are reported per 15.31(o). Band edge data is presented below.

**Equipment Used:** 1464-1480-993-1016-1025-1783

**Measurement Uncertainty:** +/-3.6 dB

**Temperature:** 23 °C

**Relative Humidity:** 49 %

**Test Data - Radiated Emissions**

**Low Channel**

Meas. Freq. (MHz)	Ant. Pol. (HV)	Duty Cycle (dB)	Meter Reading (dBuV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. limit (dBuV/m)	CR/SL Diff. (dB)	Pass Fail Unc.	Comment
											Tx 2402 MHz
4804.0	V	0	42.0	33.8	4.3	32.1	48.0	54.0	-6.0	Pass	Noise floor
7206.0	V	0	40.0	35.9	5.3	31.8	49.4	54.0	-4.6	Pass	Noise floor
9608.0	V	0	41.0	37.2	6.2	35.0	49.4	54.0	-4.6	Pass	Noise floor
12010.0	V	0	47.0	40.3	7.3	34.0	60.6	74.0	-13.4	Pass	
12010.0	V	-24.4	45.0	40.3	7.3	34.0	34.2	54.0	-19.8	Pass	
14412.0	V	0	40.0	40.6	7.3	32.3	55.6	74.0	-18.4	Pass	Noise floor
14412.0	V	-24.4	40.0	40.6	7.3	32.3	31.2	54.0	-22.8	Pass	Noise floor
16814.0	V	0	39.0	41.5	8.4	33.5	55.4	74.0	-18.6	Pass	Noise floor
16814.0	V	-24.4	39.0	41.5	8.4	33.5	31.0	54.0	-23.0	Pass	Noise floor
4804.0	H	0	42.0	33.8	4.3	32.1	48.0	54.0	-6.0	Pass	Noise floor
7206.0	H	0	40.0	35.9	5.3	31.8	49.4	54.0	-4.6	Pass	Noise floor
9608.0	H	0	41.0	37.2	6.2	35.0	49.4	54.0	-4.6	Pass	Noise floor
12010.0	H	0	45.0	40.3	7.3	34.0	58.6	74.0	-15.4	Pass	
12010.0	H	-24.4	45.0	40.3	7.3	34.0	34.2	54.0	-19.8	Pass	
14412.0	H	0	40.0	40.6	7.3	32.3	55.6	74.0	-18.4	Pass	Noise floor
14412.0	H	-24.4	40.0	40.6	7.3	32.3	31.2	54.0	-22.8	Pass	Noise floor
16814.0	H	0	39.0	41.5	8.4	33.5	55.4	74.0	-18.6	Pass	Noise floor
16814.0	H	-24.4	39.0	41.5	8.4	33.5	31.0	54.0	-23.0	Pass	Noise floor

Note: All measurements are peak unless otherwise stated.

Measurements <1000 MHz      RBW=VBW=100 kHz      Peak detector

Measurements >1000 MHz      RBW=VBW=1 MHz      Peak detector

EQUIPMENT: SN2100

**Test Data - Radiated Emissions**

Mid Channel

Meas. Freq. (MHz)	Ant. Pol. (H/V)	Duty Cycle (dB)	Meter Reading (dBUV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBUV/m)	Spec. limit (dBUV/m)	CR/SL Diff. (dB)	Pass Fail Unc.	Comment
											Tx 2441 MHz
4882.0	V	0	44.5	33.8	4.3	32.1	50.5	54.0	-3.5	Pass	
7323.0	V	0	41.5	35.9	5.3	31.8	50.9	54.0	-3.1	Pass	Noise floor
9764.0	V	0	46.7	37.2	6.2	35.0	55.1	74.0	-18.9	Pass	
9764.0	V	-24.4	46.7	37.2	6.2	35.0	30.7	54.0	-23.3	Pass	
12205.0	V	0	46.8	40.3	7.3	34.0	60.4	74.0	-13.6	Pass	
12205.0	V	-24.4	46.8	40.3	7.3	34.0	36.0	54.0	-18.0	Pass	
14646.0	V	0	46.0	40.6	7.3	32.3	61.6	74.0	-12.4	Pass	
14646.0	V	-24.4	46.0	40.6	7.3	32.3	37.2	54.0	-16.8	Pass	
17087.0	V	0	45.0	41.5	8.4	33.5	61.4	74.0	-12.6	Pass	
17087.0	V	-24.4	45.0	41.5	8.4	33.5	37.0	54.0	-17.0	Pass	
2483.5	H	0	58.5	29.0	3.1	33.0	57.6	74.0	-16.4	Pass	
4882.0	H	0	45.0	33.8	4.3	32.1	51.0	54.0	-3.0	Pass	
7323.0	H	0	41.5	35.9	5.3	31.8	50.9	54.0	-3.1	Pass	Noise floor
9764.0	H	0	46.3	37.2	6.2	35.0	54.7	74.0	-19.3	Pass	
9764.0	H	-24.4	46.3	37.2	6.2	35.0	30.3	54.0	-23.7	Pass	
12205.0	H	0	46.0	40.3	7.3	34.0	59.6	74.0	-14.4	Pass	
12205.0	H	-24.4	46.0	40.3	7.3	34.0	35.2	54.0	-18.8	Pass	
14646.0	H	0	43.0	40.6	7.3	32.3	58.6	74.0	-15.4	Pass	
14646.0	H	-24.4	43.0	40.6	7.3	32.3	34.2	54.0	-19.8	Pass	
17087.0	H	0	41	41.5	8.4	33.5	57.4	74.0	-16.6	Pass	Noise floor
17087.0	H	-24.4	41	41.5	8.4	33.5	33.0	54.0	-21.0	Pass	



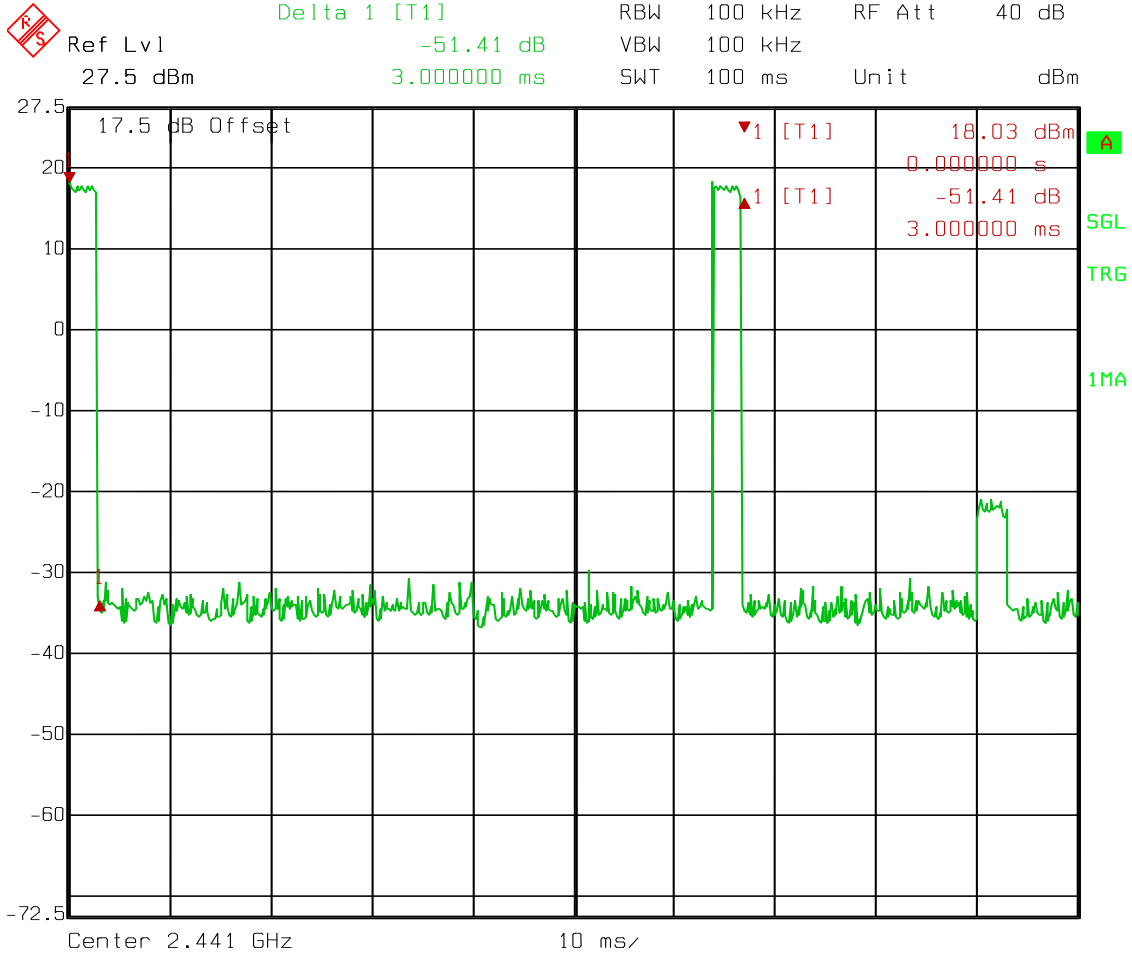
EQUIPMENT: SN2100

**Test Data - Radiated Emissions**

**High Channel**

Meas. Freq. (MHz)	Ant. Pol. (H/V)	Duty Cycle (dB)	Meter Reading (dBuV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. limit (dBuV/m)	CR/SL Diff. (dB)	Pass Fail Unc.	Comment
											Tx 2480 MHz
2483.5	V	0	61.1	29.0	3.1	33.0	60.2	74.0	-13.8	Pass	
2483.5	V	-24.4	61.1	29.0	3.1	33.0	35.8	54.0	-18.2	Pass	
4960.0	V	0	44.0	33.8	4.3	32.1	50.0	54.0	-4.0	Pass	
7440.0	V	0	41.0	35.9	5.3	31.8	50.4	54.0	-3.6	Pass	Noise floor
9920.0	V	0	43.0	37.2	6.2	35.0	51.4	54.0	-2.6	Pass	Noise floor
12400.0	V	0	42.0	40.3	7.3	34.0	55.6	74.0	-18.4	Pass	Noise floor
12400.0	V	-24.4	42.0	40.3	7.3	34.0	31.2	54.0	-22.8	Pass	Noise floor
14880.0	V	0	41.0	40.6	7.3	32.3	56.6	74.0	-17.4	Pass	Noise floor
14880.0	V	-24.4	41.0	40.6	7.3	32.3	32.2	54.0	-21.8	Pass	Noise floor
17360.0	V	0	40.0	41.5	8.4	33.5	56.4	74.0	-17.6	Pass	Noise floor
17360.0	V	-24.4	40.0	41.5	8.4	33.5	32.0	54.0	-22.0	Pass	Noise floor
2483.5	H	0	60.8	29.0	3.1	33.0	59.9	74.0	-14.1	Pass	
2484.5	H	-24.4	60.8	29.0	3.1	33.0	35.5	54.0	-18.5	Pass	
4960.0	H	0	45.0	33.8	4.3	32.1	51.0	54.0	-3.0	Pass	
7440.0	H	0	41.0	35.9	5.3	31.8	50.4	54.0	-3.6	Pass	Noise floor
9920.0	H	0	46.1	37.2	6.2	35.0	54.5	74.0	-19.5	Pass	
9920.0	H	-24.4	46.1	37.2	6.2	35.0	30.1	54.0	-23.9	Pass	
12400.0	H	0	44.5	40.3	7.3	34.0	58.1	74.0	-15.9	Pass	
12400.0	H	-24.4	44.5	40.3	7.3	34.0	33.7	54.0	-20.3	Pass	
14880.0	H	0	42.0	40.6	7.3	32.3	57.6	74.0	-16.4	Pass	Noise floor
14880.0	H	-24.4	42.0	40.6	7.3	32.3	33.2	54.0	-20.8	Pass	Noise floor
17360.0	H	0	41.3	41.5	8.4	33.5	57.7	74.0	-16.3	Pass	
17360.0	H	-24.4	41.3	41.5	8.4	33.5	33.3	54.0	-20.7	Pass	

### Duty Cycle Correction



Date: 20.FEB.2012 08:12:17

$$20 \log (6/100) = -24.4 \text{ dB}$$

**Section 8. Powerline Conducted Emissions**

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: FCC 15.207(a) RSS-Gen 7.2.4
TESTED BY: David Light	DATE: 21 February 2012

**Test Results:** Complies. The worst case emission was 43.6 dB $\mu$ V at 24.06 MHz. This is 6.4 dB below the quasi-peak specification limit of 50.0 dB $\mu$ V.

**Test Data:** Refer to attached plots

**Equipment Used:** 1188-1992-1555-1924-674-1659

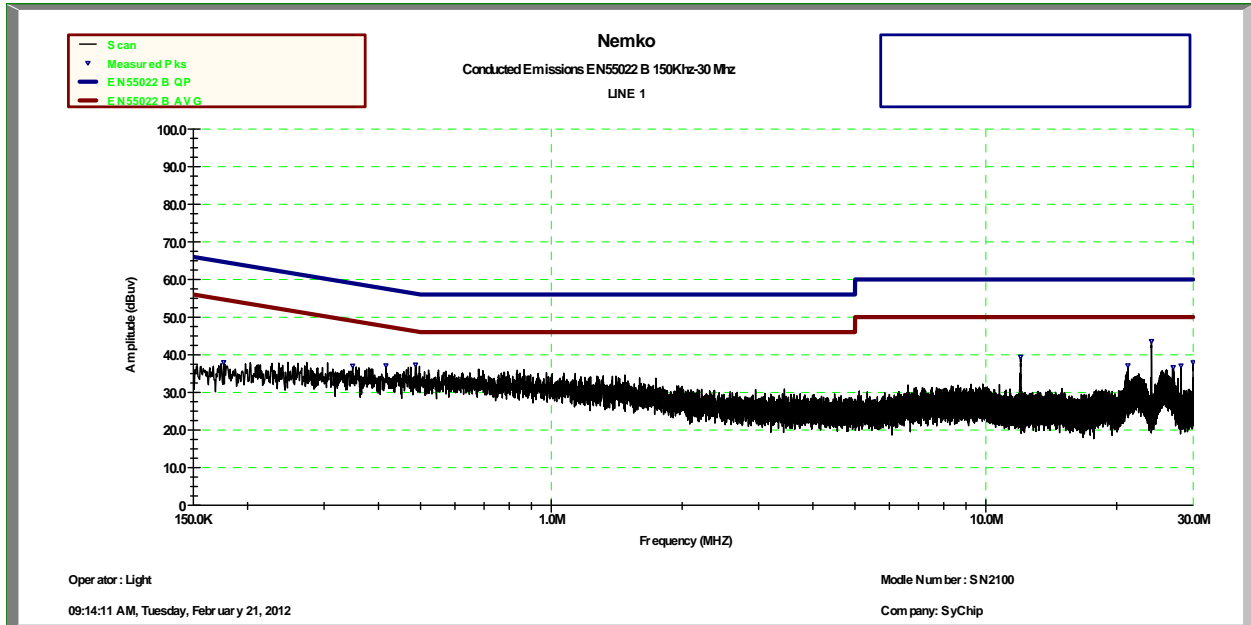
**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 23 °C

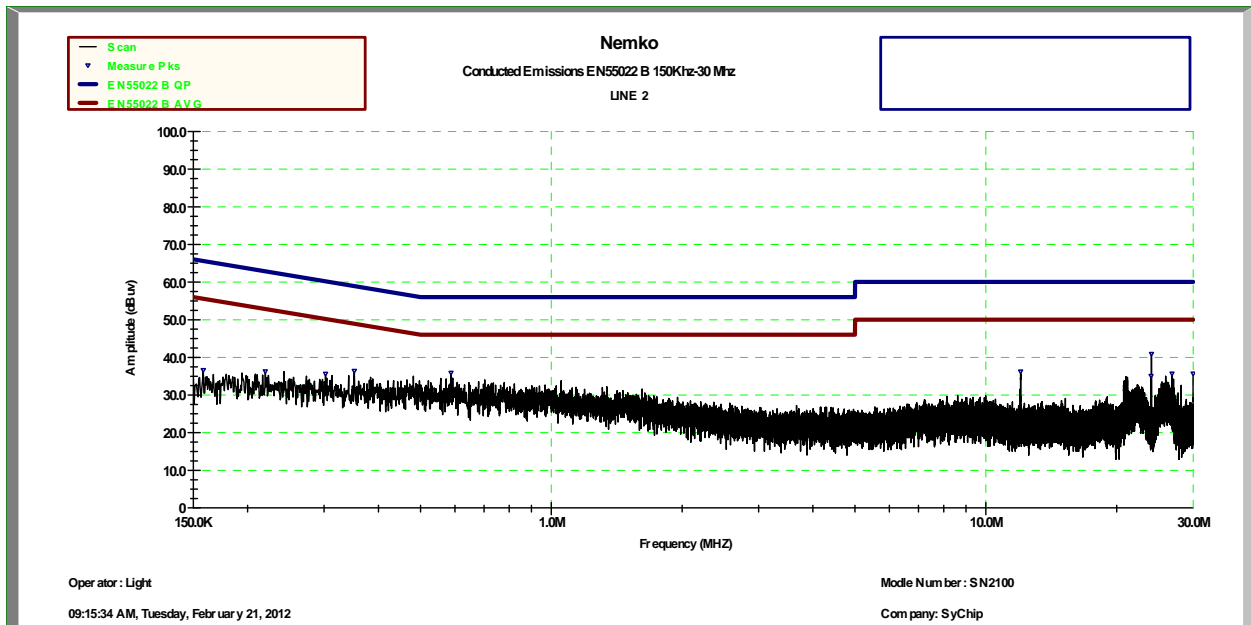
**Relative Humidity:** 49 %

Test Data – Powerline Conducted Emissions

Line 1



Line 2



**Test Data – Powerline Conducted Emissions**

Operator: Light

Model Number:

SN2100

Company: SyChip

Tuesday, February 21, 2012

Line 1

Freq. (MHz)	Peak Rdng (dBuV)	Avg Limit (dBuV)	QP Limit (dBuV)	Avg Margin	QP Margin
0.18	38.0	55.3	65.3	-17.2	-27.2
0.35	37.1	50.3	60.3	-13.2	-23.2
0.42	37.1	48.4	58.4	-11.3	-21.3
0.49	37.4	46.4	56.4	-9.0	-19.0
12.03	39.4	50.0	60.0	-10.6	-20.6
21.23	37.1	50.0	60.0	-12.9	-22.9
24.06	43.6	50.0	60.0	-6.4	-16.4
27.00	36.7	50.0	60.0	-13.3	-23.3
28.12	37.1	50.0	60.0	-12.9	-22.9
30.00	38.0	50.0	60.0	-12.0	-22.0

Line 2

Freq. (MHz)	Peak Rdng (dBuV)	Avg Limit (dBuV)	QP Limit (dBuV)	Avg Margin	QP Margin
0.16	36.6	55.8	65.8	-19.2	-29.2
0.22	36.3	54.0	64.0	-17.7	-27.7
0.30	35.6	51.6	61.6	-16.0	-26.0
0.35	36.4	50.2	60.2	-13.8	-23.8
0.59	35.9	46.0	56.0	-10.1	-20.1
12.03	36.2	50.0	60.0	-13.8	-23.8
24.00	35.0	50.0	60.0	-15.0	-25.0
24.06	40.9	50.0	60.0	-9.1	-19.1
26.83	35.7	50.0	60.0	-14.3	-24.3
30.00	35.7	50.0	60.0	-14.3	-24.3

## Section 9. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
674	Limiter	Hewlett Packard	11947A	3107A02200	01-Nov-2011	01-Nov-2012
993	Antenna, Horn	A.H. Systems	SAS-200/571	162	22-Sep-2011	22-Sep-2013
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	20-Jul-2011	20-Jul-2012
1025	Preamplifier, 25dB	Nemko USA, Inc.	LNA25	399	23-Feb-2011	23-Feb-2012
1036	Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
1082	Cable, 2m	Astrolab	32027-2-29094-72TC		VB4 Use	NR
1188	LISN	EMCO	3825/2	1214	22-Nov-2011	22-Nov-2012
1464	Spectrum Analyzer	Hewlett Packard	8563E	3551A04428	16-May-2011	16-May-2013
1472	Attenuator, 20dB,	Omni Spectra	20600-20db		Verify before use	NR
1555	High Pass Filter	Solar Electronics	7930-5.0	933125	19-May-2011	19-May-2012
1663	Spectrum Analyzer	Rohde & Schwartz	FSP3	100073	02-Sep-2011	02-Sep-2013
1480	Antenna, Bilog	Schaffner	CBL 6111D	2572	07-Feb-2012	07-Feb-2012
1783	Cable Assy,	Nemko	Chamber		26-Sep-2011	26-Sep-2012
1659	Spectrum Analyzer	R&S	FSP3	973353	27-Sept-2010	27-Sept-2012

## **ANNEX A - TEST DETAILS**

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
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**Minimum Standard:** §15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 mH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Conducted Emission (MHz)	Limit (dBmV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 mV within the frequency band 535-1705 kHz, as measured using a 50 mH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as provided in §15.205 and §§15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.



NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
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**Minimum Standard:**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
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**Minimum Standard:**

Frequency Band (MHz)	20 dB Bandwidth	No. of Hopping Channels	Average Time of Occupancy
902 - 928	<250 kHz	50	=<0.4 sec. in 20 sec.
902 - 928	=>250 kHz	25	=<0.4 sec. in 10 sec.
2400 - 2483.5	-----	75	=<0.4 sec. in 0.4 seconds multiplied by the number of hopping channels employed.
5725 - 5850	-----	75	=<0.4 sec. in 30 sec.

**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: 1 MHz

VBW: = RBW

Span: 0 Hz

LOG dB/div.: 10 dB

Sweep: Sufficient to see one hop time sequence.

Trigger: Video

The occupancy time of one hop is measured as above. The average time of occupancy is calculated over the appropriate period of time from above table

Avg. time of occupancy = (period from table/duration of one hop)/no. of channels multiplied by the duration of one hop.

For instance:

If a 2.4 GHz system has a measured hop duration time of 1 msec. and uses 75 channels, then the average time of occupancy would be:

(30 sec./0.001 sec.)/75 chan. = 400 x 1 msec. = 400 msec. or 0.4 sec. in 30 sec.

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)
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**Minimum Standard:**

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	Not defined
5725 – 5850	1 MHz

**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: At least 1% of span/div.

VBW: >RBW

Span: Sufficient to display 20 dB bandwidth

LOG dB/div.: 10 dB

Sweep: Auto

**Number of channels tested:**

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Peak Power Output

PARA. NO.: 15.247(b)

**Minimum Standard:**

Frequency Band (MHz)	No. of Hopping Channels	Maximum Peak Power Output at Antenna Port
902 - 928	at least 50	1 watt
902 – 928	25 - 49	0.25 watts
2400 – 2483.5	75	1 watt
5725 – 5850	75	1 watt

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

**Direct Measurement Method For Detachable Antennas:**

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

**Calculation Of EIRP For Integral Antenna:**

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation  $GP/4\pi R^2 = E^2/120\pi$  and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 20 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

**NAME OF TEST:** Spurious Emissions at Antenna Terminals      **PARA. NO.:** 15.247(d)

**Minimum Standard:**      In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

**THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC**

**Method Of Measurement:**

30 MHz - 10th harmonic plot

RBW: 100 kHz

VBW: 300 kHz

Sweep: Auto

Display line: -20 dBc

Lower Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz

Marker: Peak of fundamental emission

Marker Δ: Peak of highest spurious level below center frequency.

Upper Band Edge

RBW: At least 1% of span/div.

VBW: >RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz

Marker: Peak of fundamental emission

Marker Δ: Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions	PARA. NO.: 15.247(d)
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**Minimum Standard:** In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

**Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:**

Frequency (MHz)	Field Strength (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

**THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC**

**15.205 Restricted Bands**

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
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
6.125-6.218	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	2655-2900	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	Above 38.6
13.36-13.41	1718		

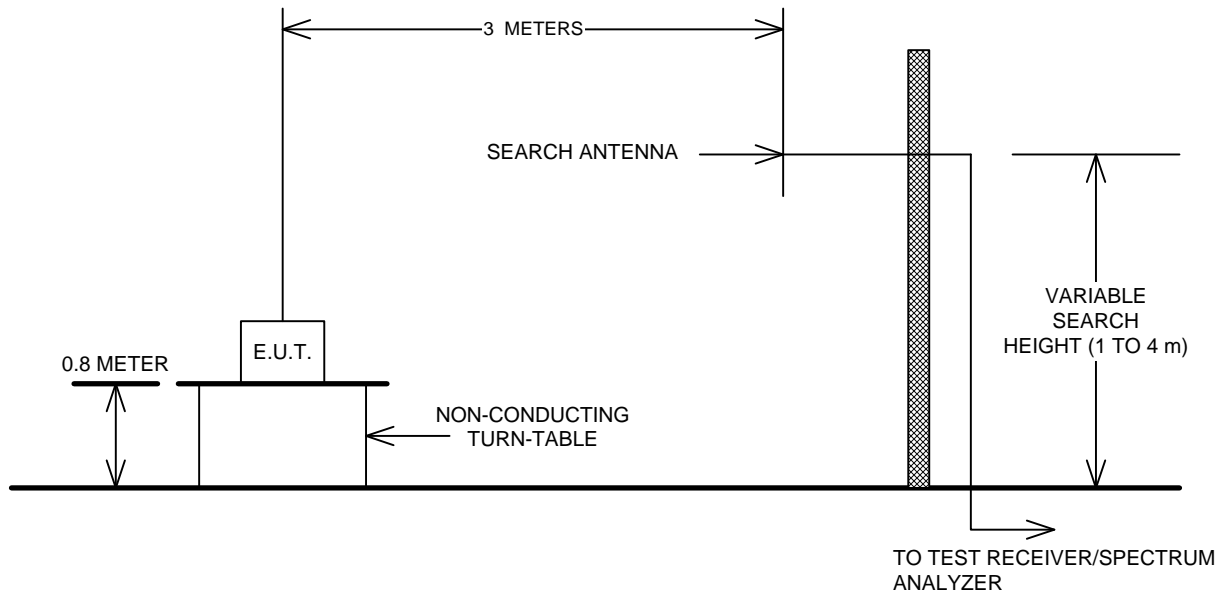
Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

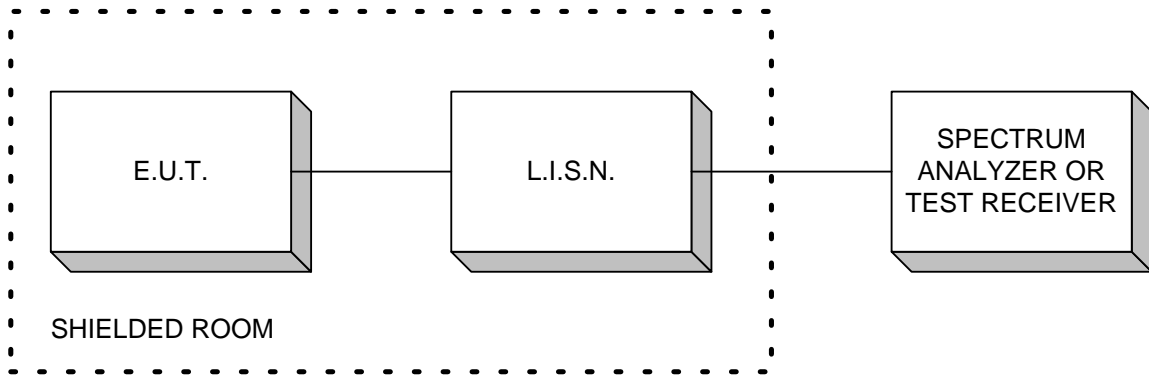
**ANNEX B - TEST DIAGRAMS**



**Test Site For Radiated Emissions**



**Conducted Emissions**



**Peak Power at Antenna Terminals**

