

EMC Test Report

Project Number: 3543693

Report Number: 3543693EMC01

Revision Level: 0

Client: Digital Dream Labs, LLC, Inc.

Equipment Under Test: Ludos Gameboard

Model: cloudBoard

Applicable Standards: FCC Part 15 Subpart C, § 15.247


RSS-210, Issue 8, December 2010

ANSI C63.10: 2009

Report issued on: 22 August 2014

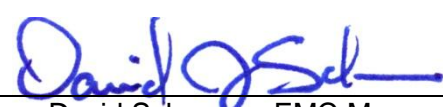
Test Result: Compliant

Tested by:



Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:



David Schramm, EMC Manager

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
Occupied Bandwidth	15.247(a) (1)	RSS-GEN 4.6.1	Compliant
Spectral Density	15.247(e)	RSS-210 A8.2(b)	Compliant
Peak Power Output	15.247(b) (3)	RSS-210 A8.4(4)	Compliant
100kHz BW 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
6dB Bandwidth	15.247(a) (2)	RSS-210 A8.2(a)	Compliant
AC Powerline Conducted Emission	15.107, 15.207	RSS-GEN 7.2.4	NA(1)

(1) The device does not connect to the AC mains

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Digital Dream Labs, LLC, Inc.

Address: 6024 Broad Street, Suite 2R

City, State, Zip, Country: Pittsburgh, PA 15206

2.1 Test Laboratory

Name: SGS North America, Inc.

Address: 620 Old Peachtree Road NW, Suite 100

City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA

Type of lab: Testing Laboratory

Certificate Number: 3212.01

2.2 General Information of EUT

Type of Product: Ludos Gameboard

Model: cloudBoard

Serial Number: 25140021, 25140002

Frequency Range: 2402 to 2480 MHz

Data Modes: Bluetooth LE

Antenna: Integral / PCB

Rated Voltage: 3.7 VDC Internal Li-Ion Battery

Sample Received Date: 21 July 2014

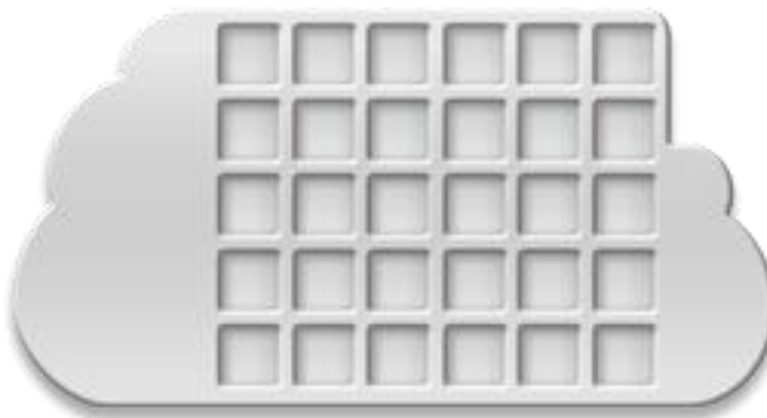
Dates of testing: 21 July – 22 August 2014

Operating Modes and Conditions

The only mode of operation was Bluetooth LE. The software provided allowed control of the channel and packet type. The device always transmitted at max power and PRBS9 packet type was used for all measurements. The duty cycle was >98%.

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

- The software allowed configuration and operation on all available unlicensed wireless device channels.
- The software allowed configuration and operation using all available modulations and data rates
- The software allowed configuration and operation on all available power out levels

2.3 EUT Connection Block Diagram

2.4 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Digital Dream Labs, LLC	Ludos Gameboard	cloudBoard	25140021, 25140002

3 Occupied Bandwidth

3.1 Test Result

Test Description	Basic Standards	Test Result
6 dB bandwidth	15.247(a) (2)	Compliant
99% Bandwidth	RSS-GEN 4.6.1	Reported

3.2 Test Method

The procedures from ANSI C63.10 (2009) clause 6.9 were used to determine the 6 dB bandwidth.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.4 °C

Relative Humidity: 32.8 %

3.4 Test Equipment

Test Date: 23-Jul-2014

Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015

Note: The calibration period equipment is 1 year.

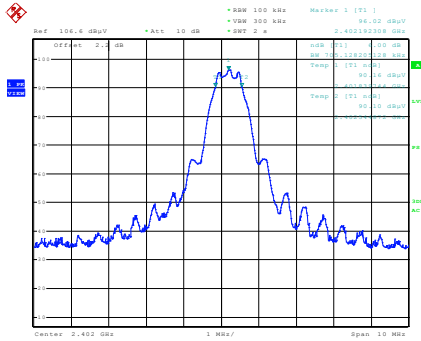
3.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

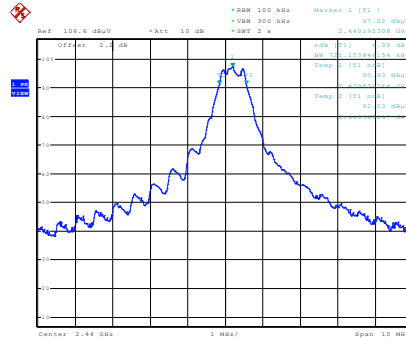
3.6 Test Data

Protocol	Channel	6dB Bandwidth (MHz)	Occupied Bandwidth (99%) (MHz)
BT LE	0	0.705	1.058
BT LE	19	0.721	1.154
BT LE	39	0.833	2.756

Channel 0

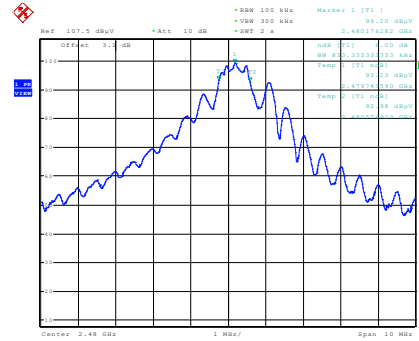


Date: 23.JUL.2014 08:41:29

6 dB Bandwidth Plots
Channel 19


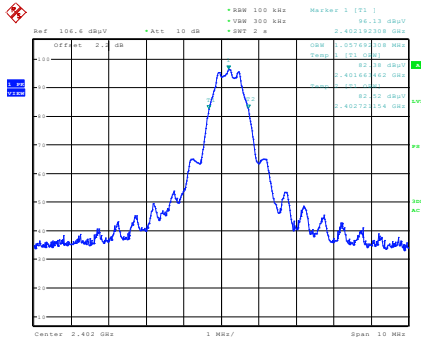
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Channel 39

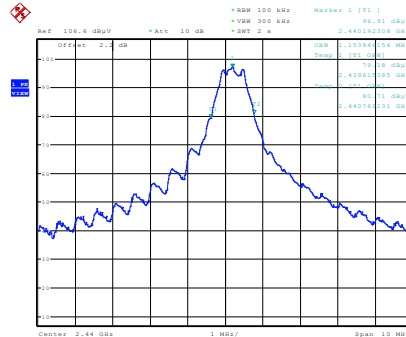


Date: 22.JUL.2014 17:11:26

Channel 0

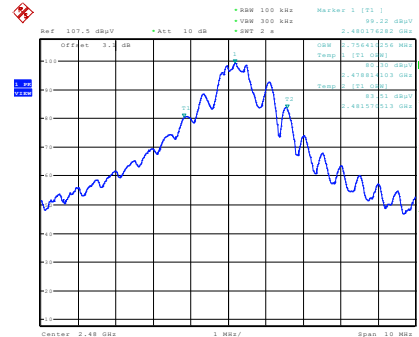


Date: 23.JUL.2014 08:40:41

99% Bandwidth Plots
Channel 19


Date: 23.JUL.2014 08:37:25

Channel 39



Date: 22.JUL.2014 17:10:05

4 Peak Output Power

4.1 Test Result

Test Description	Test Specification	Test Result
Peak Output Power	15.247(a) (1)	Compliant

4.2 Test Method

Because the device had no means for direct connection to the antenna port, power measurements were performed using radiated measurements. The measurement procedure used is defined in KDB 558074 D01 DTS Meas Guidance v03r02, Section 9.1.1. Field strength data was converted to a power measurement using a 95.2dB correction.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.4 °C
Relative Humidity: 32.8 %

4.4 Test Equipment

Test Date: 23-Jul-2014

Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015

Note: The calibration period equipment is 1 year.

4.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

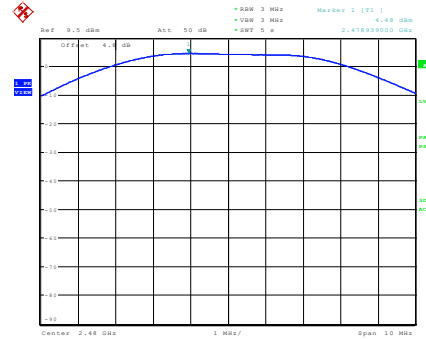
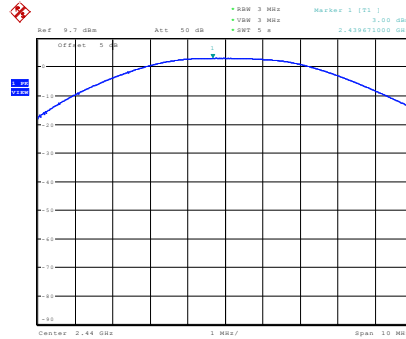
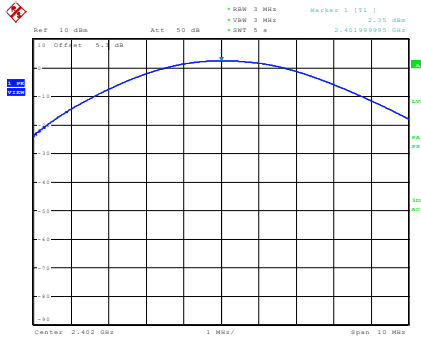
4.6 Test Data

Protocol	Channel	Output Power (dBm)
BT LE	0	2.4
BT LE	19	3.0
BT LE	39	4.5

Power Plots Channel 19

Channel 0

Channel 39



Date: 22.AUG.2014 09:37:16

Date: 22.AUG.2014 09:44:22

Date: 22.AUG.2014 09:57:25

5 100kHz RBW 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. Lowest, middle, and highest data rates were investigated. Only the worst-case (lowest data rate) for each modulation was reported.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.4 °C

Relative Humidity: 32.8 %

5.4 Test Equipment

Test Date: 23-Jul-2014

Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015

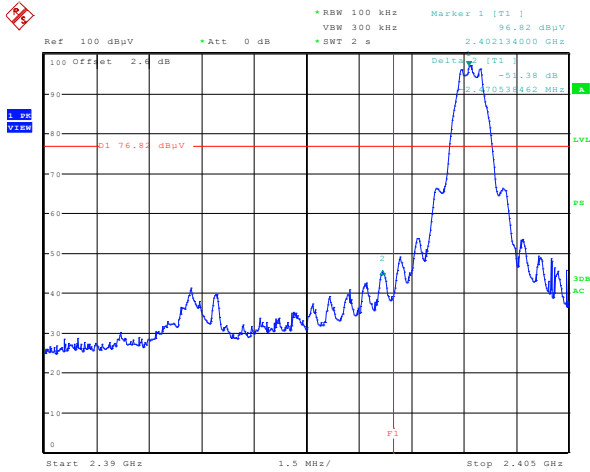
Note: The calibration period equipment is 1 year.

5.5 Test Setup Photographs

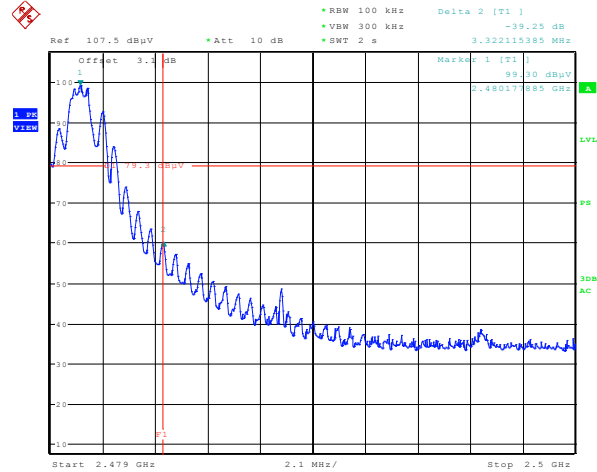
Test setup photographs are located in a separate exhibit.

5.6 Test Data

Band Edges



Date: 30.JUL.2014 16:33:53



Date: 22.JUL.2014 16:57:46

Outside of the band edge measurements above, radiated spurious emissions measured with a 1MHz RBW were more than 20dB below the fundamental measured with a 100kHz RBW. Refer to Section 7 for results. Worst case peak spurious emission was 52dBuV/m at 7440MHz (3rd harmonic of channel 13).

6 Power Spectral Density

6.1 Test Result

Test Description	Test Specification	Test Result
Power Spectral Density	15.247(e)	Compliant

6.2 Test Method

Because the measured peak power was below the 8 dBm PSD limit, no measurement was required..

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.1 °C

Relative Humidity: 47.4 %

6.4 Test Equipment

Test Date: 23-Jul-2014

Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015

Note: The calibration period equipment is 1 year.

6.5 Test Data

The maximum RF power was measured to be 4.5dBm. By default, the device complies with the 8dBm power spectral density requirement.

7 Field Strength of Spurious Radiation

7.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247 (d) and 15.209	Compliant

7.2 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.

There is a limit on spurious emissions produced by an intentional radiator in any 100 kHz Bandwidth outside the intentional emission band of -20dBc provided the radiator complies with the limits specified in 15.205© and 15.209(a).

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

7.3 Test Site

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

Environmental Conditions

Temperature: 23.8 °C

Relative Humidity: 46.6 %

7.4 Test Equipment

Test Start Date: 23-Jul-2014

Test End Date: 25-Jul-2014

Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	S/N: 100207	28-Aug-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	24-Jun-2015
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	16-Sep-2014
DRG HORN (SMALL)	3116B	ETS-LINDGREN	B079695	13-Mar-2015
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	31-Oct-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	29-Oct-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079823	29-Oct-2014

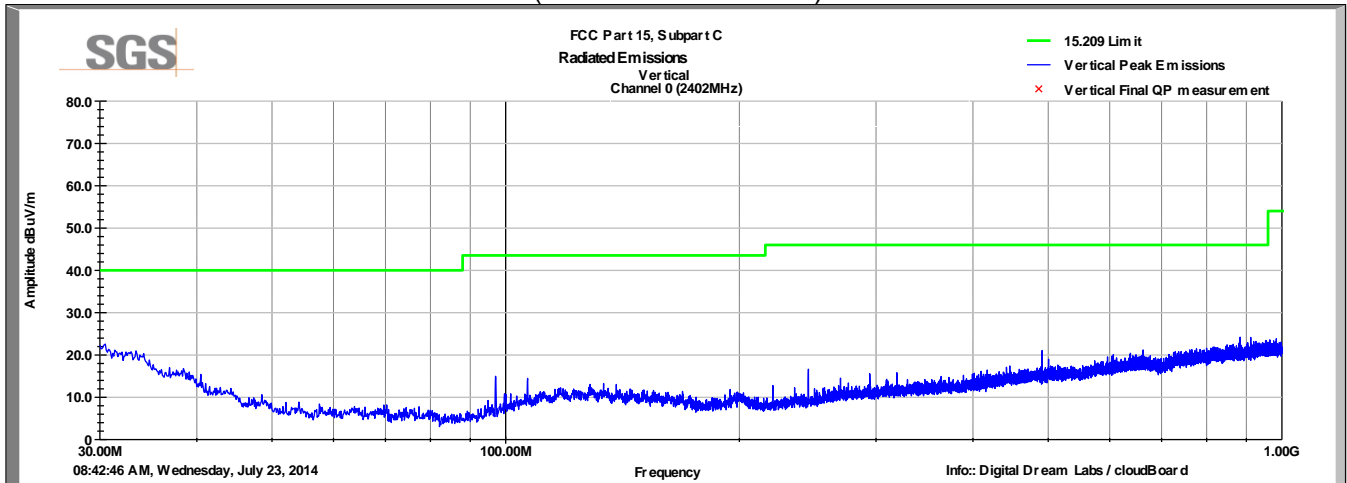
Note: The calibration period equipment is 1 year.

7.5 Test Setup Photographs

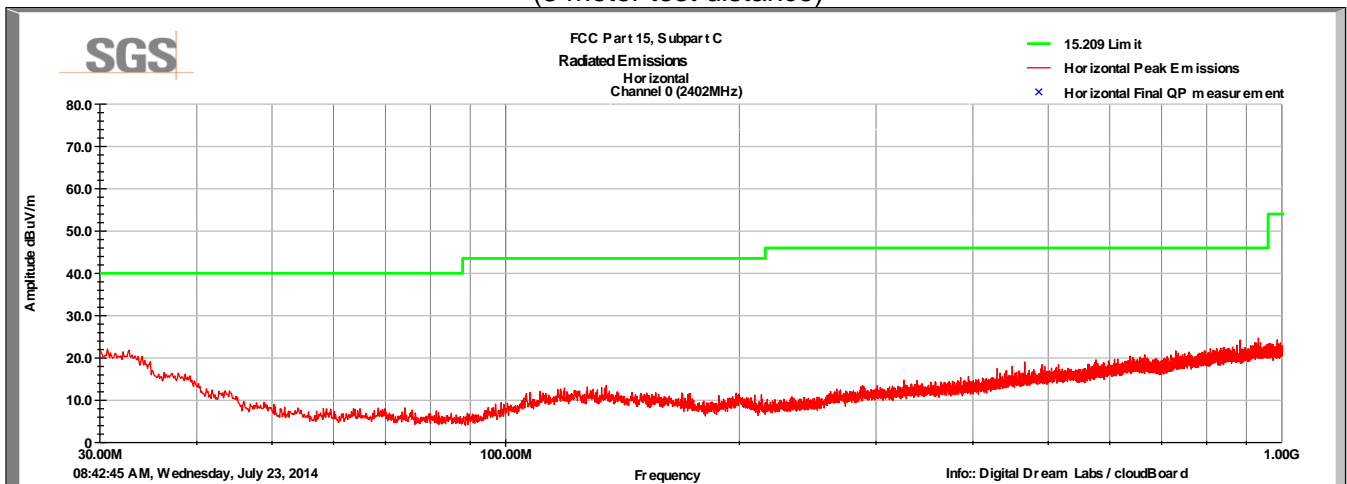
Test setup photographs are located in a separate exhibit.

7.6 Test Data

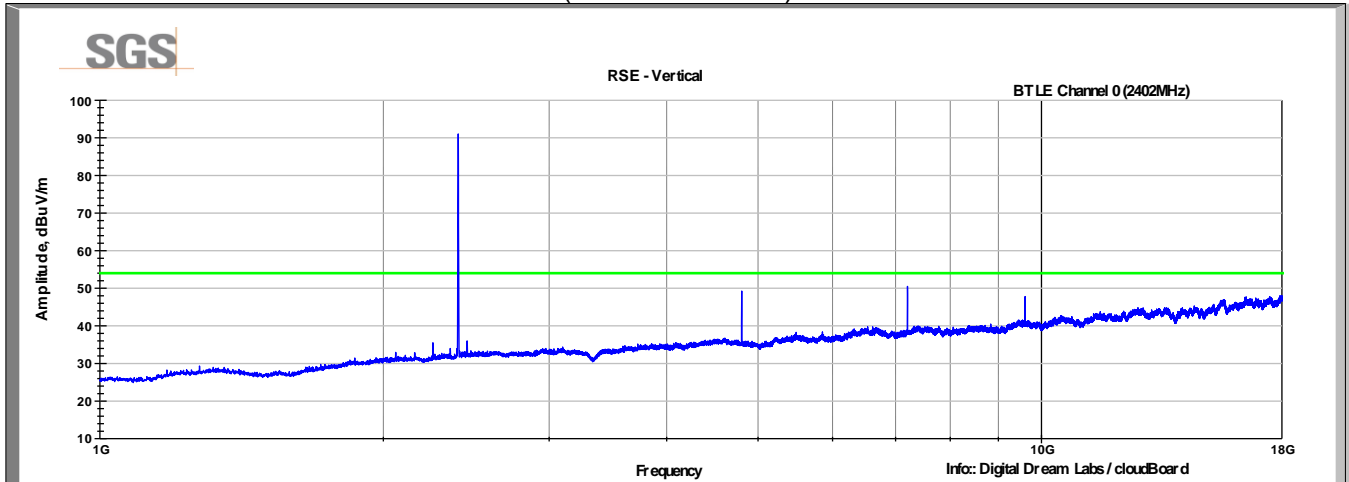
BT LE, Channel 0
30-1000MHz
Vertical
(3 meter test distance)



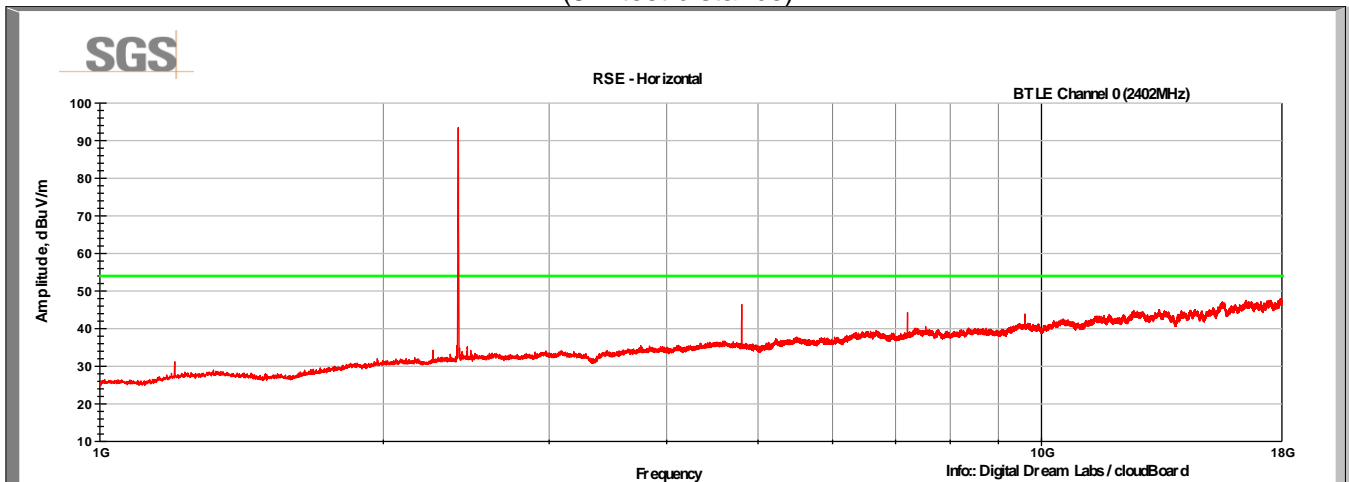
BT LE, Channel 0
30-1000MHz
Horizontal
(3 meter test distance)



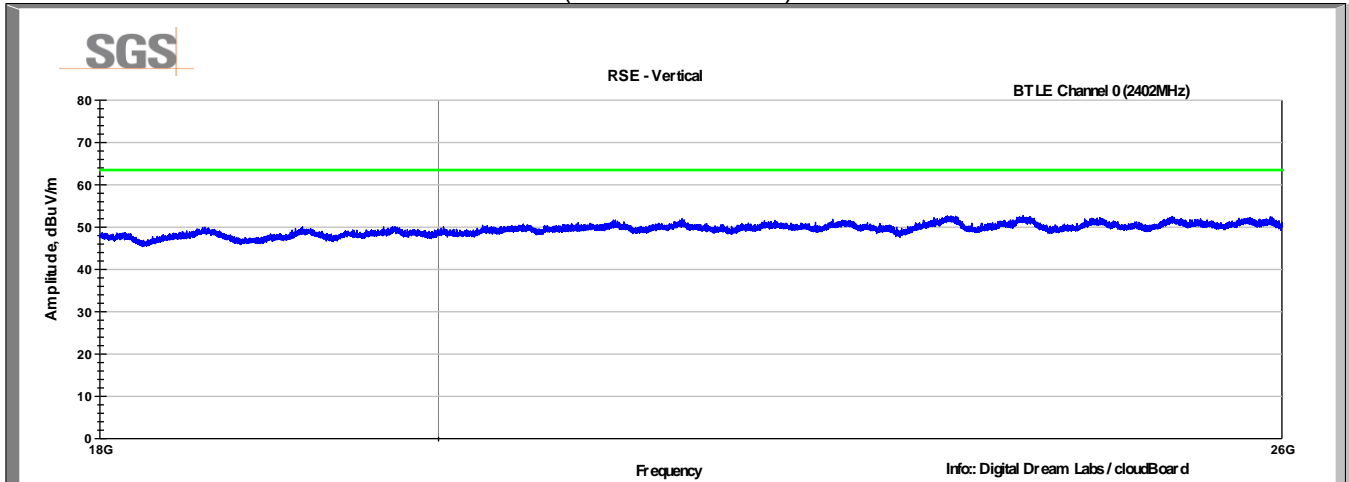
BT LE, Channel 0
1-18GHz
Vertical
(3m test distance)



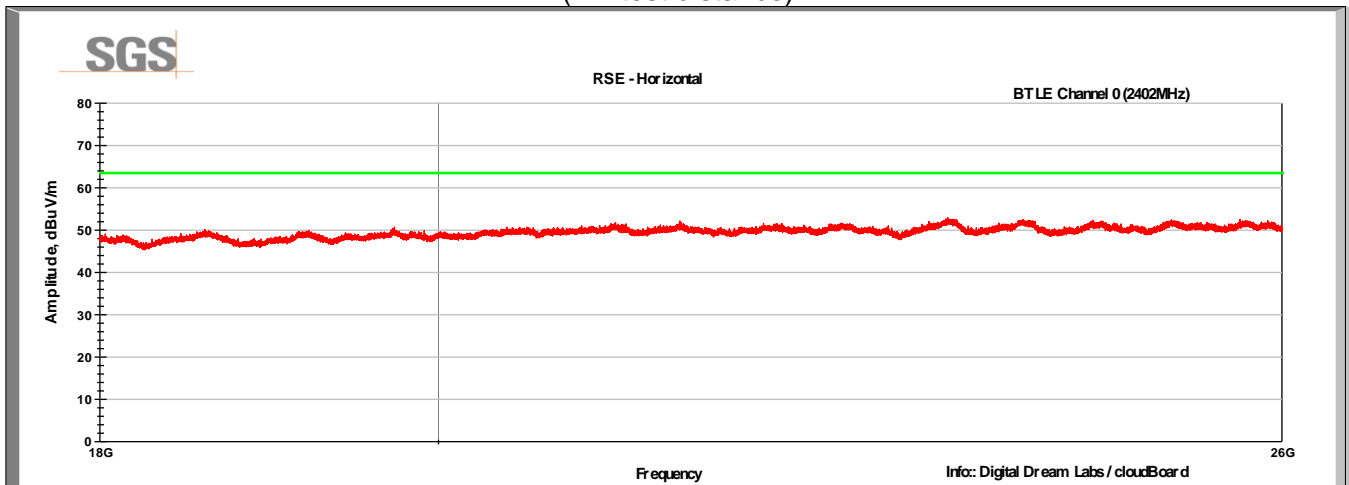
BT LE, Channel 0
1-18GHz
Horizontal
(3m test distance)



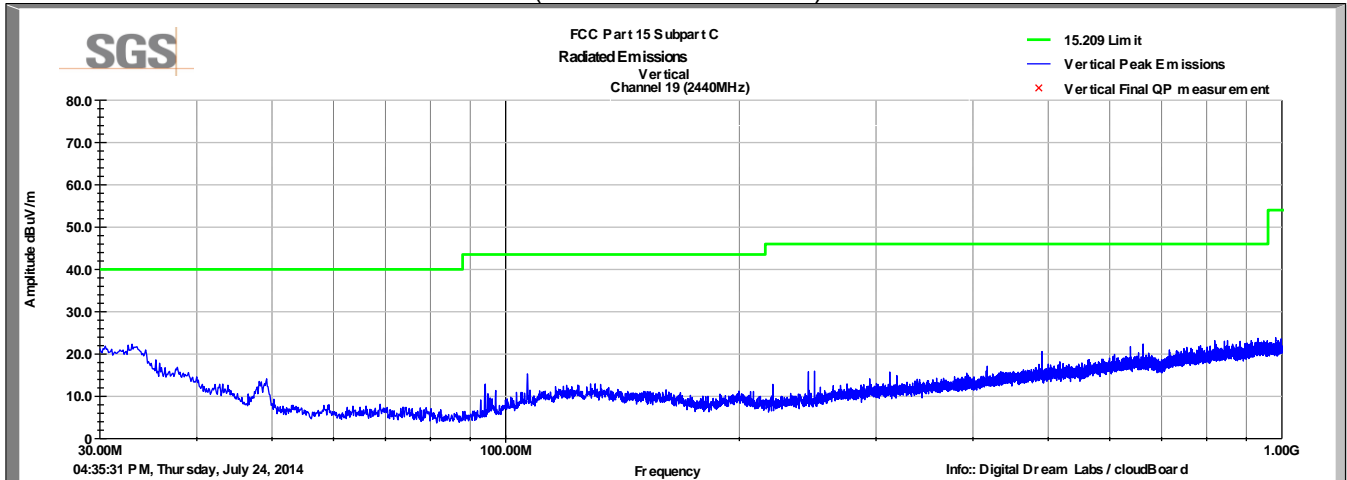
BT LE, Channel 0
18-26GHz
Vertical
(1m test distance)



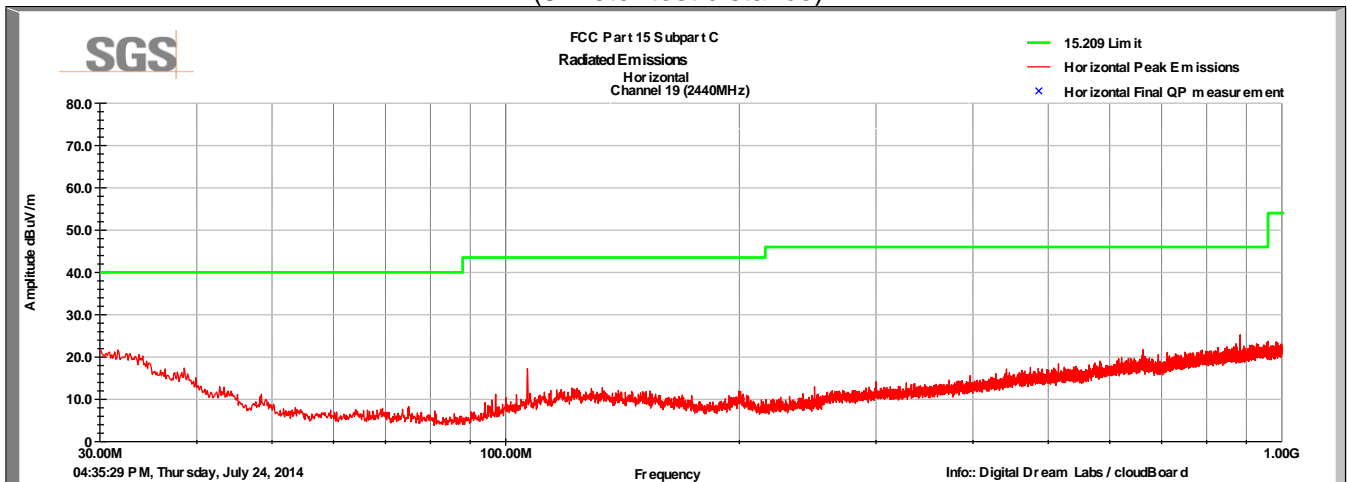
BT LE, Channel 0
18-26GHz
Horizontal
(1m test distance)



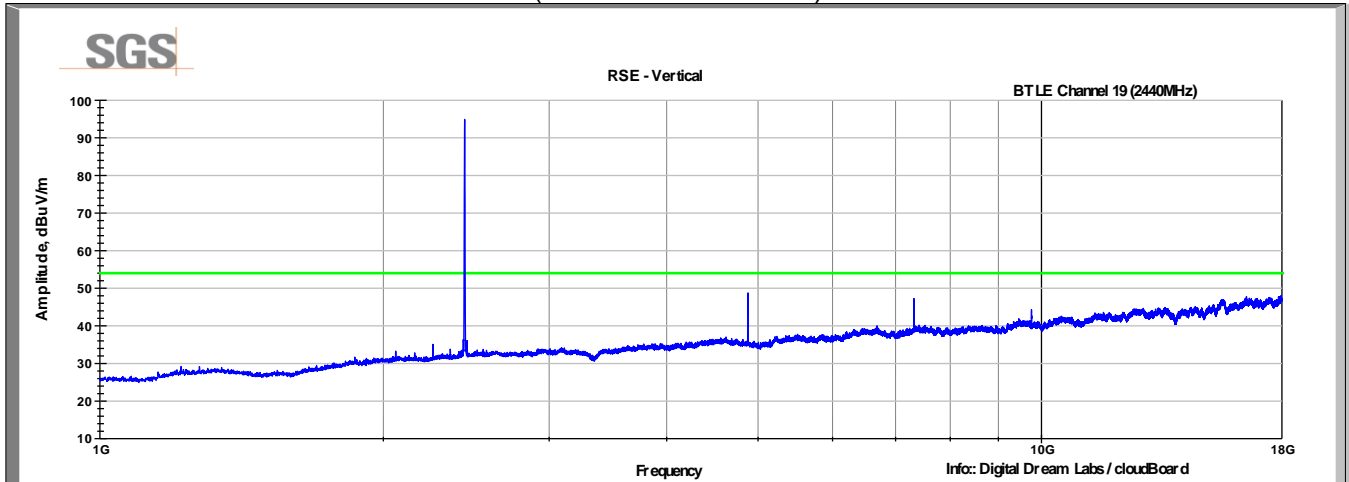
BT LE, Channel 19
30-1000MHz
Vertical
(3 meter test distance)



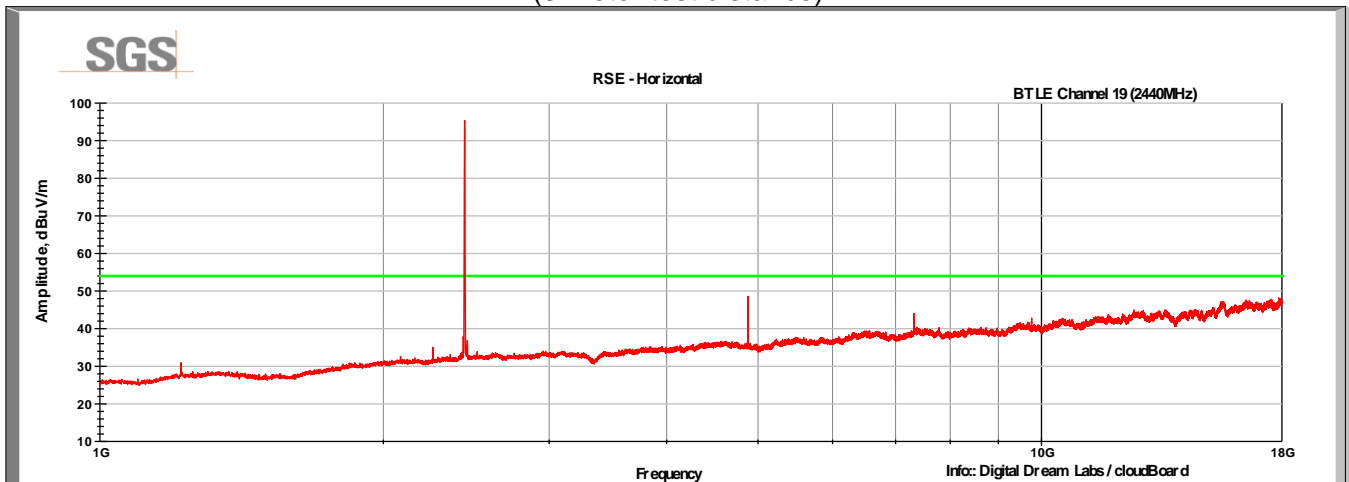
BT LE, Channel 19
30-1000MHz
Horizontal
(3 meter test distance)



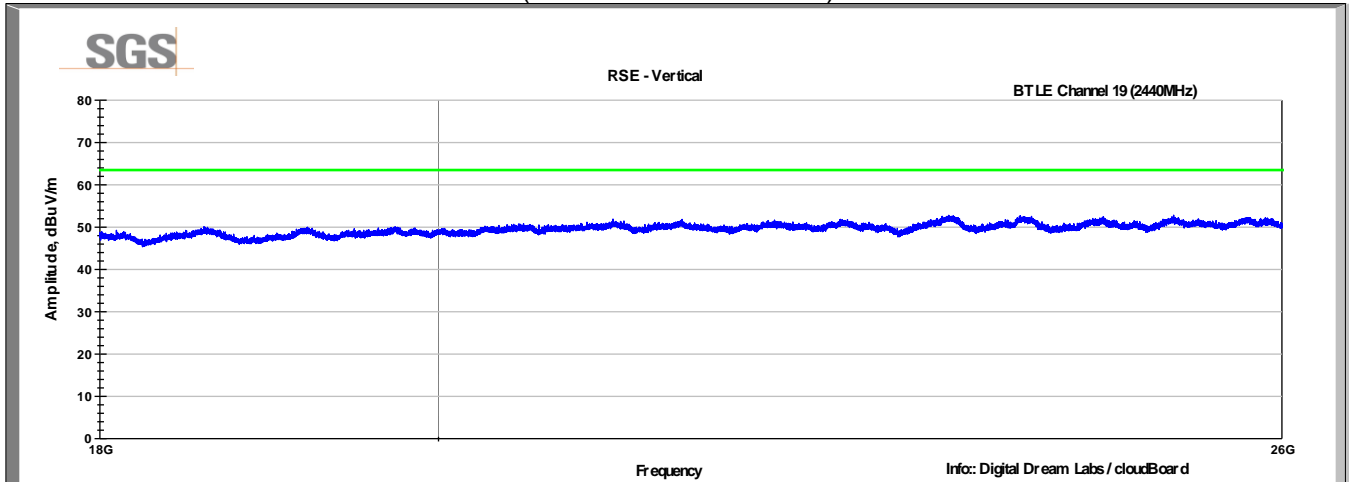
BT LE, Channel 19
1-18GHz
Vertical
(3 meter test distance)



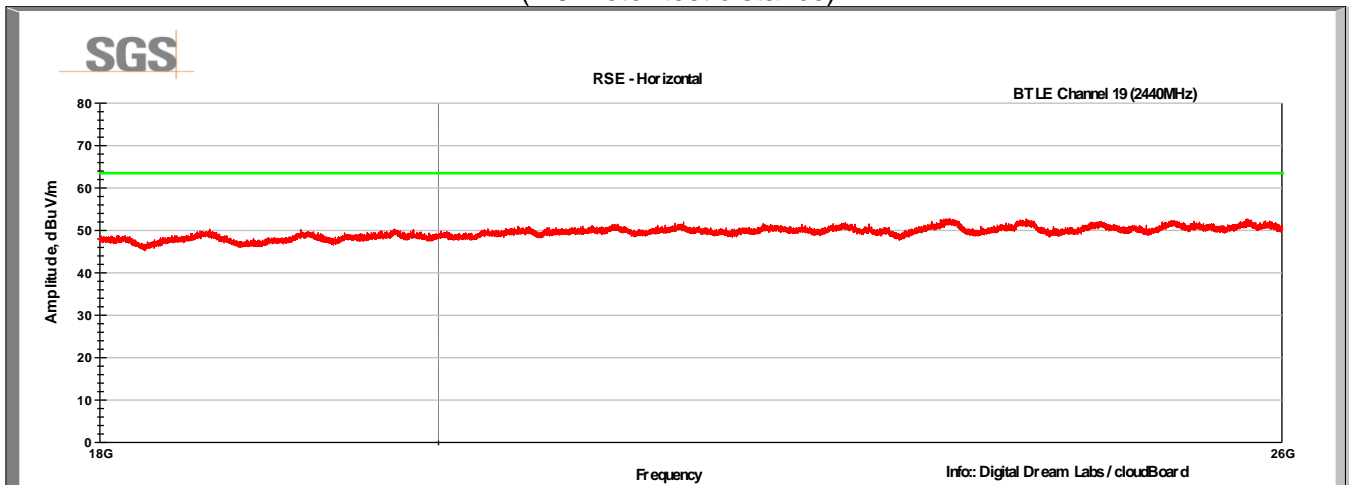
BT LE, Channel 19
1-18GHz
Horizontal
(3 meter test distance)



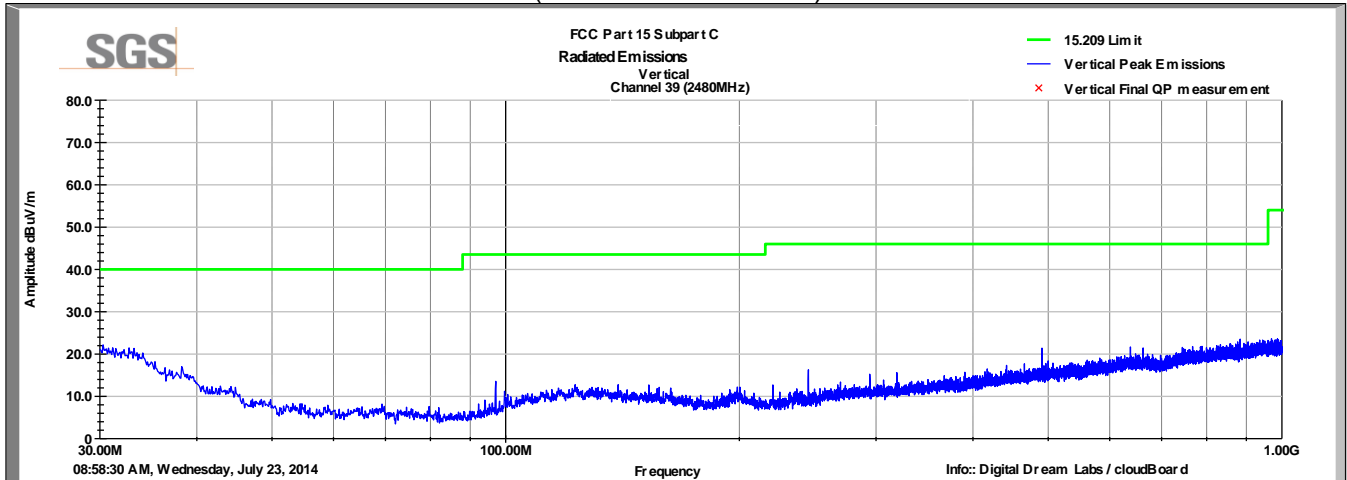
BT LE, Channel 19
18-26GHz
Vertical
(1.0 meter test distance)



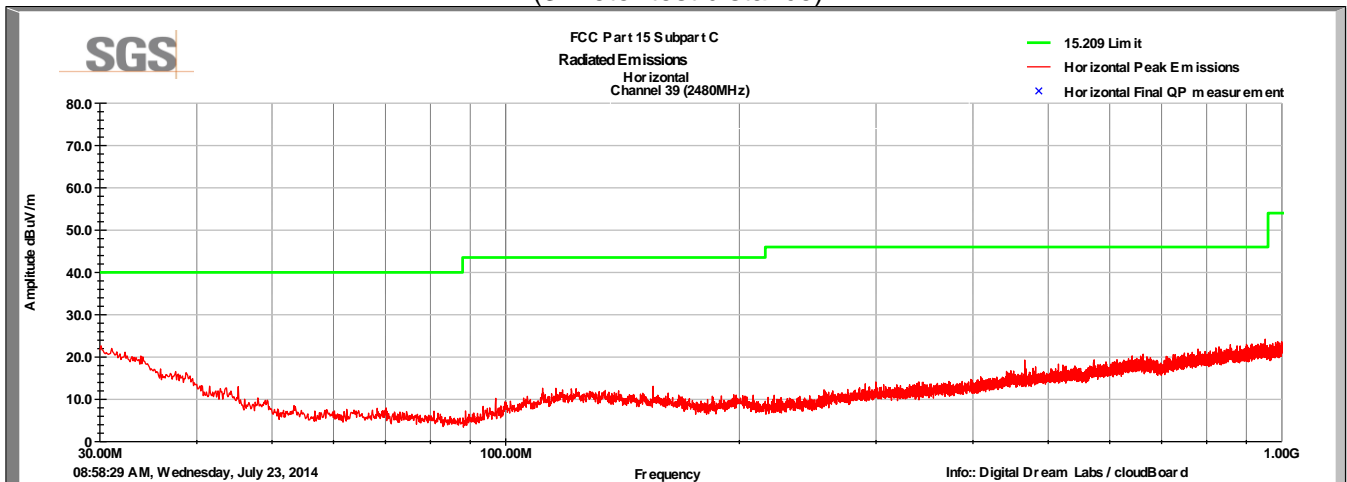
BT LE, Channel 19
18-26GHz
Horizontal
(1.0 meter test distance)



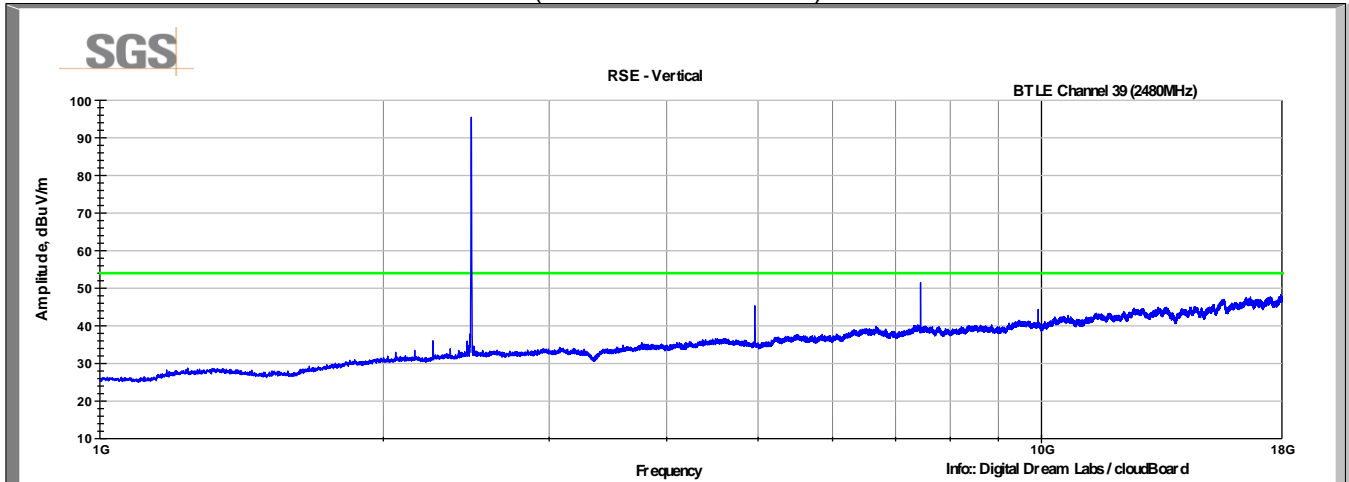
BT LE, Channel 39
30-1000MHz
Vertical
(3 meter test distance)



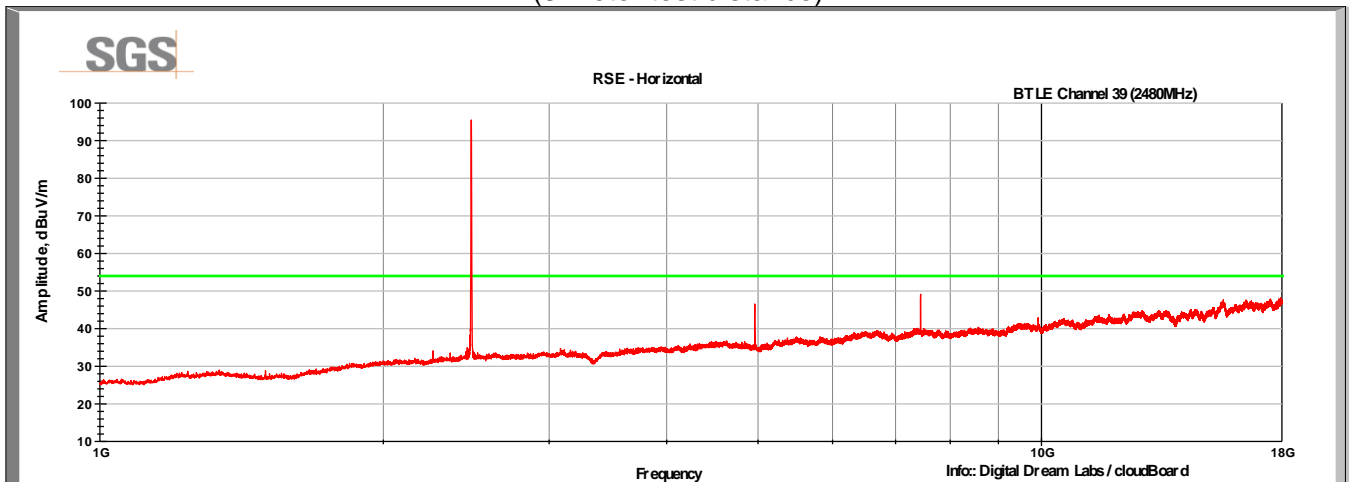
BT LE, Channel 39
30-1000MHz
Horizontal
(3 meter test distance)



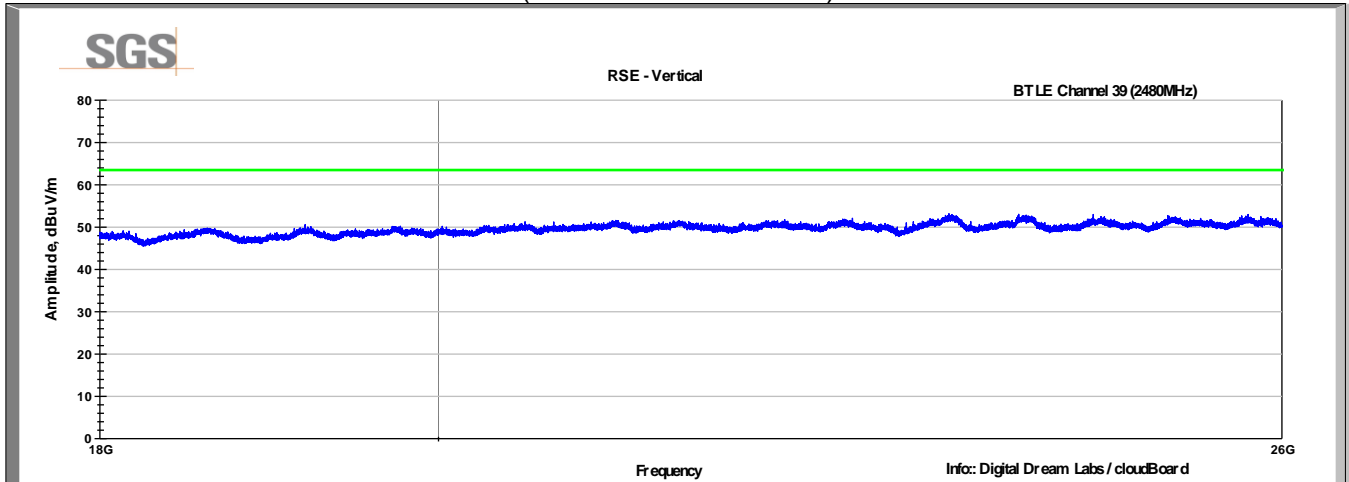
BT LE, Channel 39
1-18GHz
Vertical
(3 meter test distance)



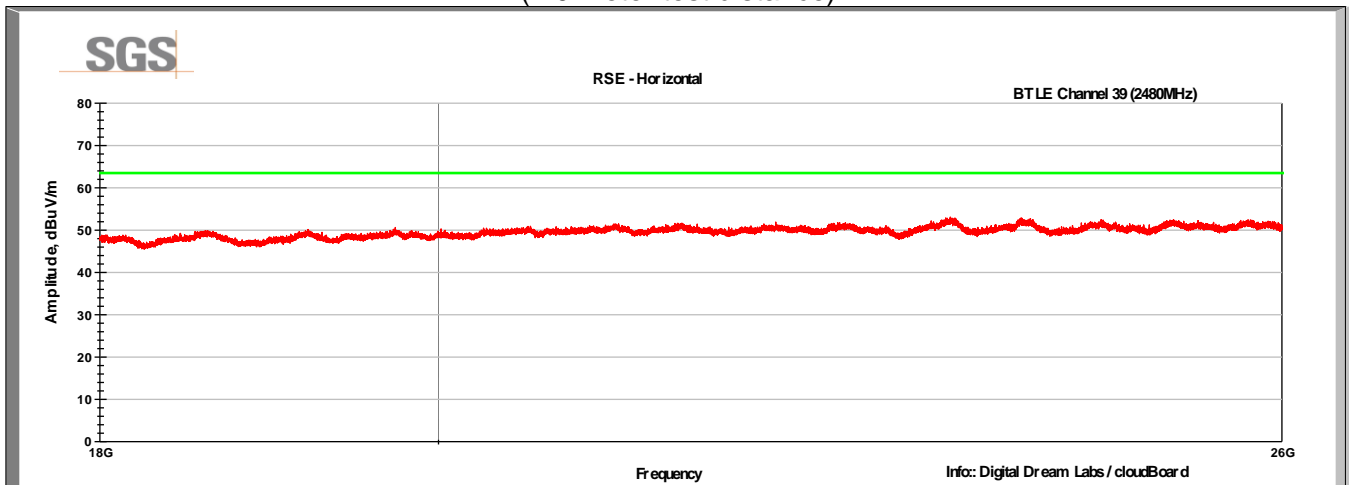
BT LE, Channel 39
1-18GHz
Horizontal
(3 meter test distance)



BT LE, Channel 39
18-26GHz
Vertical
(1.0 meter test distance)



BT LE, Channel 39
18-26GHz
Horizontal
(1.0 meter test distance)



Vertical Tabular Data

Frequency MHz	Raw Avg (dBuV)	Polarity (V/H)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)
Channel 0								
4804.00	34.3	V	34.0	5.7	33.3	40.7	54.0	-13.3
7206.00	29.4	V	35.7	10.2	33.3	42.0	54.0	-12.0
9608.00	20.5	V	36.8	14.7	32.7	39.3	54.0	-14.7
Channel 19								
4880.00	33.9	V	34.0	5.7	33.3	40.3	54.0	-13.7
7320.00	26.0	V	35.7	10.4	33.3	38.8	54.0	-15.2
Channel 39								
4960.00	30.2	V	34.1	5.9	33.3	36.9	54.0	-17.1
7440.00	29.5	V	35.8	10.7	33.2	42.8	54.0	-11.2
Avg Value = Level + AF + CL - Amp								
Margin = Avg Value - Limit								

Note: Peak data was more than 20dB below the peak limit.

Horizontal Tabular Data

Frequency MHz	Raw Avg (dBuV)	Polarity (V/H)	AF (dB/m)	CL (dB)	Amp (dB)	Avg Value (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)
Channel 0								
4804.00	31.4	H	34.0	5.7	33.3	37.8	54.0	-16.2
7206.00	23.2	H	35.7	10.2	33.3	35.8	54.0	-18.2
Channel 19								
4880.00	33.7	H	34.0	5.7	33.3	40.1	54.0	-13.9
7320.00	22.2	H	35.7	10.4	33.3	35.0	54.0	-19.0
Channel 39								
4960.00	31.4	H	34.1	5.9	33.3	38.1	54.0	-15.9
7440.00	27.3	H	35.8	10.7	33.2	40.6	54.0	-13.4
Avg Value = Level + AF + CL - Amp								
Margin = Avg Value - Limit								

Note: Peak data was more than 20dB below the peak limit.

8 Radiated Emissions at Band Edge / Restricted Band

8.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247 (d) and 15.209	Compliant

8.2 Test Method

Peak and average field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz. Measurements were completed using radiated test setups. Measurements at the 2390MHz band edge were performed using the standard emissions measurement methods of ANSI C63.10, Section 6.9.2. Measurements at the 2483.5MHz band edge were performed using the marker delta method as defined in ANSI C63.10, Section 6.9.3. The resultant data were compared to the average limit of 54 dBμV/m and peak limit of 74 dBμV/m.

8.3 Test Site

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

Environmental Conditions

Temperature: 23.4 °C

Relative Humidity: 32.8 %

8.4 Test Equipment

Test Date: 23-Jul-2014

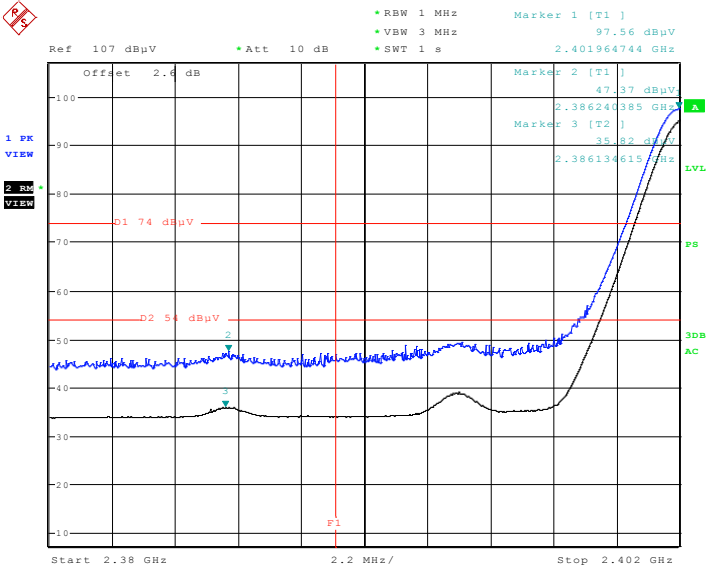
Eng: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	26-Jun-2015
ANTENNA, BILOG	JB6	SUNOL	B079689	22-Aug-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	16-Sep-2014
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079713	7-Aug-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	16-Oct-2014
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	B094463	13-Feb-2015

Note: The calibration period equipment is 1 year.

8.5 Test Data

BT LE, Ch0



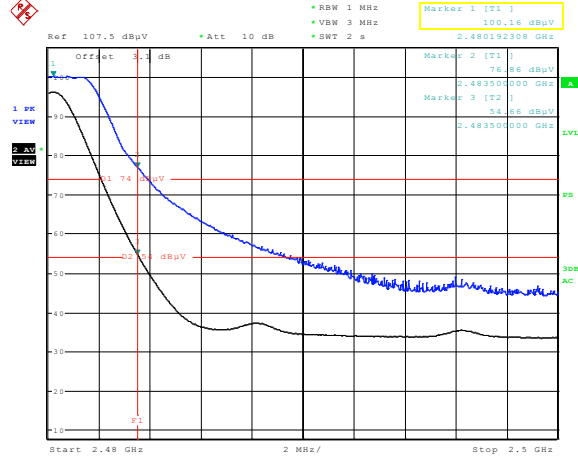
Date: 22.JUL.2014 15:19:30

BT LE, Ch39

Marker-Delta Method							
Detector	A	B	C	D	E	F	G
	2480MHz 1MHz RBW (dBuV/m)	2480MHz 30kHz RBW (dBuV/m)	2483.5MHz 30kHz RBW (dBuV/m)	Delta (dB)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Peak	100.2	99.5	53.3	46.2	54	74	-20.0
Average	96.2			46.2	50	54	-4.0

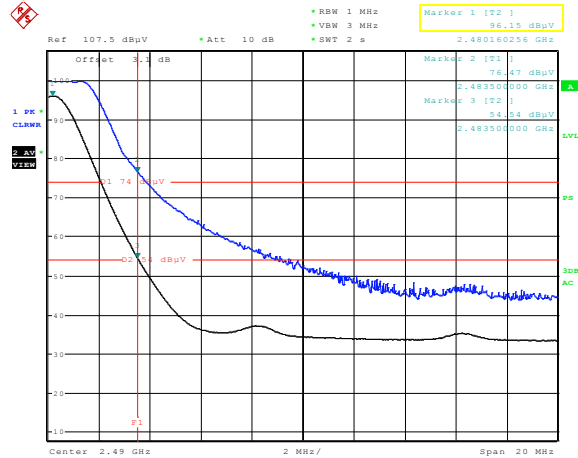
Formulas: D=B-C
 E=A-D
 G=E-F

Peak @ 1MHz RBW



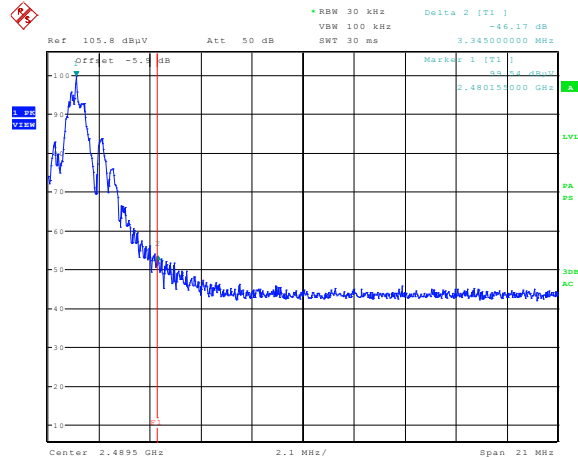
Date: 22.JUL.2014 16:28:04

Average @ 1MHz RBW



Date: 22.JUL.2014 16:51:22

Marker Delta



Date: 22.AUG.2014 16:19:53

9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	30 July 2014
1	<ul style="list-style-type: none"> - Added plots for occupied bandwidth and power measurements - Added duty cycle clarification to Section 2.4 - Added measurement results clarification to Section 5.6 - Removed WiFi references from Section 7.2 - Corrected marker-delta test method table and added plots. 	22 August 2014