25800 Commercentre Drive
Lake Forest, CA 92630 USA

Telephone: (949) 448-4100
Facsimile: (949) 448-4111
www.intertek-etlsemko.com

TEST REPORT

Report Number:	**101324794LAX-001a**
Project Number:	**G101324794**
Report Issue Date:	**11/06/2013**
Product Name:	**Boogie Board Sync**
Model Number:	**WT13106**
FCCID:	**2AAPJ-WT13106**
ICID:	**11293A-WT13106**
Standards:	**FCC 47CFR Part 15 Subpact C, Section 15.247** **FCC 47CFR Part 15 Subpart B: Unintentional Radiators** **RSS-210 Issue 8**
Radios Under Test:	**Bluetooth 2.1 + EDR**

Tested by:
Intertek Testing Services NA, Inc.
25800 Commercentre Drive
Lake Forest, CA 92630 USA

Client:
Kent Displays, Inc.
343 Portage Boulevard
Kent, OH 44240 USA

Report prepared by

Mosin Dean
EMC Project Engineer

Report reviewed by

Bryan Taylor
Engineering Team Leader

TABLE OF CONTENTS

1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK- Lake Forest is located at 25800 Commercentre Drive, Lake Forest CA. The radiated emission test site is a 3-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Peak Output Power	§ 15.247(b)(1)	RSS210 (A8.4)	Pass
12	20dB Bandwidth	§ 15.247(a)(1)	RSS210 (A8.1)	Pass
22	Channel Separation	§ 15.247(a)(1)	RSS210 (A8.1)	Pass
25	Number of Hopping Channels	§ 15.247(a)(1)(iii)	RSS210(A8.1)	Pass
29	Average Time of Occupancy	§ 15.247(a)(1)(iii)	RSS210 (A8.1)	Pass
33	Conducted Spurious Emissions	§ 15.247(d)	RSS210 (A8.5)	Pass
45	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (A8.5)	Pass Note 1
51	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (6.1)	Pass
57	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
63	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass
64	RF Exposure Evaluation	§ 15.247(i)	RSS-102	Pass

Note 1: Per manufacturer declaration, a duty cycle letter of attestation was provided for the duty cycle measurement, which resulted in a duty cycle factor (DCF) being greater than -20 dB. Therefore, for Radiated Spurious Emissions (Transmitter) a max DCF value of -20 dB was used.

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Kent Displays, Inc.
Model Number	WT13106
Serial Number	N/A
FCC Identifier	2AAPJ-WT13106
Industry Canada Identifier	11293A-WT13106
Receive Date	09/17/2013
Test Start Date	09/17/2013
Test End Date	10/20/2013
Device Received Condition	Good
Test Sample Type	Production
Frequency Range	2402 – 2480MHz
Modulation Delivery System	FHSS
Modulation Type(s)	GFSK (1 Mbps), π/4 DQPSK (2 Mbps), 8DPSK (3 Mbps)
Transmission Control	Test Commands
Test Channels	0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz)
Antenna Type (15.203)	Internal
Operating Voltage	3.2 VDC to 4.2 VDC Battery; 5 VDC USB

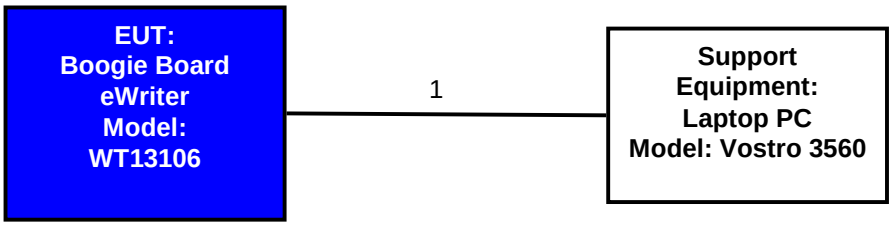
Description of Equipment Under Test
The Boogie Board Sync is a note-taking or drawing device intended to be used with Bluetooth and USB Host devices including mobile devices and personal computers.

Operating modes of the EUT:

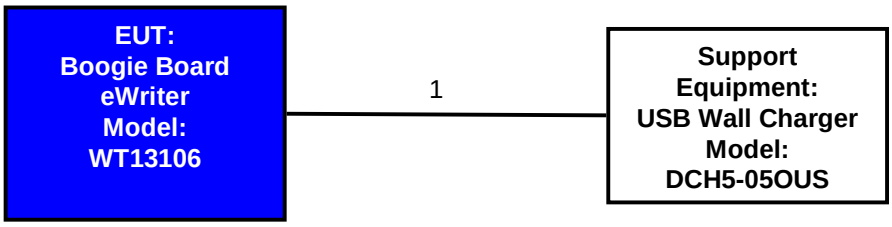
No.	**Descriptions of EUT Exercising**
1	Transmitting a FHSS signal with the hopping enabled.
2	Transmitting continuously on a single channel.
3	Receive / idle mode.

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



Conducted AC Powerline Emissions Test Setup



3.3 Cables:

Cables				
No.	Description	Length	Shielding	Ferrites
1	USB Micro Cable	1 m	Yes	No

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop PC	Dell	Vostro 3560	4STWGW1
USB Wall Charger	Emerson	DCH5-05OUS	J525L2245501L

4 Peak Output Power

4.1 Test Limits

§ 15.247(b): The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

4.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. The peak output power was measured using the marker to peak function of the spectrum analyzer.

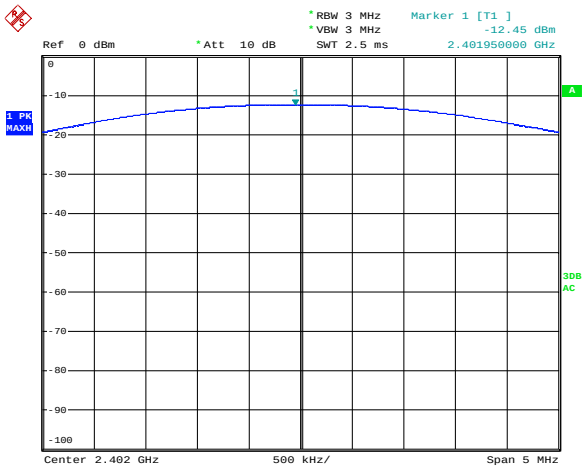
4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	100825	Rohde&Schwarz	ESCI7	1140	02/19/2013	02/19/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

4.4 Results:

Channel Number	Frequency (MHz)	Data Rate	Raw Peak Output Power (dBm)	Cable Loss (dB)	Ext. Att. Factor (dB)	Corr. Peak Output Power (dBm)	Limit (dBm)	Margin (dBm)	Result
Low (0)	2402	1 Mbps	-12.45	2.44	19.97	9.96	30	-20.04	Pass
Mid (39)	2441	1 Mbps	-12.36	2.44	19.97	10.05	30	-19.95	Pass
High (78)	2480	1 Mbps	-12.10	2.44	19.97	10.31	30	-19.69	Pass
Low (0)	2402	2 Mbps	-12.47	2.44	19.97	9.94	30	-20.06	Pass
Mid (39)	2441	2 Mbps	-12.35	2.44	19.97	10.06	30	-19.94	Pass
High (78)	2480	2 Mbps	-12.10	2.44	19.97	10.31	30	-19.69	Pass
Low (0)	2402	3 Mbps	-11.63	2.44	19.97	10.78	30	-19.22	Pass
Mid (39)	2441	3 Mbps	-11.59	2.44	19.97	10.82	30	-19.18	Pass
High (78)	2480	3 Mbps	-11.46	2.44	19.97	10.95	30	-19.05	Pass

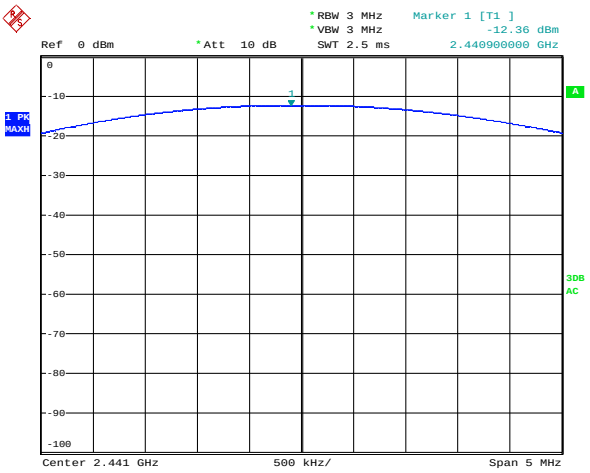
4.5 Test Plots:



1 MBPS LOW CH

Date: 2.NOV.2013 11:51:33

Peak Output Power Low Channel (1 Mbps)



1 MBPS MID CH

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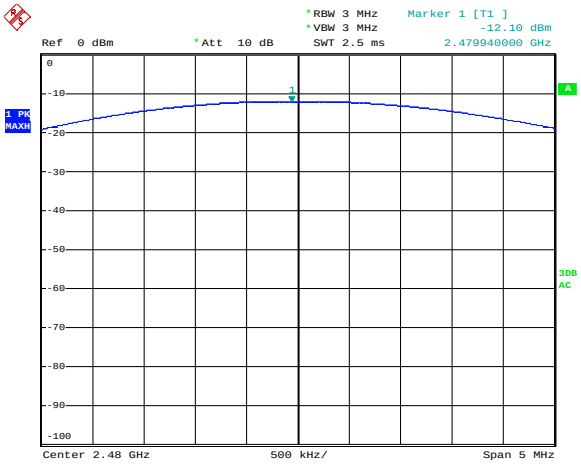
Peak Output Power Mid Channel (1 Mbps)

4.6 Test Plots:



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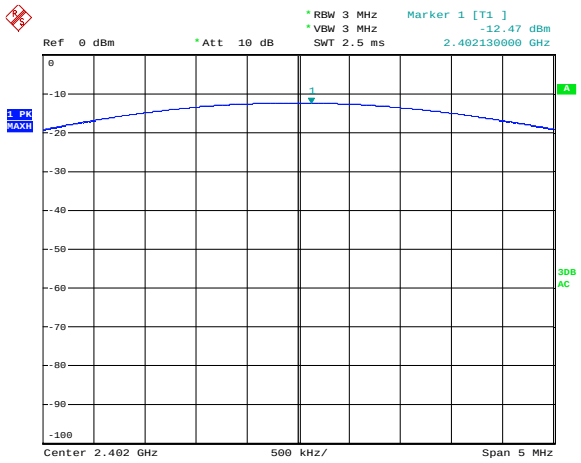
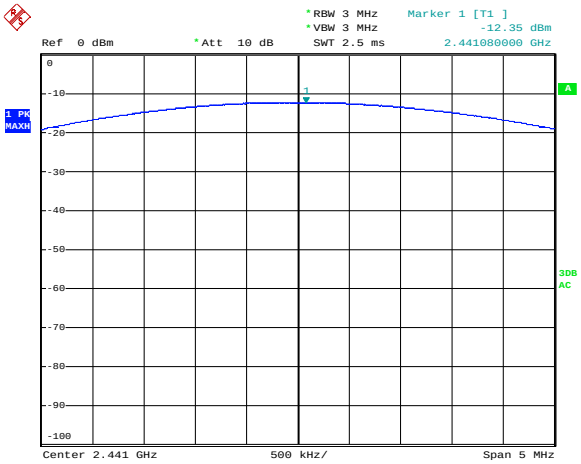
Peak Output Power High Channel (1 Mbps)



2 MBPS LOW CH
Date: 2.NOV.2013 11:55:13

Peak Output Power Low Channel (2 Mbps)

4.7 Test Plots:



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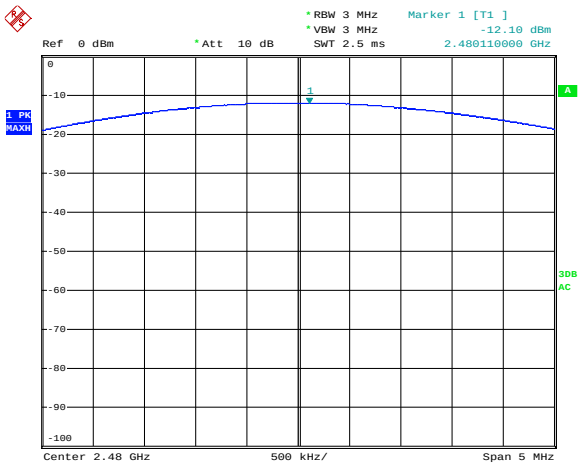
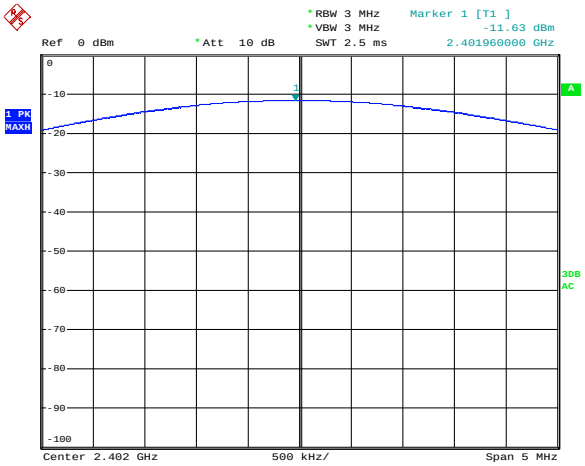
Peak Output Power Mid Channel (2 Mbps)



2 MBPS HIGH CH
Date: 2.NOV.2013 11:57:04

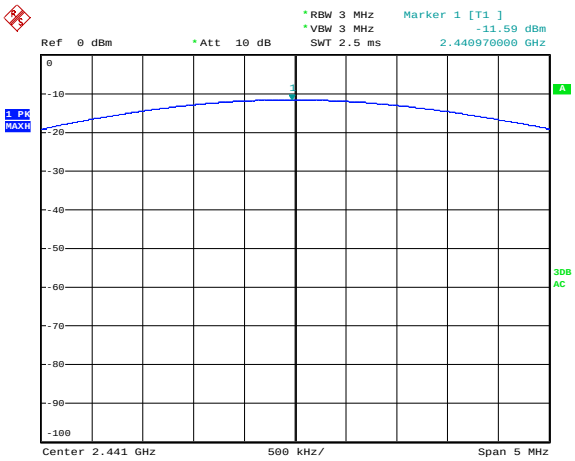
Peak Output Power High Channel (2 Mbps)

4.8 Test Plots:



3 MBPS LOW CH
Date: 2.NOV.2013 11:58:45

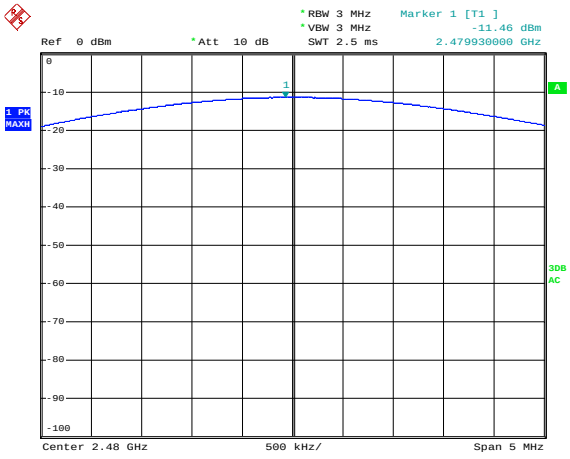
Peak Output Power Low Channel (3 Mbps)



3 MBPS MID CH
Date: 2.NOV.2013 12:00:48

Peak Output Power Mid Channel (3 Mbps)

4.9 Test Plots:



Peak Output Power High Channel (3 Mbps)

5 20dB Bandwidth and 99% Occupied Bandwidth

5.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

5.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

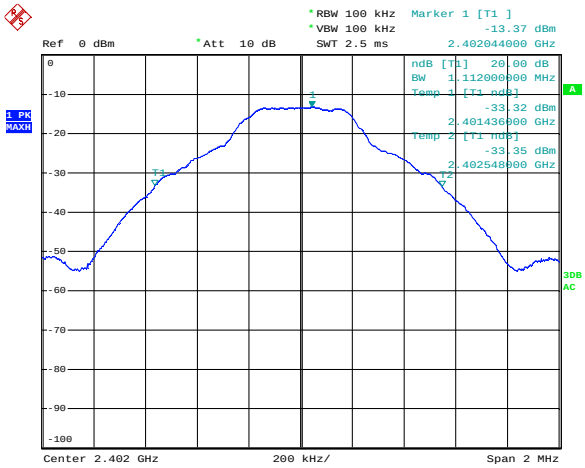
5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	100825	Rohde&Schwarz	ESCI7	1140	02/19/2013	02/19/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

5.4 Results:

Channel	Data Rate	Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied Bandwidth (kHz)
Low	1 Mbps	2402	1.112	928.0
Mid	1 Mbps	2441	1.104	940.0
High	1 Mbps	2480	1.112	928.0
Low	2 Mbps	2402	1.448	1260.0
Mid	2 Mbps	2441	1.448	1260.0
High	2 Mbps	2480	1.448	1256.0
Low	3 Mbps	2402	1.432	1264.0
Mid	3 Mbps	2441	1.428	1268.0
High	3 Mbps	2480	1.428	1260.0

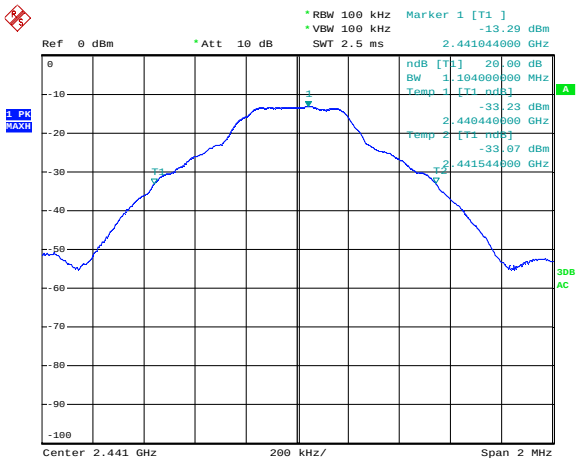
5.5 Test Plots:



1 MBPS LOW CH

Date: 2.NOV.2013 12:11:59

20dB Bandwidth Low Channel (1 Mbps)

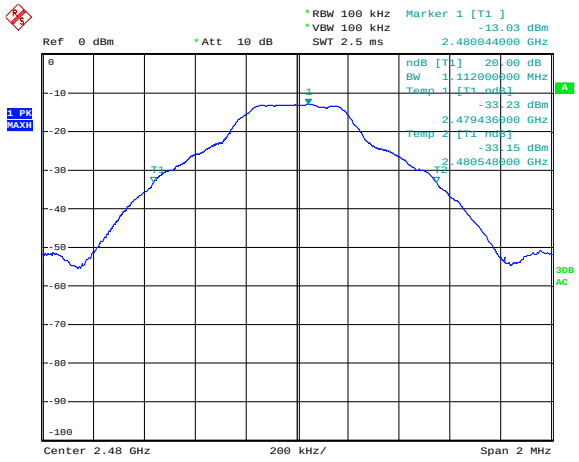


1 MBPS MID CH

Date: 2.NOV.2013 12:13:20

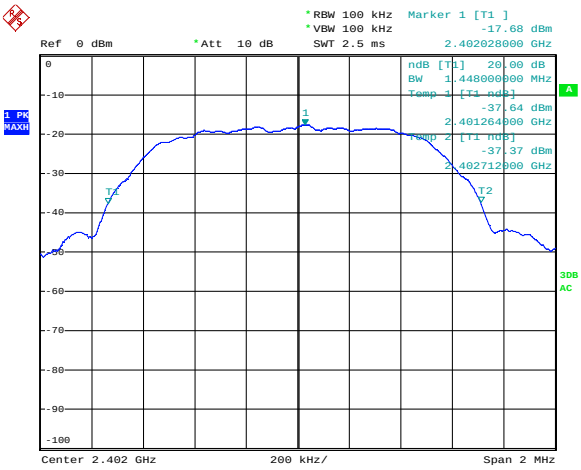
20dB Bandwidth Mid Channel (1 Mbps)

5.6 Test Plots:



1 MBPS HIGH CH
Date: 2.NOV.2013 12:14:22

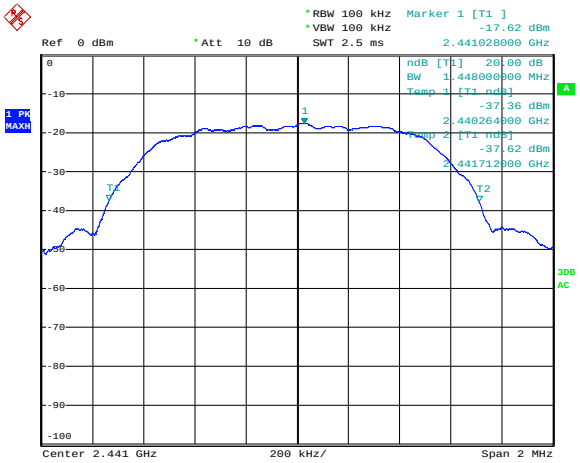
20dB Bandwidth High Channel (1 Mbps)



2 MBPS LOW CH
Date: 2.NOV.2013 12:16:12

20dB Bandwidth Low Channel (2 Mbps)

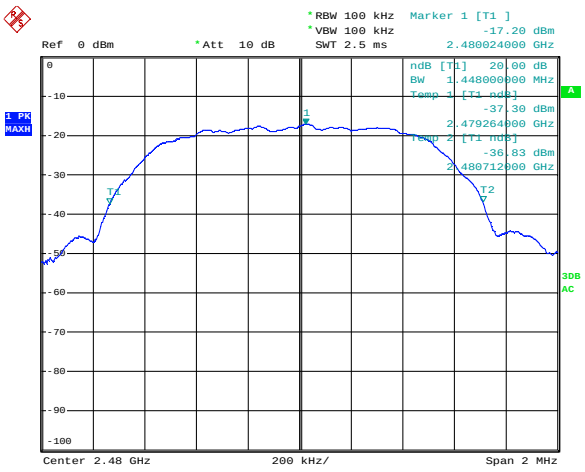
5.7 Test Plots:



2 MBPS MID CH

Date: 2.NOV.2013 12:17:14

20dB Bandwidth Mid Channel (2 Mbps)

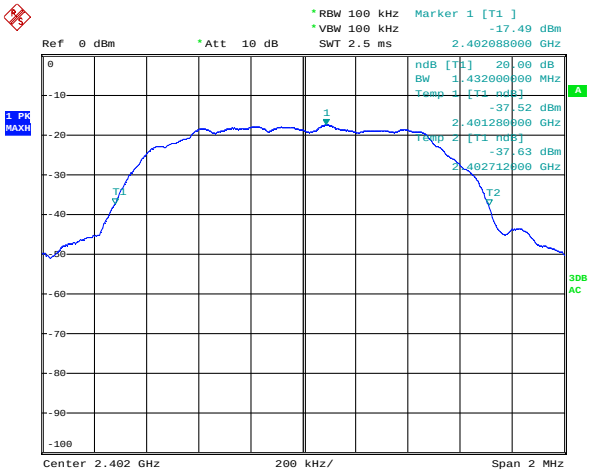


2 MBPS HIGH CH

Date: 2.NOV.2013 12:18:02

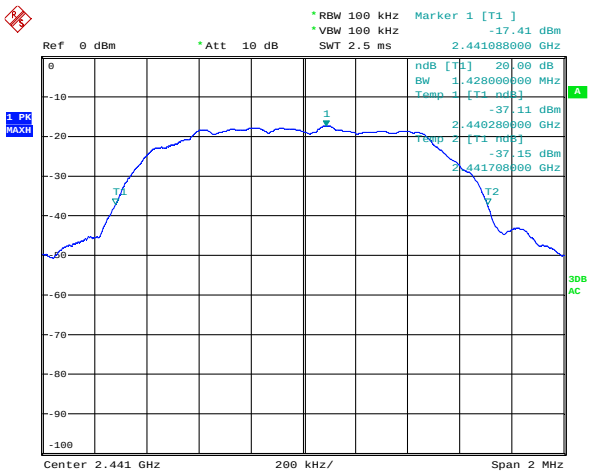
20dB Bandwidth High Channel (2 Mbps)

5.8 Test Plots:



3 MBPS LOW CH
Date: 2.NOV.2013 12:19:38

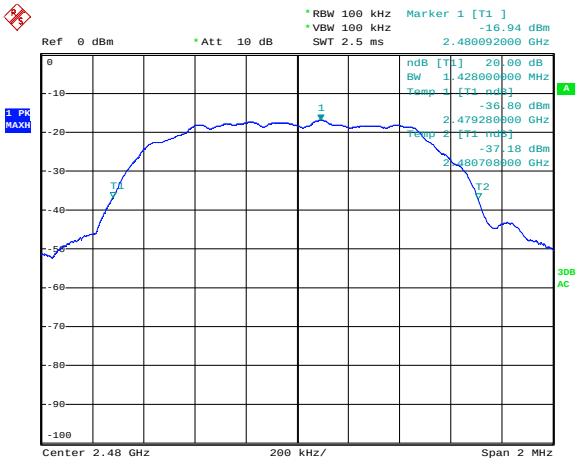
20dB Bandwidth Low Channel (3 Mbps)



3 MBPS MID CH
Date: 2.NOV.2013 12:20:41

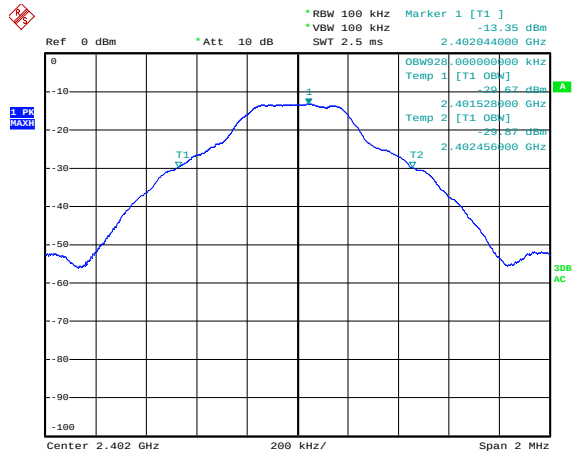
20dB Bandwidth Mid Channel (3 Mbps)

5.9 Test Plots:



3 MBPS HIGH CH
Date: 2.NOV.2013 12:21:42

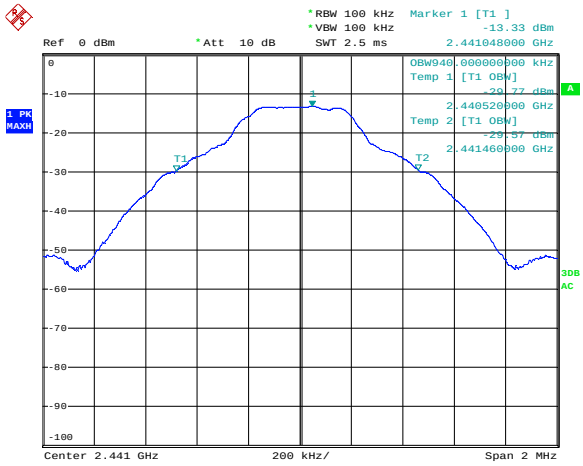
20dB Bandwidth High Channel (3 Mbps)



1 MBPS LOW CH 99% OBW
Date: 2.NOV.2013 12:25:28

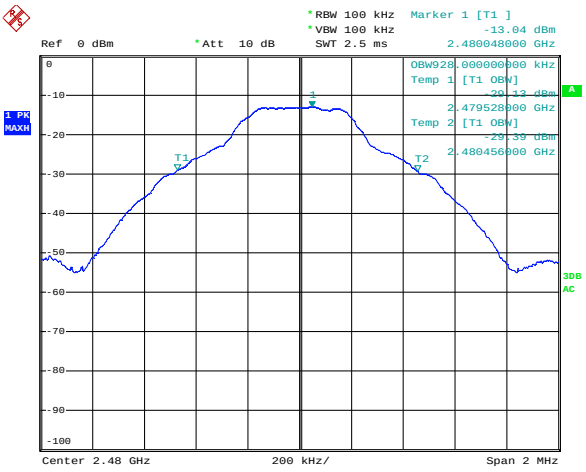
99% Occupied Bandwidth Low Channel (1 Mbps)

5.10 Test Plots:



1 MBPS MID CH 99% OBW
Date: 2.NOV.2013 12:26:14

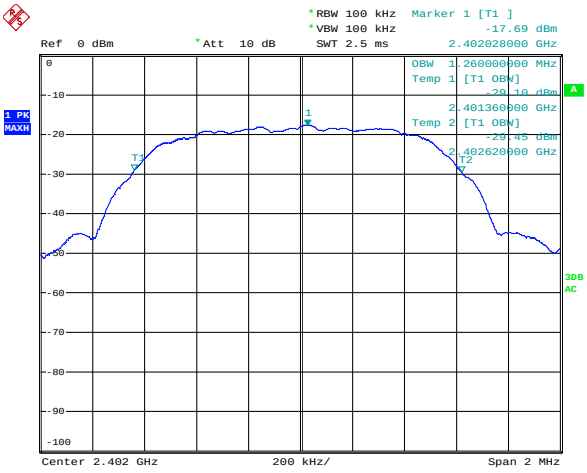
99% Occupied Bandwidth Mid Channel (1 Mbps)



1 MBPS HIGH CH 99% OBW
Date: 2.NOV.2013 12:27:07

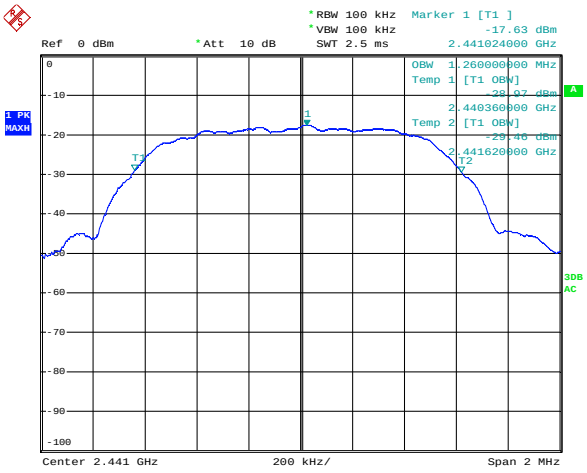
99% Occupied Bandwidth High Channel (1 Mbps)

5.11 Test Plots:



2 MBPS LOW CH 99% OBW
Date: 2.NOV.2013 12:28:48

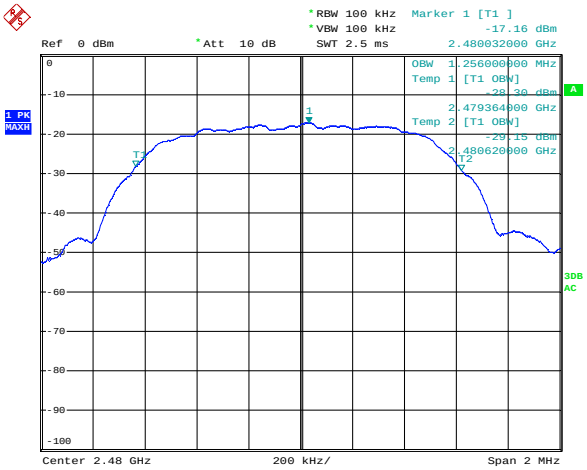
99% Occupied Bandwidth Low Channel (2 Mbps)



2 MBPS MID CH 99% OBW
Date: 2.NOV.2013 12:29:35

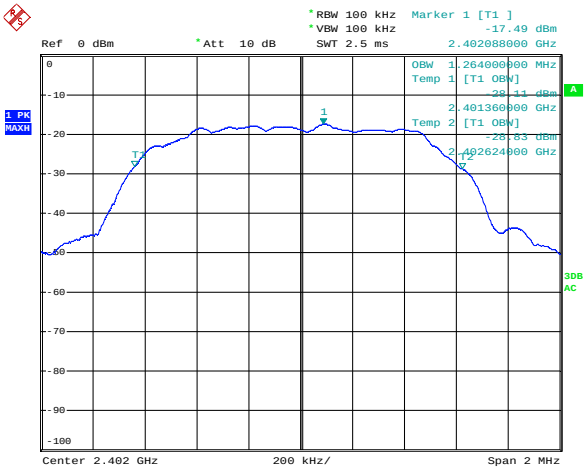
99% Occupied Bandwidth Mid Channel (2 Mbps)

5.12 Test Plots:



2 MBPS HIGH CH 99% OBW
Date: 2.NOV.2013 12:30:16

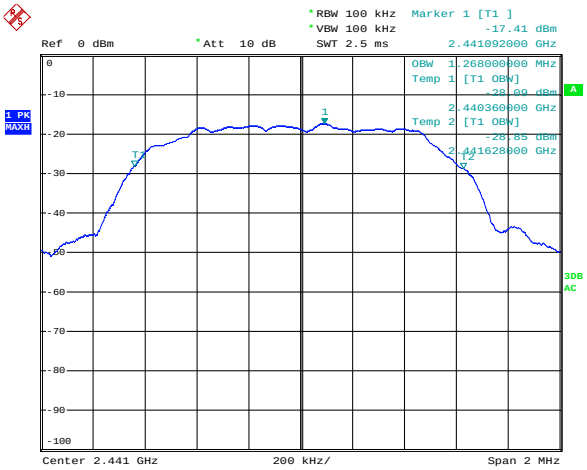
99% Occupied Bandwidth High Channel (2 Mbps)



3 MBPS LOW CH 99% OBW
Date: 2.NOV.2013 12:31:22

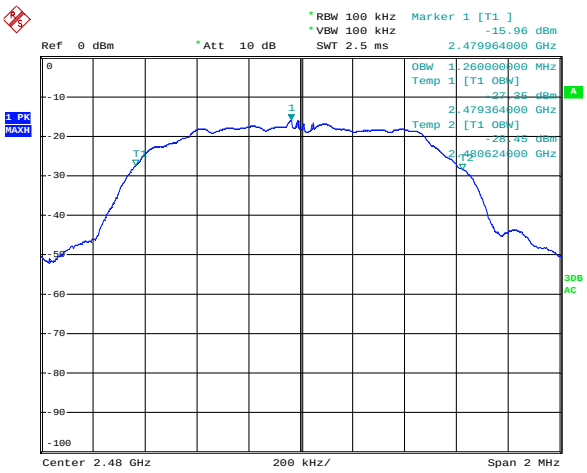
99% Occupied Bandwidth Low Channel (3 Mbps)

5.13 Test Plots:



3 MBPS MID CH 99% OBW
Date: 2.NOV.2013 12:32:06

99% Occupied Bandwidth Mid Channel (3 Mbps)



3 MBPS HIGH CH 99% OBW
Date: 2.NOV.2013 12:32:52

99% Occupied Bandwidth High Channel (3 Mbps)

6 Channel Separation

6.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) 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.

6.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

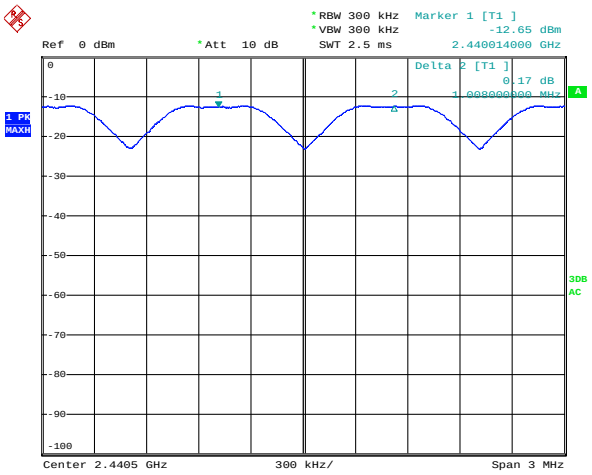
6.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	100825	Rohde&Schwarz	ESCI7	1140	02/19/2013	02/19/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

6.4 Results:

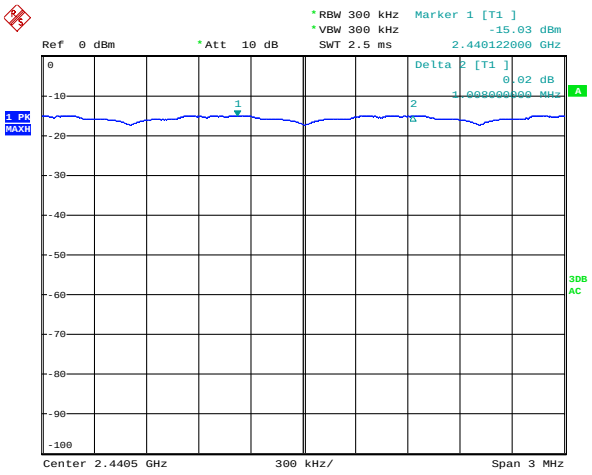
Data Rate	Frequency (MHz)	Frequency Seperation (MHz)
1 Mbps	2441	1.008
2 Mbps	2441	1.008
3 Mbps	2441	1.17

6.5 Test Plots:



1 MBPS CH SEP MID CH
Date: 2.NOV.2013 13:07:42

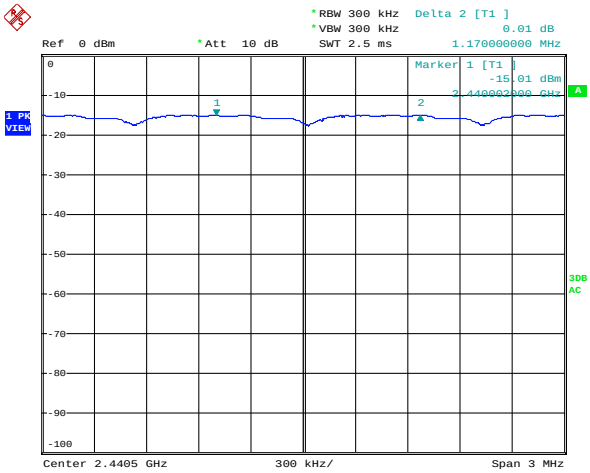
Carrier Frequency Separation (1 Mbps)



2 MBPS CH SEP MID CH
Date: 2.NOV.2013 14:00:30

Carrier Frequency Separation (2 Mbps)

6.6 Test Plots:



Carrier Frequency Separation (3 Mbps)

7 Number of Hopping Channels

7.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) (i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

7.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

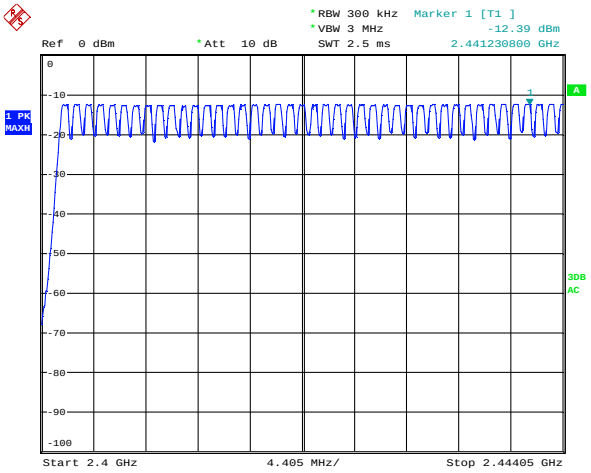
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	100825	Rohde&Schwarz	ESCI7	1140	02/19/2013	02/19/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

7.4 Results:

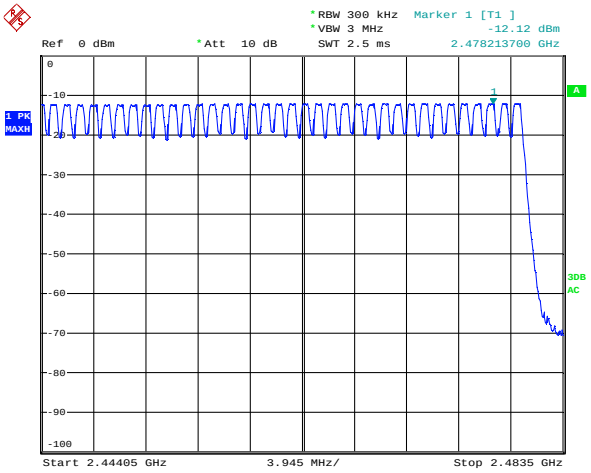
The plot below shows that there are 79 hopping frequencies channels being used

7.5 Test Plots:



1 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:06:53

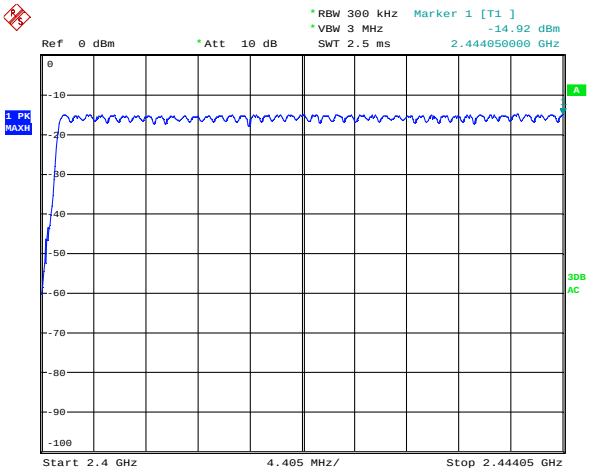


1 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:08:18

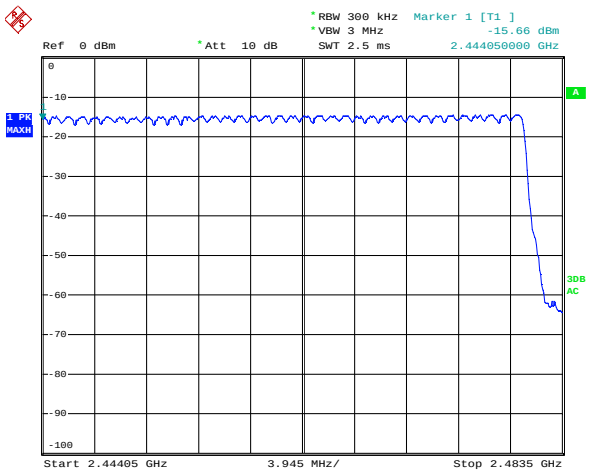
Number of Hopping Frequencies (1 Mbps)

7.6 Test Plots:



2 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:11:49

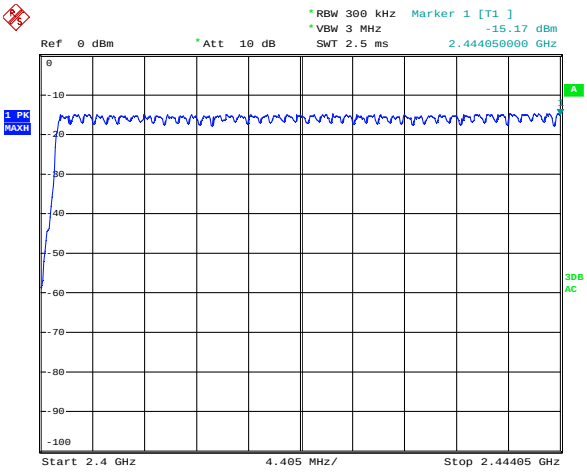


2 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:14:25

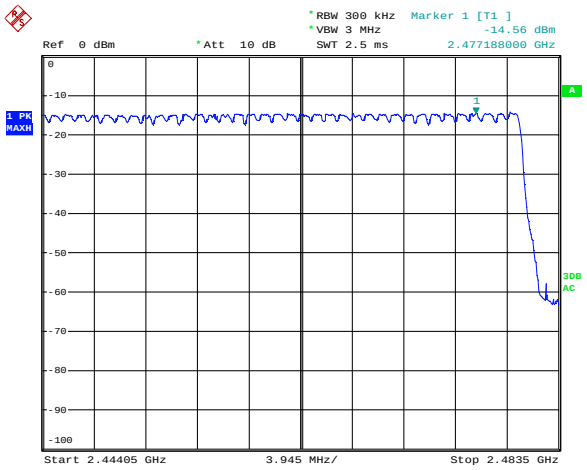
Number of Hopping Frequencies (2 Mbps)

7.7 Test Plots:



3 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:16:49



3 MBPS NUM OF HOPPING CH

Date: 2.NOV.2013 14:18:14

Number of Hopping Frequencies (3 Mbps)

8 Time of Occupancy

8.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used

8.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

8.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	100825	Rohde&Schwarz	ESCI7	1140	02/19/2013	02/19/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

8.4 Results:

The total “on” time over the measurement period is less than the 400mS limit.

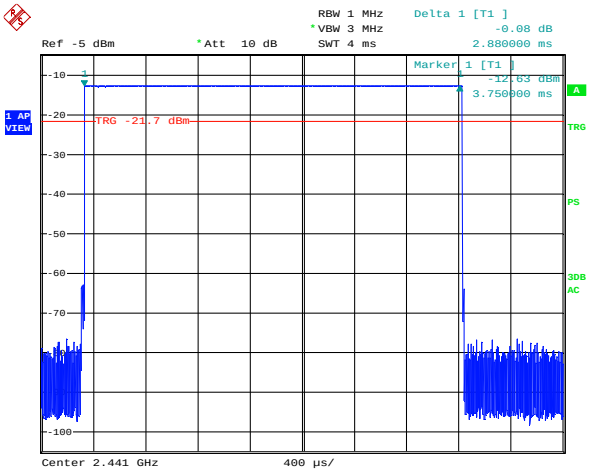
Measurement Period Calculation

Number of Hopping Channels Used = 79
Measurement Period = 0.4 x N
Measurement Period = 0.4 x 79
Measurement Period = 31.6 seconds

Time of Occupancy Calculation

Mode	Number of Transmissions in a 31.6sec Frame (79 Hopping Ch x 0.4)	Transmission Single Pulse On Time (mS)	Result (mS)	Limit (mS)
1 Mbps	18 (times in 5sec) * (31.6sec / 5sec) = 114	2.880	328.32	400
2 Mbps	21 (times in 5sec) * (31.6sec / 5sec) = 133	2.904	386.23	400
3 Mbps	21 (times in 5sec) * (31.6sec / 5sec) = 133	2.896	385.17	400
Time of occupancy = Transmission Single Pulse On Time x Number of Transmissions				

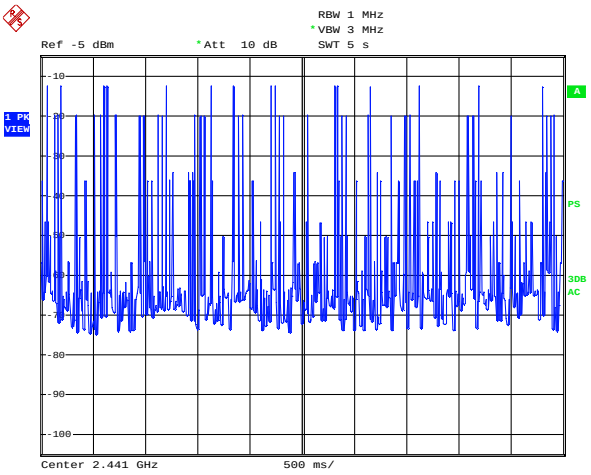
8.5 Test Plots:



1 Mbps Dwell Time

Date: 5.NOV.2013 19:30:33

Channel Occupancy Dwell Time (1 Mbps)

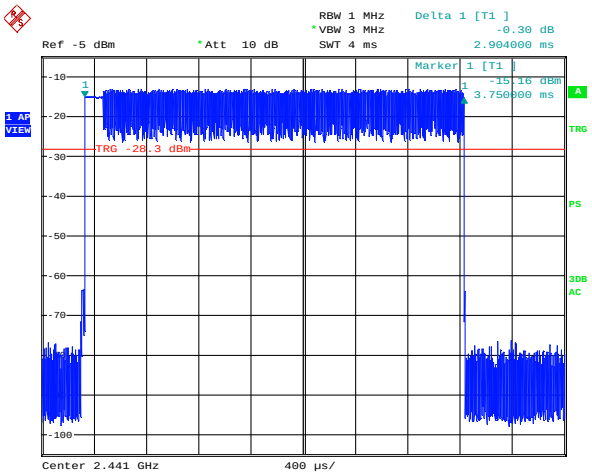


1 Mbps Dwell Time

Date: 5.NOV.2013 19:44:23

Number of Transmissions in 5 seconds (1 Mbps)

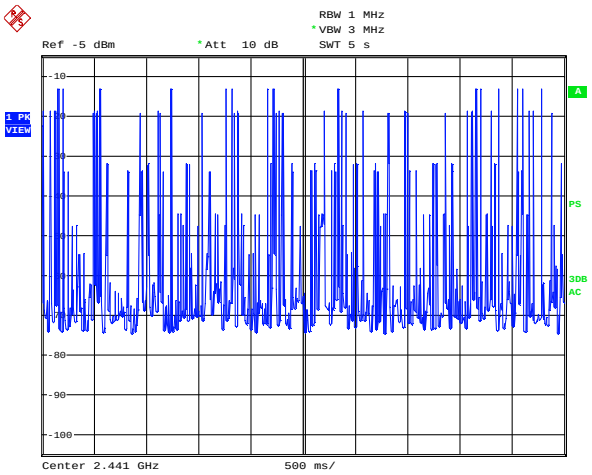
8.6 Test Plots:



2 Mbps Dwell Time

Date: 5.NOV.2013 19:33:21

Channel Occupancy Dwell Time (2 Mbps)

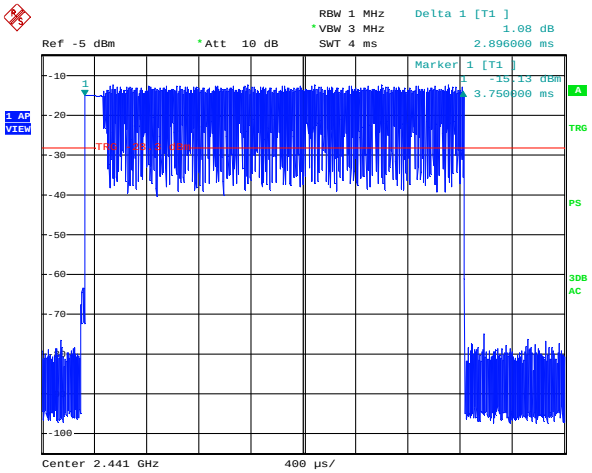


2 Mbps Dwell Time

Date: 5.NOV.2013 19:46:26

Number of Transmissions in 5 seconds (2 Mbps)

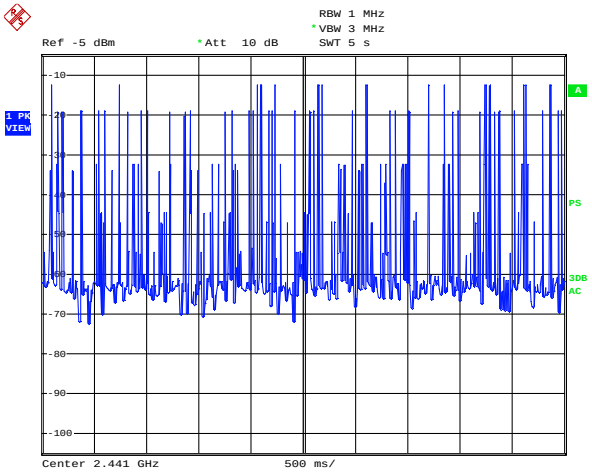
8.7 Test Plots:



3 Mbps Dwell Time

Date: 5.NOV.2013 19:34:46

Channel Occupancy Dwell Time (3 Mbps)



3 Mbps Dwell Time

Date: 5.NOV.2013 19:47:20

Number of Transmissions in 5 seconds (3 Mbps)

9 Conducted Spurious Emissions

9.1 Test Limits

§ 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

9.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

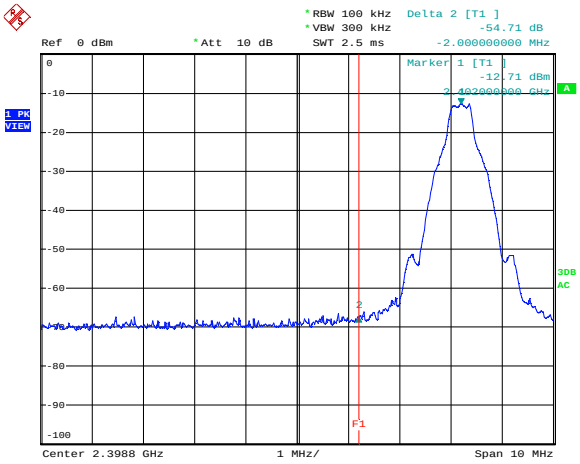
9.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	1093-4495-40	Rohde&Schwarz	FSP	690	04/11/2013	04/11/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014
20 dB Attenuator	BB3802	Weinchel	1	706	08/12/2013	08/12/2014

9.4 Results:

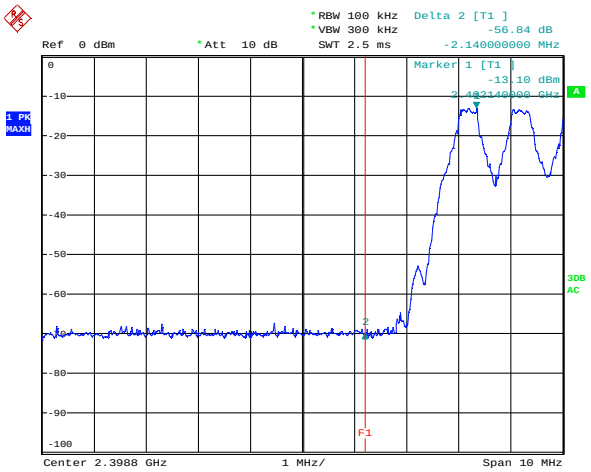
The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria. Plots are also presented showing the band edge compliance.

9.5 Test Plots:



1 MBPS BANDEDGE LOW CH, FH OFF
Date: 2.NOV.2013 15:23:53

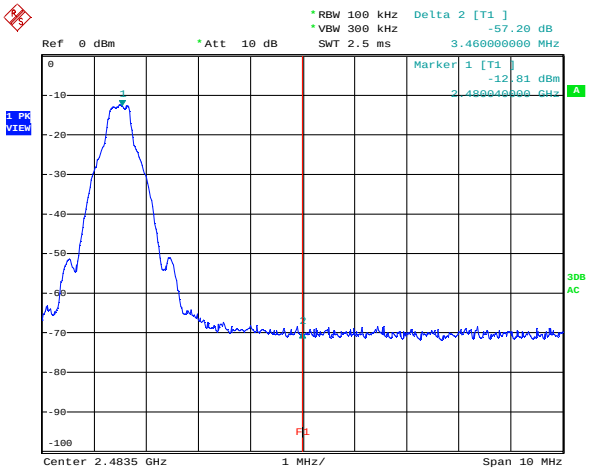
Conducted Band Edge Low Channel FH Off (1 Mbps)



1 MBPS BANDEDGE LOW CH, FH ON
Date: 2.NOV.2013 15:25:54

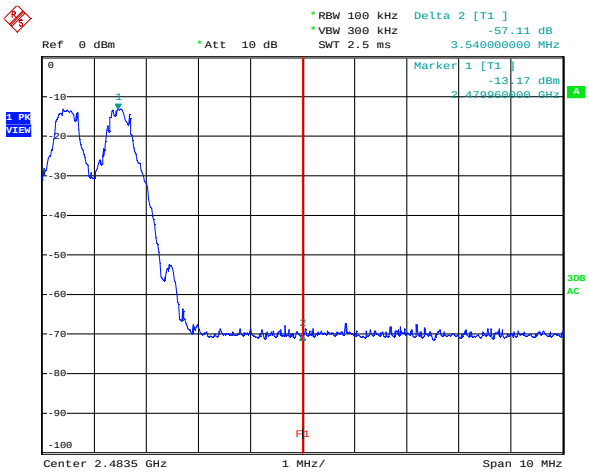
Conducted Band Edge Low Channel FH On (1 Mbps)

9.6 Test Plots:



1 MBPS BANDEDGE HIGH CH, FH OFF
Date: 2.NOV.2013 15:50:35

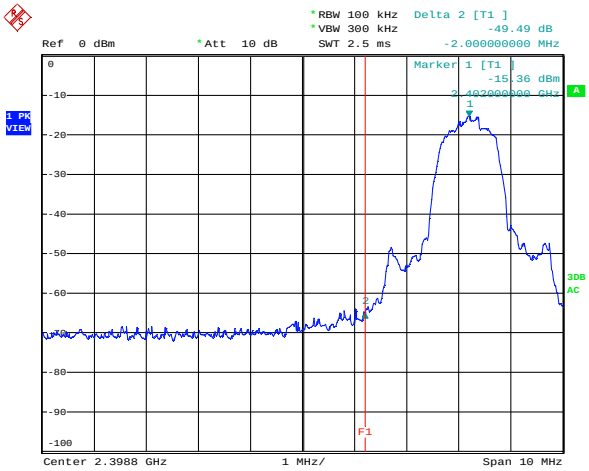
Conducted Band Edge High Channel FH Off (1 Mbps)



1 MBPS BANDEDGE HIGH CH, FH ON
Date: 2.NOV.2013 15:52:10

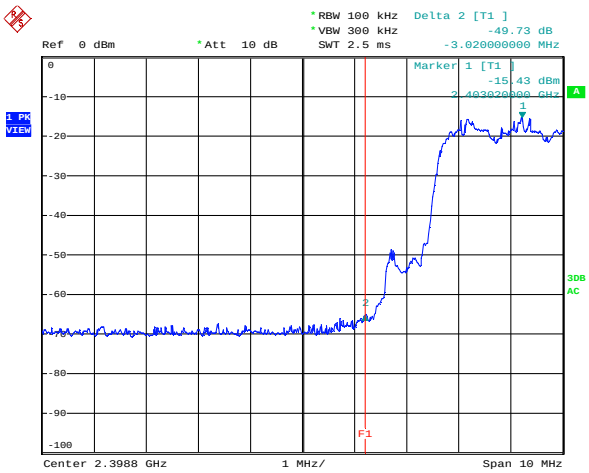
Conducted Band Edge High Channel FH On (1 Mbps)

9.7 Test Plots:



2 MBPS BANDEDGE LOW CH, FH OFF
Date: 2.NOV.2013 15:27:30

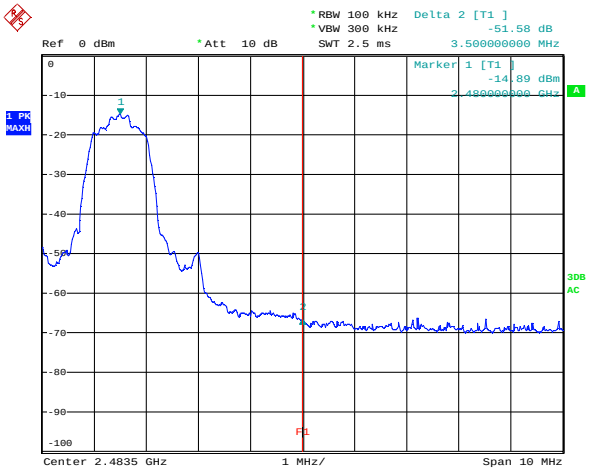
Conducted Band Edge Low Channel FH Off (2 Mbps)



2 MBPS BANDEDGE LOW CH, FH ON
Date: 2.NOV.2013 15:31:20

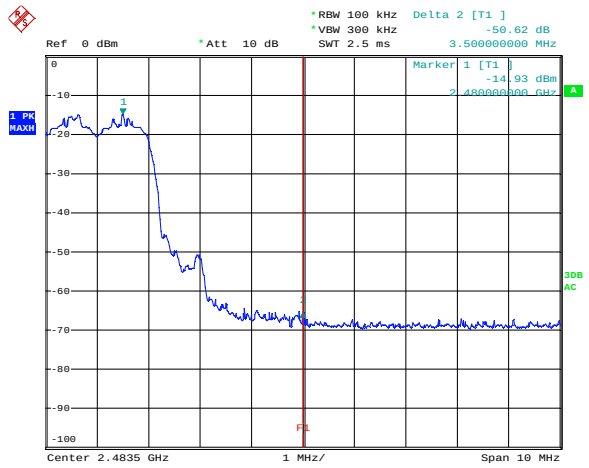
Conducted Band Edge Low Channel FH On (2 Mbps)

9.8 Test Plots:



2 MBPS BANDEDGE HIGH CH, FH OFF
Date: 2.NOV.2013 15:55:34

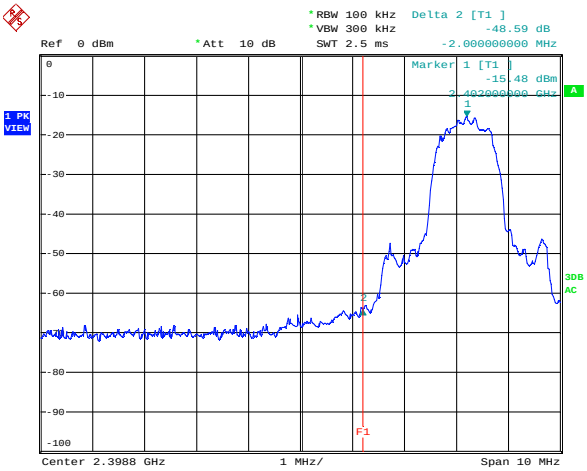
Conducted Band Edge High Channel FH Off (2 Mbps)



2 MBPS BANDEDGE HIGH CH, FH ON
Date: 2.NOV.2013 16:09:11

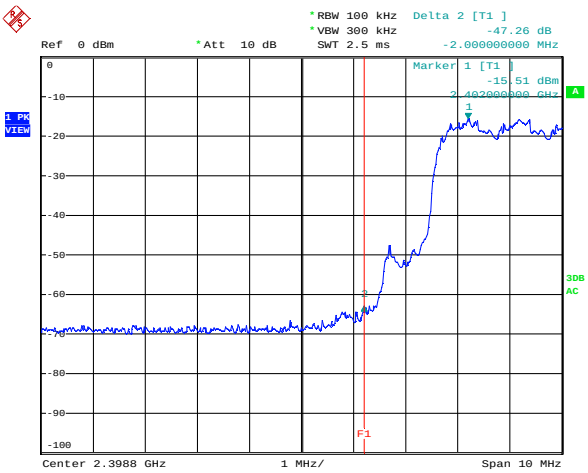
Conducted Band Edge High Channel FH On (2 Mbps)

9.9 Test Plots:



3 MBPS BANDEDGE LOW CH, FH OFF
Date: 2.NOV.2013 15:35:01

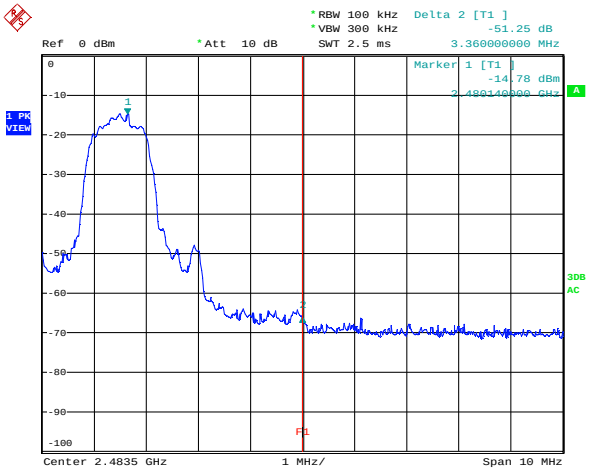
Conducted Band Edge Low Channel FH Off (3 Mbps)



3 MBPS BANDEDGE LOW CH, FH ON
Date: 2.NOV.2013 15:47:06

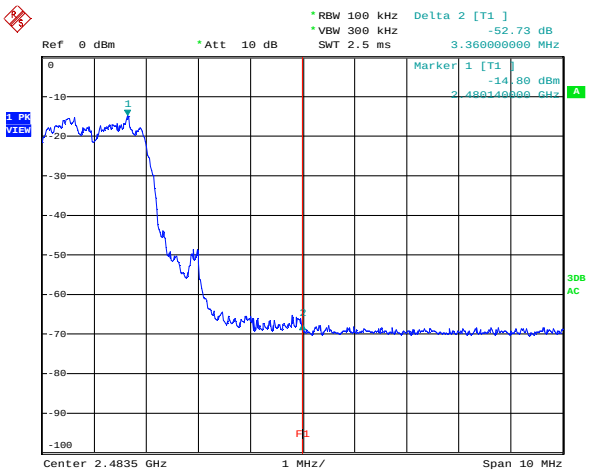
Conducted Band Edge Low Channel FH On (3 Mbps)

9.10 Test Plots:



3 MBPS BANDEDGE HIGH CH, FH OFF
Date: 2.NOV.2013 16:11:13

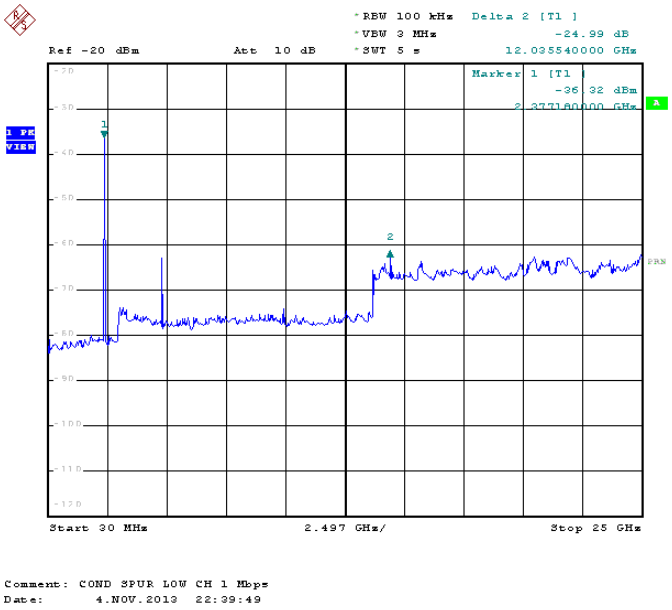
Conducted Band Edge High Channel FH Off (3 Mbps)



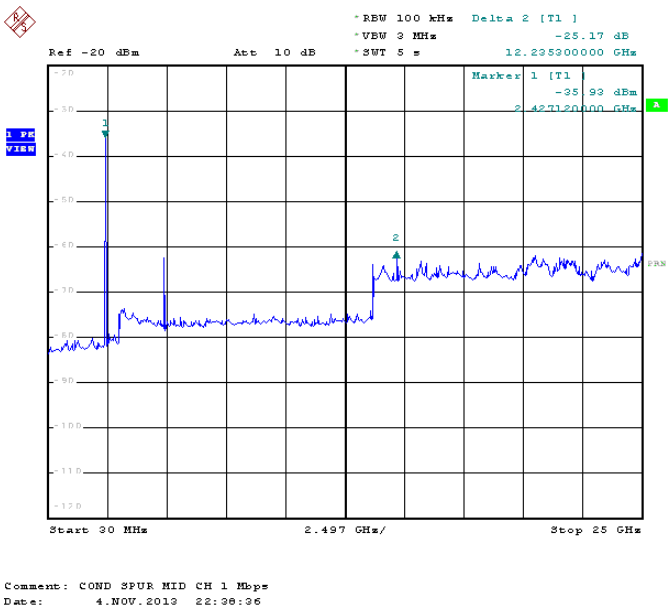
3 MBPS BANDEDGE HIGH CH, FH ON
Date: 2.NOV.2013 16:14:57

Conducted Band Edge High Channel FH On (3 Mbps)

9.11 Test Plots:

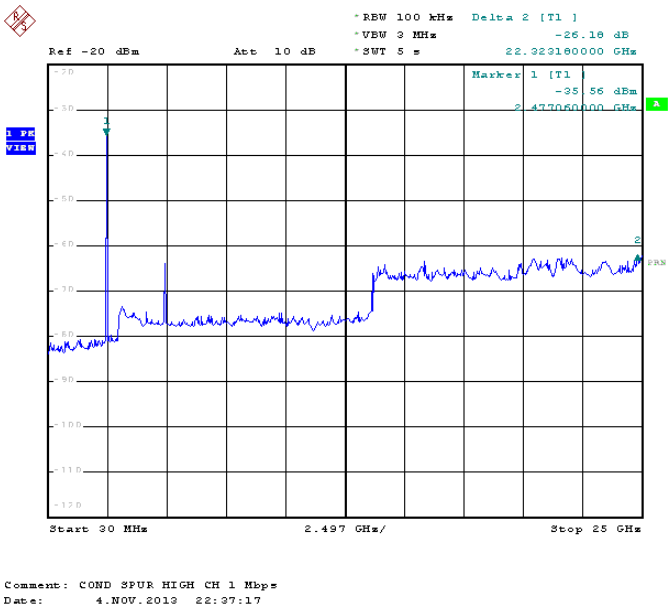


Conducted Spurious Emissions Low Channel 30 MHz-25 GHz (1 Mbps)

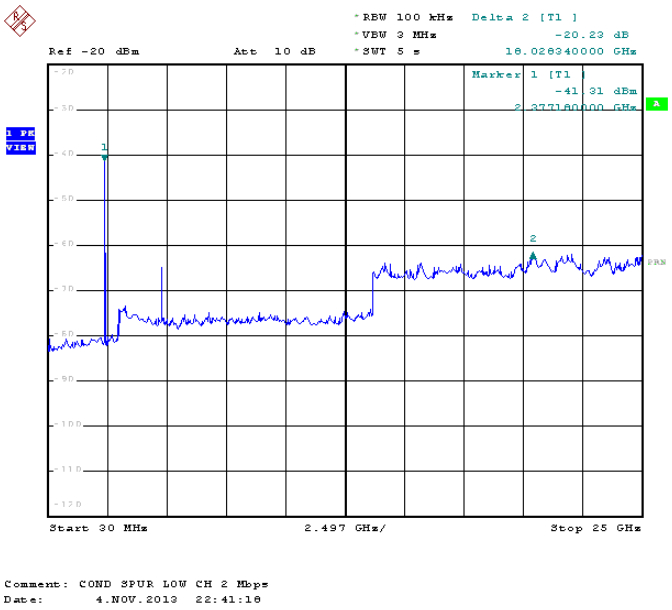


Conducted Spurious Emissions Mid Channel 30 MHz-25 GHz (1 Mbps)

9.12 Test Plots:

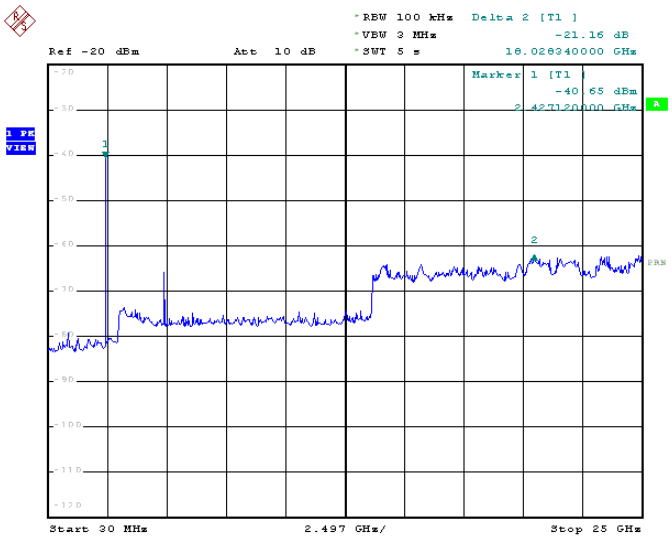


Conducted Spurious Emissions High Channel 30 MHz – 25 Ghz (1 Mbps)

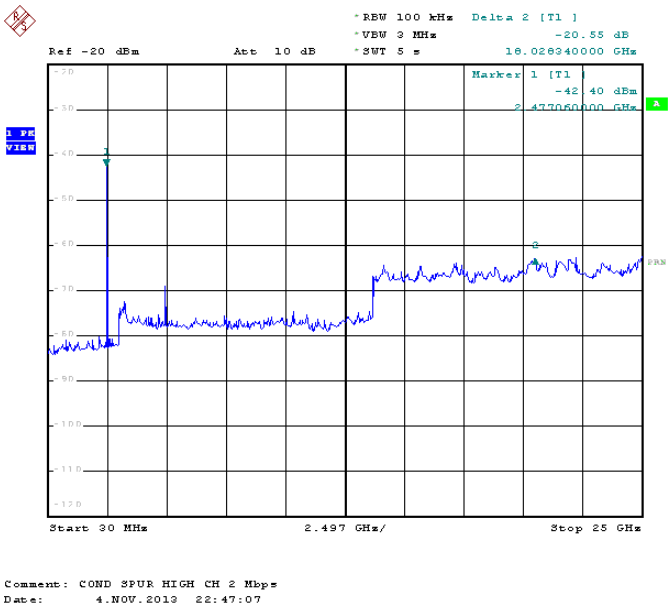


Conducted Spurious Emissions Low Channel 30 MHz – 25 Ghz (2 Mbps)

9.13 Test Plots:

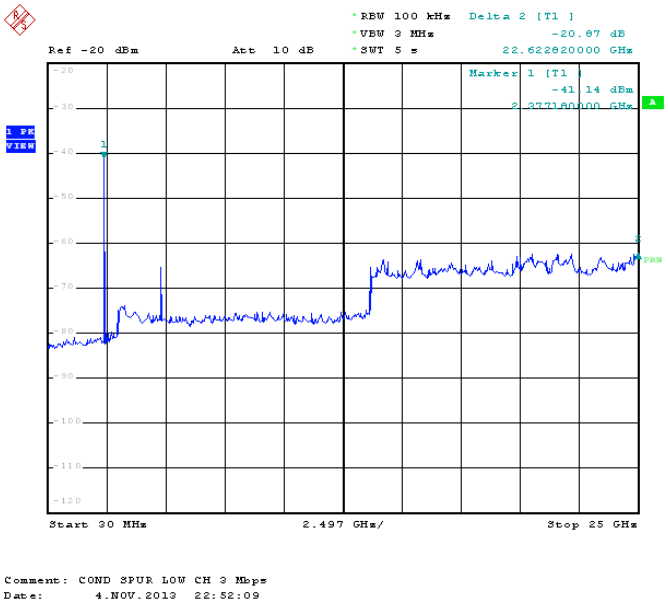


Conducted Spurious Emissions Mid Channel 30 MHz – 25 GHz (2 Mbps)

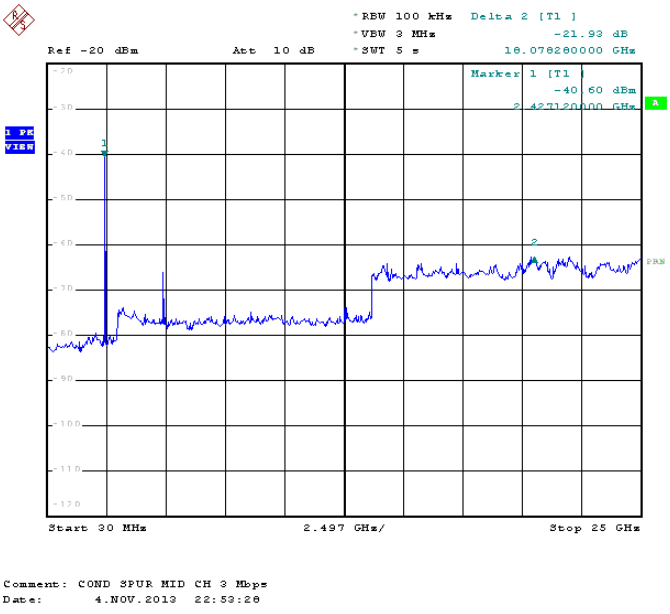


Conducted Spurious Emissions High Channel 30 MHz – 25 GHz (2 Mbps)

9.14 Test Plots:

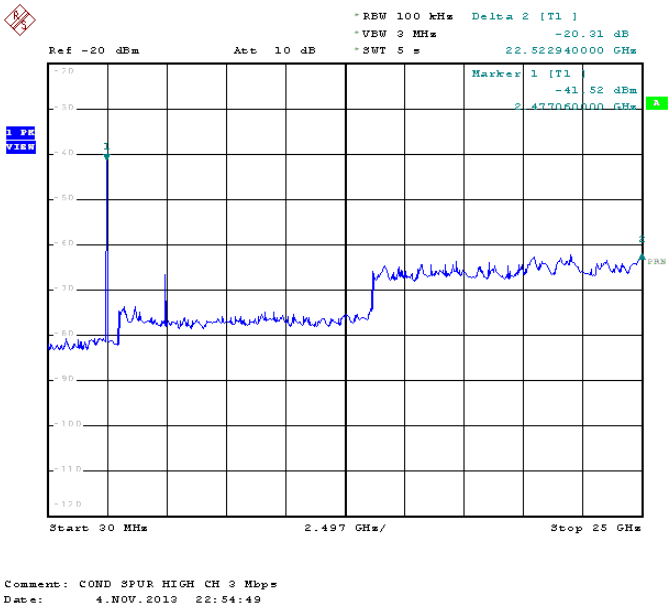


Conducted Spurious Emissions Low Channel 30 MHz – 25 GHz (3 Mbps)



Conducted Spurious Emissions Mid Channel 30 MHz – 25 GHz (3 Mbps)

9.15 Test Plots:



Conducted Spurious Emissions High Channel 30 MHz – 25 GHz (3 Mbps)

10 Radiated Spurious Emissions (Transmitter)

10.1 Test Limits

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

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	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	[2]
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

10.2 Test Procedure

ANSI C63.10: 2009 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

10.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF+AG+DCF+DF

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)
AG = Amplifier Gain
DCF = Duty Cycle Factor
DF = Distance Factor

Example Calculation:

RA = 54.01 dBµV
AF = 40.13 dB
CF = 3.76 dB
AG = -43.66
DCF = -6.78
DF = 0

FS = 54.01+40.13+3.76– 43.66 – 6.78 + 0 = 47.46 dBµV/m

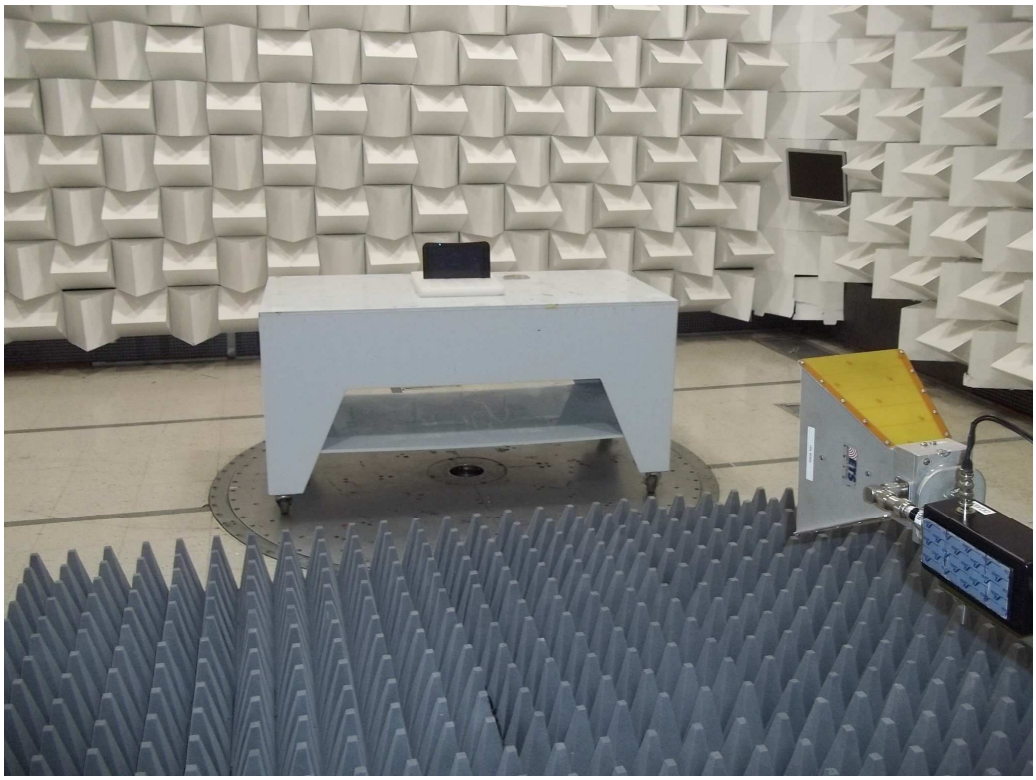
10.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	ID	Cal. Date	Cal. Due
Spectrum Analyzer	1093-4495-40	Rohde&Schwarz	FSP	690	04/11/2013	04/11/2014
Preamplifier	1685147	Miteq	AMF-6D-005018 00-24-10P	1135	01/04/2013	01/04/2014
1-18 GHz Horn Antenna	00031628	ETS	3115	IN692	10/14/2013	10/14/2014
18-26 GHz Horn Antenna	9307-1012	EMCO	3160-09	571	Calibration Not Required, Category III Equipment	Calibration Not Required, Category III Equipment
10 dB Attenuator	350	Weinschel	1	709	08/12/2013	08/12/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014

10.5 Results:

All spurious emissions were attenuated by at least 20dB below the level of the fundamental as required by Part 15.247(d). Additionally, all emissions falling within restricted bands of operation and at the band edges were found to be below the limit specified in Part 15.209(a). The spurious emissions listed in the following tables are the worst case emissions. Emissions not reported were at or below the measurement noise floor. The test sample was evaluated at both horizontal and vertical antenna polarity, along with three orthogonal axes since it was a hand held device and could be used in any orientation.

10.6 Test Setup Photographs:



10.7 Test Data:

Tx at 2402 MHz (1 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4804	Pk	70.76	-30.09	33	73.67	74	-0.33
4804	Av	70.76	-50.09	33	53.67	54	-0.33
12010	Pk	60.77	-39.61	40.13	61.29	74	-12.71
12010	Av	60.77	-59.61	40.13	41.29	54	-12.71
19216*	Pk	53.29	-37.42	40.3	56.17	74	-17.83
19216*	Av	53.29	-57.42	40.3	36.17	54	-17.83

Tx at 2441 MHz (1 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4882	Pk	70.53	-30.09	33.35	73.79	74	-0.21
4882	Av	70.53	-50.09	33.35	53.79	54	-0.21
7323	Pk	62.05	-27.83	37.13	71.35	74	-2.65
7323	Av	62.05	-47.83	37.13	51.35	54	-2.65
12205	Pk	60.23	-39.74	40.58	61.07	74	-12.93
12205	Av	60.23	-59.74	40.58	41.07	54	-12.93
19528*	Pk	54.64	-37.87	40.3	57.07	74	-16.93
19528*	Av	54.64	-57.87	40.3	37.07	54	-16.93

Tx at 2480 MHz (1 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4960	Pk	70.51	-30	33.35	73.86	74	-0.14
4960	Av	70.51	-50	33.35	53.86	54	-0.14
7440	Pk	64.35	-27.94	37.12	73.53	74	-0.47
7440	Av	64.35	-47.94	37.12	53.53	54	-0.47
12400	Pk	64.89	-39.42	40.31	65.78	74	-8.22
12400	Av	64.89	-59.42	40.31	45.78	54	-8.22
19840*	Pk	54.32	-40.02	40.3	54.6	74	-19.4
19840*	Av	54.32	-60.02	40.3	34.6	54	-19.4
22320*	Pk	53.72	-36.78	40.3	57.24	74	-16.76
22320*	Av	53.72	-56.78	40.3	37.24	54	-16.76

* Noise floor measurement
Note 1: Corr. Factor = CF + AG + DCF + DF + Att.
Note 2: FS = RA + Corr. Factor + AF

10.8 Test Data:

Tx at 2402 MHz (2 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4804	Pk	69.71	-30.09	33.1	72.72	74	-1.28
4804	Av	69.71	-50.09	33.1	52.72	54	-1.28
12010	Pk	57.75	-39.61	39.2	57.34	74	-16.66
12010	Av	57.75	-59.61	39.2	37.34	54	-16.66
19216	Pk	43.26	-37.42	40.3	46.14	74	-27.86
19216	Av	43.26	-57.42	40.3	26.14	54	-27.86

Tx at 2441 MHz (2 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4882	Pk	70.87	-30.09	33.1	73.88	74	-0.12
4882	Av	70.87	-50.09	33.1	53.88	54	-0.12
7323	Pk	62.01	-27.83	36.47	70.65	74	-3.35
7323	Av	62.01	-47.83	36.47	50.65	54	-3.35
12205	Pk	64.53	-39.74	38.91	63.7	74	-10.3
12205	Av	64.53	-59.74	38.91	43.7	54	-10.3
19528	Pk	42.87	-37.87	40.3	45.3	74	-28.7
19528	Av	42.87	-57.87	40.3	25.3	54	-28.7

Tx at 2480 MHz (2 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4960	Pk	70.43	-30	33.31	73.74	74	-0.26
4960	Av	70.43	-50	33.31	53.74	54	-0.26
7440	Pk	64.25	-27.94	36.68	72.99	74	-1.01
7440	Av	64.25	-47.94	36.68	52.99	54	-1.01
12400	Pk	63.61	-39.42	38.75	62.94	74	-11.06
12400	Av	63.31	-59.42	38.75	42.64	54	-11.36
19840	Pk	43.53	-40.02	40.3	43.81	74	-30.19
19840	Av	43.53	-60.02	40.3	23.81	54	-30.19
22320	Pk	43.11	-36.78	40.3	46.63	74	-27.37
22320	Av	43.11	-56.78	40.3	26.63	54	-27.37

* Noise floor measurement
Note 1: Corr. Factor = CF + AG + DCF + DF + Att.
Note 2: FS = RA + Corr. Factor + AF

10.9 Test Data:

Tx at 2402 MHz (3 Mbps)

Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4804	Pk	70.33	-30.09	33.1	73.34	74	-0.66
4804	Av	70.33	-50.09	33.1	53.34	54	-0.66
12010	Pk	58	-39.61	39.2	57.59	74	-16.41
12010	Av	58	-59.61	39.2	37.59	54	-16.41
19216	Pk	44.27	-37.42	40.3	47.15	74	-26.85
19216	Av	44.27	-57.42	40.3	27.15	54	-26.85

Tx at 2441 MHz (3 Mbps)

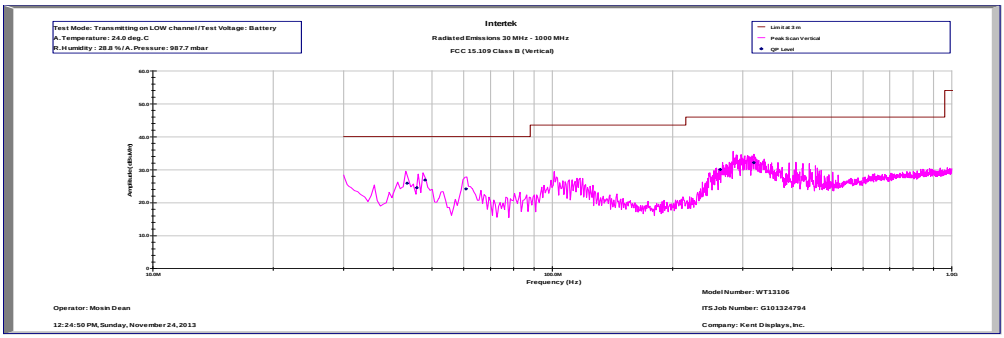
Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4882	Pk	70.75	-30.09	33.1	73.76	74	-0.24
4882	Av	70.75	-50.09	33.1	53.76	54	-0.24
7323	Pk	63.13	-27.83	36.47	71.77	74	-2.23
7323	Av	63.13	-47.83	36.47	51.77	54	-2.23
12205	Pk	66.88	-39.74	38.91	66.05	74	-7.95
12205	Av	66.88	-59.74	38.91	46.05	54	-7.95
19528	Pk	42.64	-37.87	40.3	45.07	74	-28.93
19528	Av	42.64	-57.87	40.3	25.07	54	-28.93

Tx at 2480 MHz (3 Mbps)

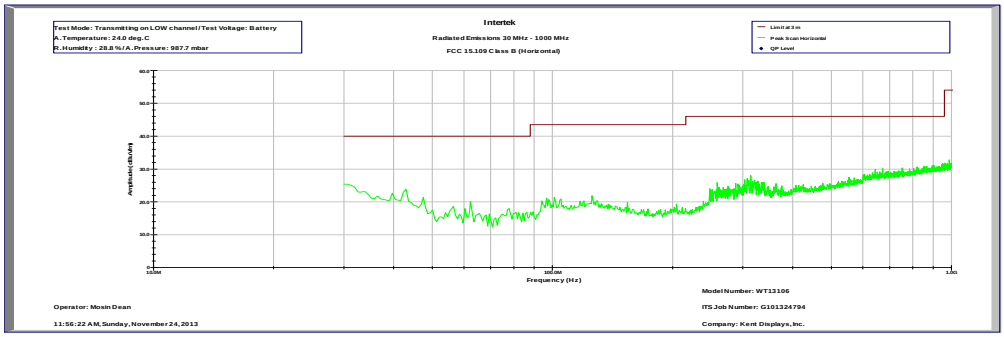
Frequency	Detector	RA	Corr. Factor	AF	FS	Limit at 3m	Margin
MHz	Pk/Av	dB(uV)	(dB)	dB(1/m)	dB(uV/m)	dB(uV/m)	dB
4960	Pk	70.48	-30	33.31	73.79	74	-0.21
4960	Av	70.48	-50	33.31	53.79	54	-0.21
7440	Pk	63.63	-27.94	36.68	72.37	74	-1.63
7440	Av	63.63	-47.94	36.68	52.37	54	-1.63
12400	Pk	66.04	-39.42	38.75	65.37	74	-8.63
12400	Av	66.04	-59.42	38.75	45.37	54	-8.63
19840	Pk	43.91	-40.02	40.3	44.19	74	-29.81
19840	Av	43.91	-60.02	40.3	24.19	54	-29.81
22320	Pk	42.89	-36.78	40.3	46.41	74	-27.59
22320	Av	42.89	-56.78	40.3	26.41	54	-27.59

* Noise floor measurement
Note 1: Corr. Factor = CF + AG + DCF + DF + Att.
Note 2: FS = RA + Corr. Factor + AF

Radiated emissions Tx Mode (continued)



Low channel Plots 30-1000MHz Per 15.209 Vertical



Low channel Plots 30-1000MHz Per 15.209 Horizontal

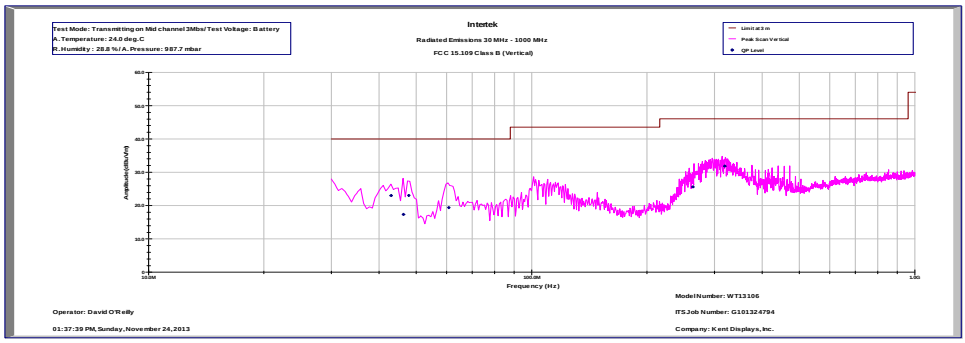
Test: Radiated Emissions
Frequency Range: 30 MHz to 1000 MHz
Limits: Class B
Measurement Distance: 3 meters
EUT: Boogie Board Sync
Tx mode in 8 DPSK presented as worse case mode.

Measurement Uncertainty: 4.2 dB
Temperature: 24.0 ˚C
Relative Humidity: 28.8 %
Power Input: Battery

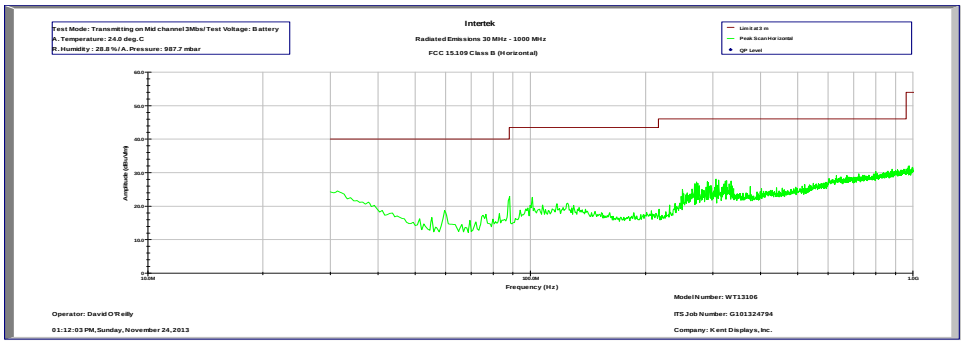
FCC 15.209 (QP)							
Frequency MHz	**Quasi Pk FS dB(uV/m)**	**Limit@10m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**AG dB**	**AF dB(1/m)**	**CF dB**
43.293 V	25.9	40	-14.1	15.4	0	10	0.5
45.782 V	24.5	40	-15.5	15.1	0	8.9	0.5
48.001 V	26.9	40	-13.1	18.4	0	7.9	0.6
60.812 V	24.2	40	-15.8	16.5	0	7.1	0.6
263.343 V	30.1	46	-15.9	15.5	0	13.3	1.3
319.511 V	32.2	46	-13.8	16.8	0	14	1.4
Detectors/Bandwithds (Det/RBW/VBW)= 120/300kHz							

Quasi FS – (Final) Quasi Peak Field Strength
RA – Receiver (quasi peak) Amplitude
AG – Preamp Gain
AF – Antenna Factor
CF – Cable Factor
Calculation: FS=RA+AF+CF-AG

Test results: (*)The EUT PASSED Radiated Emission test with -13.1dB margin at 48.001 MHz.
Deviations, Additions, or Exclusions: None



Mid Channel Plots 30-1000MHz Per 15.209 Vertical



Mid Channel Plots 30-1000MHz Per 15.209 Horizontal

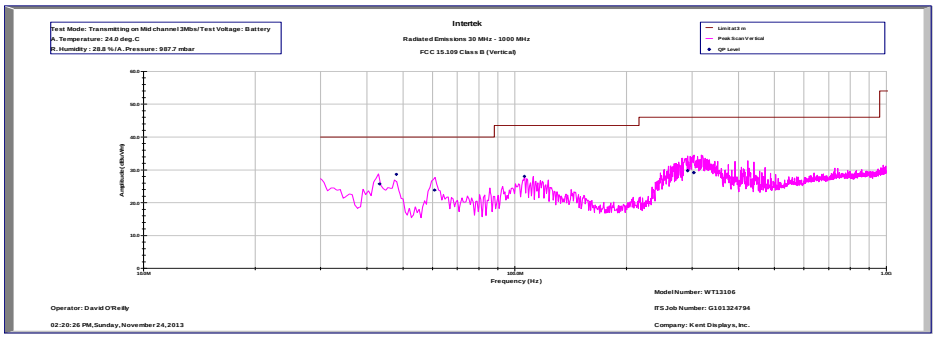
Test: Radiated Emissions
Frequency Range: 30 MHz to 1000 MHz
Limits: Class B
Measurement Distance: 3 meters
EUT: Boogie Board Sync
Tx mode in 8 DPSK presented as worse case mode

Measurement Uncertainty: 4.2 dB
Temperature: 24.0 ˚C
Relative Humidity: 28.8 %
Power Input: Battery

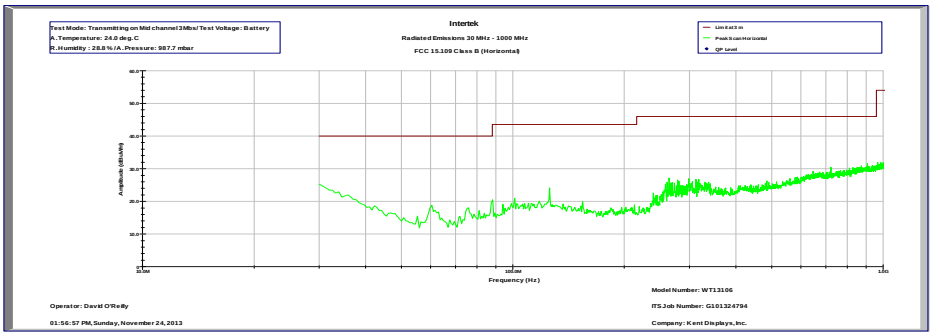
FCC 15.209, (QP)							
Frequency MHz	**Quasi Pk FS dB(uV/m)**	**Limit@10m dB(uV/m)**	**Margin dB**	**RA dB(uV)**	**AG dB**	**AF dB(1/m)**	**CF dB**
42.983 V	23	40	-17	12.4	0	10.1	0.5
46.283 V	17.3	40	-22.7	8.1	0	8.7	0.6
47.801 V	23	40	-17	14.5	0	8	0.6
60.809 V	19.4	40	-20.6	11.6	0	7.1	0.6
263.668 V	25.6	46	-20.4	11	0	13.3	1.3
319.343 V	31.8	46	-14.2	16.5	0	14	1.4
Detectors/Bandwithds (Det/RBW/VBW)= 120/300kHz							

Quasi FS – (Final) Quasi Peak Field Strength
RA – Receiver (quasi peak) Amplitude
AG – Preamp Gain
AF – Antenna Factor
CF – Cable Factor
Calculation: FS=RA+AF+CF-AG

Test results: (*)The EUT PASSED Radiated Emission test with -13.1dB margin at 48.001 MHz.
Deviations, Additions, or Exclusions: None



High Channel Plots 30-1000MHz Per 15.209 Vertical



High Channel Plots 30-1000MHz Per 15.209 Horizontal

Test: Radiated Emissions
Frequency Range: 30 MHz to 1000 MHz
Limits: Class B
Measurement Distance: 3 meters
EUT: Boogie Board Sync
Tx mode in 8 DPSK presented as worse case mode.

Measurement Uncertainty: 4.2 dB
Temperature: 24.0 ˚C
Relative Humidity: 28.8 %
Power Input: Battery

FCC 15.209, (QPI)							
Frequency MHz	Quasi Pk FS dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	RA dB(uV)	AG dB	AF dB(1/m)	CF dB
43.264	25.7	40	-14.3	15.2	0	10	0.5
48.003	28.7	40	-11.3	20.2	0	7.9	0.6
60.806	23.8	40	-16.2	16.1	0	7.1	0.6
106.16	28	43.5	-15.5	14.4	0	12.8	0.8
292.006	29.8	46	-16.2	15.2	0	13.2	1.3
303.348	29.2	46	-16.8	14.4	0	13.4	1.4
Detectors/Bandwithds (Det/RBW/VBW)= 120/300kHz							

Quasi FS – (Final) Quasi Peak Field Strength
RA – Receiver (quasi peak) Amplitude
AG – Preamp Gain
AF – Antenna Factor
CF – Cable Factor
Calculation: FS=RA+AF+CF-AG

Test results: (*)The EUT PASSED Radiated Emission test with -13.1dB margin at 48.001 MHz.
Deviations, Additions, or Exclusions: None

11 Radiated Spurious Emissions (Receiver)

11.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

These limits are identical to those in RSS-GEN

11.2 Test Procedure

ANSI C63.4: 2009

11.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF+AG+DCF+DF

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)
AG = Amplifier Gain
DCF = Duty Cycle Factor
DF = Distance Factor

Example Calculation:

RA = 54.01 dBµV
AF = 40.13 dB
CF = 3.76 dB
AG = -43.66
DCF = -6.78
DF = -10.5

FS = 54.01 + 40.13 + 3.76 – 43.66 – 6.78 – 10.5 = 36.96 dBµV/m

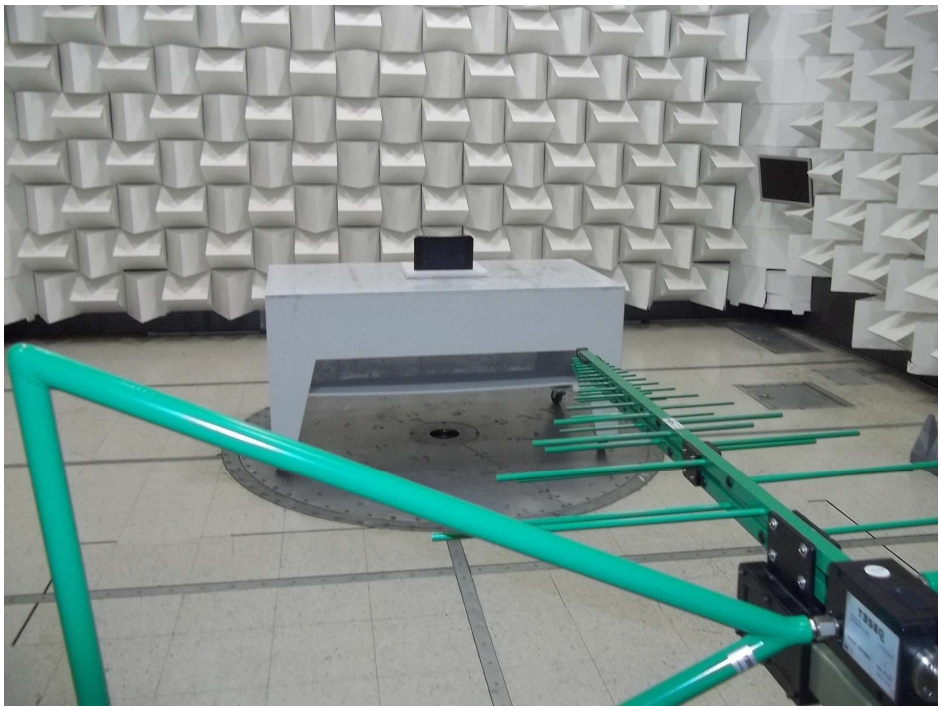
Test Equipment Used:

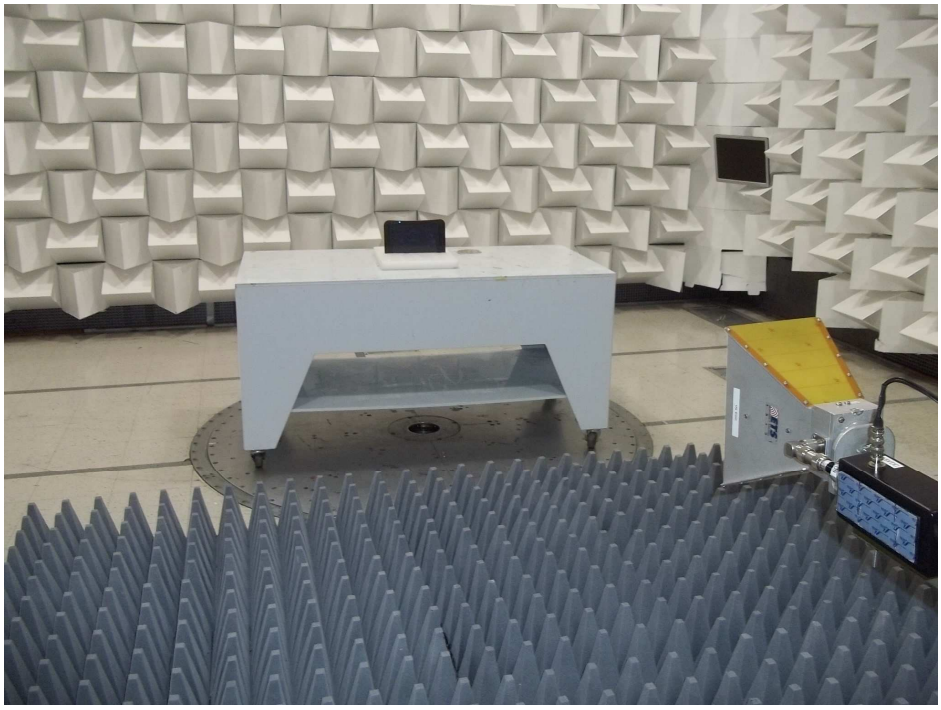
Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
Spectrum Analyzer	1093-4495-40	Rohde&Schwarz	FSP	690	04/11/2013	04/11/2014
Preamplifier	1685147	Miteq	AMF-6D-00501800-24-10P	1135	01/04/2013	01/04/2014
1-18 GHz Horn Antenna	1513	A.H. Systems	SAS-571	1093	11/19/2012	11/19/2013
Bilog Antenna	32852	TESEQ	CBL6112D	1147	02/01/2013	02/01/2014
High Frequency Cable	320	A.H. Systems	SAC-26G-6	1374	07/18/2013	07/18/2014

11.4 Results:

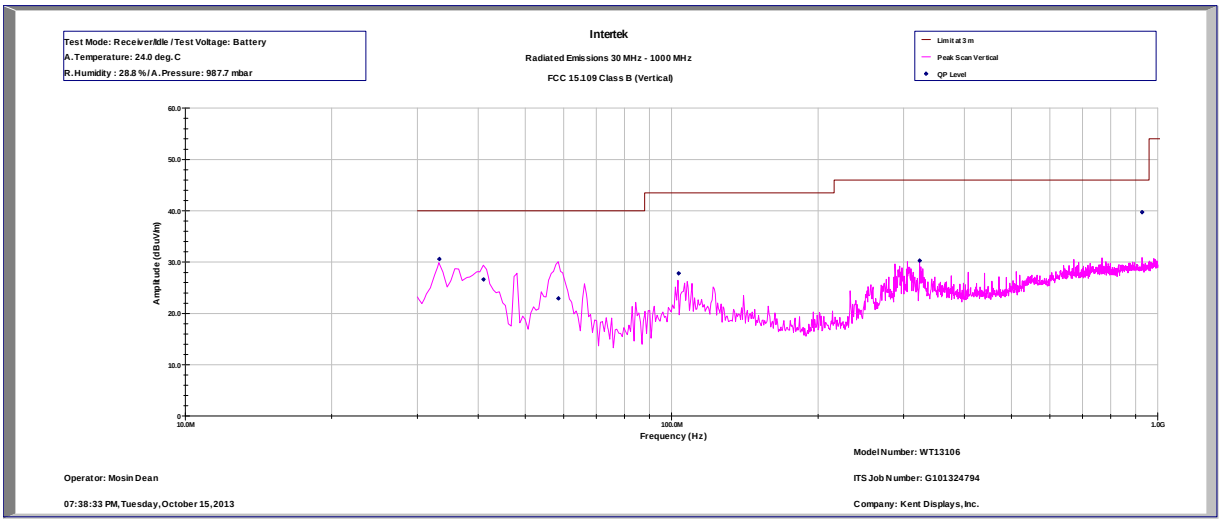
All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1.

11.5 Test Setup Photographs:

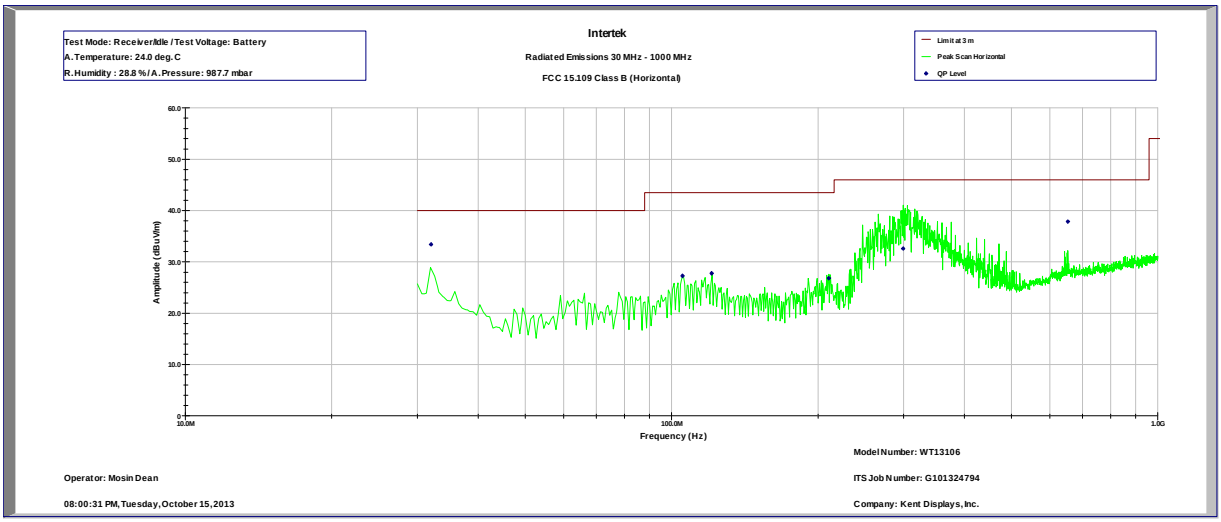




11.6 Test Plots:

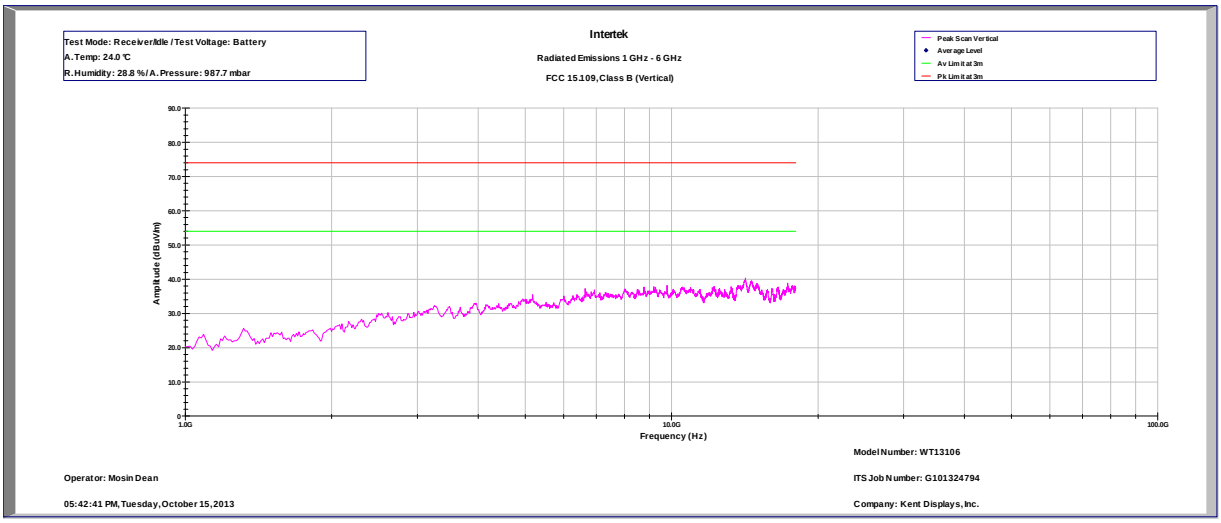


Radiated Emissions Peak Scan Vertical Polarization 30-1000 MHz

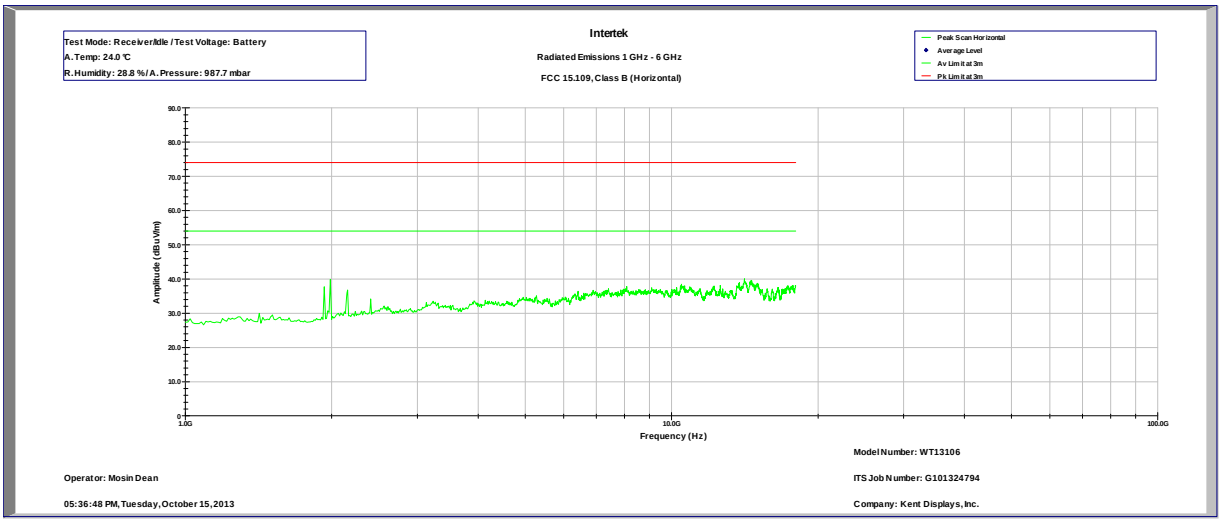


Radiated Emissions Peak Scan Horizontal Polarization 30-1000 MHz

11.7 Test Plots:



Radiated Emissions Peak Scan Vertical Polarization / Frequency Range: 1-18 GHz



Radiated Emissions Peak Scan Horizontal Polarization / Frequency Range:1-18 GHz

Note 1: All Peak emissions from 1-18 GHz are below the average limits specified in 15.109. Final field strength emissions were not taken due to low emissions in this frequency range.

11.8 Test Data:

Test: Radiated Emissions
Frequency Range: 30 MHz to 1000 MHz
Limits: Class B
Measurement Distance: 3 meters
EUT: Boogie Board Sync

Measurement Uncertainty: 4.2 dB
Temperature: 24.0 ˚C
Relative Humidity: 28.8 %
Power Input: Battery

FCC 15.109, Class B (QP-Vertical)							
Frequency MHz	Quasi Pk FS dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	RA dB(uV)	AG dB	AF dB(1/m)	CF dB
33.31	30.6	40	-9.4	14.3	0	15.8	0.5
41.05	26.6	40	-13.4	14.7	0	11.4	0.5
58.50	22.9	40	-17.1	15.3	0	7	0.6
103.40	27.8	43.5	-15.7	14.4	0	12.6	0.8
323.63	30.3	46	-15.7	14.9	0	14	1.4
928.16 (*)	39.7	46	-6.3	16.8	0	20.6	2.4
Detectors/Bandwithds (Det/RBW/VBW)= 120/300kHz							

FCC 15.109, Class B (QP-Horizontal)							
Frequency MHz	Quasi Pk FS dB(uV/m)	Limit@10m dB(uV/m)	Margin dB	RA dB(uV)	AG dB	AF dB(1/m)	CF dB
32.01	33.4	40	-6.6	14.3	0	18.6	0.5
105.33	27.3	43.5	-16.2	14.3	0	12.1	0.8
120.83	27.7	43.5	-15.8	14.2	0	12.7	0.9
210.50	26.8	43.5	-16.7	15	0	10.6	1.1
299.50	32.6	46	-13.4	17.4	0	13.8	1.4
653.05	37.8	46	-8.2	16.1	0	19.7	2
Detectors/Bandwithds (Det/RBW/VBW)= 120/300kHz							

Quasi FS – (Final) Quasi Peak Field Strength
RA – Receiver (quasi peak) Amplitude
AG – Preamp Gain
AF – Antenna Factor
CF – Cable Factor
DF – Distance Factor
Calculation: FS=RA+AF+CF-AG-DCF

Test Result:	(*)The EUT PASSED Radiated Emissions test in the frequency range of 30-1000 MHz with 6.3 dB margin at 928.16 MHz.

Deviations, Additions, or Exclusions: None

12 AC Powerline Conducted Emissions

12.1 Test Limits

§ 15.107(e): 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 μH/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 emission (MHz)	Conducted limit (dBμV)	
	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.

12.2 Test Procedure

ANSI C63.4: 2009

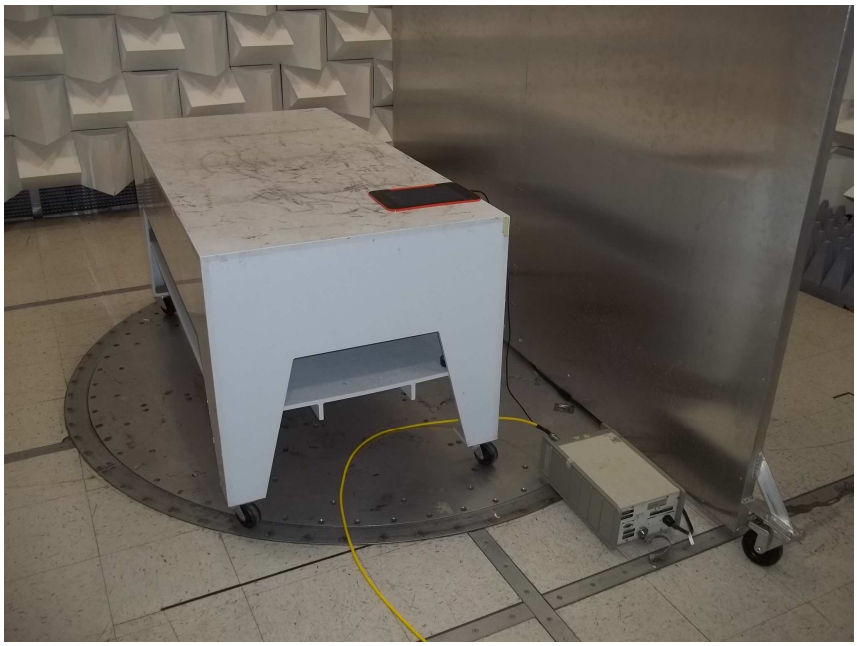
12.3 Test Equipment Used:

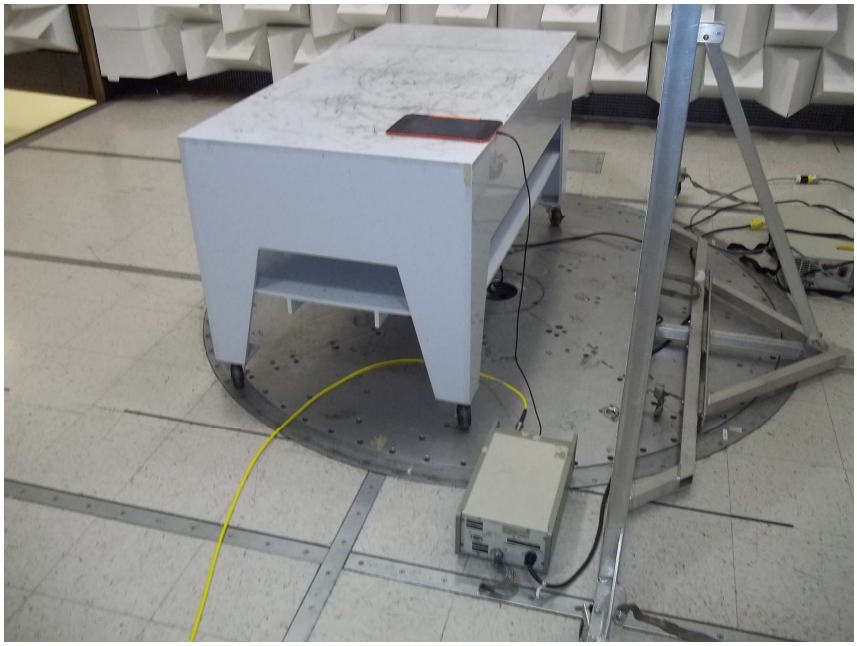
Description	Serial Number	Manufacturer	Model	IID	Cal. Date	Cal. Due
EMI Test Receiver	1166.5950.07	Rohde & Schwarz	ESCI7	1140	02/19/2013	02/19/2014
LISN	9605-1039	EMCO	3816/2	546	12/17/2012	12/17/2013
High Frequency RF Cable	828	Insulated Wire	7 ft.	798	07/09/2013	07/09/2014

12.4 Results:

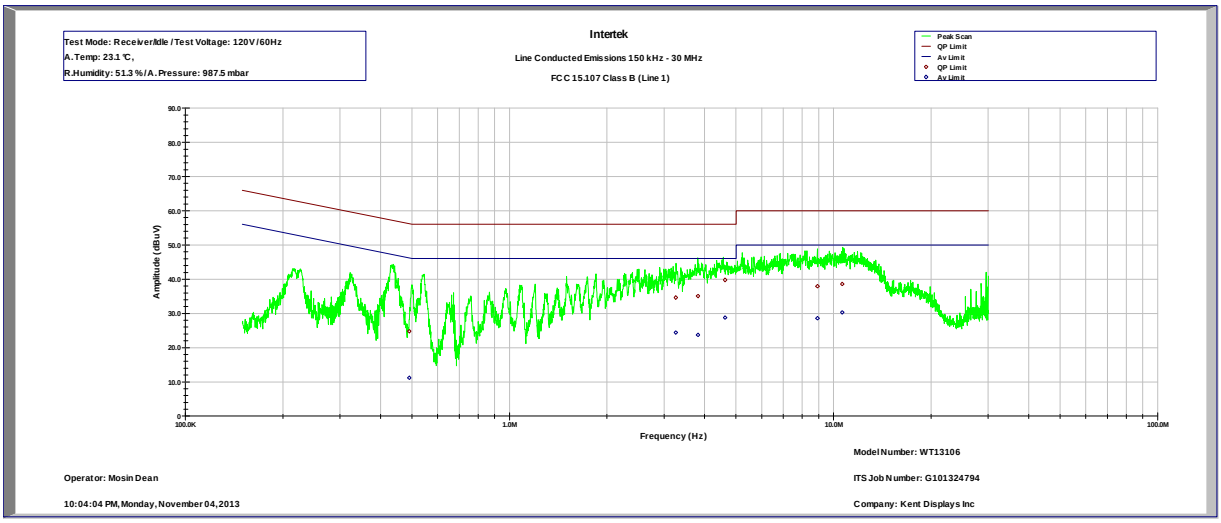
The sample tested was found to comply.

12.5 Test Setup Photographs:

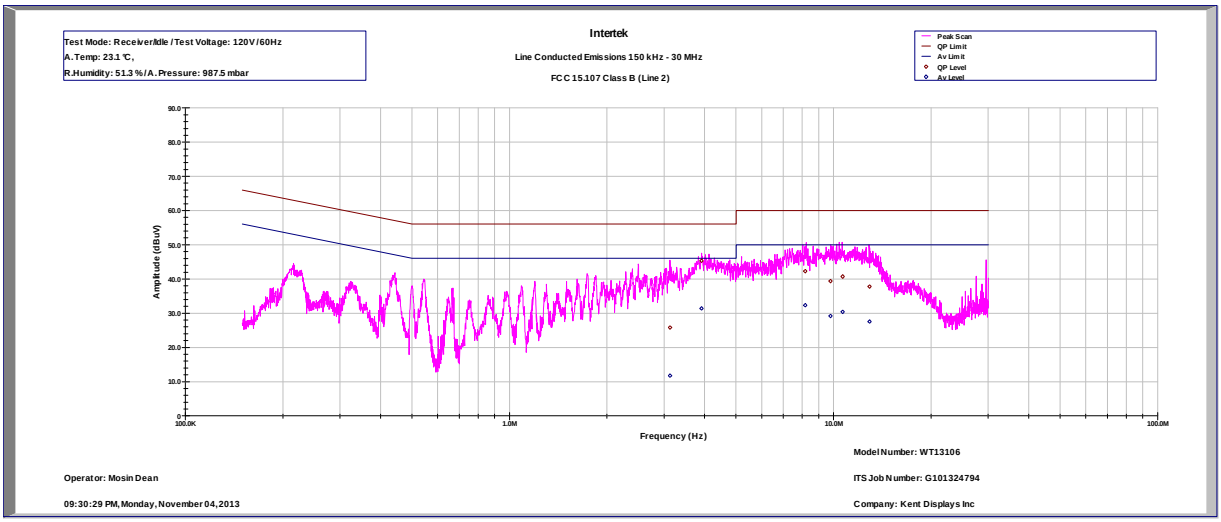




12.6 Test Plots:



Conducted Emissions Peak Scan – Line 1 at 120VAC/60Hz, Receiver/Idle Mode



Conducted Emissions Peak Scan – Line 2 at 120VAC/60Hz, Receiver/Idle Mode

12.7 Test Data:

Test: Conducted Emissions
Frequency Range: 150 kHz to 30 MHz
Limits: Class B
Power Input: 120VAC/60Hz

Measurement Uncertainty: 2.4 dB
Temperature: 23.1 ˚C
Relative Humidity: 51.3 %
EUT: Boogie Board Sync (Receiver/Idle Mode

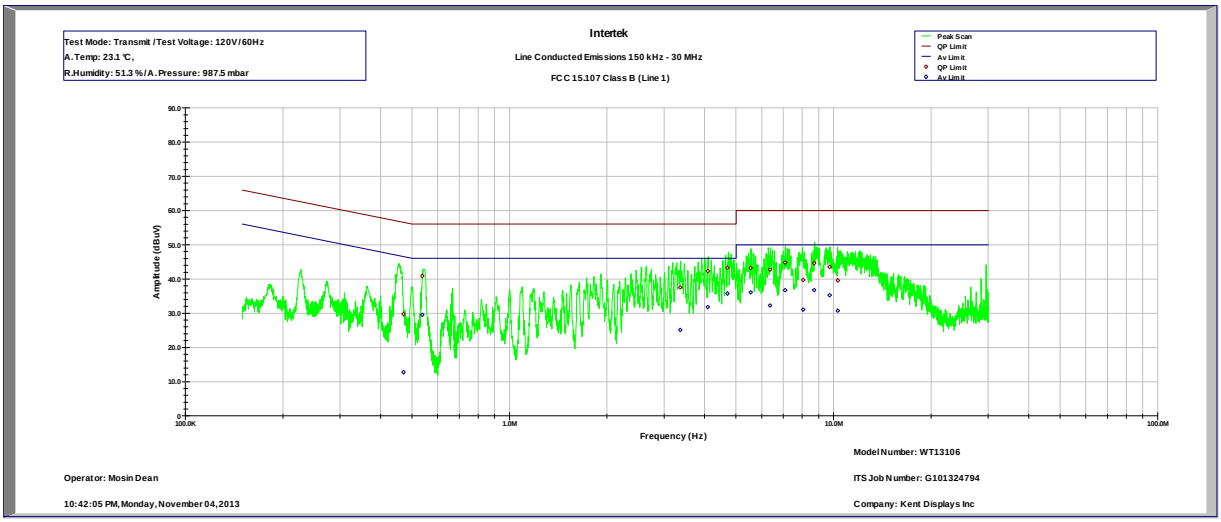
FCC Party 15.107, Class B (Line 1)						
Frequency (MHz)	Av Level (dBuV)	QP Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Av Margin (dB)	QP Margin (dB)
0.490	11.2	24.8	46.3	56.3	-35.1	-31.5
3.25	24.4	34.6	46	56	-21.6	-21.4
3.81	23.7	35.1	46	56	-22.3	-20.9
4.62	28.7	39.8	46	56	-17.3	-16.2
8.91	28.6	37.9	50	60	-21.4	-22.1
10.63	30.3	38.6	50	60	-19.7	-21.4
Detectors/Bandwidths (Det/RBW/VBW)= 9/30kHz						

FCC Part 15.107, Class B (Line 2)						
Frequency (MHz)	Av Level (dBuV)	QP Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Av Margin (dB)	QP Margin (dB)
3.12	11.8	25.8	46	56	-34.2	-30.2
3.91 (*)	31.4	45.3	46	56	-14.6	-10.7
8.17	32.3	42.3	50	60	-17.7	-17.7
9.77	29.2	39.4	50	60	-20.8	-20.6
10.65	30.4	40.7	50	60	-19.6	-19.3
12.90	27.5	37.8	50	60	-22.5	-22.2
Detectors/Bandwidths (Det/RBW/VBW)= 9/30kHz						

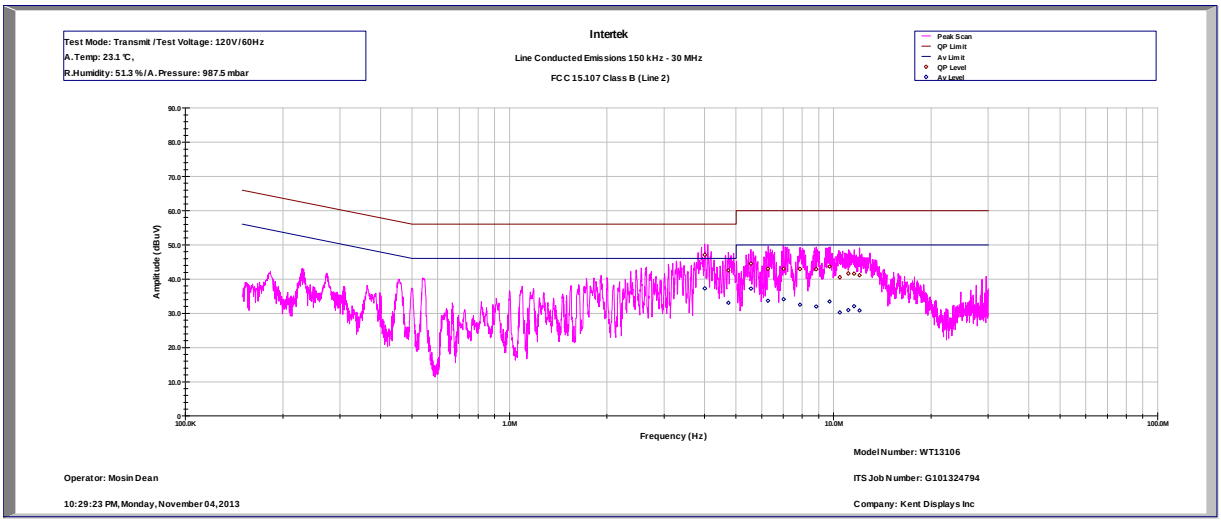
Test Result: (*)The EUT PASSED Conducted Emission test with 10.7 dB margin at 3.91 MHz.

Deviations, Additions, or Exclusions: None

12.8 Test Plots:



Conducted Emissions Peak Scan – Line 1 at 120VAC/60Hz, Transmit Mode



Conducted Emissions Peak Scan – Line 2 at 120VAC/60Hz, Transmit Mode

12.9 Test Data:

Test: Conducted Emissions
Frequency Range: 150 kHz to 30 MHz
Limits: Class B
Power Input: 120VAC/60Hz

Measurement Uncertainty: 2.4 dB
Temperature: 23.1˚C
Relative Humidity: 51.3%
EUT: Boogie Board Sync (Transmit Mode)

FCC Party 15.107, Class B (Line 1)						
Frequency (MHz)	Av Level (dBuV)	QP Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Av Margin (dB)	QP Margin (dB)
0.470	12.7	29.7	46.8	56.8	-34.1	-27.1
0.538	29.5	40.9	46	56	-16.5	-15.1
3.36	25.1	37.5	46	56	-20.9	-18.5
4.09	31.8	42.3	46	56	-14.2	-13.7
4.70	35.8	43.3	46	56	-10.2	-12.7
5.54	36.1	43.2	50	60	-13.9	-16.8
6.36	32.2	42.7	50	60	-17.8	-17.3
7.08	36.7	44.8	50	60	-13.3	-15.2
8.04	31	39.7	50	60	-19	-20.3
8.71	36.7	44.6	50	60	-13.3	-15.4
9.71	35.3	43.5	50	60	-14.7	-16.5
10.28	30.7	39.6	50	60	-19.3	-20.4
Detectors/Bandwidths (Det/RBW/VBW)= 9/30kHz						

FCC Part 15.107, Class B (Line 2)						
Frequency (MHz)	Av Level (dBuV)	QP Level (dBuV)	Av Limit (dBuV)	QP Limit (dBuV)	Av Margin (dB)	QP Margin (dB)
4.00 (*)	37.3	47.1	46	56	-8.7	-8.9
4.73	33.1	42.5	46	56	-12.9	-13.5
5.55	37.2	44.5	50	60	-12.8	-15.5
6.26	33.6	43	50	60	-16.4	-17
7.00	34.1	43	50	60	-15.9	-17
7.86	32.5	43	50	60	-17.5	-17
8.83	32	42.9	50	60	-18	-17.1
9.71	33.4	43.7	50	60	-16.6	-16.3
10.44	30.3	40.5	50	60	-19.7	-19.5
11.09	31	41.6	50	60	-19	-18.4
11.56	32.1	41.5	50	60	-17.9	-18.5
12.01	30.8	41.1	50	60	-19.2	-18.9
Detectors/Bandwidths (Det/RBW/VBW)= 9/30kHz						

Test Result: (*)The EUT PASSED Conducted Emission test with 8.7 dB margin at 4.00 MHz.

Deviations, Additions, or Exclusions: None

13 Antenna Requirement per FCC Part 15.203

13.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

13.2 Results:

The sample tested met the antenna requirement. The antenna used was permanently attached and integral to the PCB.

14 RF Exposure Evaluation

The EUT is a Wireless Module used in a mobile application. It will be located at least 20 cm from any body part of the user or nearby persons. For mobile wireless devices the RF Exposure Limit is Maximum Permissible Exposure (MPE).

The maximum conducted output power is 10.95 dBm (12.45 mW); maximum antenna gain is 2.97 dBi.

Therefore, to comply with RF Exposure Requirement, the MPE is calculated.
The maximum Peak EIRP calculated with the following equation,

$EIRP(dBm) = P_T - L_C + G_a$

P_T = Power of transmitter
L_C = Cable loss
G_a = Antenna gain of transmitter

EIRP = 16.36 dBm = 0.0432 W

The Power Density can be calculated using the formula

$S = EIRP/ 4\pi D^2$

Where: S is Power Density in W/m2
D is the distance from the antenna in meters.

It is considered that 20 cm is the minimum distance that any persons will be next to the EUT.
At 0.2 m, S = 0.0860 W/m2, which is below the FCC MPE Limit of 10 W/m2 for uncontrolled environment

15 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

16 Revision History

Revision Number	Revision Contents	Date	Prepared By	Reviewed By
0	Original issue	11/6/2013	Mosin Dean	Bryan Taylor
1	Updated to include radiated emissions in TX mode on pages 51, 52, 53	11/24/13	David O'Reilly	Bryan Taylor