EMC Test Report

Project Number: 3543741EMC01

Report Number: 3543741EMC01 **Revision Level:** 0

Client: Radio Systems

Equipment Under Test: Sport DogTek 2.0 Handheld Unit

Applicable Standards: ANSI C63.10: 2009
FCC Part 15 Subpart C, § 15.247
RSS-210, Issue 8, December 2010

Report issued on: 28AUG2014

Test Result: Compliant

Tested by: Brian Forster, EMC Engineer

Reviewed by: David Schramm, EMC Manager

Table of Contents

1 Summary of Test Results

Test Description	Test Specification		Test Result
Occupied Bandwidth	15.247(a)(1)	RSS-210 A8.1(a)	Compliant
Peak Power Output	15.247(a)(1)	RSS-210 A8.4(4)	Compliant
Conducted Spurious Emissions	15.247(d)	RSS-210 A8.5	Compliant
Band Edge	15.247(d)	RSS-210 A8.5	Compliant
Radiated Spurious Emissions	15.247(d), 15.35(b),15.209	RSS-210 A8.5	Compliant
Pseudo-Random Hop Sequence	15.247(a) (1)	RSS-210 A8.1(a)	Compliant
Channel Separation	15.247(a) (1)	RSS-210 A8.1(b)	Compliant
Number of Hopping Channels	15.247(a) (1)(i)	RSS-210 A8.1(d)	Compliant
Dwell Time	15.247(a) (1)(i)	RSS-210 A8.1(d)	Compliant
Number of hopping frequencies	15.247(a) (1)(i)	RSS-210 A8.1(d)	Compliant
Field strength of receiver spurious radiation	NA	RSS-210 2.3	Compliant

1.1 *Modifications Required for Compliance*

None

2 General Information

2.1 *Client Information*

Name:	Radio Systems
Address:	10427 Petsafe Way
City, State, Zip, Country:	Knoxville TN 37932

2.2 *Test Laboratory*

Name:	SGS North America, Inc.
Address:	620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country:	Suwanee, GA 30024, USA

2.3 *General Information of EUT*

Marketing Name:	Sport DogTek 2.0 Handheld Unit
Model:	
Serial Number:	
Frequency Range:	
Number of channels:	50
Modulation type:	GFSK
Antenna:	Detachable customer supplied
Rated Voltage:	3.7 VDC Internal Battery
Sample Received Date:	30 July 2014
Dates of testing:	25 – 27 August 2014

2.4 *Operating Modes and Conditions*

The EUT was configured in software to allow the EUT to run continuously exercising all modes of operation.

During testing, the hopping sequence was stopped in accordance with Section 5.1 of ANSI C63.10-2009 so that the low, mid and high channels could be tested independently.

As specified in Section 5.10.5 of ANSI C63.10:2009:

- Software was designed to allow the EUT to operate
  - at normal operating duty cycle
- Since this is a frequency hopping system, the software allowed the hopping sequence to be turned off

3 Occupied Bandwidth

3.1 *Test Result*

Test Description	Basic Standards	Test Result
Occupied Bandwidth	15.247(a)(1) RSS-210 A8.1(a)	Pass

3.2 *Test Method*

Measurements were taken using the 99% OBW function of the measurement receiver.

3.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.4 °C
Relative Humidity: 47.8 %

3.4 *Test Equipment*

Test Date: 27-Aug-2014 Tester: JOP

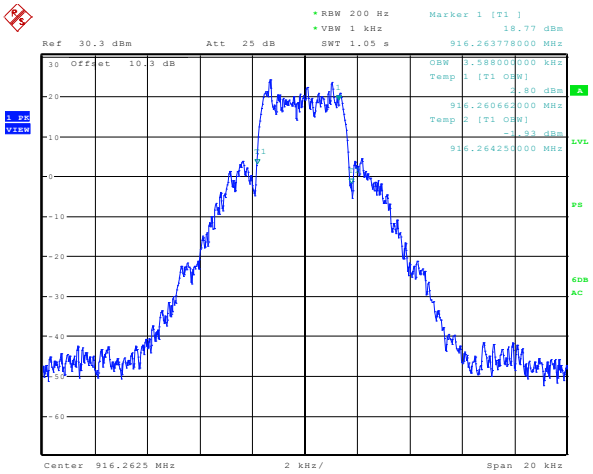
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
COAXIAL CABLE	1134	GORE	B094785	5-Aug-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095593	7-Aug-2015

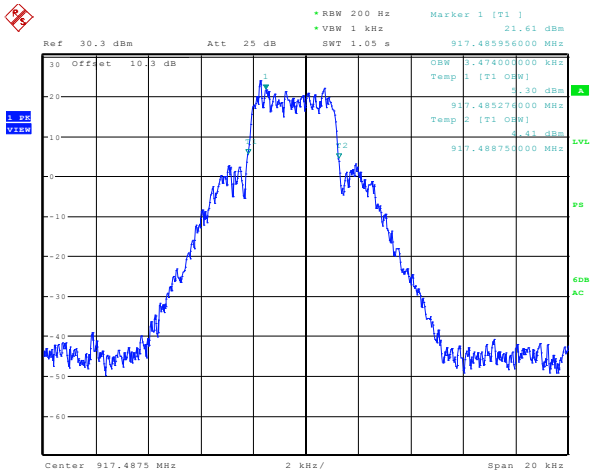
Note: The calibration period equipment is 1 year.

3.5 *Test Data*

Unit	Frequency	Channel No	99% bandwidth kHz
HNAR*50002	916.2625 MHz	50	3.588
HNAR*50002	917.4875	99	3.474

20 dB Bandwidth Plot
Handheld





4 Peak Output Power

4.1 *Test Result*

Test Description	Test Specification	Test Result
Peak Output Power	RSS-210 A.8.4(1)	Compliant

4.2 *Test Method*

The measurement procedure used is defined in KDB 558074 D01 DTS Meas Guidance v03r02, Section 9.1.1. The output of the EUT was directly connected to a spectrum analyzer with the following settings:

a) Set the RBW ≥ *DTS bandwidth*. (1MHz used)
b) Set VBW ≥ 3 × RBW. (3MHz used)
c) Set span ≥ 3 x RBW (3MHz used)
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

Limit

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.

4.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.4 °C
Relative Humidity: 47.8 %

4.4 *Test Equipment*

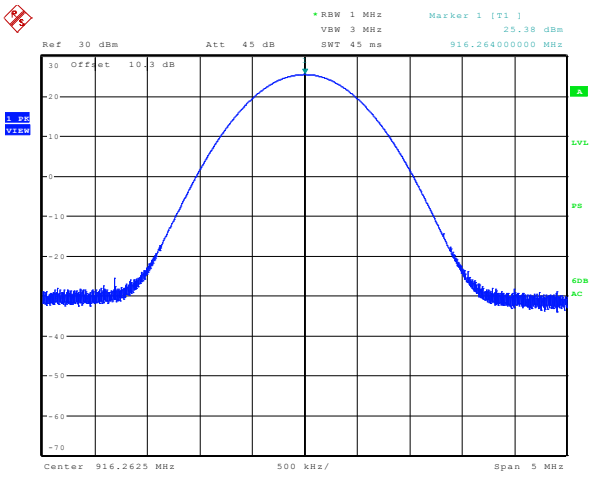
Test Date: 26-Aug-2014 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
COAXIAL CABLE	1134	GORE	B094785	5-Aug-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095593	7-Aug-2015

Note: The calibration period equipment is 1 year. The attenuator was verified before use using the ZVL Network Analyzer.

4.5 *Test Data*

Unit	Channel No	Peak Power dBm	Limit	Margin
HNAR*50002	50	25.38	30	-4.62
HNAR*50002	99	24.50	30	-5.50



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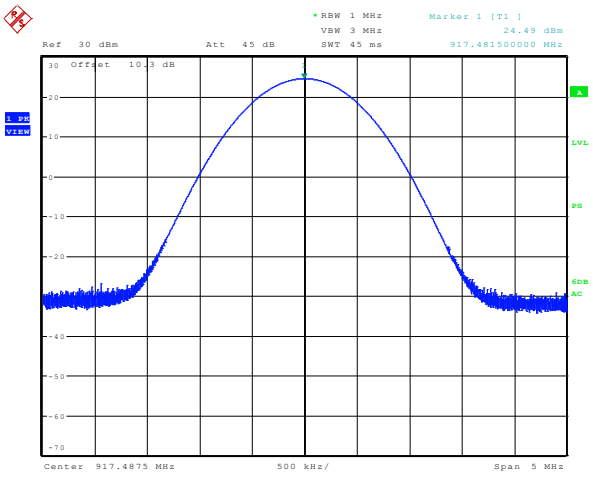


Date: 26.AUG.2014 15:42:56

5 Conducted Spurious Emissions

5.1 *Test Result*

Test Description	Test Specification	Test Result
Conducted Spurious Emissions	15.247(d)	Compliant

5.2 *Test Method*

The test data was measured using a spectrum analyzer with

- Peak detector, max hold
- Resolution bandwidth of at least 100 kHz
- Video bandwidth at least 3x RBW
- Frequency range: 30 MHz to 25 GHz

The limit is 20 dB below the measured peak power.

5.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.4 °C
Relative Humidity: 57.0 %

5.4 *Test Equipment*

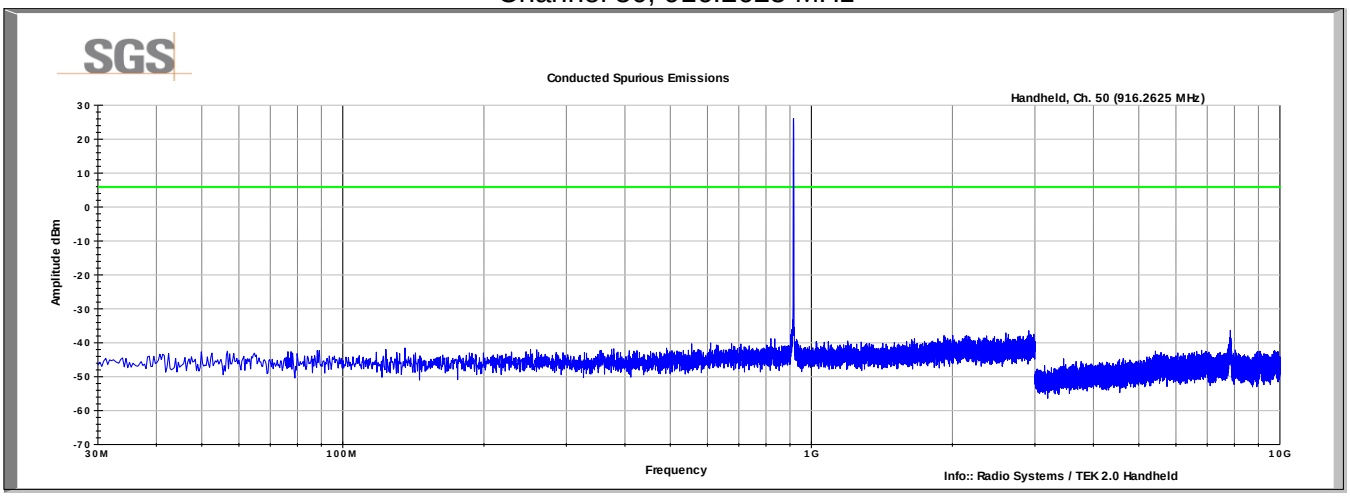
Test Date: 26-Aug-2014 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	28-Aug-2015
COAXIAL CABLE	1134	GORE	B094785	5-Aug-2015
10DB ATTENUATOR	10DB	UNKNOWN	B095593	7-Aug-2015

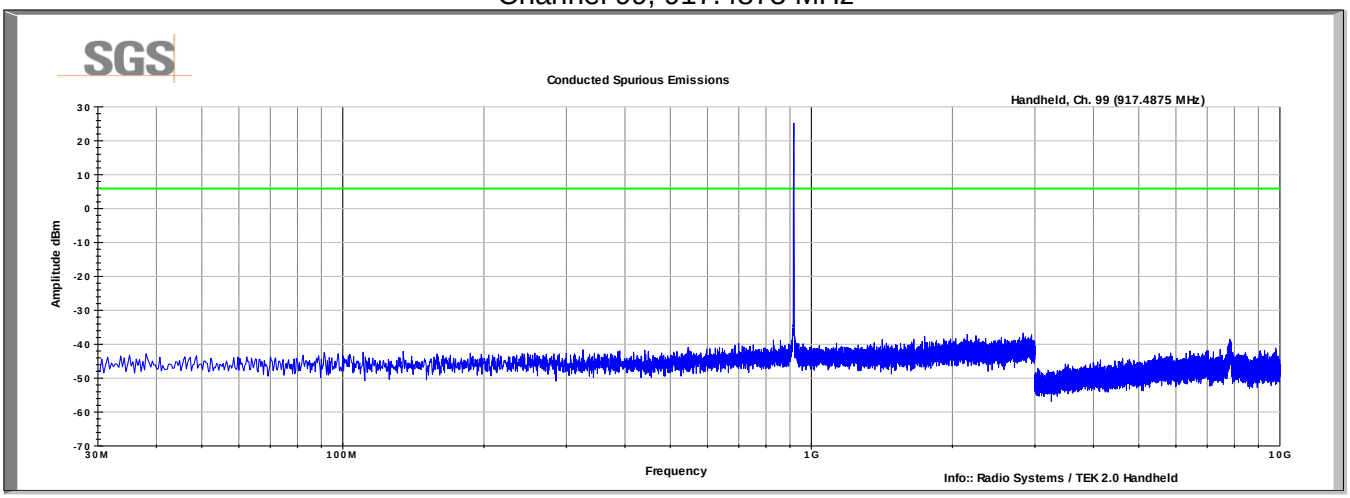
Note: The calibration period equipment is 1 year.

5.5 *Test Data*

Channel 50, 916.2625 MHz

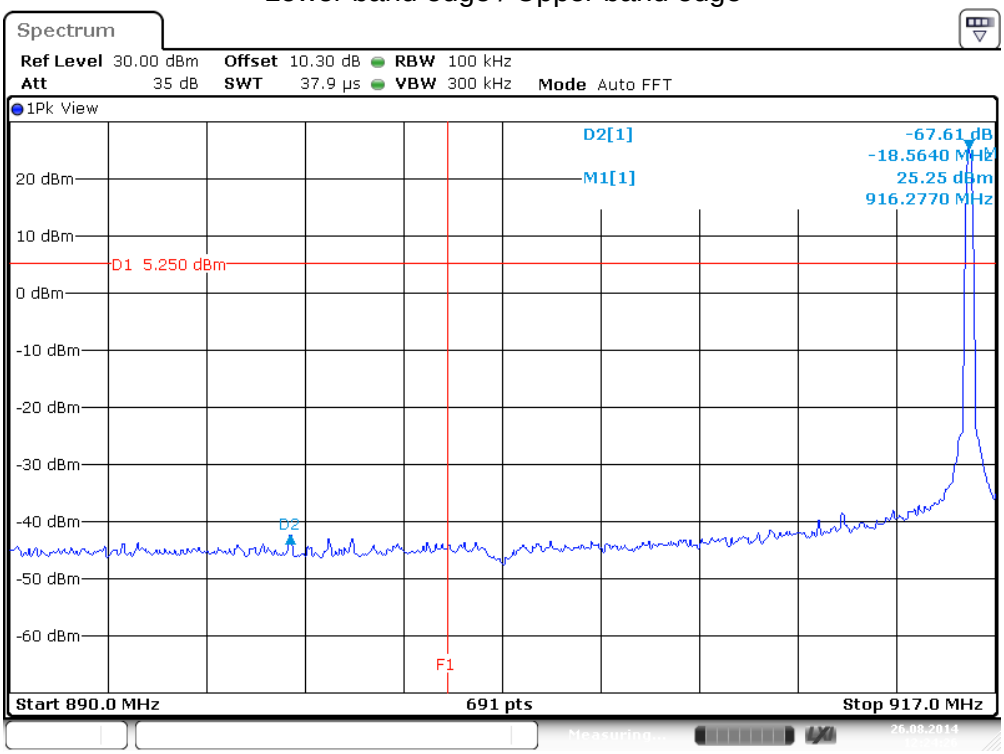


Channel 99, 917.4875 MHz



No spurious emissions detected within 20dB of the limit.

Lower band edge / Upper band edge



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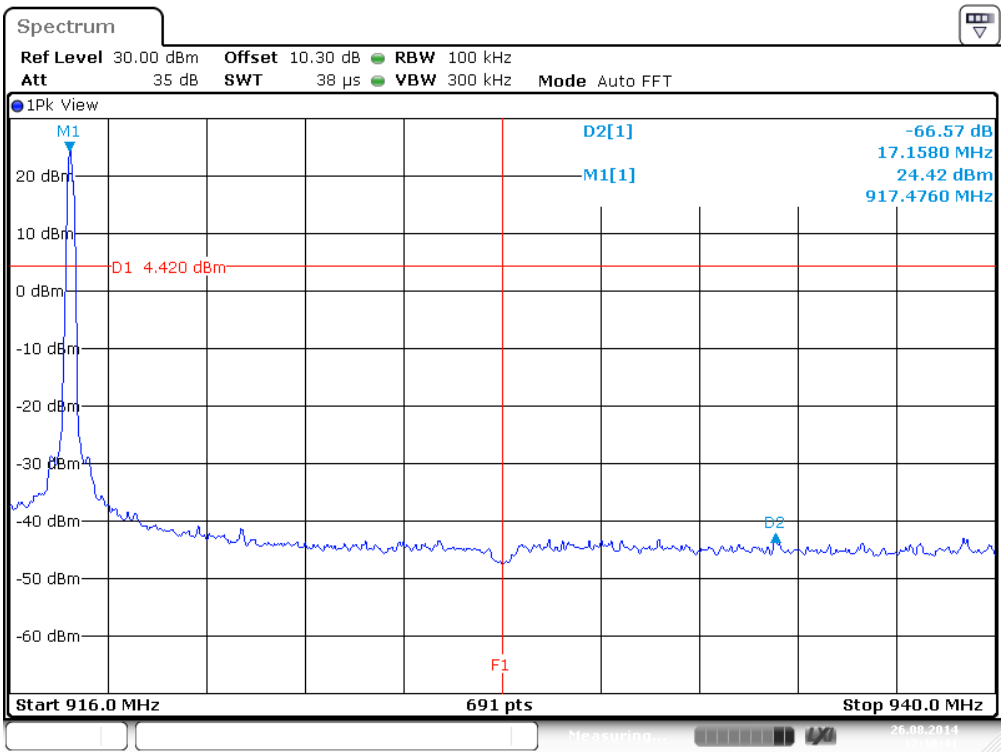


Date: 26.AUG.2014 12:18:41

6 Field Strength of Spurious Radiation

6.1 *Test Result*

Test Description	Test Specification	Test Result
Field strength of spurious radiation	RSS 210 2.6, A2.9 (1)(2)	Compliant

6.2 *Test Method*

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. For harmonics of the fundamental, Average measurements were made by correcting the peak value with the duty cycle correction factor. For emissions other than harmonics of the fundamental, the Average measurements were made using the Average detector. The receivers resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHZ and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Test distance:

30 MHz to 1 GHz - The EUT to measurement antenna distance is 3 meters
1 to 18 GHz - The EUT to measurement antenna distance is 3 meters
18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

Frequency	Limits(1)		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 (2)	--
88 - 216 MHz	150	43.5 (2)	--
216 - 960 MHz	200	46 (2)	--
960 - 1000 MHz	500	54 (2)	--
1 - 40 GHz	500	54 (3)	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.
(2) Quasi-peak limit
(3) Average limit

6.3 *Test Site*

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions
Temperature: 24.4 °C
Relative Humidity: 43.5 %

6.4 *Test Equipment*

Test Date: 26-Aug-2014 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
BILOG ANTENNA	CBL 6143A	TESEQ	B085931	29-Oct-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	24-Jun-2015
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	4-Aug-2015
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	4-Aug-2015
HIGH PASS FILTER	HPM50108	MICRO-TRONICS	B079802	16-Oct-2014

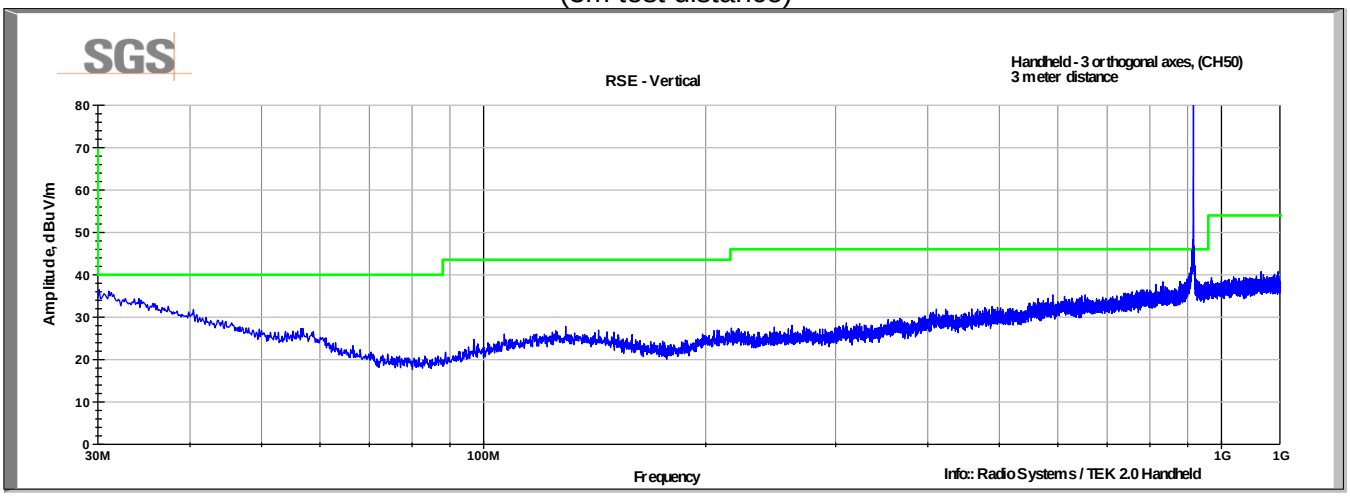
Note: The calibration period equipment is 1 year.

6.5 *Test Setup Photographs*

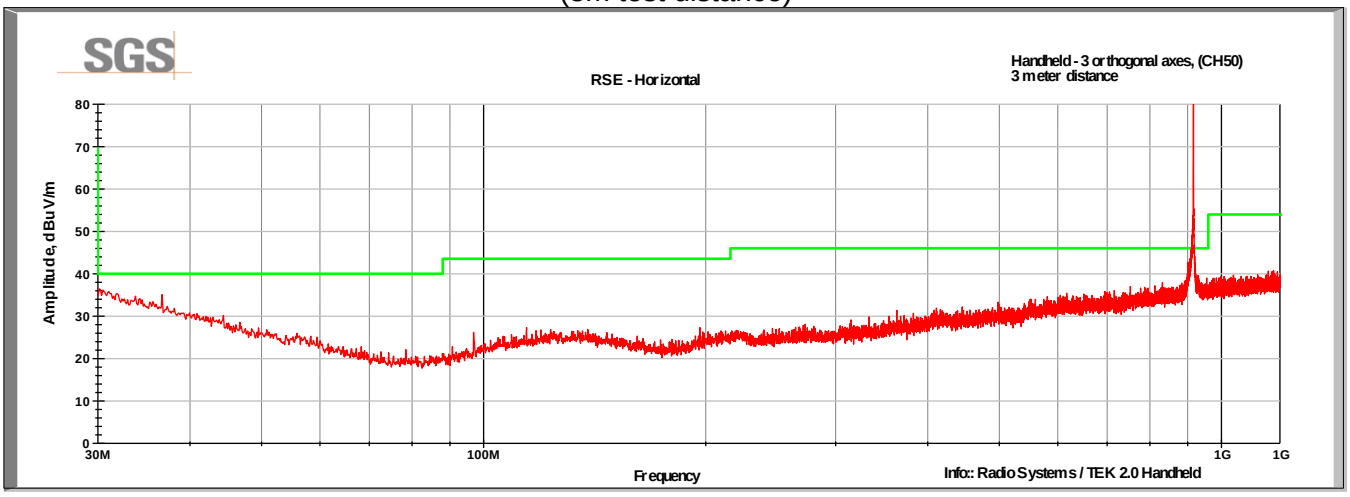
Test setup photographs are located in a separate exhibit.

6.6 *Test Data*

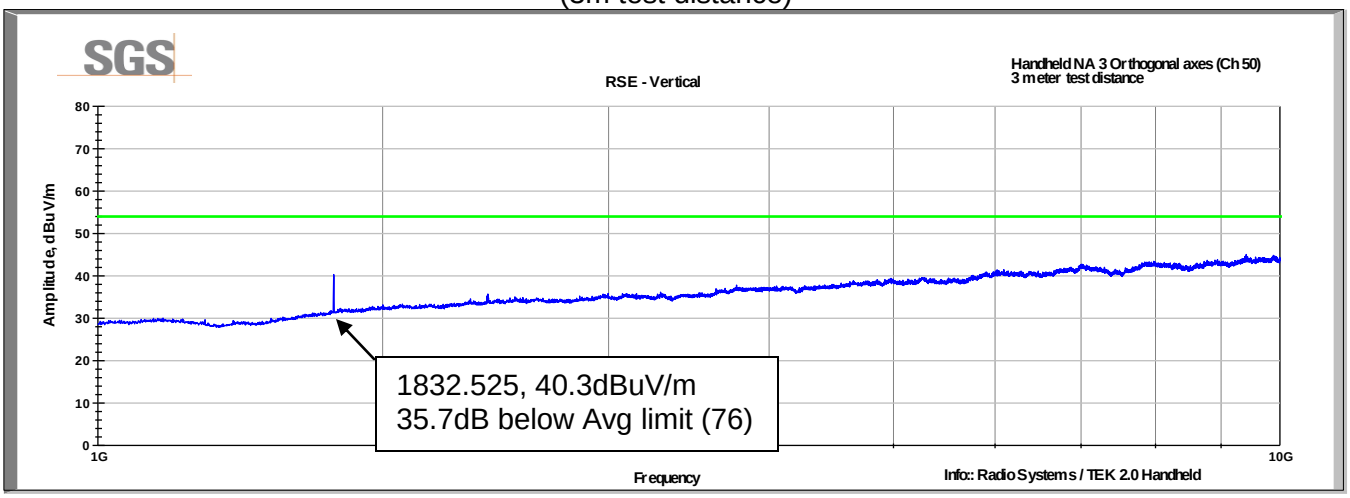
Channel 50
30-1000MHz
Vertical
(3m test distance)



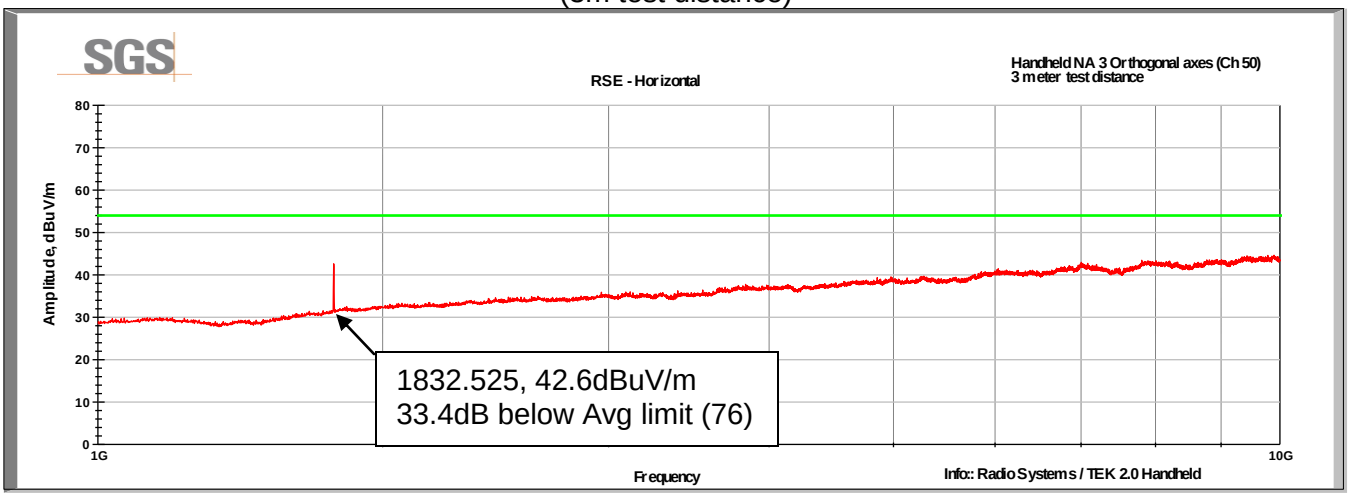
Channel 50
30-1000MHz
Horizontal
(3m test distance)



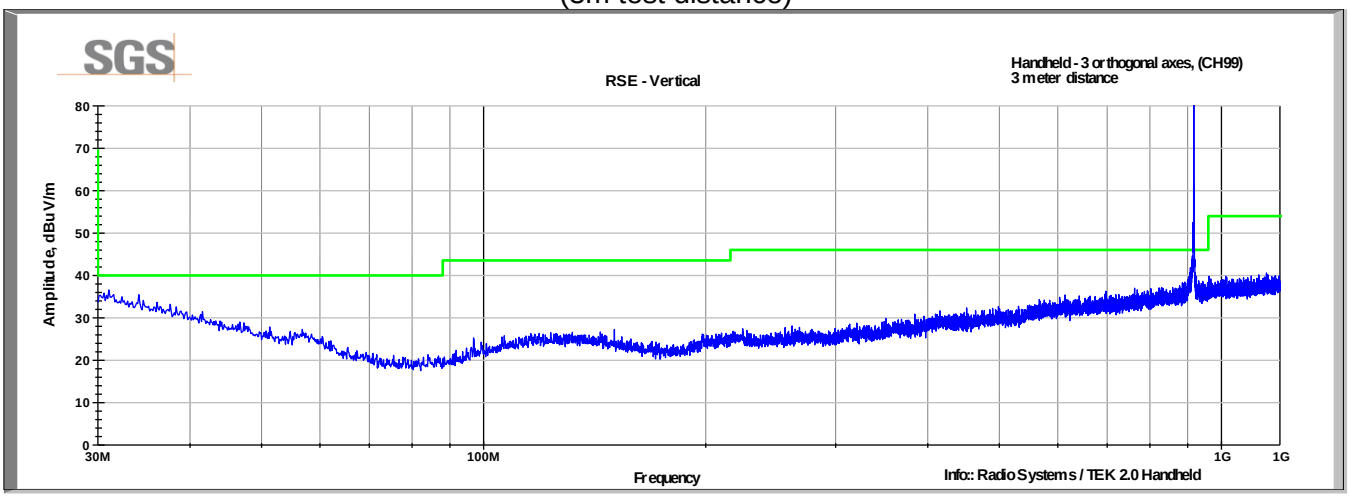
Channel 50
1-10GHz
Vertical
(3m test distance)



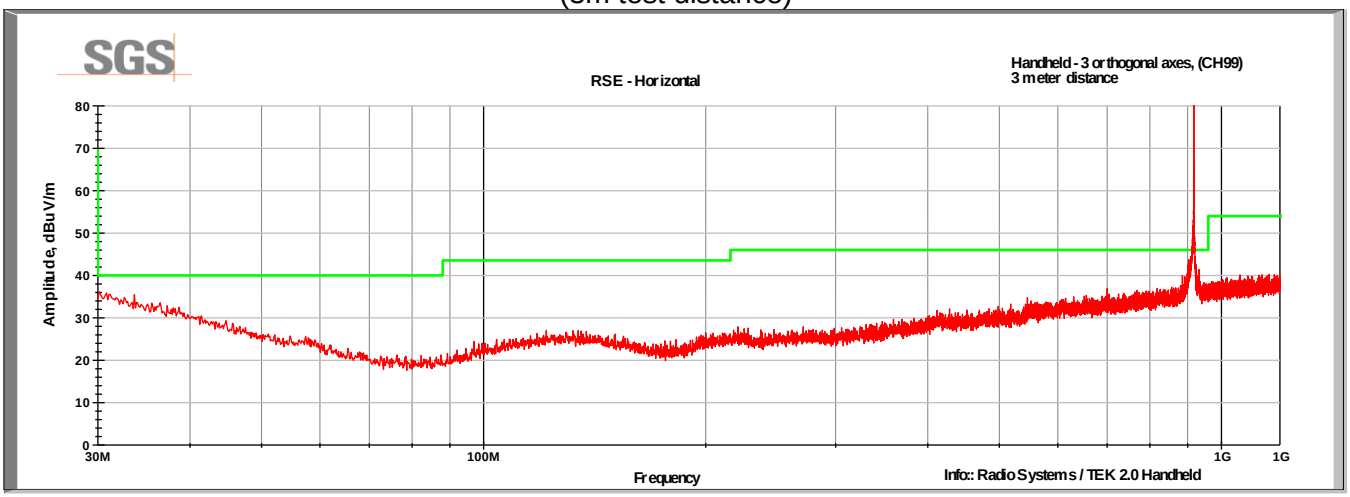
Channel 50
1-10GHz
Horizontal
(3m test distance)



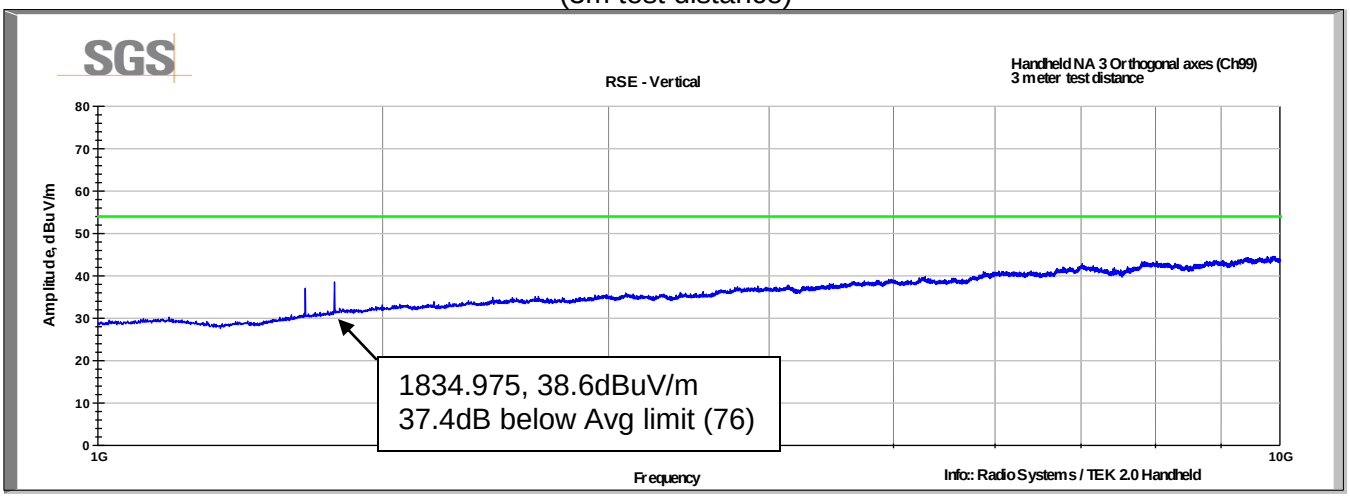
Channel 99
30-1000MHz
Vertical
(3m test distance)



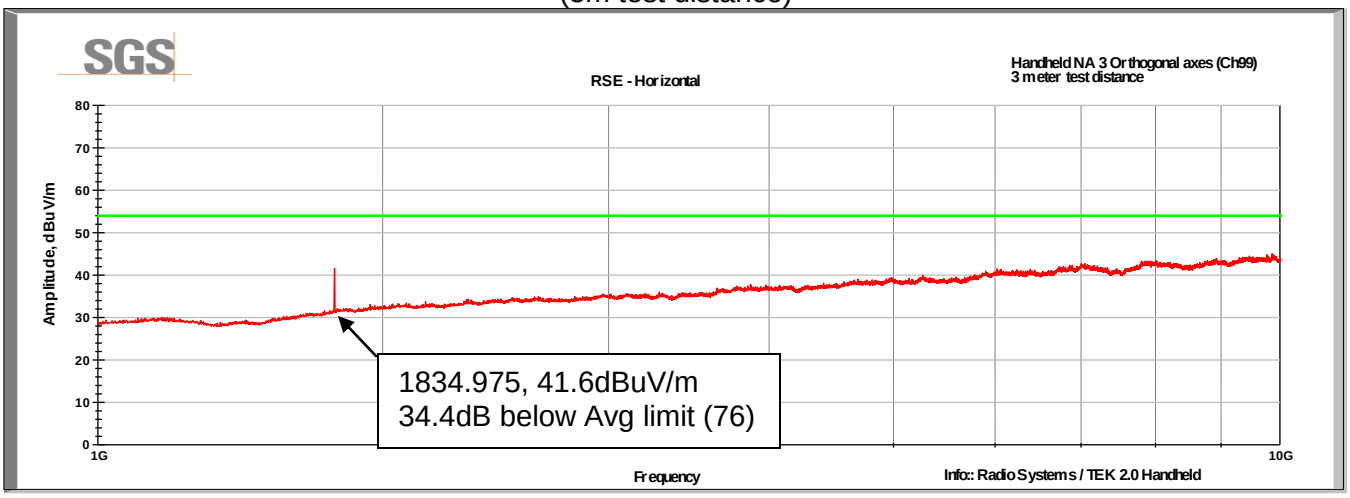
Channel 99
30-1000MHz
Horizontal
(3m test distance)



Channel 99
1-10GHz
Vertical
(3m test distance)



Channel 99
1-10GHz
Horizontal
(3m test distance)



7 Pseudo-Random Hop Sequence

7.1 *Test Result*

Test Description	Test Specification	Test Result
Pseudo-Random Hop Sequence	FCC Part 15.247(a)(1) RSS-210 A8.1(a)	Compliant(1)

Note (1): The theory of operation states that the device and operates using a pseudo-random hopping technique.

7.2 *Test Method*

Compliance is demonstrated by Manufacturer's declaration or is stated in the Theory of Operation.

Requirement

The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.

8 Channel Separation

8.1 *Test Result*

Test Description	Test Specification	Test Result
Number of Hopping Channels	FCC Part 15.247(a)(1) RSS-210 A8.1(b)	Compliant

8.2 *Test Method*

The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 100 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement

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 band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

8.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

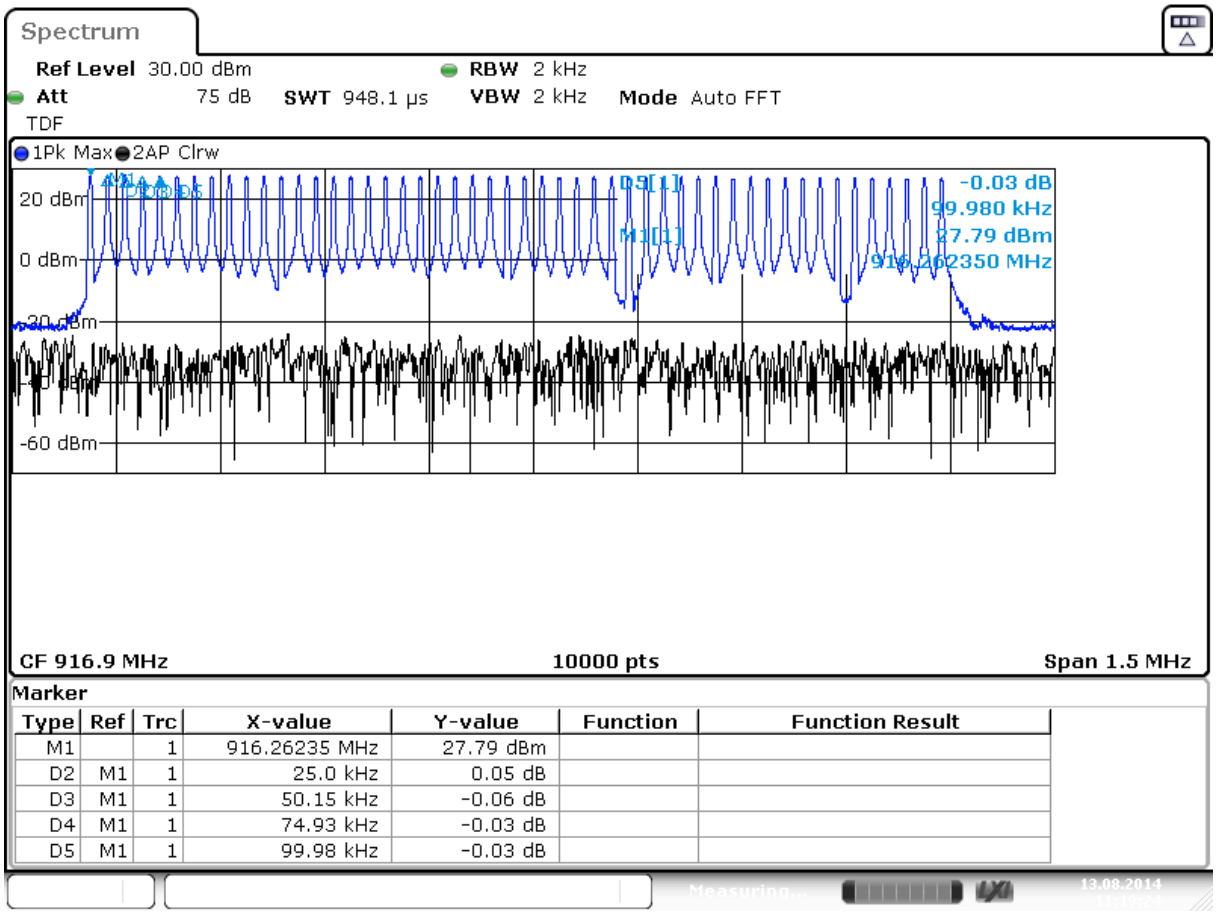
Temperature: 22.7 °C
Relative Humidity: 37.8 %

8.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Spectrum Analyzer	FSV 30	R&S	101595	28 Aug 2014
Bluetooth Tester	CBT	R&S	100011	CNR

Note: The calibration period equipment is 1 year.

8.5 *Test Data*



Date: 13.AUG.2014 11:19:25

9 Number of Hopping Channels

9.1 *Test Result*

Test Description	Test Specification	Test Result
Number of Hopping Channels	FCC Part 15.247(a)(1)iii RSS-210 A8.1(d)	Compliant

9.2 *Test Method*

The test data was measured using a spectrum analyzer with Peak detector (max hold) and a resolution bandwidth of 30 kHz. The trace was allowed to stabilize until all channels were displayed.

Requirement
Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

9.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions
Temperature: 22.7 °C
Relative Humidity: 37.8 %

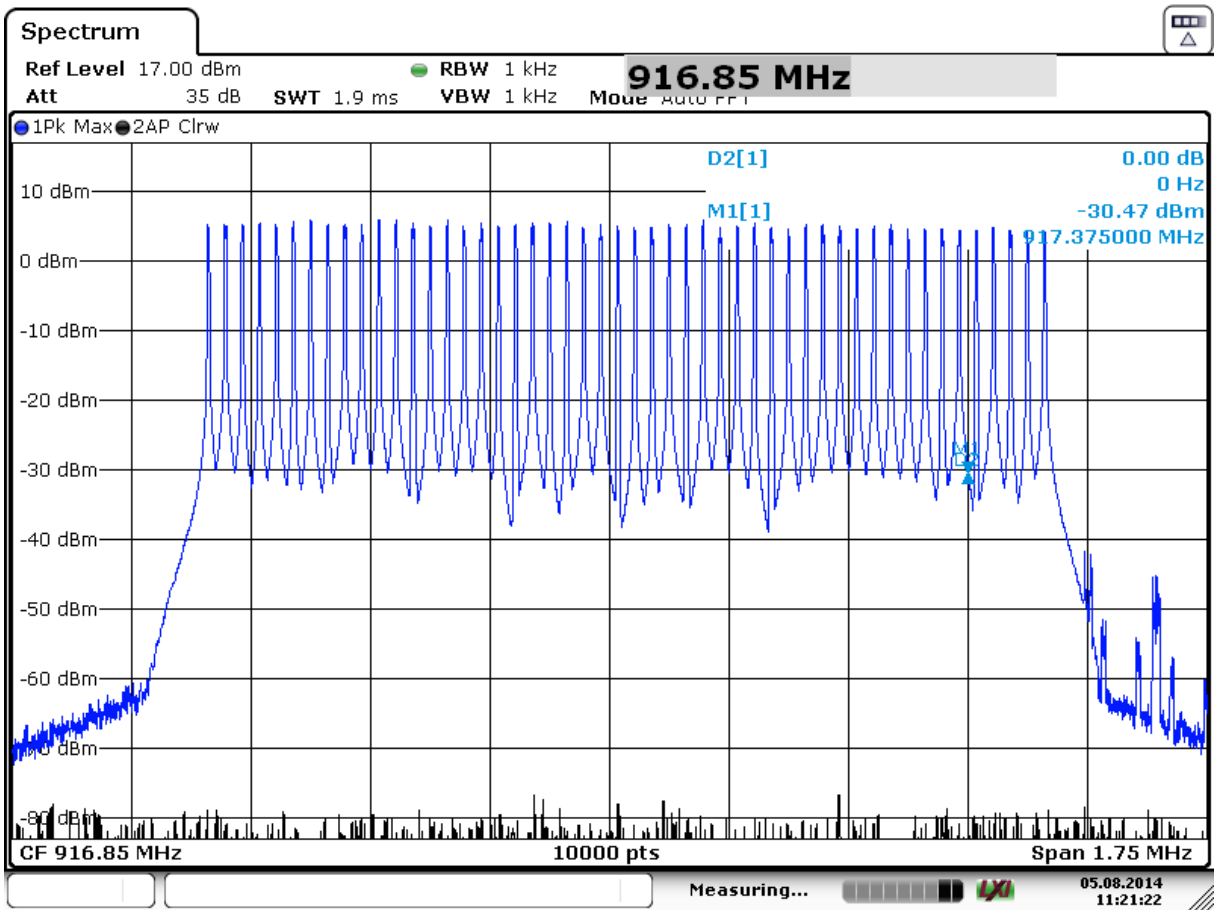
9.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Spectrum Analyzer	FSV 30	R&S	101595	28 Aug 2014
Bluetooth Tester	CBT	R&S	100011	CNR

Note: The calibration period equipment is 1 year.

9.5 *Test Data*

There are 50 Channels.



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10 Dwell Time

10.1 *Test Result*

Test Description	Test Specification	Test Result
Dwell Time	FCC Part 15.247(a)(1)iii RSS-210 A8.1(d)	Compliant

10.2 *Test Method*

The EUT was operated in normal transmission command mode and the pulse width of the packet was measured and the number of pulses were counted over the total observation period.

Requirement

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

10.3 *Test Site*

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C
Relative Humidity: 46.9 %

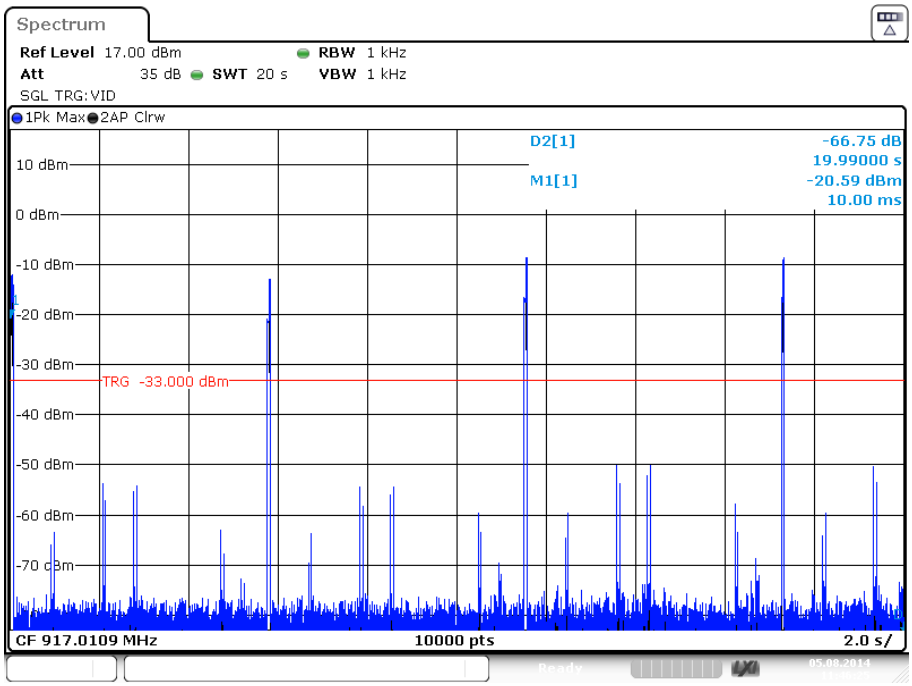
10.4 *Test Equipment*

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
Spectrum Analyzer	FSV 30	R&S	101595	28 Aug 2014
TEK 2.0 GPS Unit	G Collar	RS	GNAR50105	CNR

Note: The calibration period equipment is 1 year.

10.5 *Test Data*

Measured total dwell time over 20 seconds was measured to be 278 ms.



Date: 5.AUG.2014 11:46:25

11 Receiver Spurious Emissions

11.1 *Test Result*

Test Description	Test Specification	Test Result
Field strength of spurious radiation	RSS-210 2.3	Compliant

11.2 *Test Method*

The initial preliminary exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak detector above 1GHz. The receivers resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHZ and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Test distance:

30 MHz to 1 GHz - The EUT to measurement antenna distance is 3 meters
1 to 18 GHz - The EUT to measurement antenna distance is 3 meters
18 to 40 GHz - The EUT to measurement antenna distance is 1 meter

Frequency	Limits(1)		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 (2)	--
88 - 216 MHz	150	43.5 (2)	--
216 - 960 MHz	200	46 (2)	--
960 - 1000 MHz	500	54 (2)	--
1 - 40 GHz	500	54 (3)	74

(4) These limits are applicable to emissions outside of the intentional transmit frequency band.
(5) Quasi-peak limit
(6) Average limit

11.3 *Test Site*

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 24.4 °C
Relative Humidity: 43.5 %

11.4 *Test Equipment*

Test Date: 26-Aug-2014 Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	28-Jul-2015
BILOG ANTENNA	CBL 6143A	TESEQ	B085931	29-Oct-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	24-Jun-2015
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
RF CABLE - 12000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079714	4-Aug-2015
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	4-Aug-2015
HIGH PASS FILTER	HPM50108	MICRO-TRONICS	B079802	16-Oct-2014

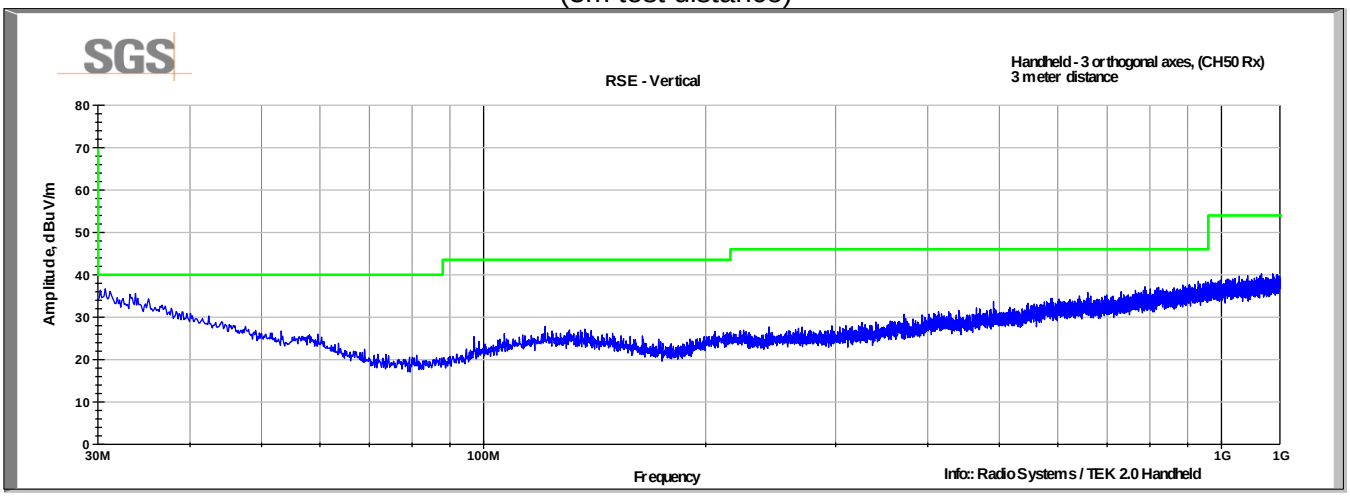
Note: The calibration period equipment is 1 year.

11.5 *Test Setup Photographs*

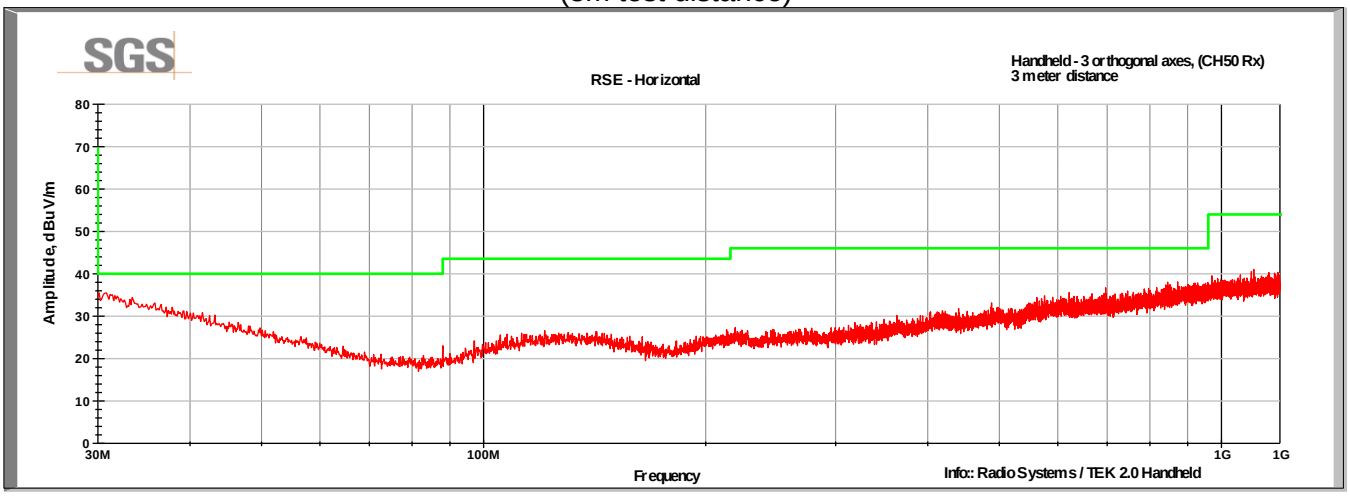
Test setup photographs are located in a separate exhibit.

11.6 *Test Data*

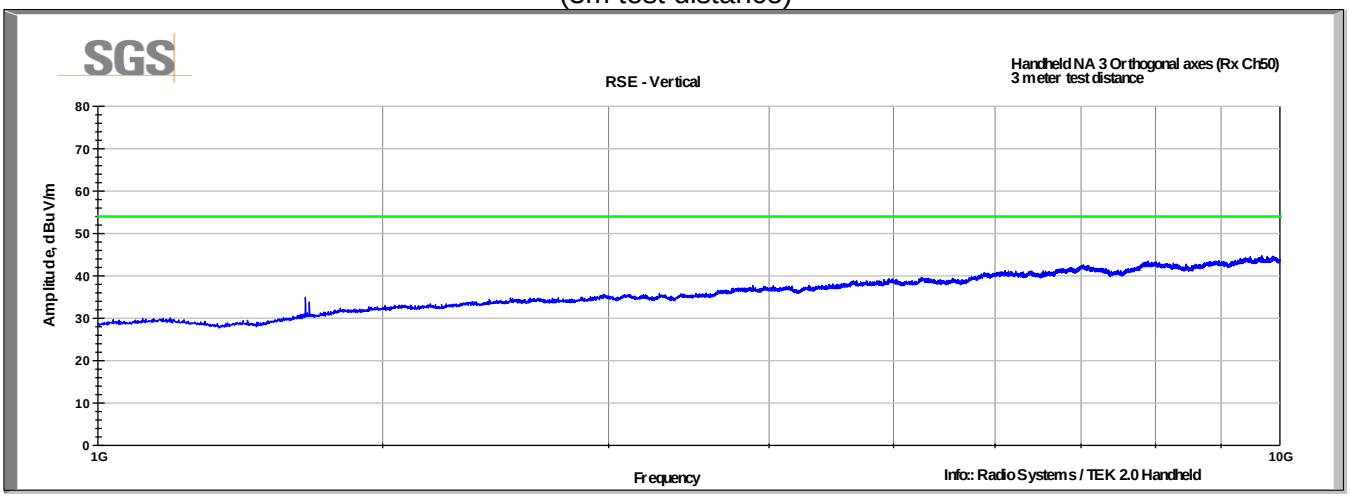
Channel 50 (Rx Mode)
30-1000MHz
Vertical
(3m test distance)



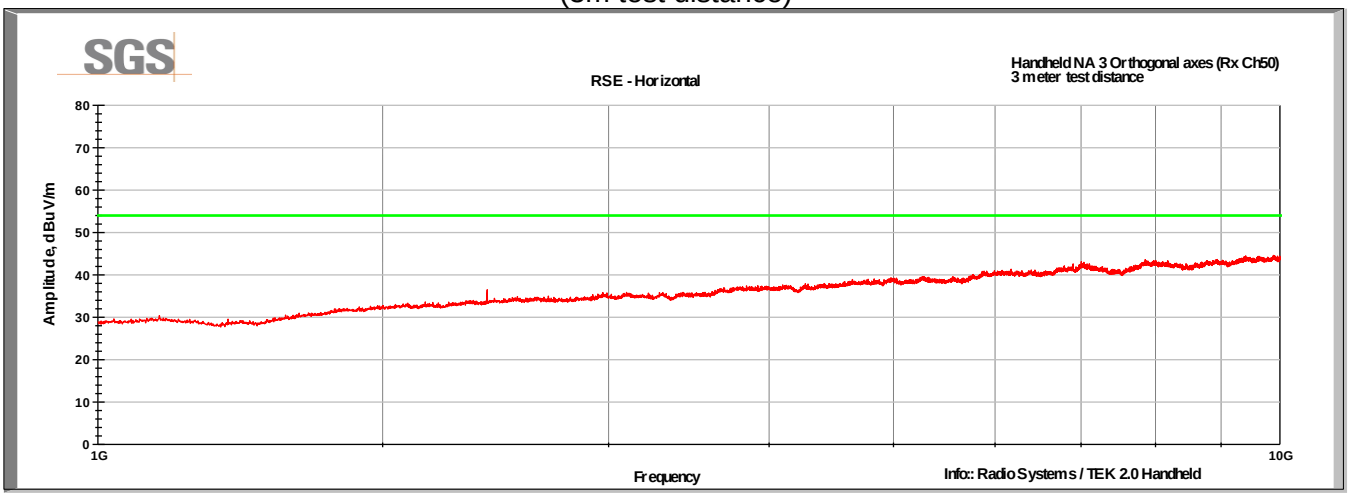
Channel 50 (Rx Mode)
30-1000MHz
Horizontal
(3m test distance)



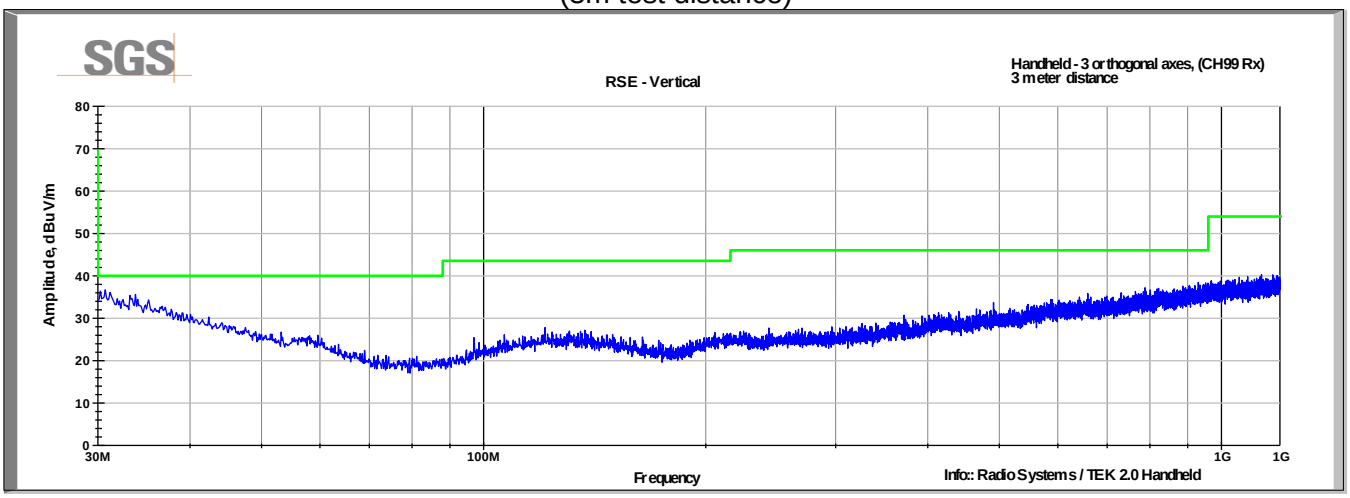
Channel 50 (Rx Mode)
1-10GHz
Vertical
(3m test distance)



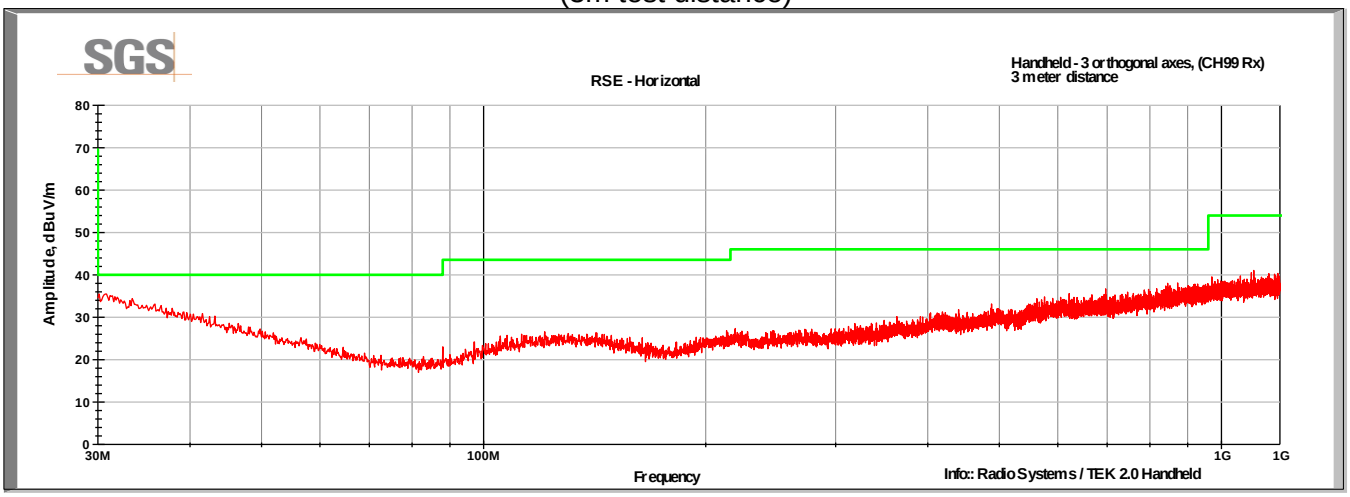
Channel 50 (Rx Mode)
1-10GHz
Horizontal
(3m test distance)



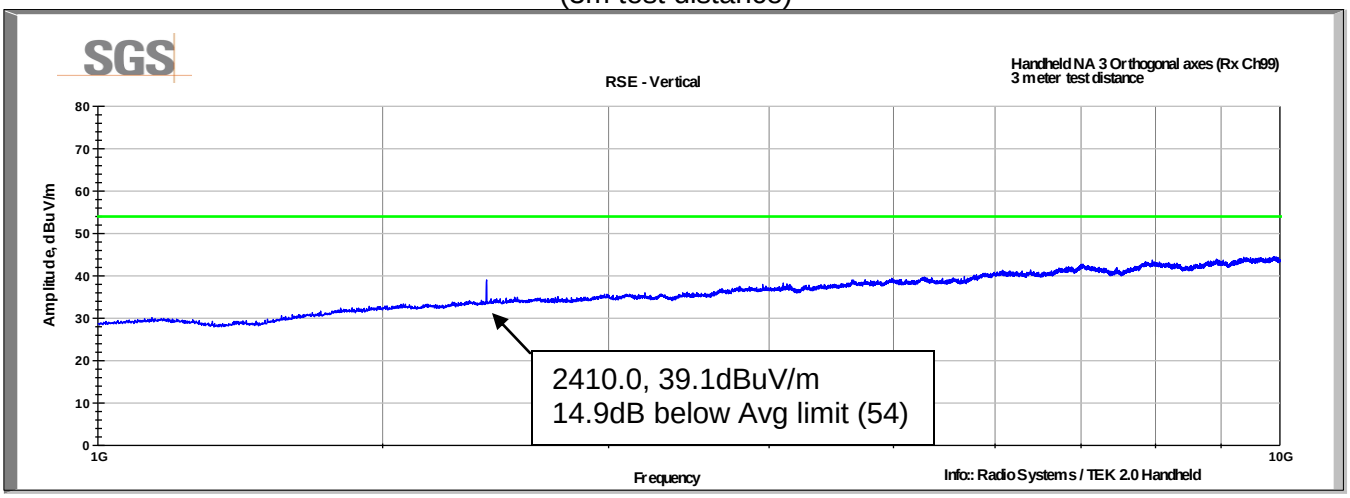
Channel 99 (Rx Mode)
30-1000MHz
Vertical
(3m test distance)



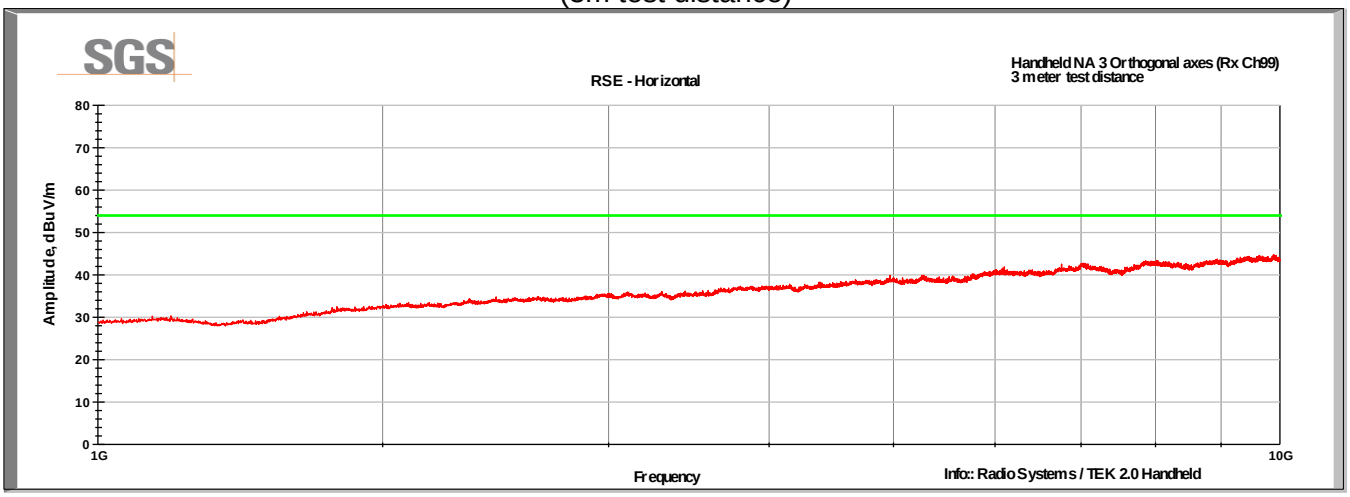
Channel 99 (Rx Mode)
30-1000MHz
Horizontal
(3m test distance)



Channel 99 (Rx Mode)
1-10GHz
Vertical
(3m test distance)



Channel 99 (Rx Mode)
1-10GHz
Horizontal
(3m test distance)



12 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	28AUG2014