

EMC Test Report

Project Number: 3071804

Report Number: 3071804EMC02

Revision Level: 0

Client: Airo Wireless, Inc.

Equipment Under Test: Intrinsically Safe Cellular Phone

Model: I-SAFE™28

Applicable Standards: FCC Part 15 Subpart C, § 15.247

RSS-210, Issue 8, December 2010

ANSI C63.10: 2009

Report issued on: 11 Sept 2013

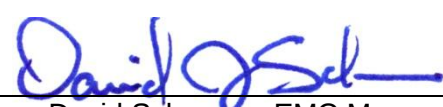
Test Result: Compliant

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
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
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	Compliant

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Airo Wireless, Inc.
Address: 12 Piedmont Center, Suite 205
City, State, Zip, Country: Atlanta, GA 30305

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: Intrinsically Safe Cellular Phone
Model: I-SAFE™ 28
Serial Number: 0232210032 (conducted)
0232210078 (radiated)
FCC ID: QDL-ISAFE28
Frequency Range: 2412 to 2462 MHz
Data Modes: 802.11gn
Antenna: Integral

Rated Voltage: 3.7 VDC Internal Battery

Sample Received Date: 02 August 2013
Dates of testing: 05 August – 06 September 2013



Test Report Number: 3071804EMC02 Rev: 0

Airo Wireless / I-SAFE™28

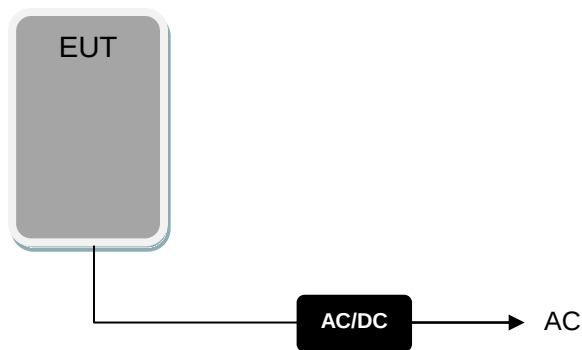
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Operating Modes and Conditions

Modulations used: For fundamental and spurious measurements, the EUT was configured to operate continuously with Wi-Fi modulation enabled.

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	Airo Wireless	EUT	I-SAFE™28	0232210032 (conducted) 0232210078 (radiated)
B	Phihong	Switching Power Supply	PSB05R-050Q	P22701348A3

3 Occupied Bandwidth

3.1 Test Result

Test Description	Basic Standards	Test Result
6 dB bandwidth	15.247(a) (2)	Compliant

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: 24.4 °C

Relative Humidity: 47.8 %

3.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	12-Dec-2013

Note: The calibration period equipment is 1 year.

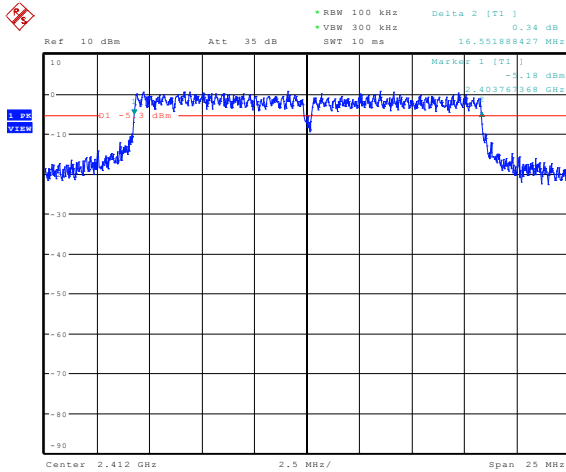
3.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

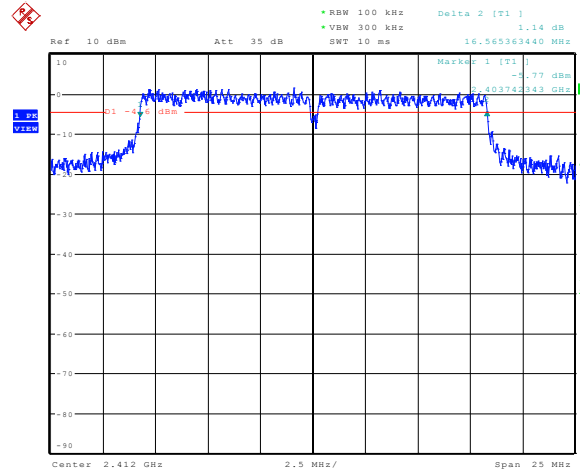
3.6 Test Data

Protocol	Channel	Data Rate	6dB Bandwidth (MHz)
802.11g	1	6	16.55
802.11g	1	36	16.57
802.11g	1	54	16.57
802.11g	6	6	16.59
802.11g	6	36	16.55
802.11g	6	54	16.48
802.11g	11	6	16.55
802.11g	11	36	16.59
802.11g	11	54	16.57
802.11n	1	MCS0	16.29
802.11n	1	MCS7	16.55
802.11n	6	MCS0	16.55
802.11n	6	MCS7	16.59
802.11n	11	MCS0	16.54
802.11n	11	MCS7	16.58

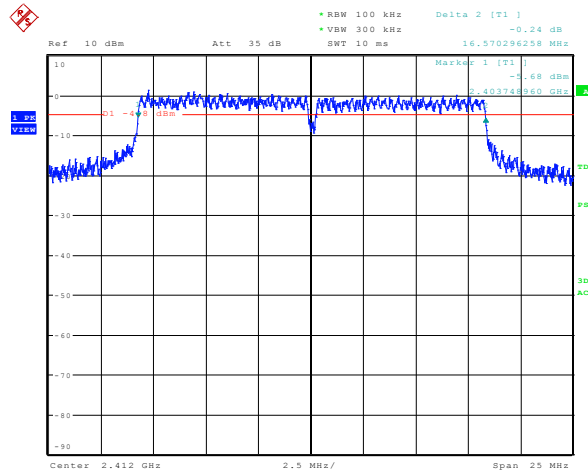
6 dB Bandwidth Plots, 802.11g Channel 1 Data rates: 6, 36, 54Mb/s



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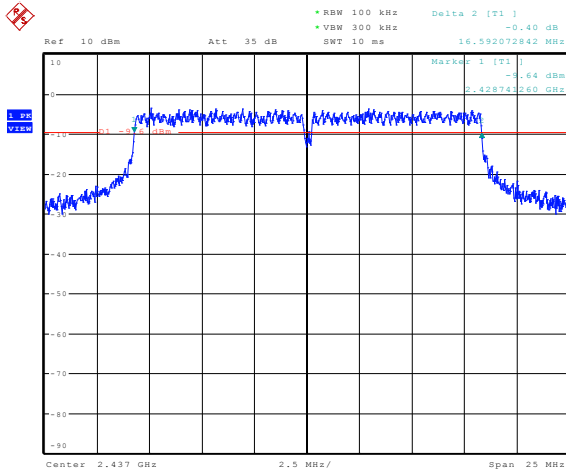


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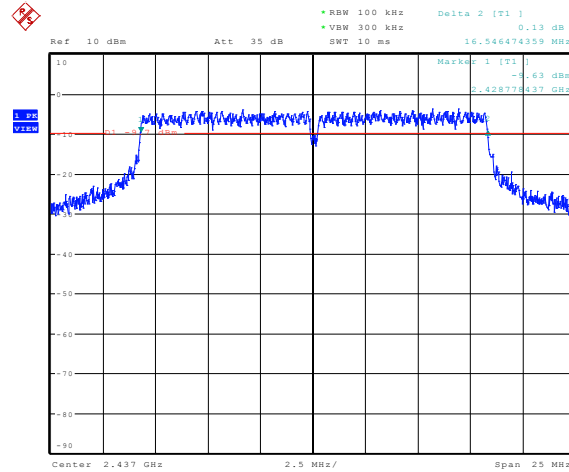


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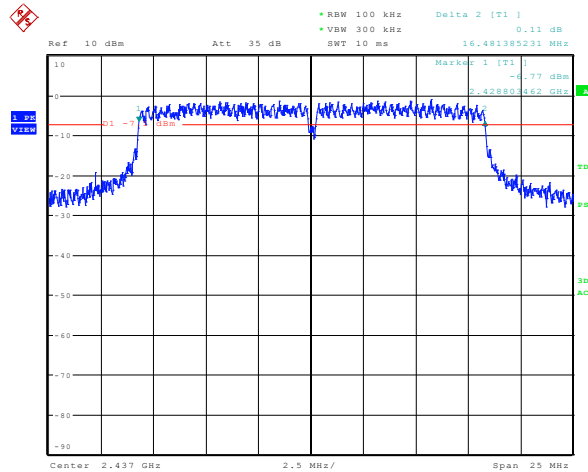
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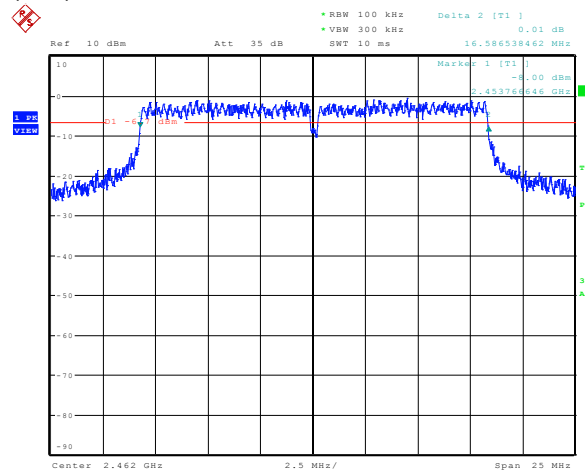
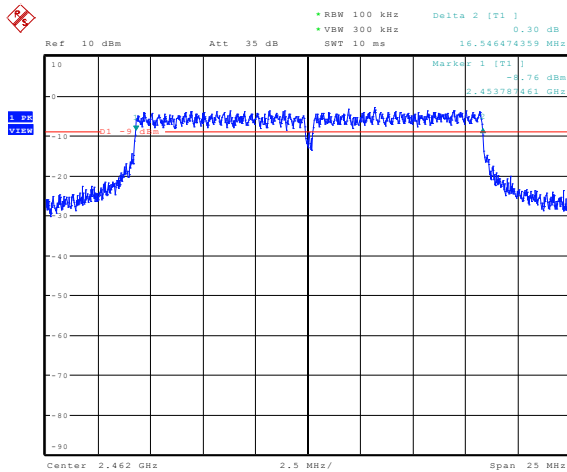


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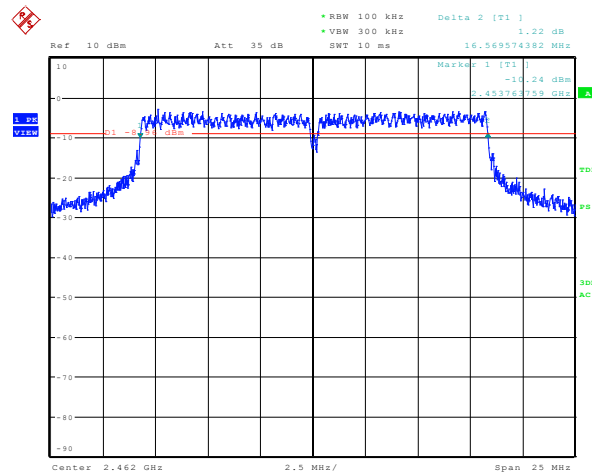
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6 dB Bandwidth Plots, 802.11g
Channel 11
Data rates: 6, 36, 54Mb/s



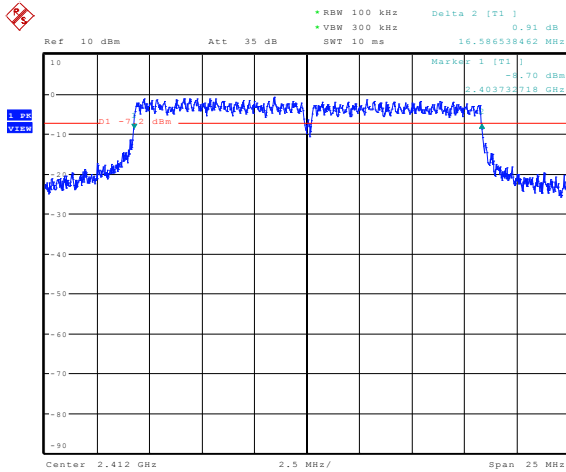
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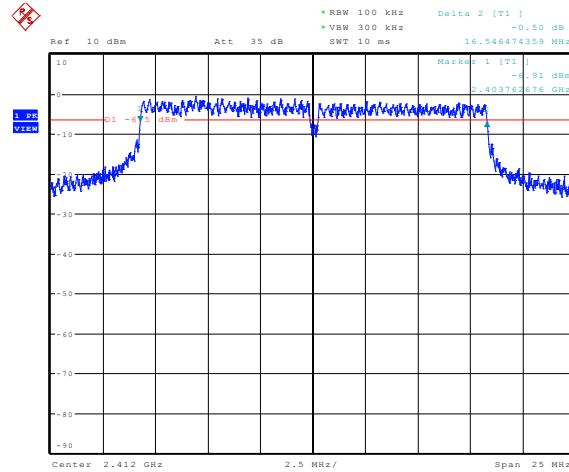


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6 dB Bandwidth Plots, 802.11n Channel 1 Data rates: MCS0, MCS7

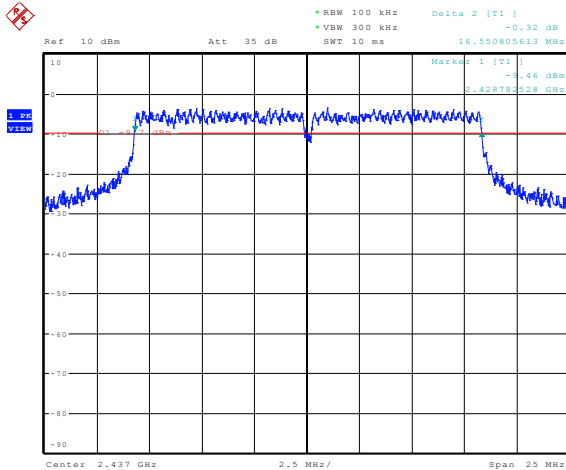


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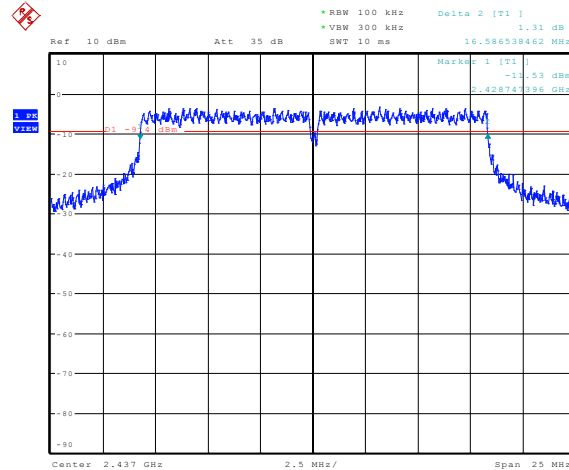


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6 dB Bandwidth Plots, 802.11n Channel 6 Data rates: MCS0, MCS7

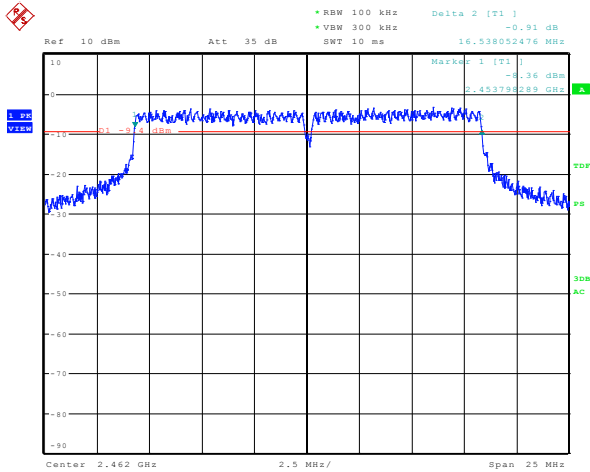


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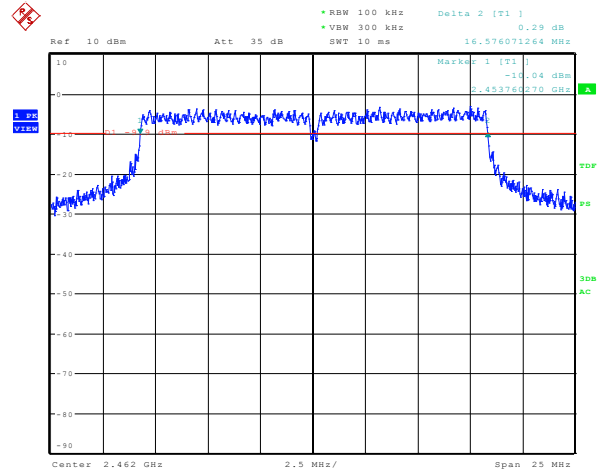


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6 dB Bandwidth Plots, 802.11n
Channel 11
Data rates: MCS0, MCS7



Date: 14.AUG.2013 20:22:06



Date: 14.AUG.2013 20:19:44

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

The power measurements were recorded using the integrated band power method. Data was recorded using the channel power measurement function of the ESU receiver.

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: 21.9 °C
Relative Humidity: 28.9 %

4.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	12-Dec-2013

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	Data Rate	Channel Power (dBm)
802.11g	1	6	13.85
802.11g	1	36	13.84
802.11g	1	54	13.86
802.11g	6	6	11.76
802.11g	6	36	11.84
802.11g	6	54	11.8
802.11g	11	6	9.88
802.11g	11	36	9.87
802.11g	11	54	9.84
802.11n	1	MCS0	11.87
802.11n	1	MCS7	11.87
802.11n	6	MCS0	9.42
802.11n	6	MCS7	9.4
802.11n	11	MCS0	9.47
802.11n	11	MCS7	9.42

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. 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: 25.1 °C

Relative Humidity: 41.0 %

5.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013

Note: The calibration period equipment is 1 year.

5.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

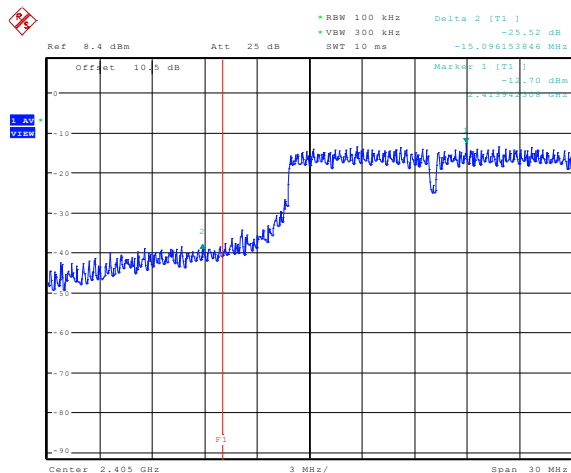
5.6 Test Data

802.11g

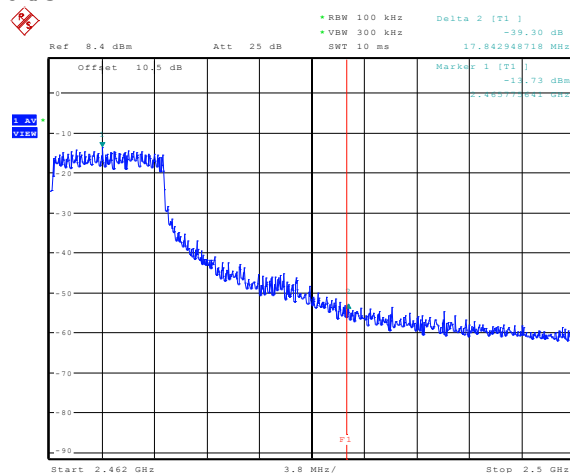
Lower band edge / Upper band edge

Channel 1 / Channel 11

6Mbit/s



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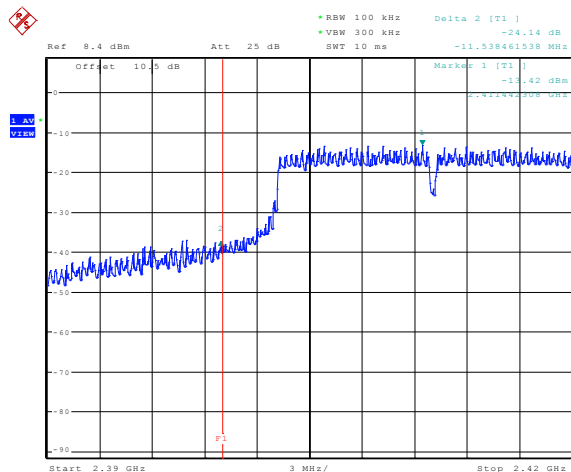
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802.11n

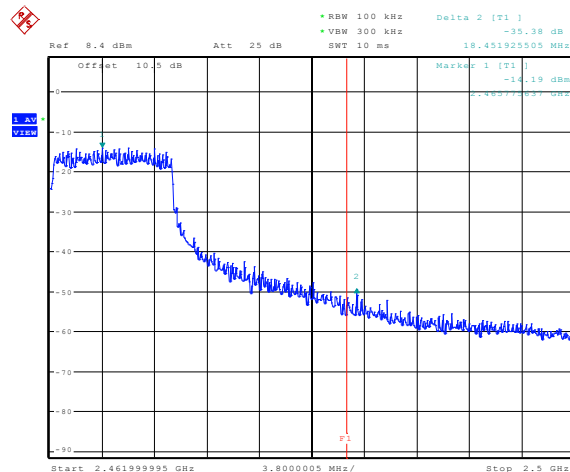
Lower band edge / Upper band edge

Channel 1 / Channel 11

MCS0

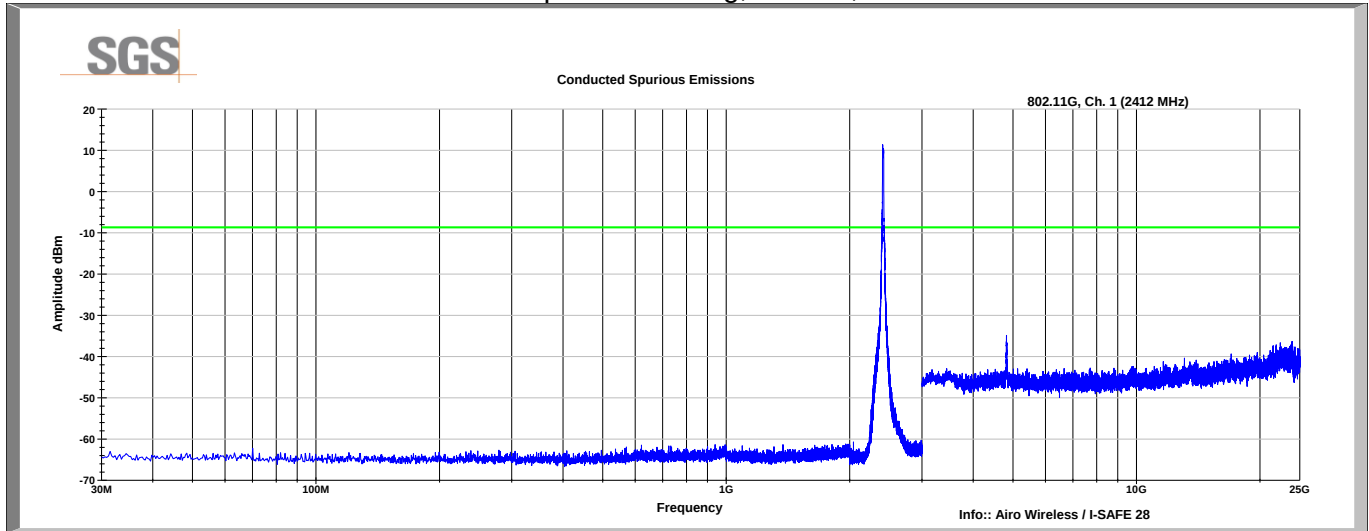


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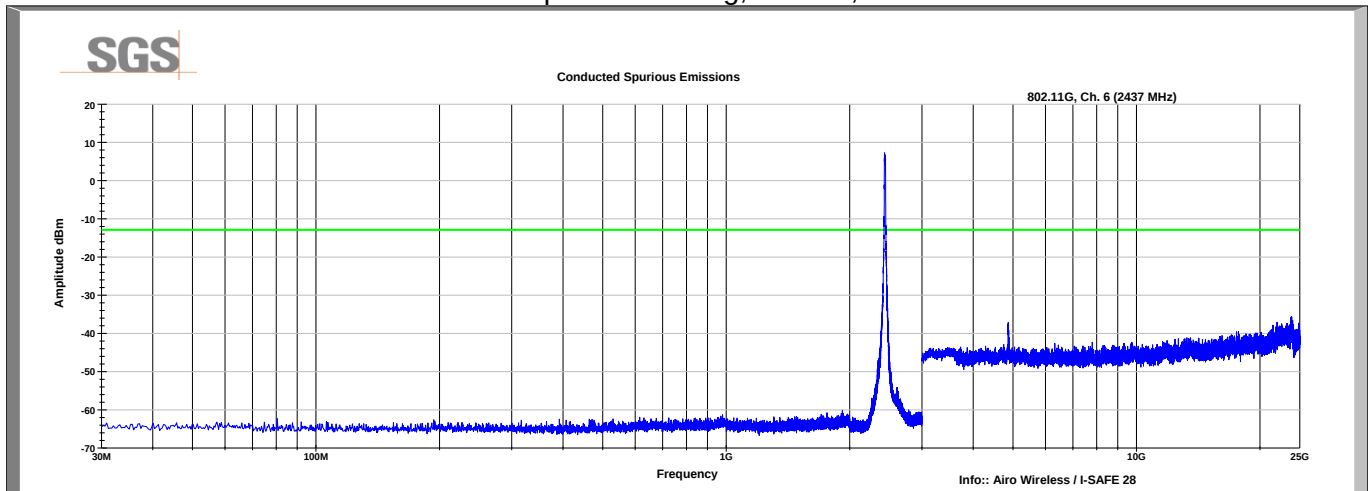


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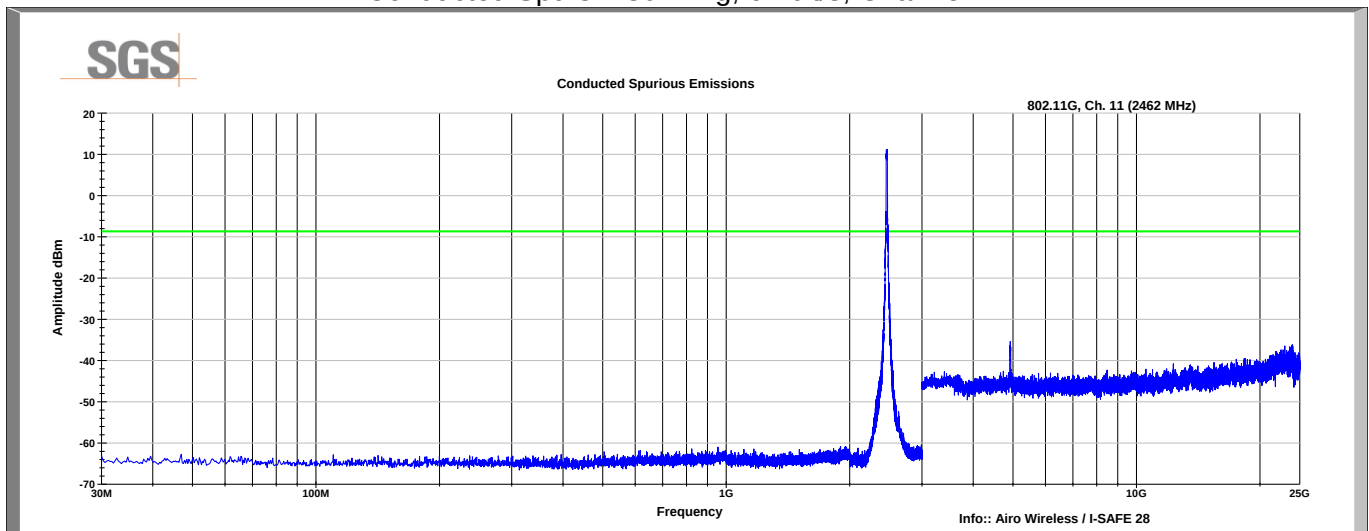
Conducted Spurs – 802.11g, 6Mbit/s, Channel 1



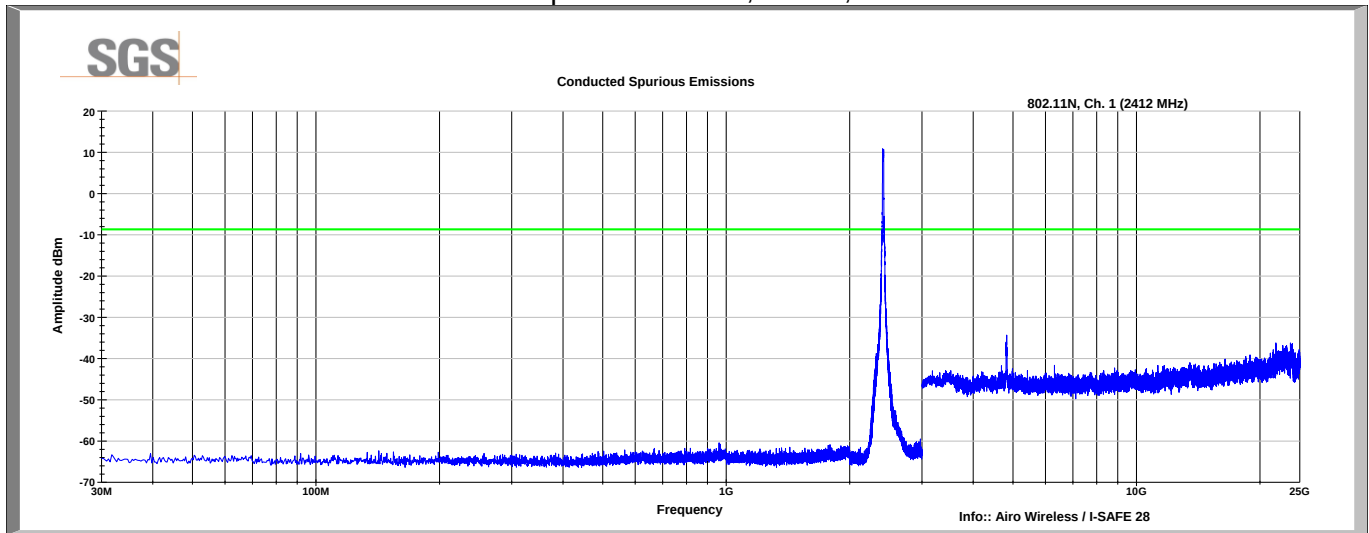
Conducted Spurs – 802.11g, 6Mbit/s, Channel 6



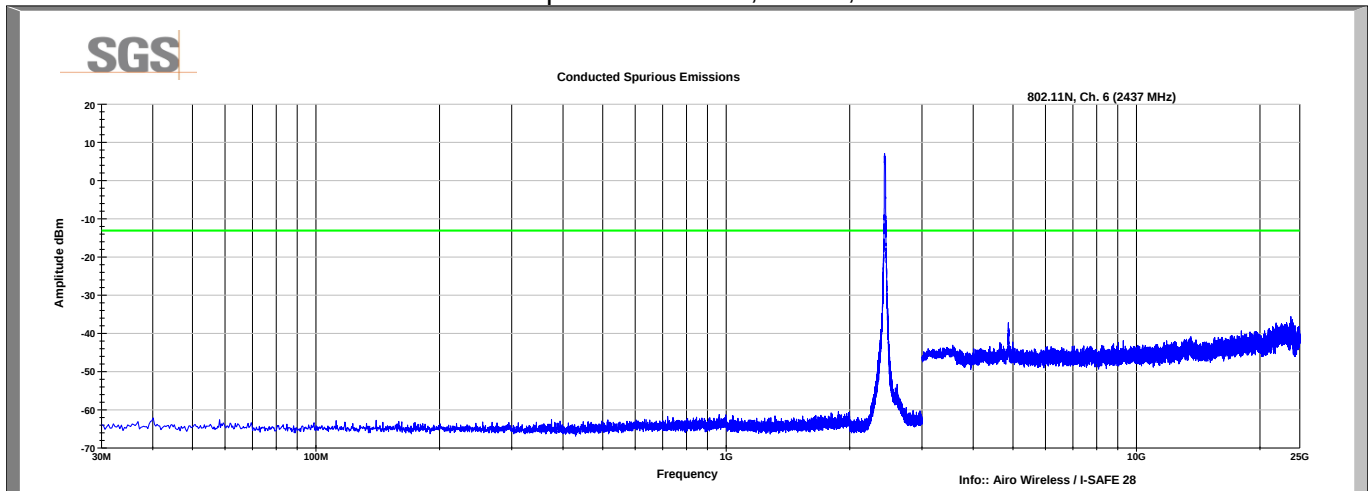
Conducted Spurs – 802.11g, 6Mbit/s, Channel 11



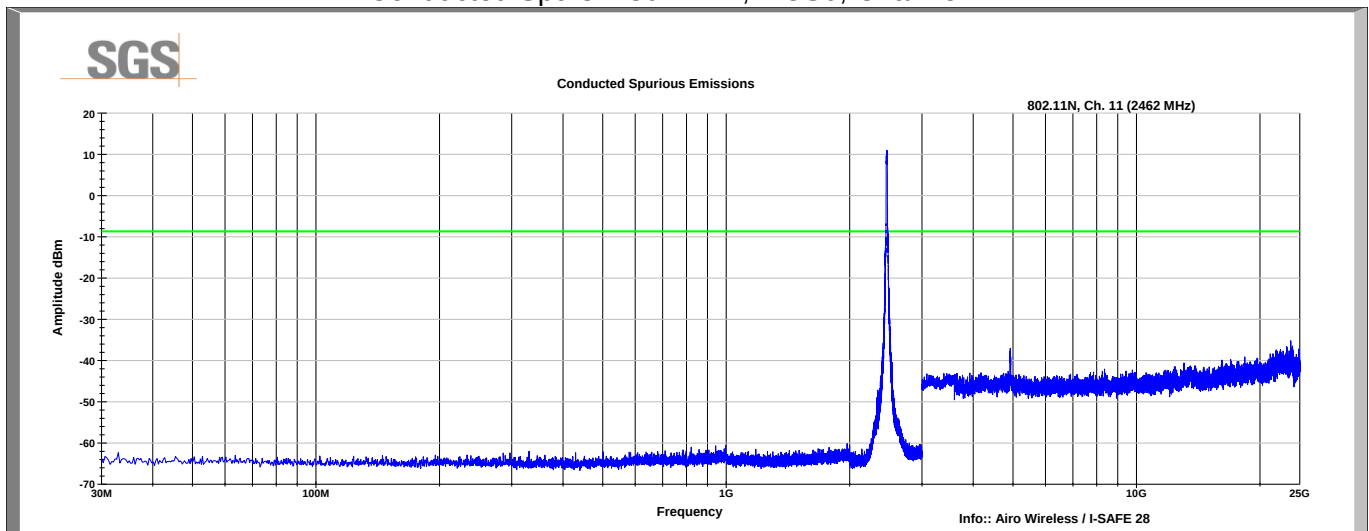
Conducted Spurs – 802.11n, MCS0, Channel 1



Conducted Spurs – 802.11 n, MCS0, Channel 6



Conducted Spurs – 802.11 n, MCS0, Channel 11



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

- RMS detector, trace averaging over 100 sweeps
- Resolution bandwidth of 3 kHz < RBW < 100 kHz
- Video bandwidth at 3xRBW

The limit is 8 dBm.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.1 °C

Relative Humidity: 47.4 %

6.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	12-Dec-2013

Note: The calibration period equipment is 1 year.

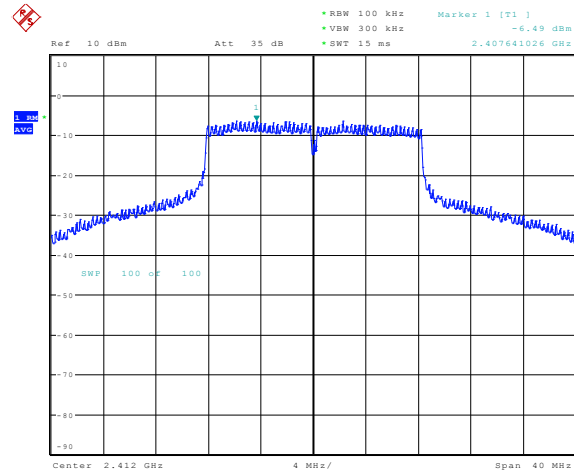
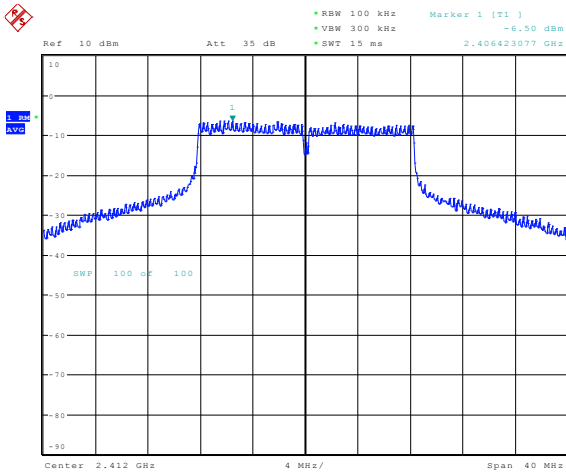
6.5 Test Setup Photographs

Test setup photographs are located in a separate exhibit.

6.6 Test Data

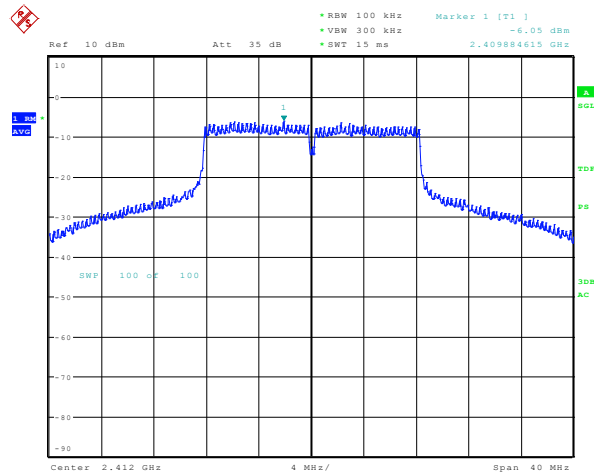
Protocol	Channel	Data Rate	PSD (dBm)
802.11g	1	6	-6.5
802.11g	1	36	-6.49
802.11g	1	54	-6.3
802.11g	6	6	-8.98
802.11g	6	36	-8.88
802.11g	6	54	-9.02
802.11g	11	6	-10.51
802.11g	11	36	-10.55
802.11g	11	54	-10.6
802.11n	1	MCS0	-8.9
802.11n	1	MCS7	-8.6
802.11n	6	MCS0	-8.81
802.11n	6	MCS7	-8.55
802.11n	11	MCS0	-10.83
802.11n	11	MCS7	-10.99

802.11g **Channel 1** **Data Rates: 6, 36 and 54 MB**



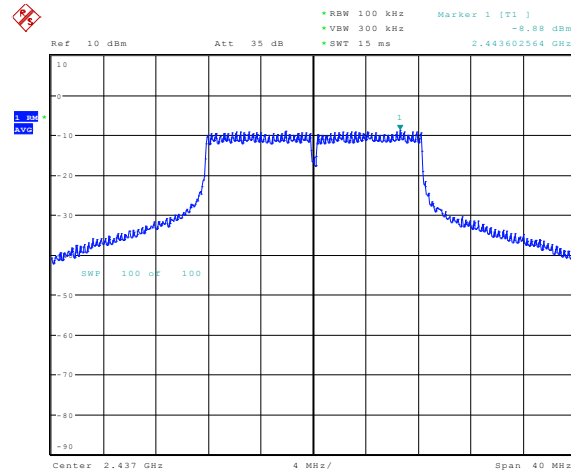
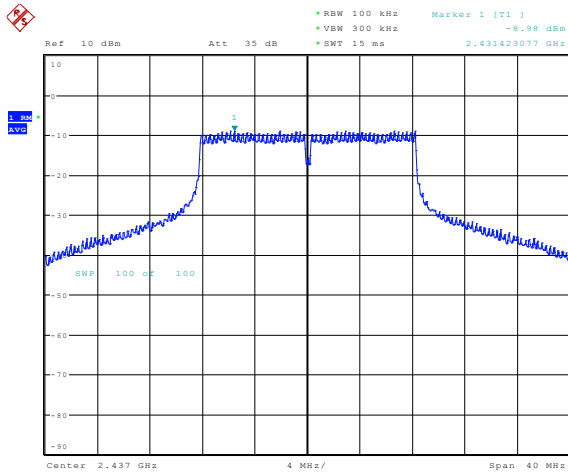
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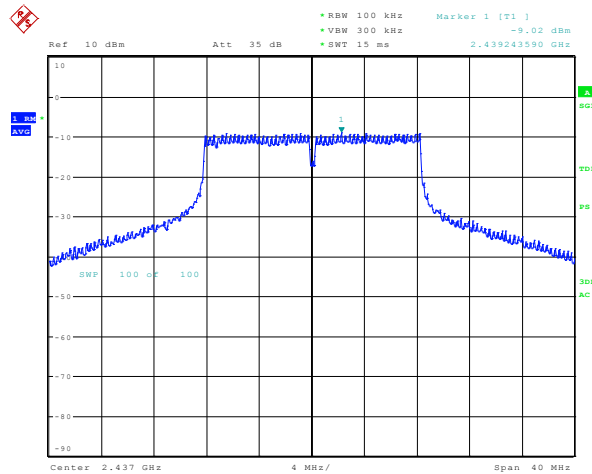
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802.11g **Channel 6** **Data Rates: 6, 36 and 54 MB**



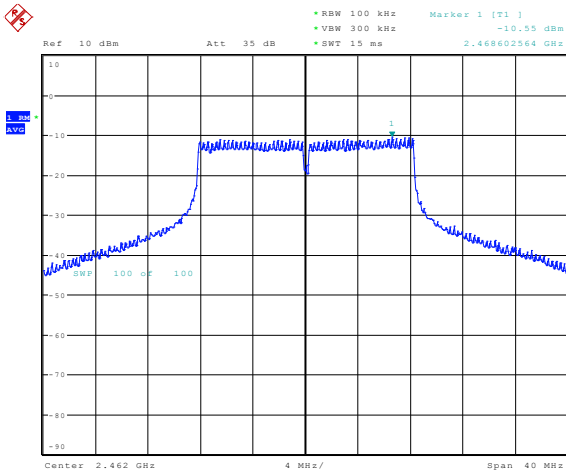
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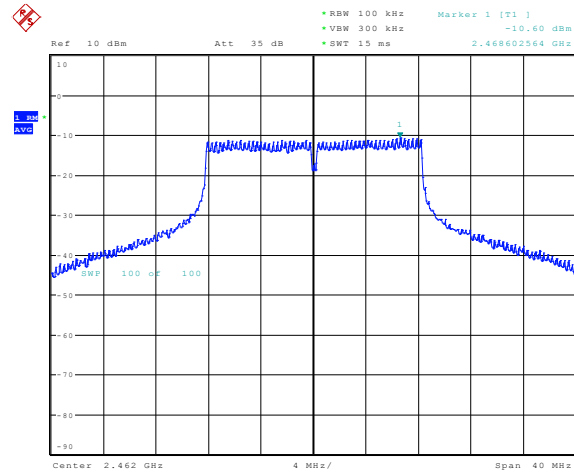


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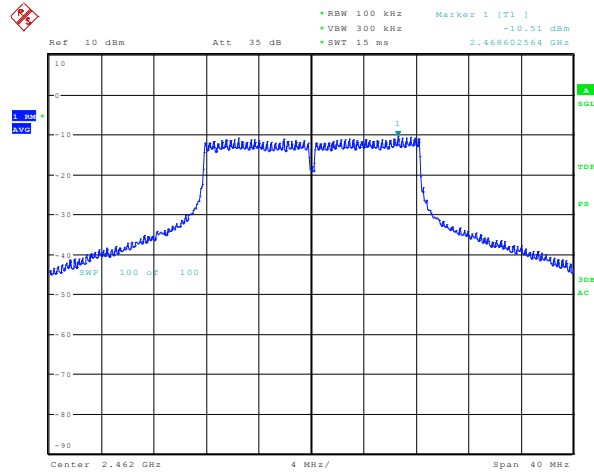
802.11g **Channel 11** **Data Rates: 6, 36 and 54 MB**



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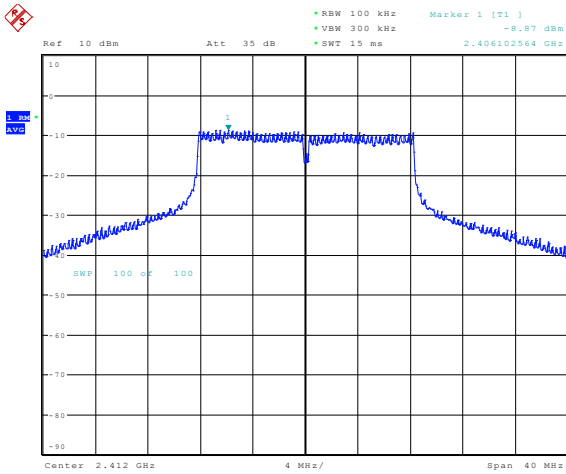


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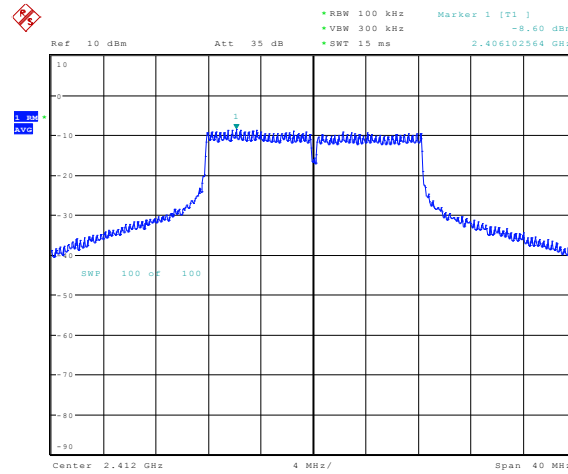
802.11n

Channel 1

Data Rates: MCS0 and MCS7



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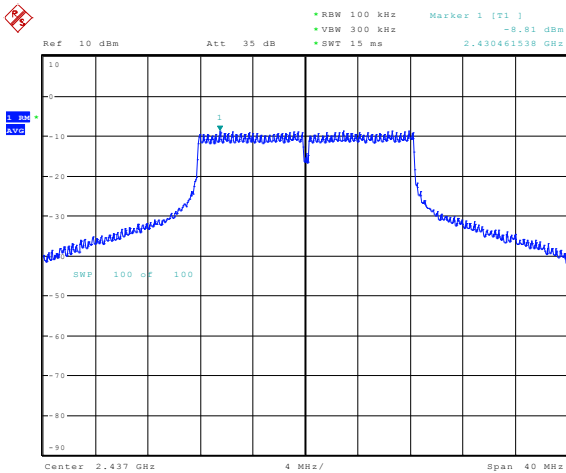


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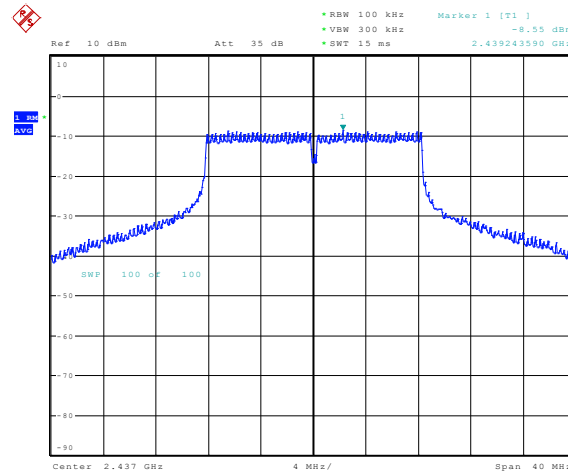
802.11n

Channel 6

Data Rates: MCS0 and MCS7

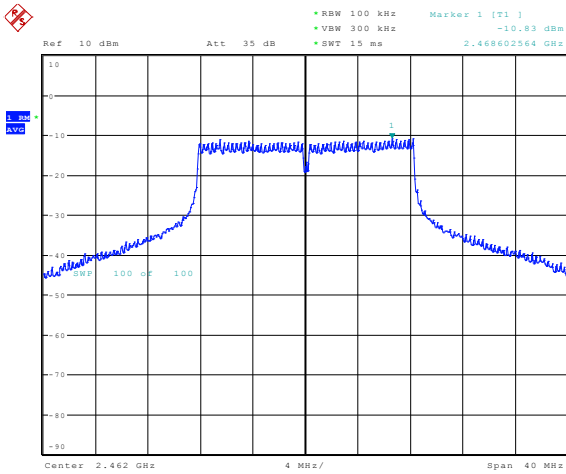


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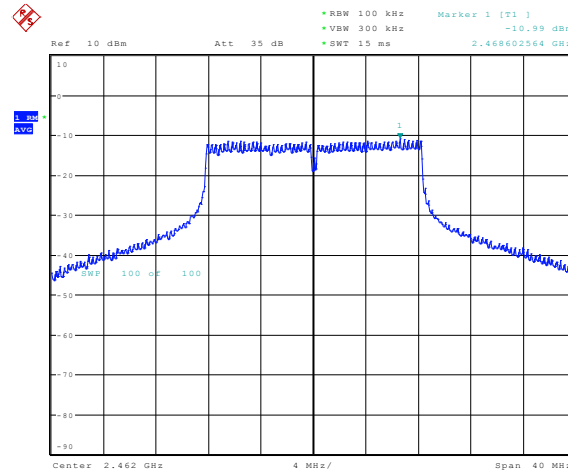


Date: 15.AUG.2013 16:25:29

802.11n
Channel 11
Data Rates: MCS0 and MCS7



Date: 14.AUG.2013 17:38:12



Date: 14.AUG.2013 20:17:01

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

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. 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).

Measurements were made in the following modes of operation: 802.11b,g,n at high, mid and low channels at the lowest data rate for each. No spurious emissions were detected in any mode of operation in the range 30 MHz to 26 GHz. The Prescan plots for the 802.11b are reported as the worst case mode of operation.

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

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	12-Sep-2013
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	25-Mar-2014
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	20-Sep-2013
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	20-Sep-2013
RF CABLE	SF106	HUBER&SUHNER	B085888	22-Oct-2013
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079716	20-Sep-2013
COAXIAL CABLE	1134	GORE	B094785	16-May-2014
RF CABLE	SF106	HUBER&SUHNER	B085892	23-Oct-2013
DESKTOP AMPLIFIER 1-18 GHZ	NSP1800-25-HG	MITEQ	B085930	30-Oct-2013
FIXED GAIN AMPLIFIER	NSP1840-HG	MITEQ	B087572	22-Oct-2013
BAND REJECT FILTER	BRM50702	MICRO-TRONICS	NA	105

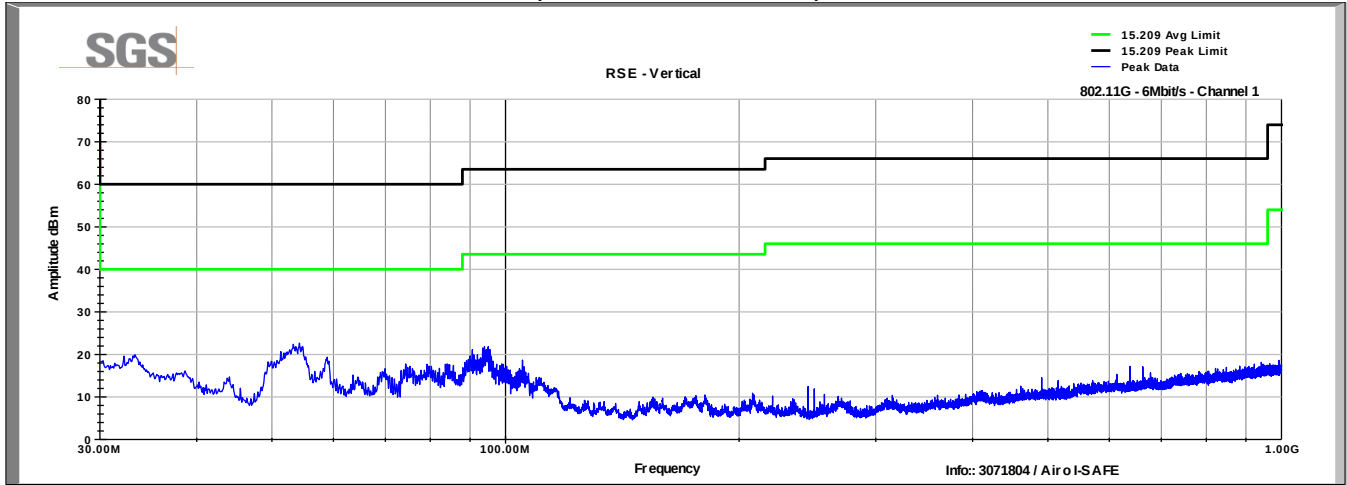
Note: The calibration period equipment is 1 year.

7.5 Test Setup Photographs

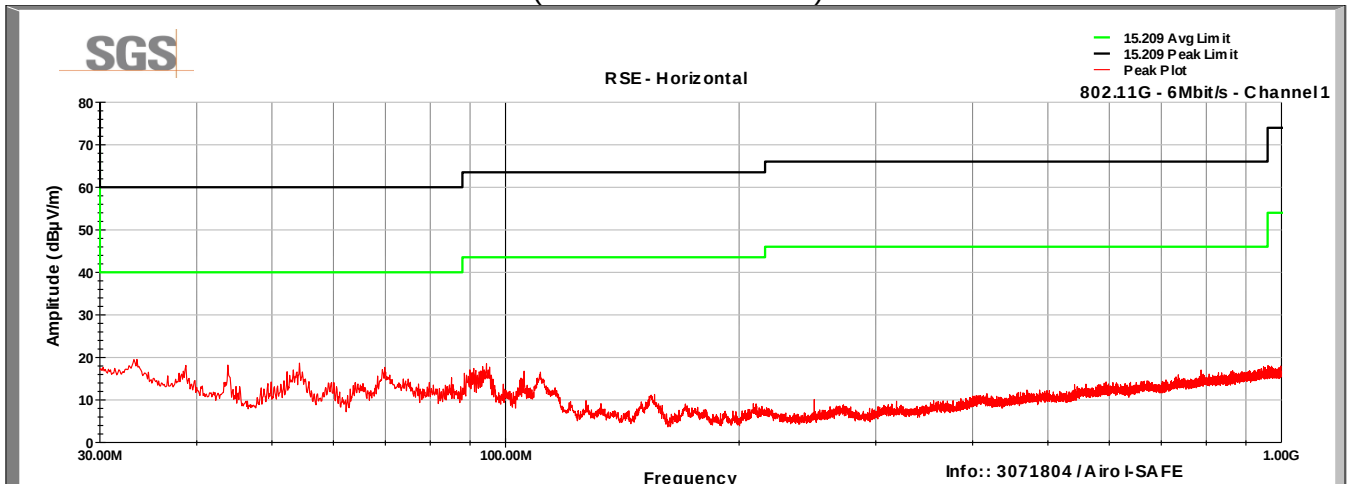
Test setup photographs are located in a separate exhibit.

7.6 Test Data

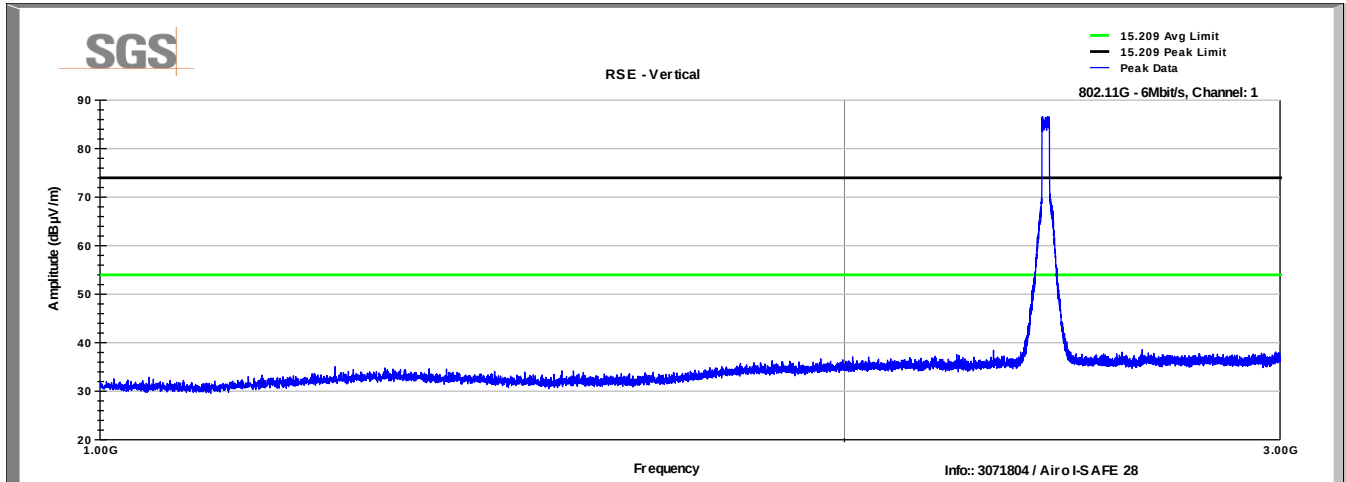
802.11g, 6Mbit/s, Channel 1
30-1000MHz
Vertical
(3 meter test distance)



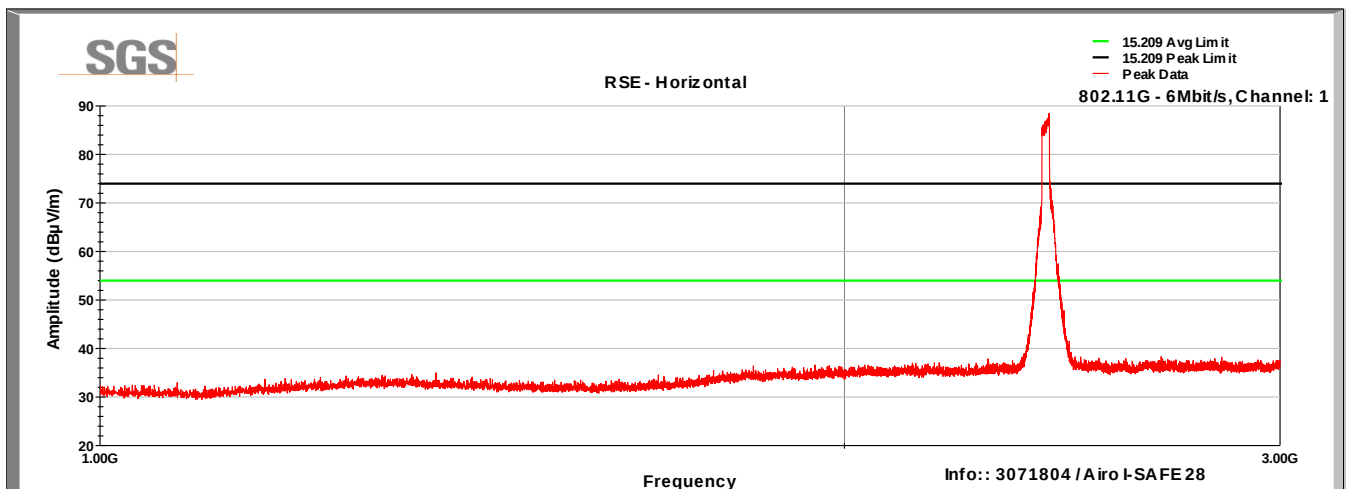
802.11g, 6Mbit/s, Channel 1
30-1000MHz
Horizontal
(3 meter test distance)



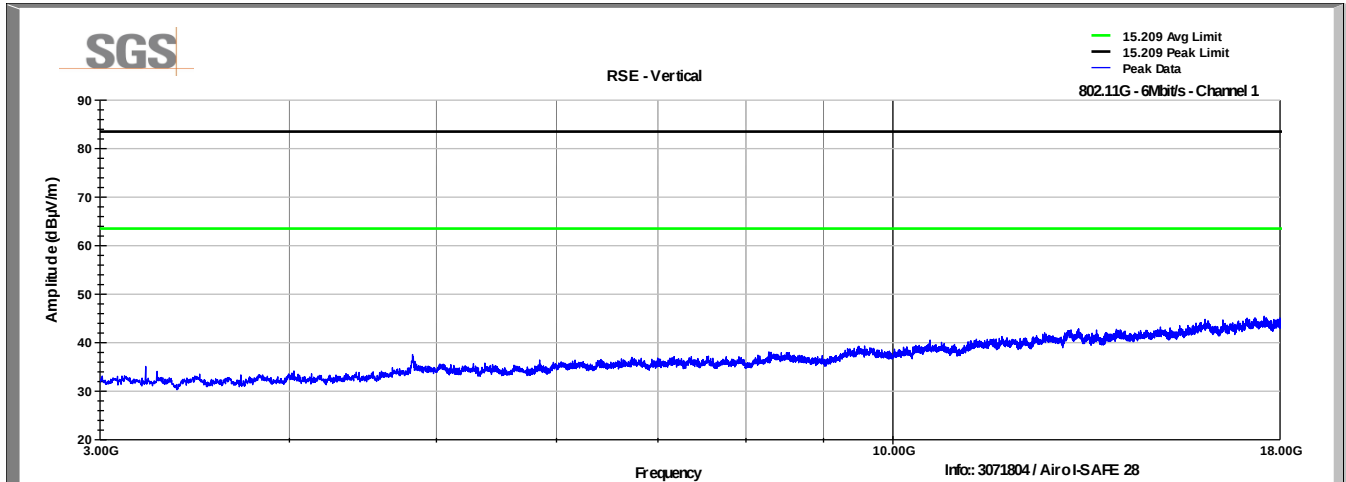
802.11g, 6Mbit/s, Channel 1
1-3GHz
Vertical
(3m test distance)



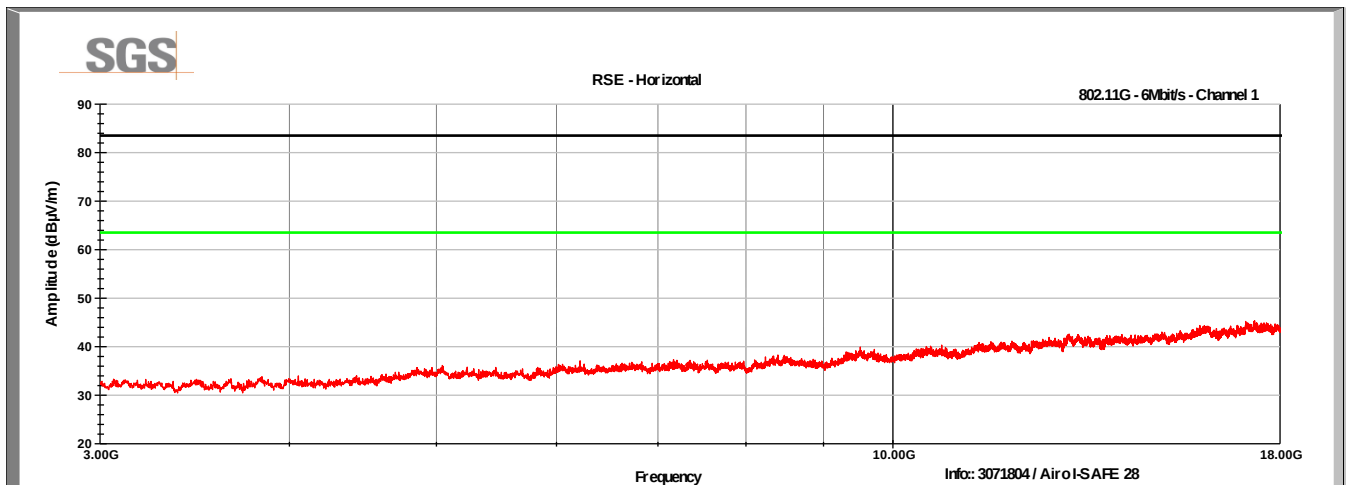
802.11g, 6Mbit/s, Channel 1
1-3GHz
Horizontal
(3m test distance)



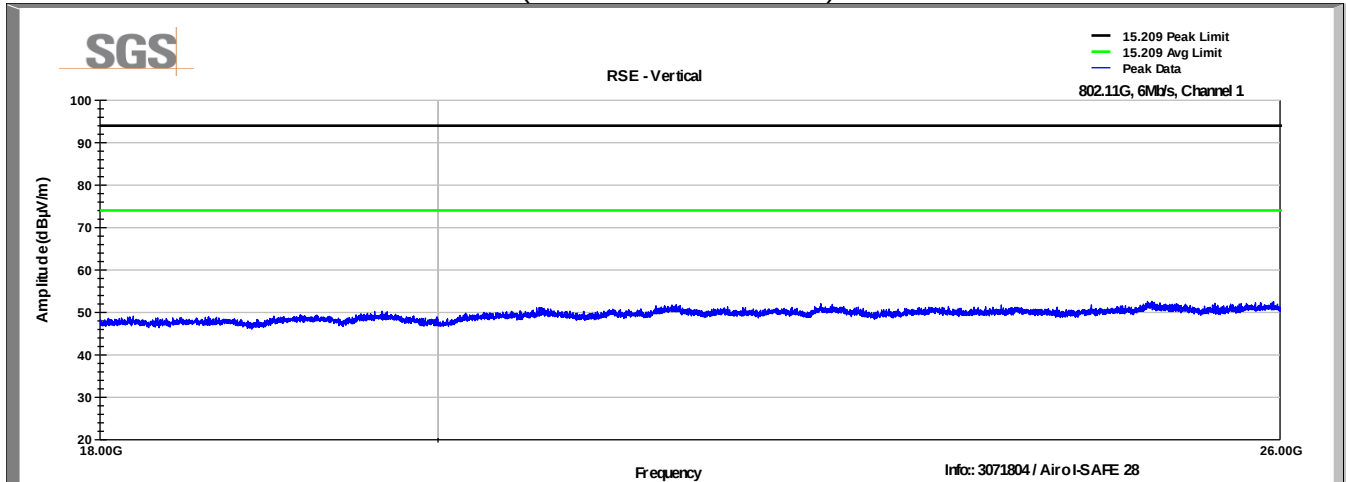
802.11g, 6Mbit/s, Channel 1
3-18GHz
Vertical
(1m test distance)



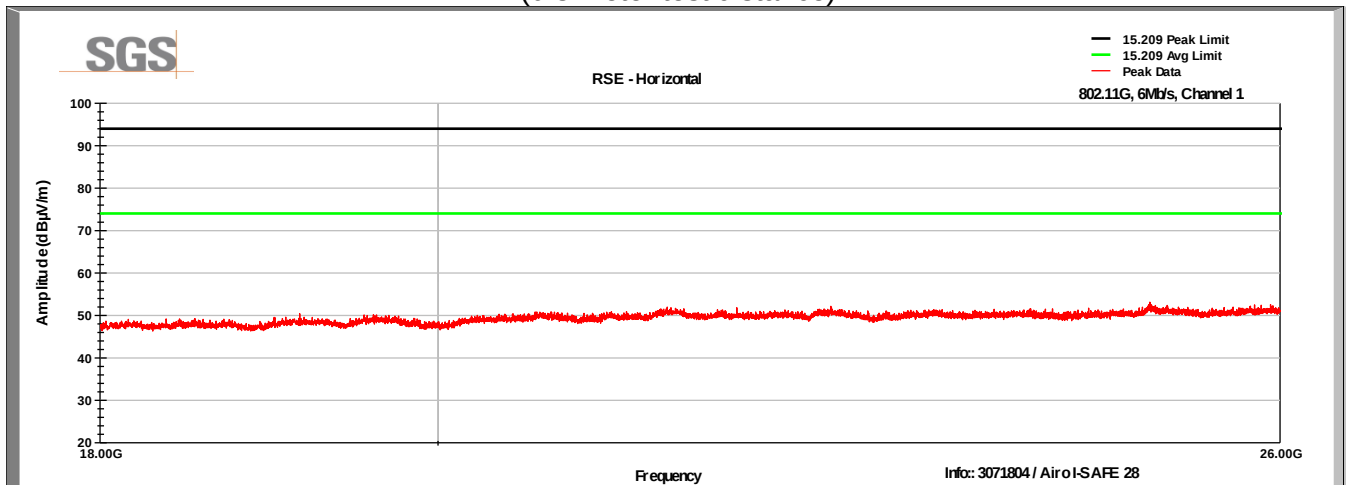
802.11g, 6Mbit/s, Channel 1
3-18GHz
Horizontal
(1m test distance)



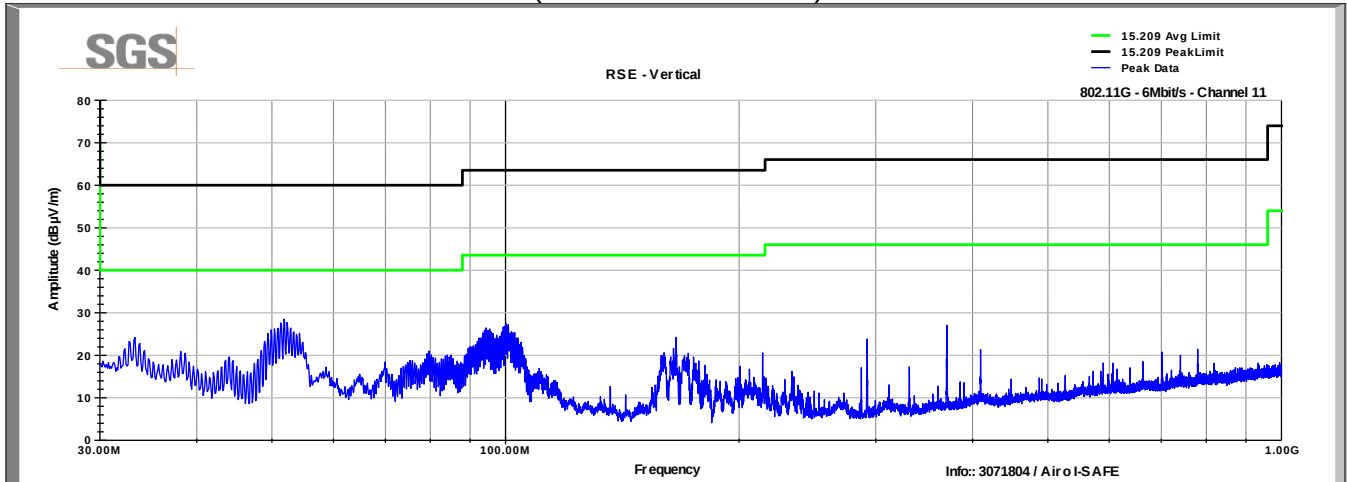
802.11g, 6Mbit/s, Channel 1
18-26GHz
Vertical
(0.3 meter test distance)



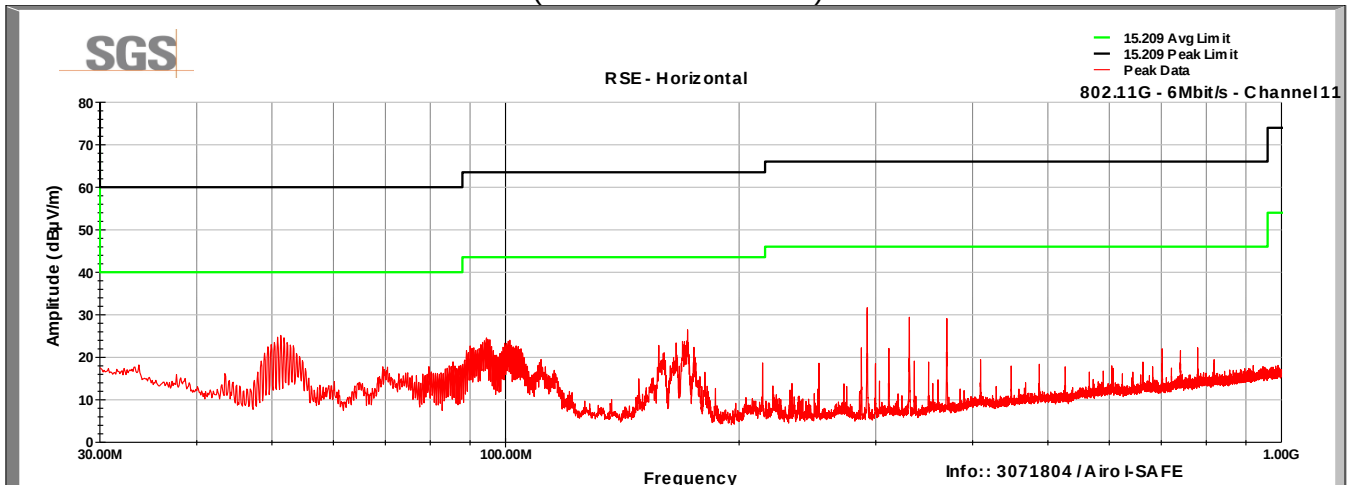
802.11g, 6Mbit/s, Channel 1
18-26GHz
Horizontal
(0.3 meter test distance)



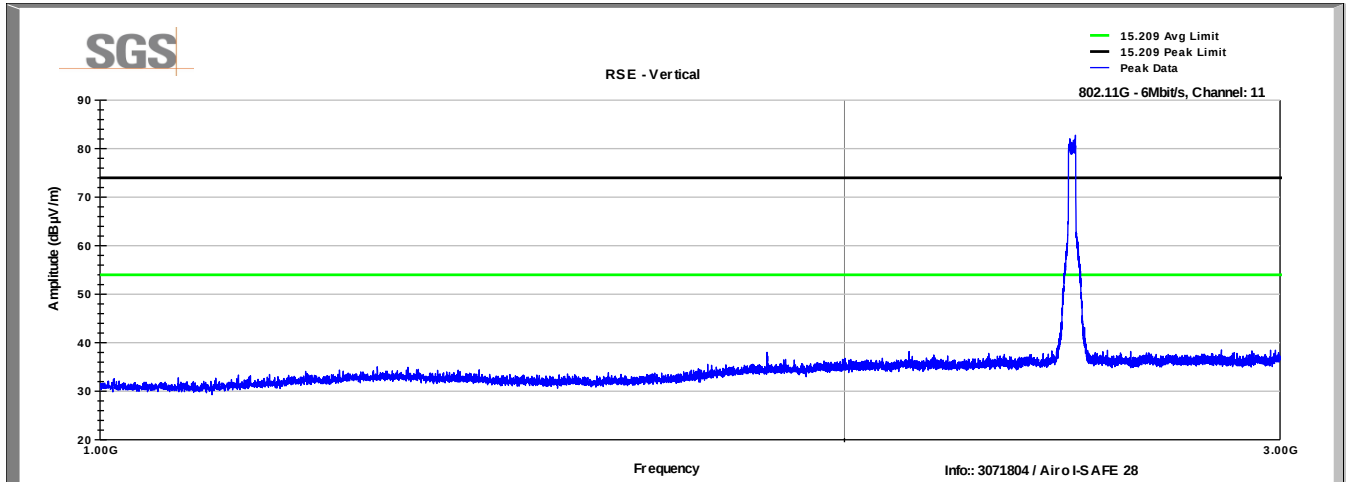
802.11g, 6Mbit/s, Channel 11
30-1000MHz
Vertical
(3 meter test distance)



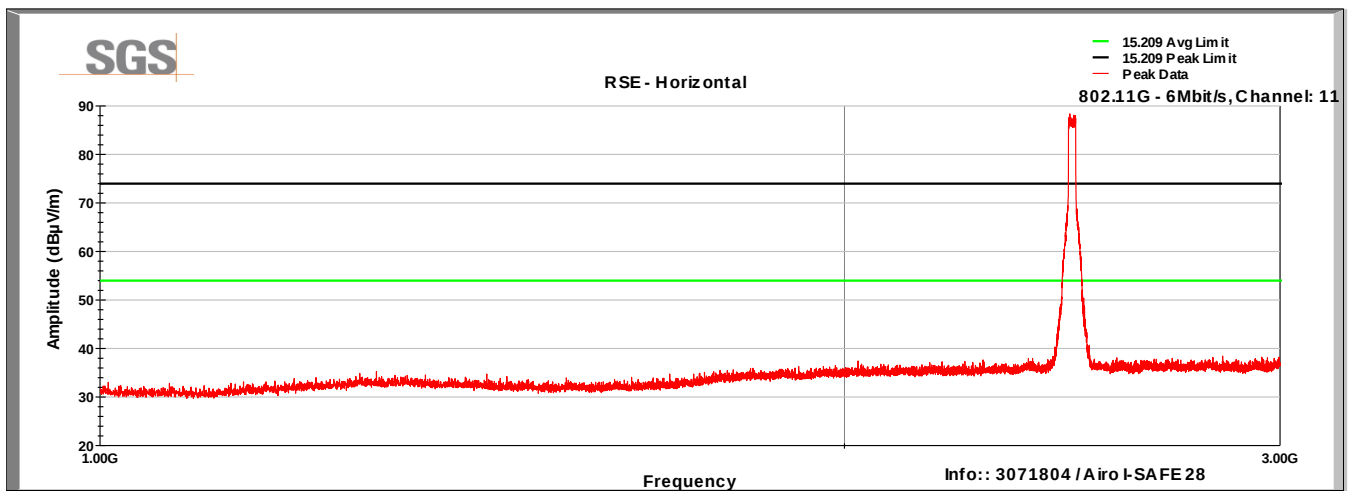
802.11g, 6Mbit/s, Channel 11
30-1000MHz
Horizontal
(3 meter test distance)



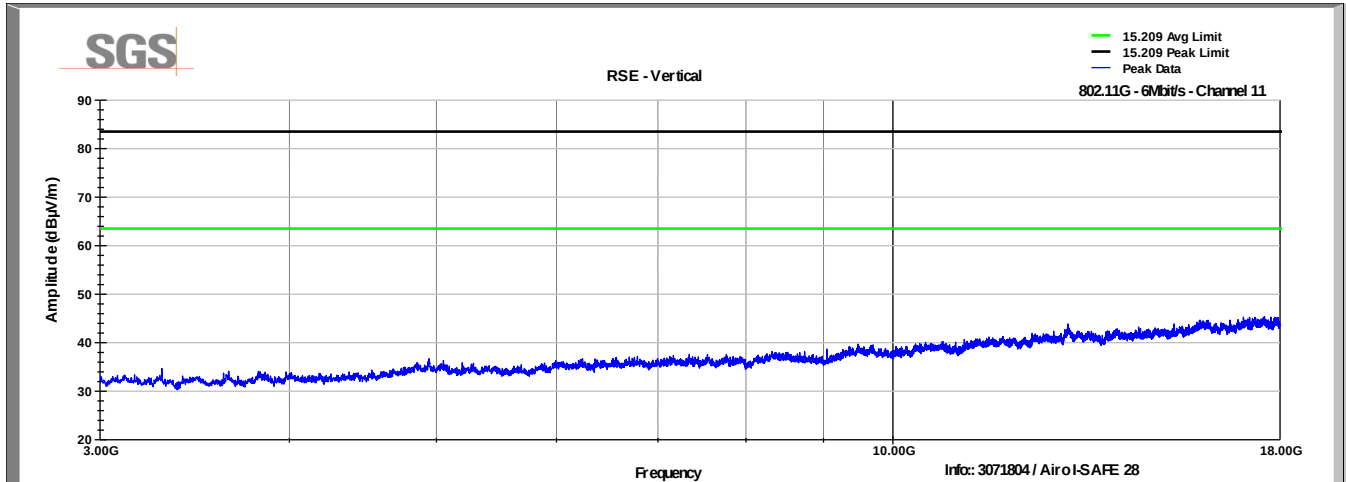
802.11g, 6Mbit/s, Channel 11
1-3GHz
Vertical
(3 meter test distance)



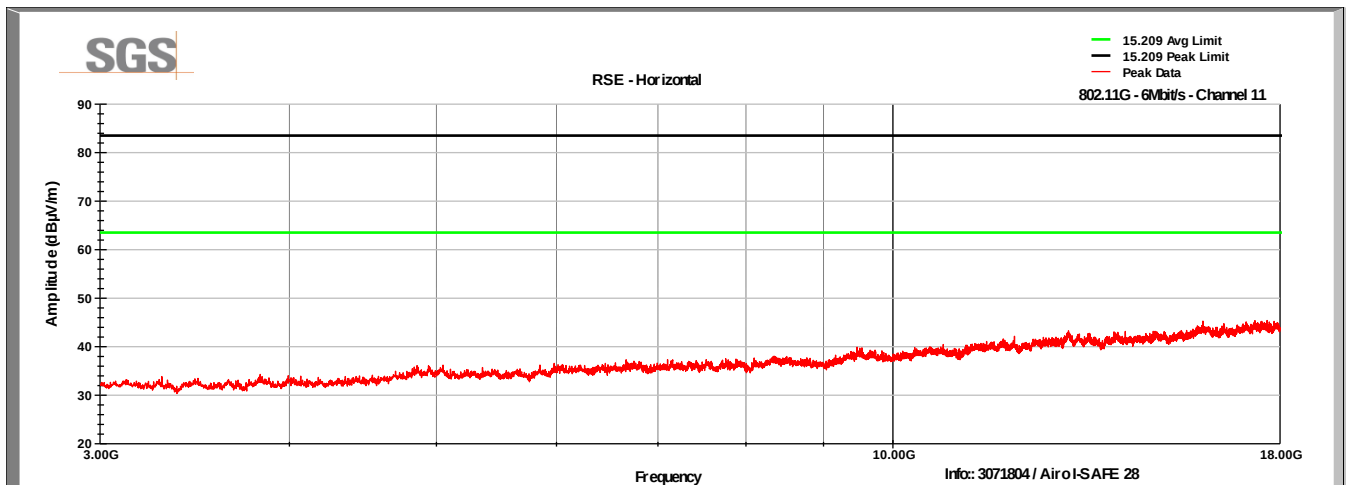
802.11g, 6Mbit/s, Channel 11
1-3GHz
Horizontal
(3 meter test distance)



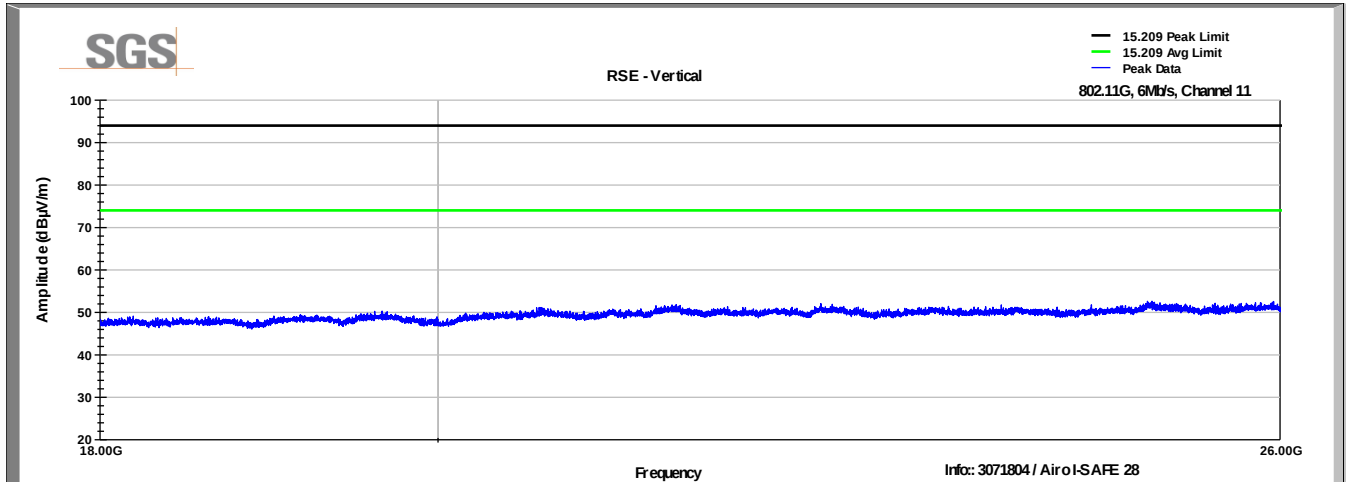
802.11g, 6Mbit/s, Channel 11
3-18GHz
Vertical
(1 meter test distance)



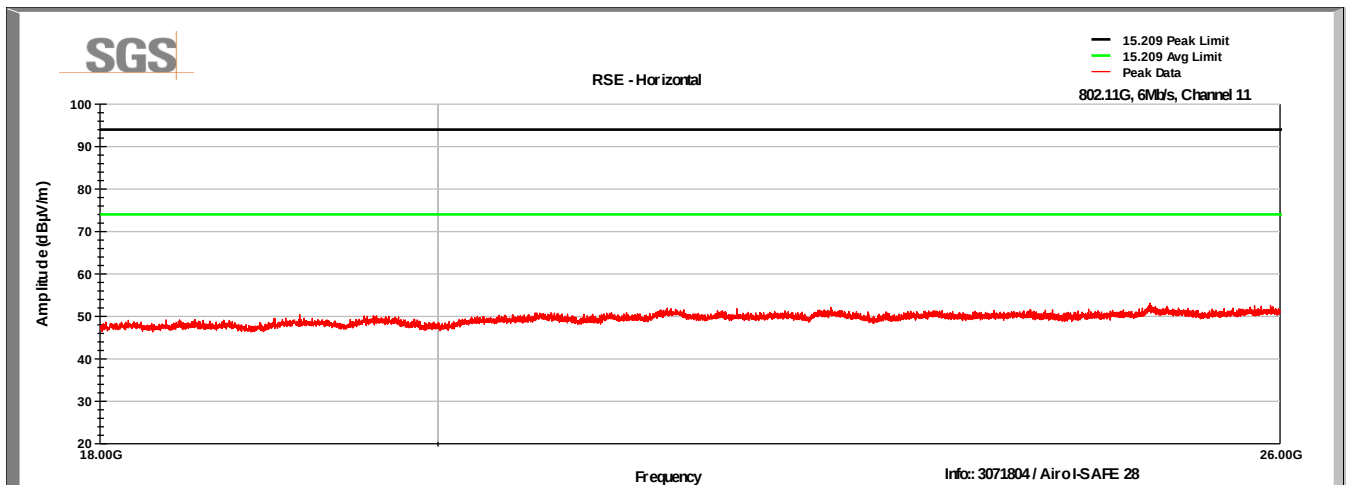
802.11g, 6Mbit/s, Channel 11
3-18GHz
Horizontal
(1 meter test distance)



802.11g, 6Mbit/s, Channel 11
18-26GHz
Vertical
(0.3 meter test distance)



802.11g, 6Mbit/s, Channel 11
18-26GHz
Horizontal
(0.3 meter test distance)



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 made using the conducted methods defined in Section 12 of FCC publication D01 DTS Meas Guidance v03r01. The measurements were recorded and using the equation $E = EIRP - 20\log D + 104.8$, the readings were converted to a radiated field strength equivalent. The resultant data were compared to the average limit of 54 dBμV/m and peak limit of 74 dBμV/m.

Measurements were made in the following modes of operation: 802.11g and n at low and high channels. The worst-case data rates of 6Mbit/s and MCS0 were used.

8.3 Test Site

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

Environmental Conditions

Temperature: 24.8 °C

Relative Humidity: 30.7 %

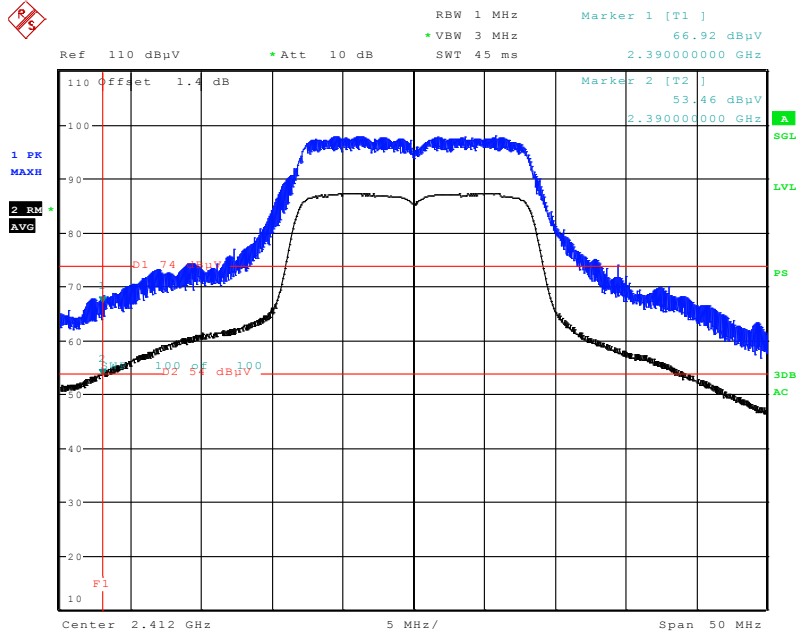
8.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013

Note: The calibration period equipment is 1 year.

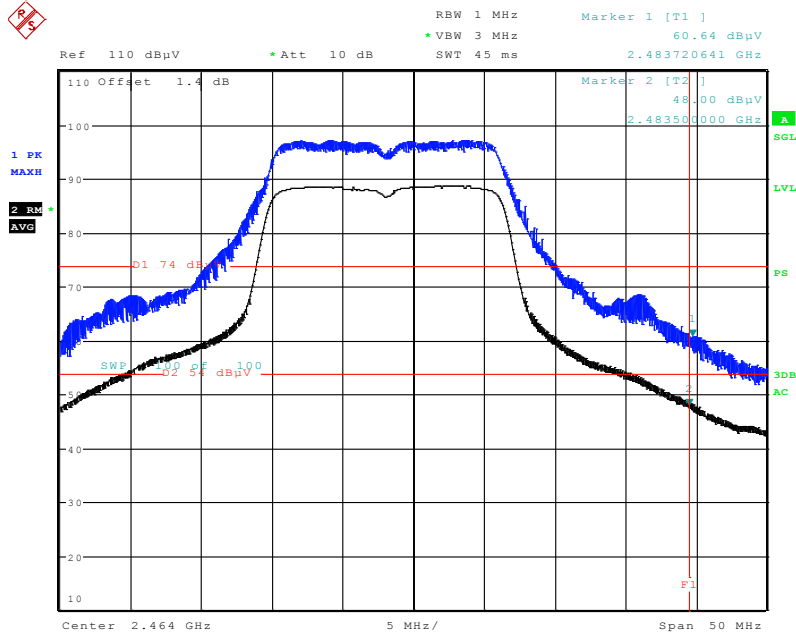
8.5 Test Data

802.11g, 6Mbit/s, Ch1 (worst case)



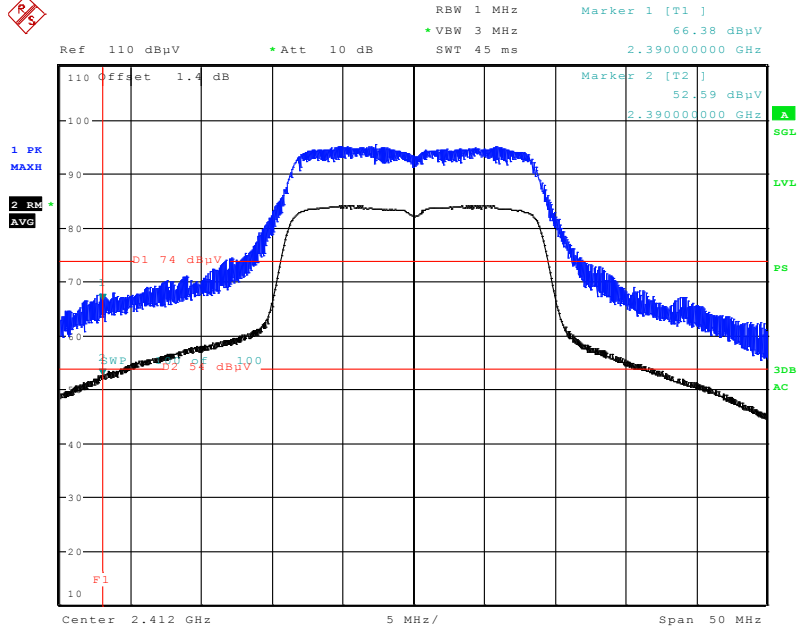
Date: 4.SEP.2013 10:51:06

802.11g, 6Mbit/s, Ch11 (worst case)



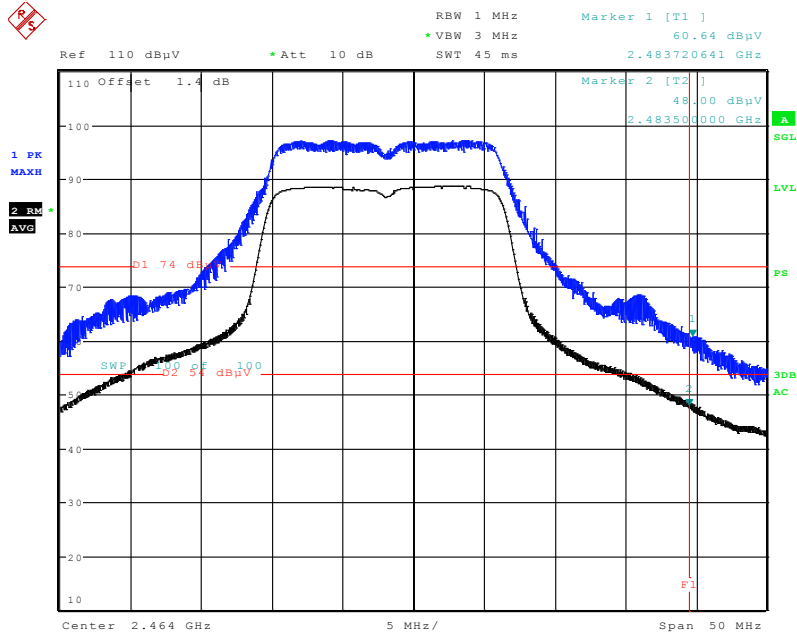
Date: 4.SEP.2013 10:32:11

802.11n, MCS0, Ch1 (worst case)



Date: 4.SEP.2013 10:46:35

802.11n, MCS0, Ch11 (worst case)



Date: 4.SEP.2013 10:32:11

9 Conducted Emissions

9.1 Test Result

Test Description	Basic Standards	Test Result
Conducted Emissions	15.107, Class B ANSI C63.4:2009	Compliant

9.2 Test Method

With the receivers resolution bandwidth was set to 9 kHz the initial preliminary exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBuV)		Class B Limits (dBuV)	
	FCC	CISPR	FCC	CISPR
0.15 to 0.5 MHz		Avg 66 QP 79		Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz		Avg 60 QP 73		Avg 46 Pk 56
5 to 30 MHz		Avg 60 QP 73		Avg 50 Pk 60

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.4 °C

Relative Humidity: 47.8 %

9.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
TWO-LINE V-NETWORK	NNB 51	TESEQ	B085882	9-Oct-2013
17 FT N TYPE COAX CABLE	HS 84133232	HUBER&SUHNER	B079661	13-Aug-2013

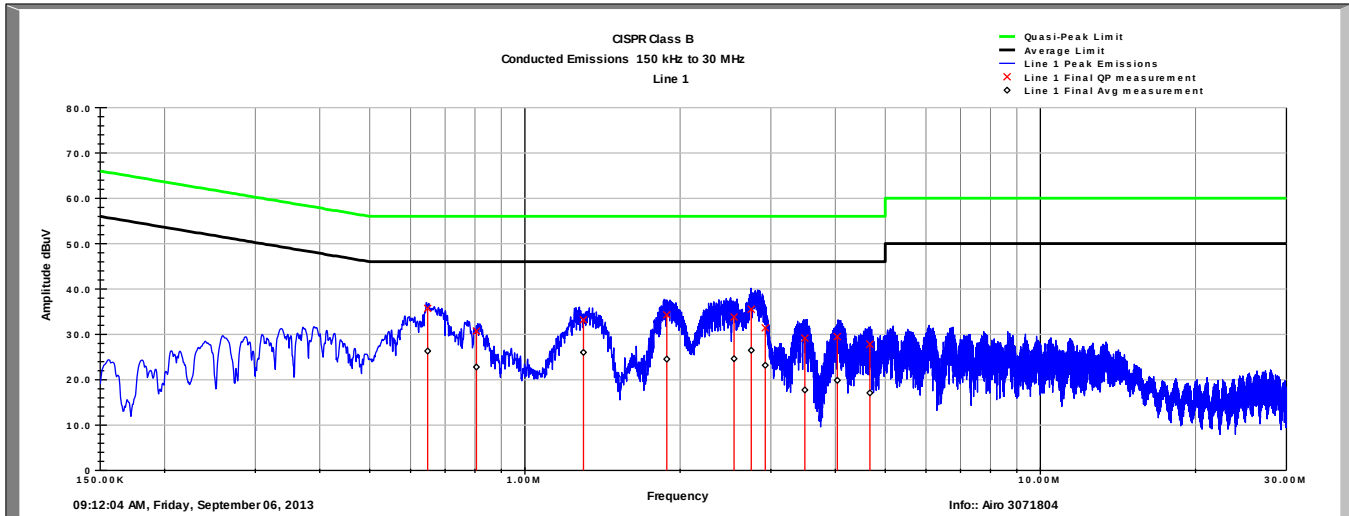
Note: The calibration period equipment is 1 year.

Software:

“Conducted Emissions” TILE! profile dated 10 Nov 2011

9.5 Test Data

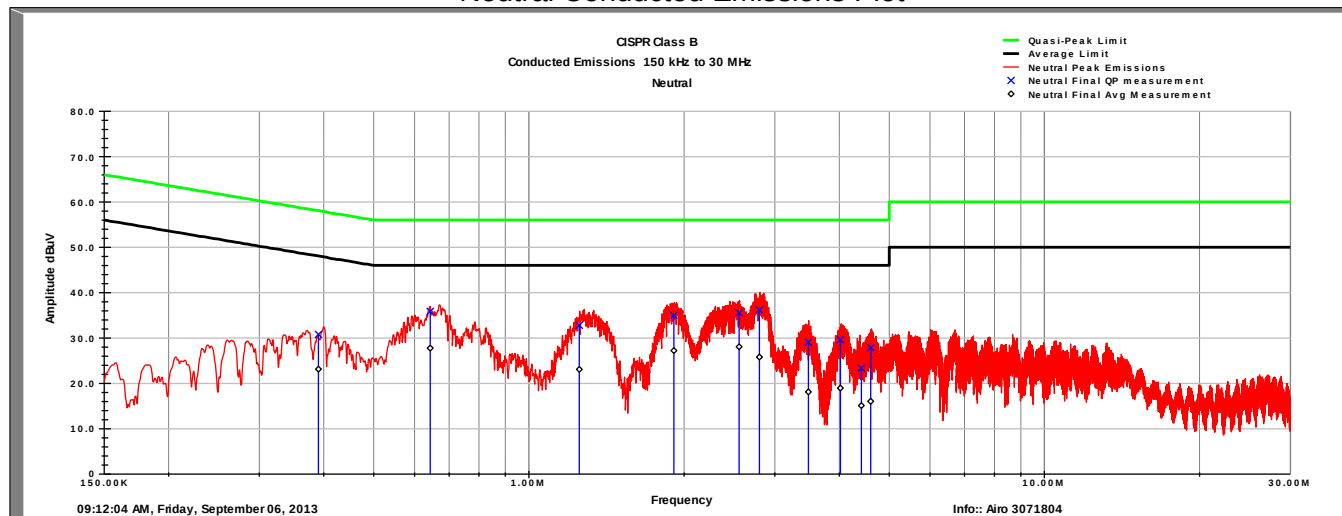
Line 1 Conducted Emissions Plot



Line 1 Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.648	35.7	56.0	-20.3	26.3	46.0	-19.7
0.805	30.7	56.0	-25.3	22.8	46.0	-23.2
1.298	33.2	56.0	-22.8	26.0	46.0	-20.0
1.885	34.3	56.0	-21.7	24.5	46.0	-21.5
2.546	33.8	56.0	-22.2	24.6	46.0	-21.4
2.749	35.5	56.0	-20.5	26.5	46.0	-19.5
2.927	31.4	56.0	-24.6	23.2	46.0	-22.8
3.493	29.2	56.0	-26.8	17.7	46.0	-28.3
4.037	29.5	56.0	-26.5	19.9	46.0	-26.1
4.669	27.8	56.0	-28.2	17.1	46.0	-28.9

Neutral Conducted Emissions Plot



Neutral Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.391	30.8	58.1	-27.3	23.1	48.1	-25.0
0.644	35.9	56.0	-20.1	27.8	46.0	-18.2
1.253	32.8	56.0	-23.2	23.1	46.0	-22.9
1.911	35.0	56.0	-21.0	27.2	46.0	-18.8
2.557	35.5	56.0	-20.5	28.1	46.0	-17.9
2.800	36.2	56.0	-19.8	25.8	46.0	-20.2
3.485	29.1	56.0	-26.9	18.1	46.0	-27.9
4.020	29.6	56.0	-26.4	19.0	46.0	-27.0
4.416	23.4	56.0	-32.6	15.1	46.0	-30.9
4.604	27.9	56.0	-28.1	16.0	46.0	-30.0

10 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	11 Sept 2013