



TEST REPORT

Date: 2012-06-06

Report No.: 60.870.12.012.01F

Applicant: AMX LLC
3000 Research Drive Richardson, Tx 75082,
USA

Description of Samples: Model name: Bluetooth Handset
Brand name: AMX
Model no.: MXA-HST
FCCID: CWU-HST

Date Samples Received: 2012-05-10

Date Tested: 2012-05-10 to 2012-06-04

Investigation Requested: FCC Part 15 Subpart C, Section 15.247

Conclusions: The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remarks: ----

Checked by: Approved by:-

Ray Cheung
Project Engineer
Wireless & Telecom Department

Jeff Pong
Operation Manager
Wireless & Telecom Department



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Photos of Test Setup

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External EUT Photos

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Internal EUT Photos



1.0 General Details

1.1 Test Laboratory

SEM. Test Compliance Service Co. Ltd
3/F, Jinbao Commerce Building, Xin'an Fanshen Road,
Bao'an District, Shenzhen.
Registration Number: 994117

Tested by:

A handwritten signature in blue ink that appears to read "John Zhi".

John Zhi

1.2 Applicant Details

Applicant

AMX LLC
3000 Research Drive Richardson, Tx 75082, USA.

Manufacturer

Foshan Shunde Alford Electronics Co. Ltd.
Xinjiao Industrial Park, Daliang, Shunde, Foshan City,
Guangdong Province, China



1.3 Equipment Under Test [EUT]

Description of EUT

Product Description:	Bluetooth Handset
Model No.:	MXA-HST
Brand Name:	AMX
FCCID:	CWU-HST
Rating:	- Cradle: .5VDC, 500mA - Handset: 3.7V 640mAh li-ion rechargeable
Operated Frequency:	2402 - 2480 MHz
No. of Operated Channel:	79
Accessories and Auxiliary Equipments:	- Notebook - Bluetooth dongle - AC/DC power adaptor
Antenna Type:	Omini-directional Antenna
Manufacture of Antenna:	Misubishi
Antenna Gain:	0.5 dBi
Antenna Model:	N/A

General Operation of EUT

The EUT is the Bluetooth Handset.

FHSS Operation Principle:

This module is controlled by Bluetooth microchip to generate Pseudorandom Frequency Hopping Sequence, this module support 79 hopping channels.

1.4 Related Submittal(s) Grants

This is a signal application subjected to Certificate Authorization.



2.0 Technical Details

2.1 Investigations Requested

Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.4: 2003

2.2 Test Standards and Results Summary Tables

Test Condition	Test Requirement	Test Result	
		Pass	N/A
Number of Frequency Hopping	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
20dB Bandwidth Measurement	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Hopping Channel Carrier Frequency Separation	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Average Time of Occupancy	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Pseudorandom Hopping Algorithm	Section 15.247 (a1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Band Edge Measurement	Section 15.247	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Maximum Output Power	Section 15.247 (b1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Out of Band Emission	Section 15.247 (d)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Radiated Emission in Restricted Band	Section 15.247 (d)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Conducted Emission on AC Mains	Section 15.207	<input checked="" type="checkbox"/>	<input type="checkbox"/>
RF Exposure	Section 15.247 (i)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Antenna Requirement	Section 15.203	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		See note 1	

Note 1 : The EUT uses a permanently attached antenna, which in accordance to Section 15.203, is considered sufficient to comply with the provisions of this section.

Remark: N/A - Not Applicable



3.0 Test Methodology

3.1 Radiated Emission

The sample was placed 0.8m above the ground plane on a standard emission test site *. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

3.2 Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

$$\begin{aligned} \text{FS} &= R + \text{System Factor} \\ \text{System Factor} &= \text{AF} + \text{CF} + \text{FA} - \text{PA} \end{aligned}$$

Where FS = Net Field Strength in dBuV/m at 3 meters.

R = Reading of Spectrum Analyzer / Test Receiver in dBuV.

AF = Antenna Factor in dB.

CF = Cable Attenuation Factor in dB.

FA = Filter Attenuation Factor in dB.

PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

3.3 Conducted Emissions

The test was performed in accordance with ANSI C63.4: 2003, with the following: initial measurements were performed in peak and average detection modes on the live line of personal computer, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.



4.0 Test Results

4.1 Number of Hopping Frequency

Test Requirement: FCC part 15 section 15.247 (a1)(iii)
 Test Date: 2012-05-31
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

Result: PASS

Measured Result :

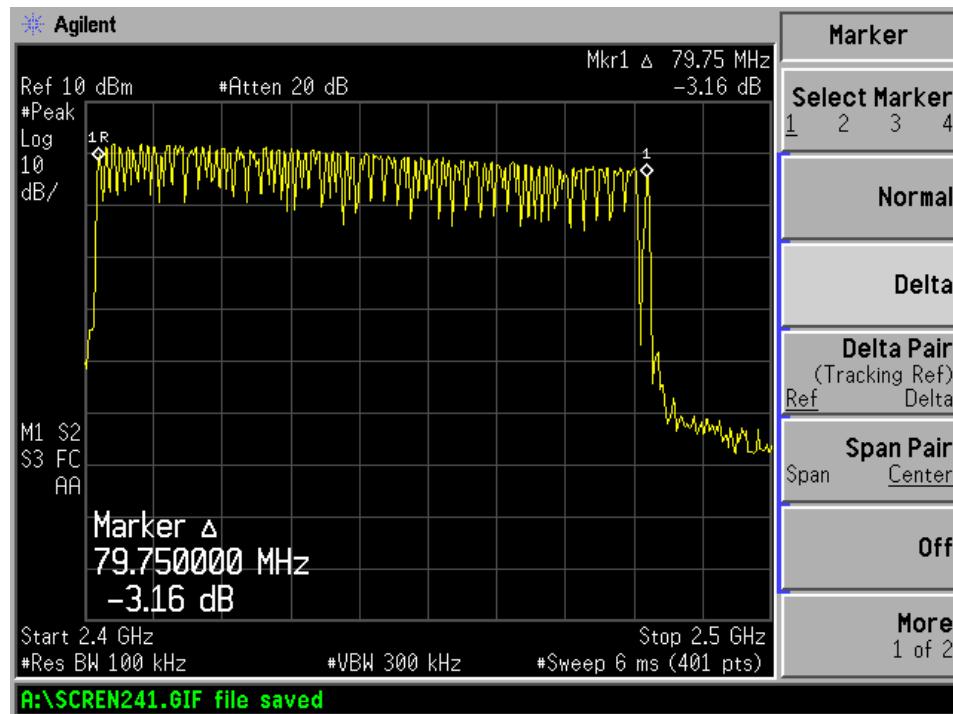
Operating Channel Frequency in sequence:

2402 ; 2403 ; 2404 ; 2405 ; 2406 ; 2407 ; 2408 ; 2409 ; 2410 ; 2411 ; 2412 ; 2413 ; 2414 ; 2415 ;
 2416 ; 2417 ; 2418 ; 2419 ; 2420 ; 2421 ; 2422 ; 2423 ; 2424 ; 2425 ; 2426 ; 2427 ; 2428 ; 2429 ;
 2430 ; 2431 ; 2432 ; 2433 ; 2434 ; 2435 ; 2436 ; 2437 ; 2438 ; 2439 ; 2440 ; 2441 ; 2442 ; 2443 ;
 2444 ; 2445 ; 2446 ; 2447 ; 2448 ; 2449 ; 2450 ; 2451 ; 2452 ; 2453 ; 2454 ; 2455 ; 2456 ; 2457 ;
 2458 ; 2459 ; 2460 ; 2461 ; 2462 ; 2463 ; 2464 ; 2465 ; 2466 ; 2467 ; 2468 ; 2469 ; 2470 ; 2471 ;
 2472 ; 2473 ; 2474 ; 2475 ; 2476 ; 2477 ; 2478 ; 2479 ; 2480

Limit for Number of Hopping Channel [Section 15.247 (a1)(iii)]

At least 15 non-overlapping channels for 2400-2483.5MHz.

Result data graph shows the number of operation channels:





4.2 20dB Bandwidth Measurement

Test Requirement: FCC part 15 section 15.247 (a1)
 Test Date: 2012-05-31
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

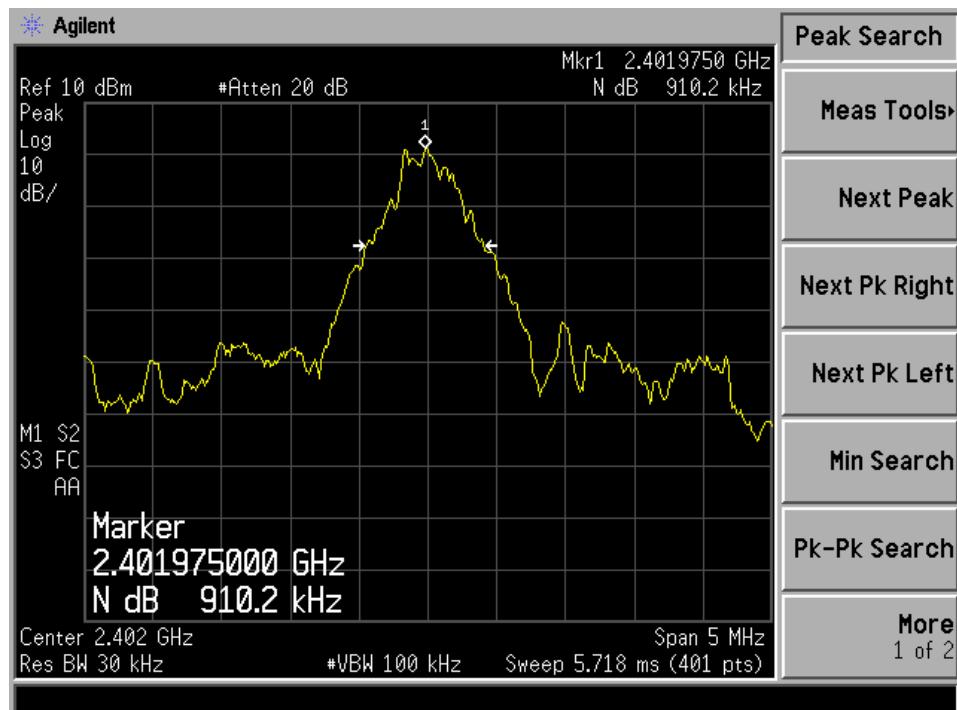
Test Setup:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Channel	Measured frequency (MHz)	20dB Bandwidth (MHz)
Lowest	2.402	0.910
Middle	2.441	0.923
Highest	2.480	0.898

This result is used for checking the hopping channel carrier frequencies separation.

Result data graph shows 20 dB bandwidth, CF = 2.402GHz, BW = 0.910MHz

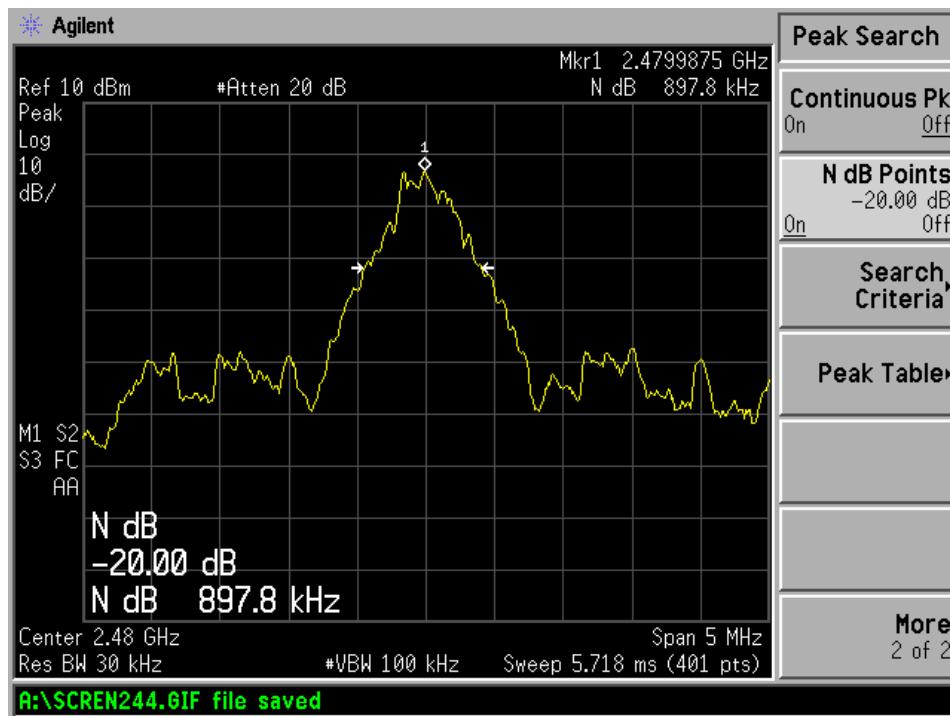




Result data graph shows 20 dB bandwidth, CF = 2.441GHz, BW = 0.923MHz



Result data graph shows 20 dB bandwidth, CF = 2.480GHz, BW = 0.898MHz





4.3 Hopping Channel Carrier Frequency Separation

Test Requirement: FCC part 15 section 15.247 (a1)
 Test Date: 2012-05-31
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

Result: PASS

Measured Result :

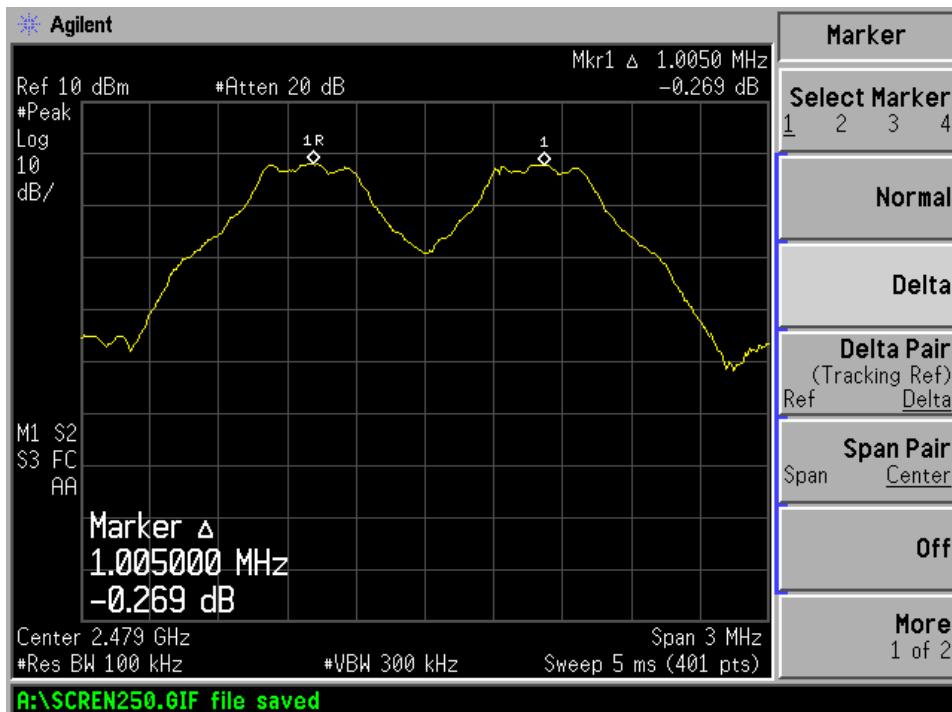
Refer to the delta marker, the frequency separation between two adjacent channels is 1.005 MHz, therefore, the requirement of channel separated by a two-third of the 20dB bandwidth of the hopping channel is applied.

According to the test result shown in section 4.2, the maximum 20dB bandwidth is 0.923 MHz, so the hopping channel separation of this EUT is found to comply with the requirement.

Limits for Hopping Channel Separation [Section 15.247 (a1)]:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Result data graph shows the channel separation





4.4 Average Time of Channel Occupancy

Test Requirement: FCC part 15 section 15.247 (a1)(iii)
Test Date: 2012-05-31
Mode of Operation: Transmitting mode.
Detector Function: Zero span

Result : PASS

Measured Result :

Observing period = $79 \times 0.4\text{s} = 31.6\text{s}$

Measure the maximum time duration of one single pulse;

DH5 Packet permit maximum :
= $1600 / 79 / 6$
= 3.37 hop/s in each channel (5 times slots Rx, 1 times slot Tx)
Transmission Times within observing period
= 3.37×31.6
= 106.6

DH3 Packet permit maximum :
= $1600 / 79 / 4$
= 5.06 hop/s in each channel (3 times slots Rx, 1 times slot Tx)
Transmission Times within observing period
= 5.06×31.6
= 160

DH1 Packet permit maximum :
= $1600 / 79 / 2$
= 10.12 hop/s in each channel (1 times slots Rx, 1 times slot Tx)
Transmission Times within observing period
= 10.12×31.6
= 320

Dwell Time = Pulse Duration \times Length of Transmission time

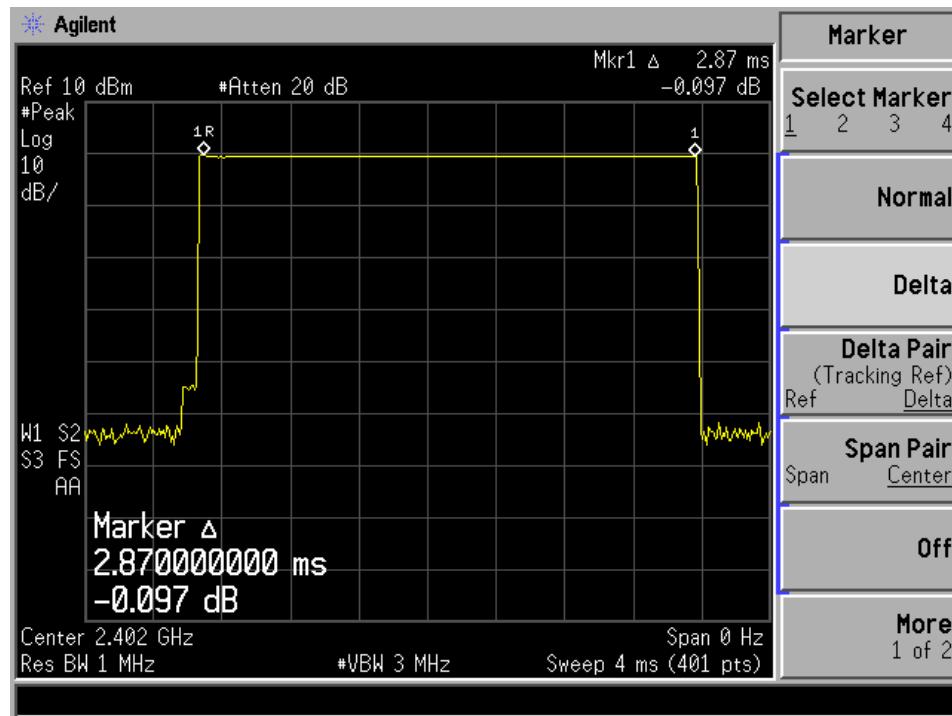
Result shown as below table and data graph.

Limits for Average Time of Occupancy [Section 15.247 (a1)(iii)]:

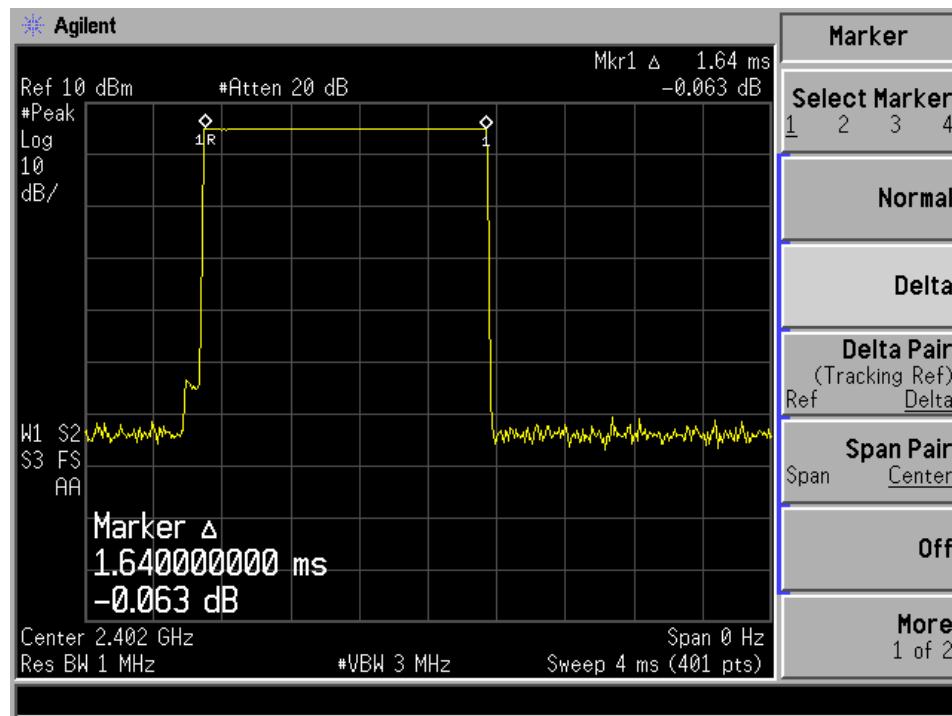
The average time of occupancy on any channel shall not be greater than 0.4 second within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Result data graph shows the pulses duration of DH5 Package

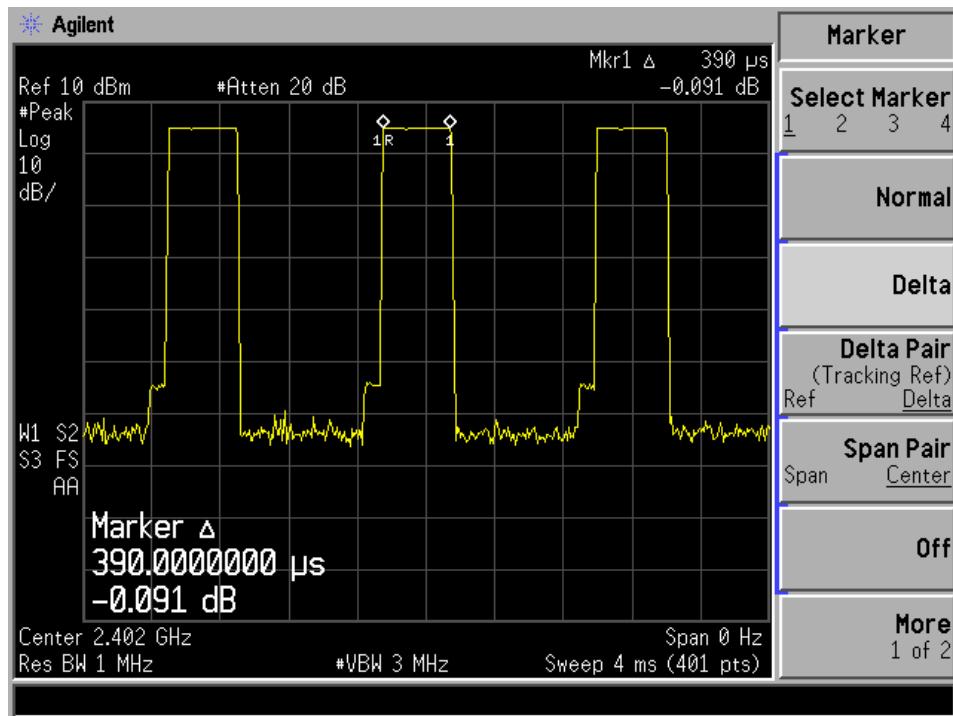


Result data graph shows the pulses duration of DH3 Package





Result data graph shows the pulses duration of DH1 Package

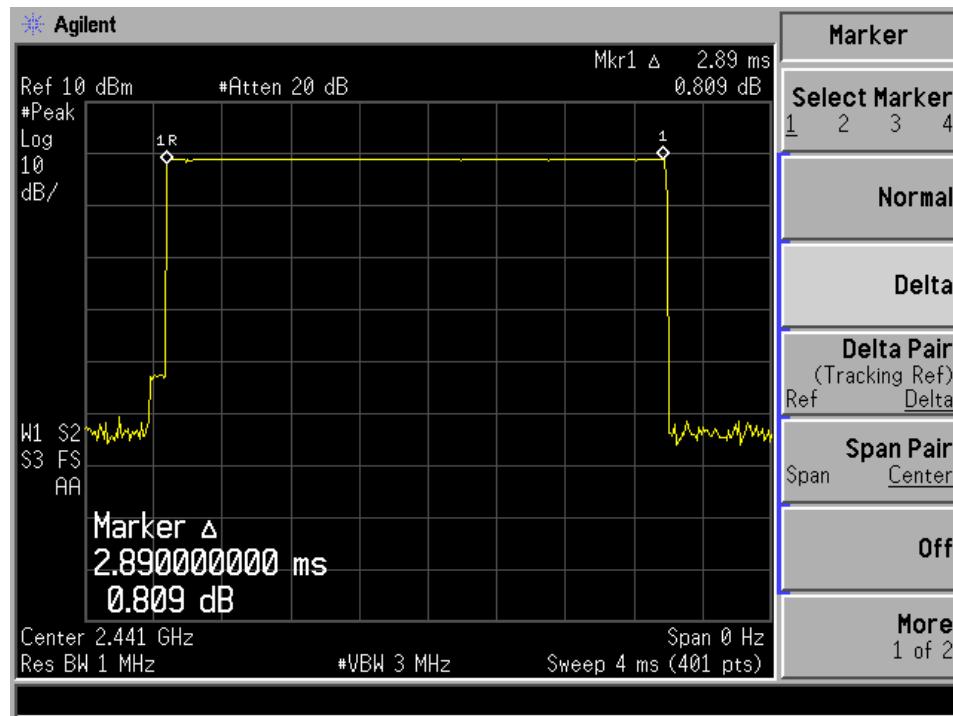


The table shown the result of Lowest Channel at 1Mbps

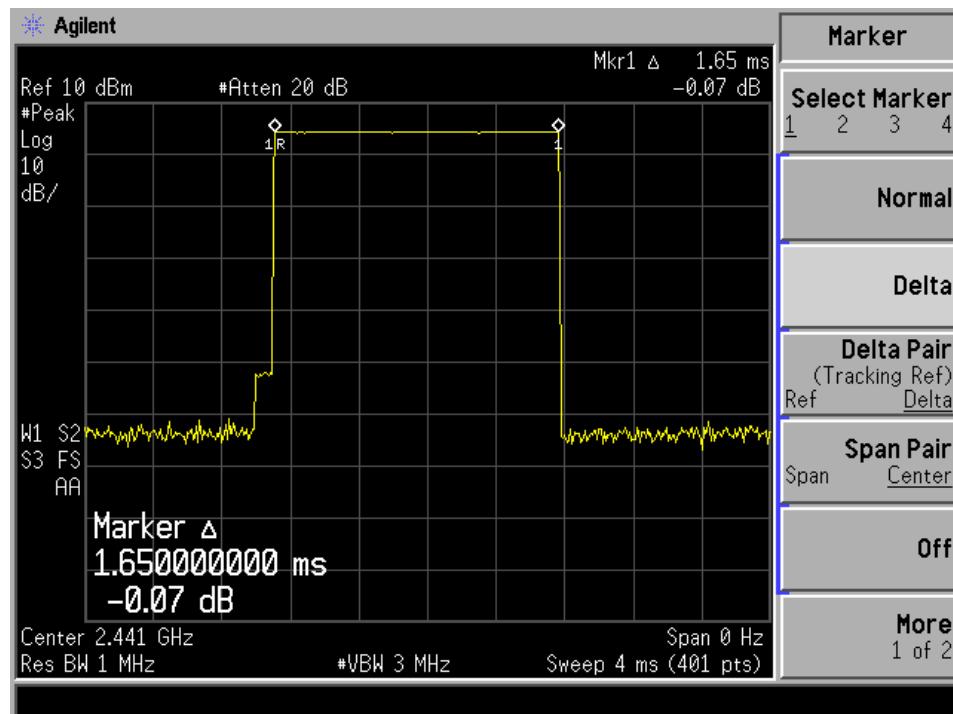
Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell time (ms)	Limit (ms)
DH5	2402	2.87	305.9	400
DH3	2402	1.64	262.4	400
DH1	2402	0.39	124.8	400



Result data graph shows the pulses duration of DH5 Package

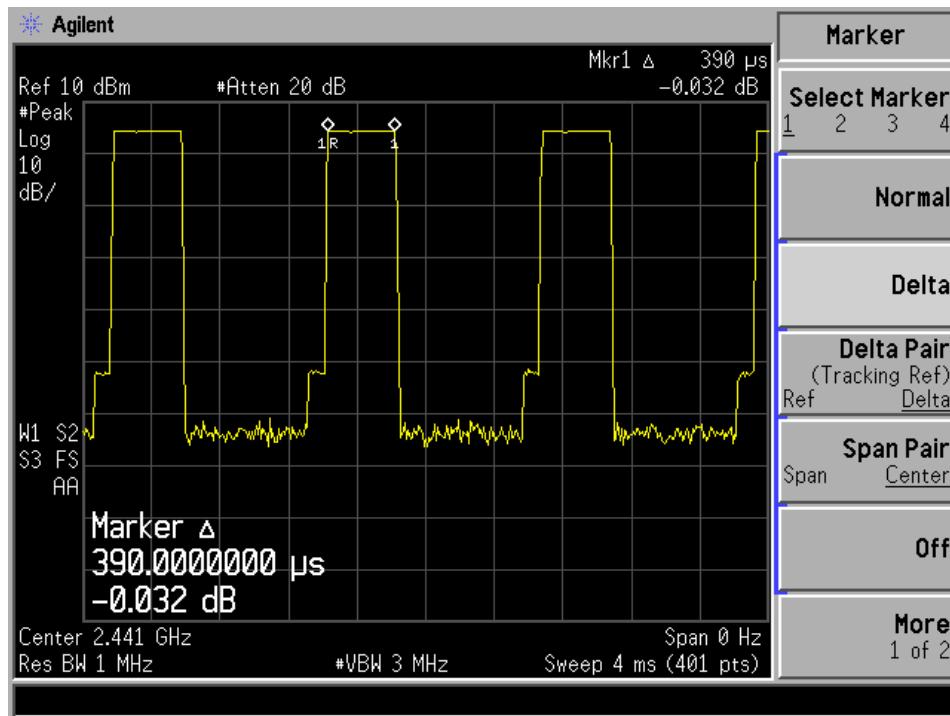


Result data graph shows the pulses duration of DH3 Package





Result data graph shows the pulses duration of DH1 Package

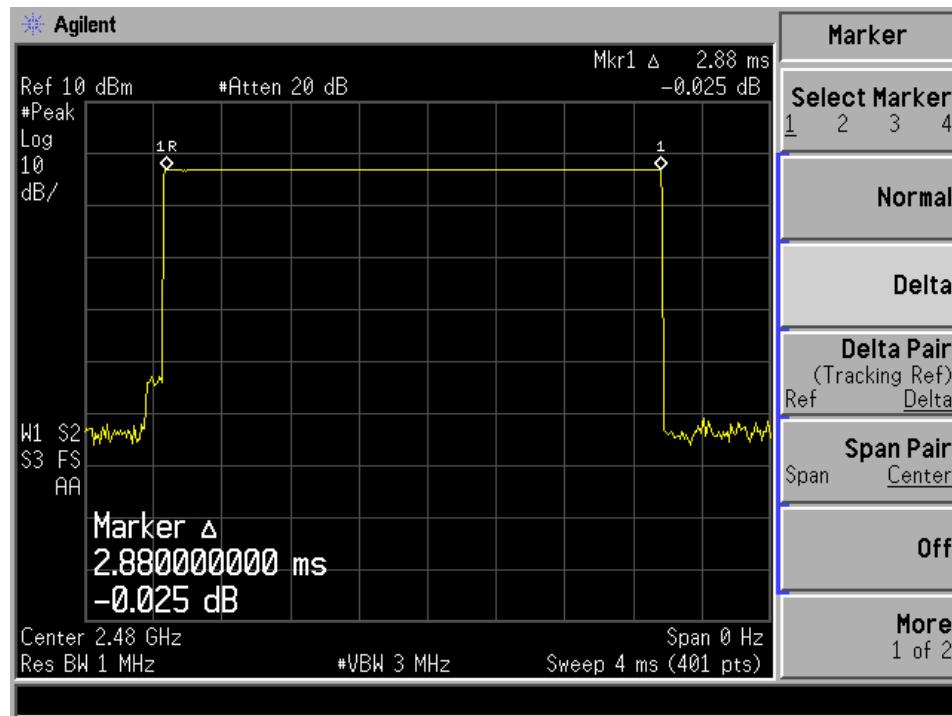


The table shown the result of Middle Channel at 1Mbps

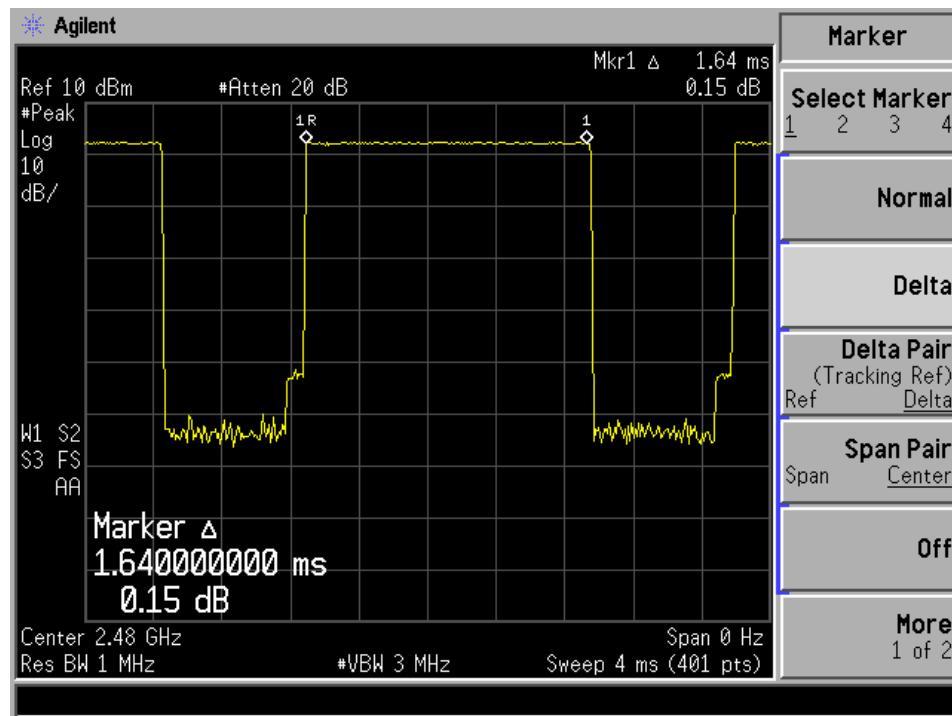
Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell time (ms)	Limit (ms)
DH5	2441	2.89	308.1	400
DH3	2441	1.65	264.0	400
DH1	2441	0.39	124.8	400



Result data graph shows the pulses duration of DH5 Package

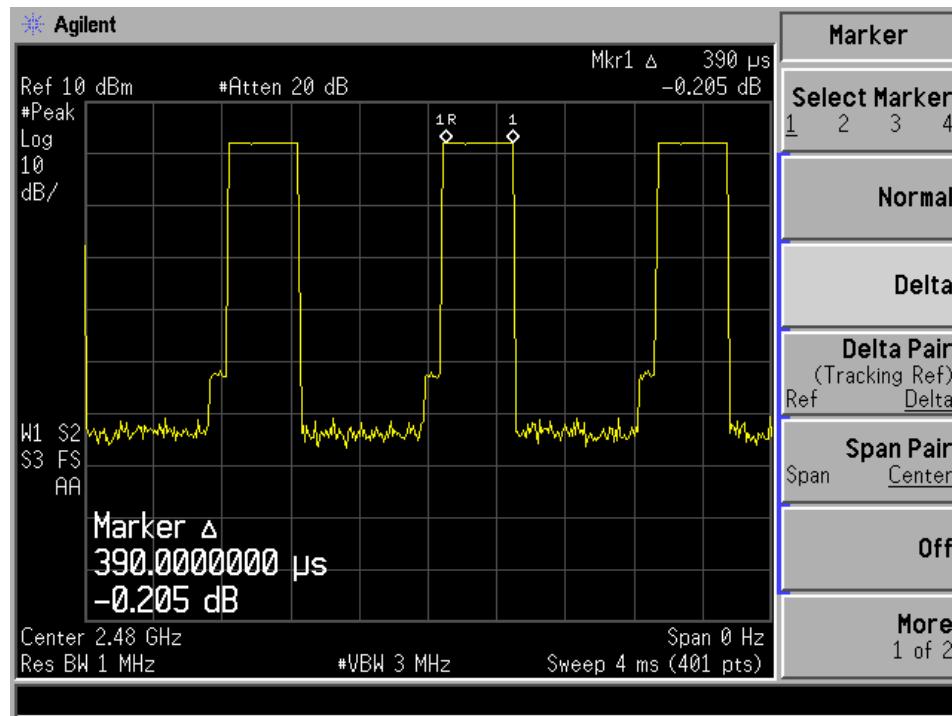


Result data graph shows the pulses duration of DH3 Package





Result data graph shows the pulses duration of DH1 Package



The table shown the result of Highest Channel at 1Mbps

Data Packet	Frequency (MHz)	Pulse Duration (ms)	Dwell time (ms)	Limit (ms)
DH5	2480	2.88	307.0	400
DH3	2480	1.64	262.4	400
DH1	2480	0.39	124.8	400



4.5 Band Edge Measurement

Test Requirement: FCC part 15 section 15.247
 Test Date: 2012-05-31
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

Result: PASS

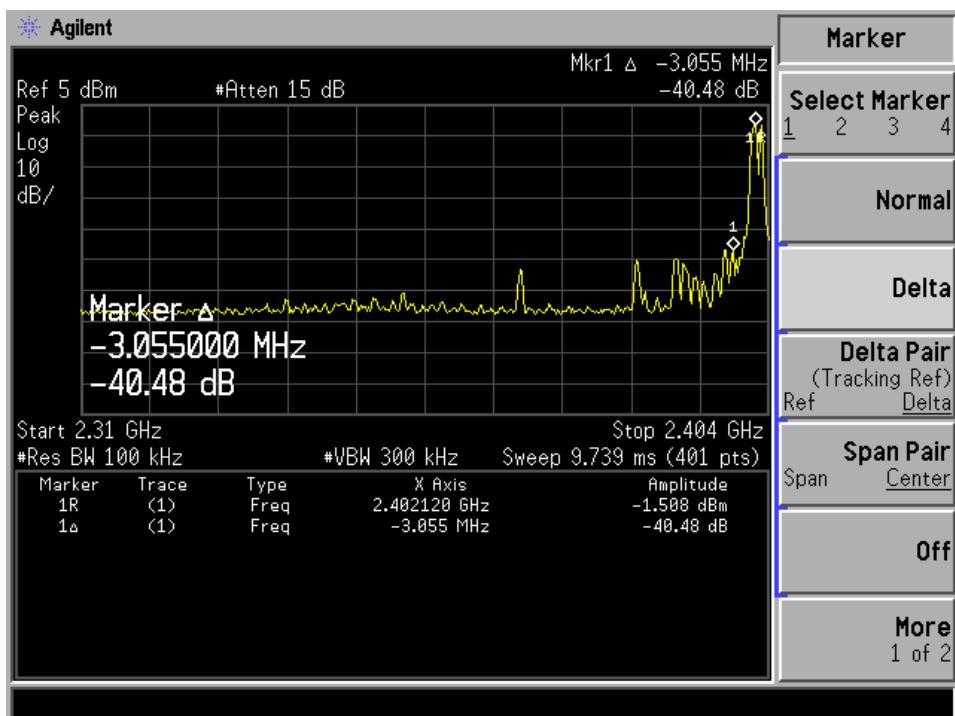
Measured Result :

Refer to the data graph, it shows the frequency of lower band edge and upper band edge separately.

Limits of Band Edge for Carrier Frequencies Operated within the Bands [Section 15.247]:

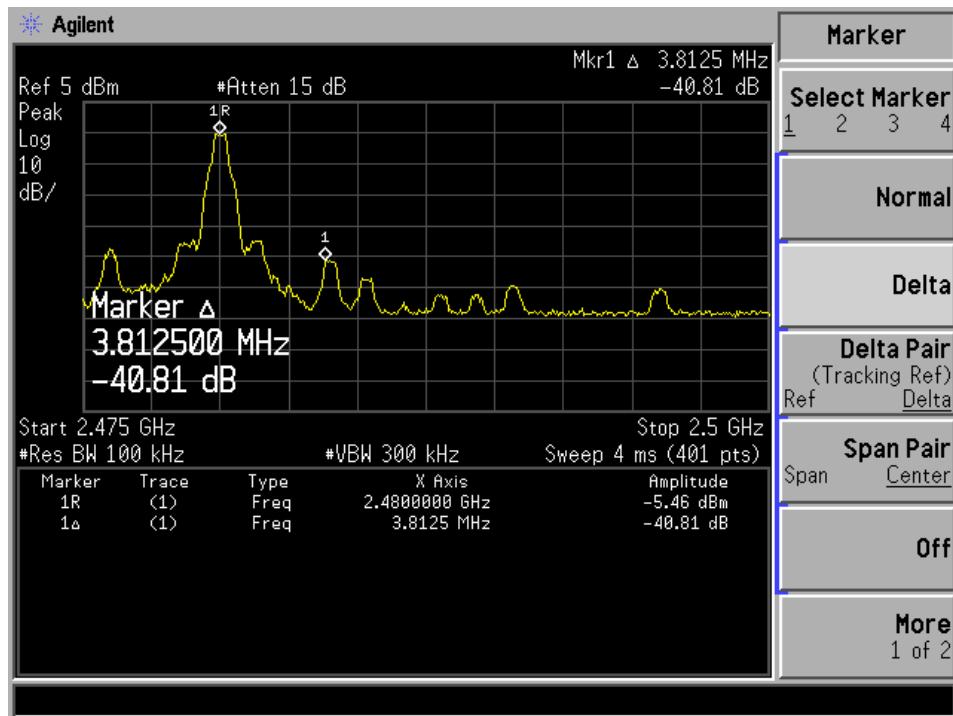
The carrier frequencies should operate within 2400-2483.5MHz.

Result data graph shows the frequency of lower channel.





Result data graph shows the frequency of upper channel.





4.6 Maximum Output Power

Test Requirement: FCC part 15 section 15.247 (b1)
 Test Method: ANSI C63.4:2003
 Test Date: 2012-05-31
 Mode of Operation: Transmitting mode.
 Detector Function: Peak
 Measurement BW: RBW 1MHz ; VBW 1MHz

Test Setup:



=

Result : PASS

1M bps

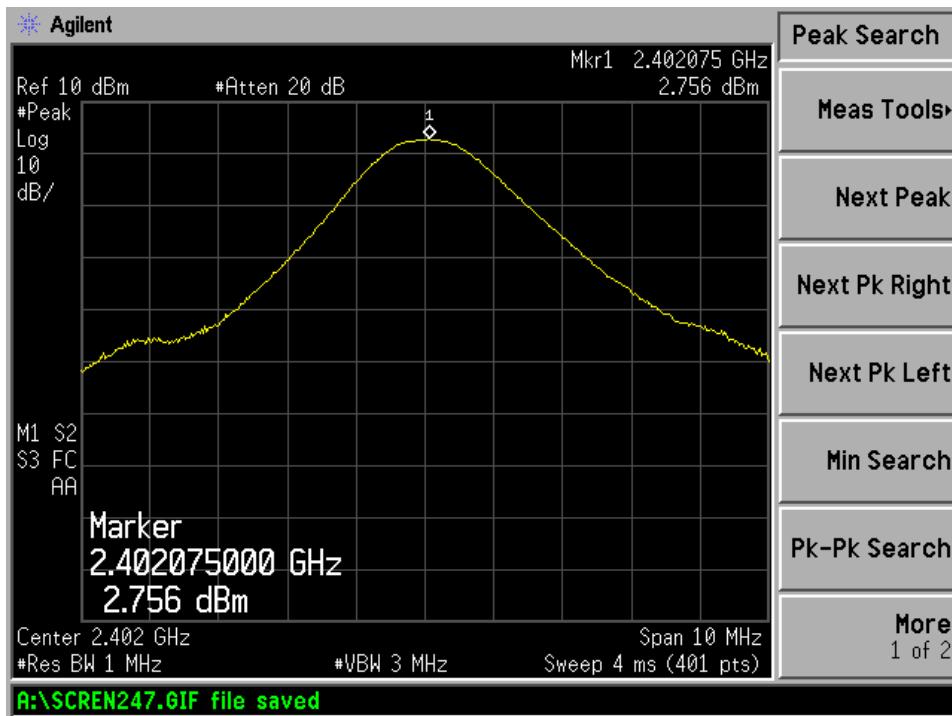
Frequency (MHz)	Peak Output Power		Limit	
	(dBm)	(W)	(dBm)	(W)
Lowest Channel : 2402	2.76	0.0019	21	0.125
Middle Channel : 2441	1.11	0.0013	21	0.125
Highest Channel : 2480	-1.77	0.0007	21	0.125

Limits for Maximum Output Power [Section 15.247 (a1)(iii)]:

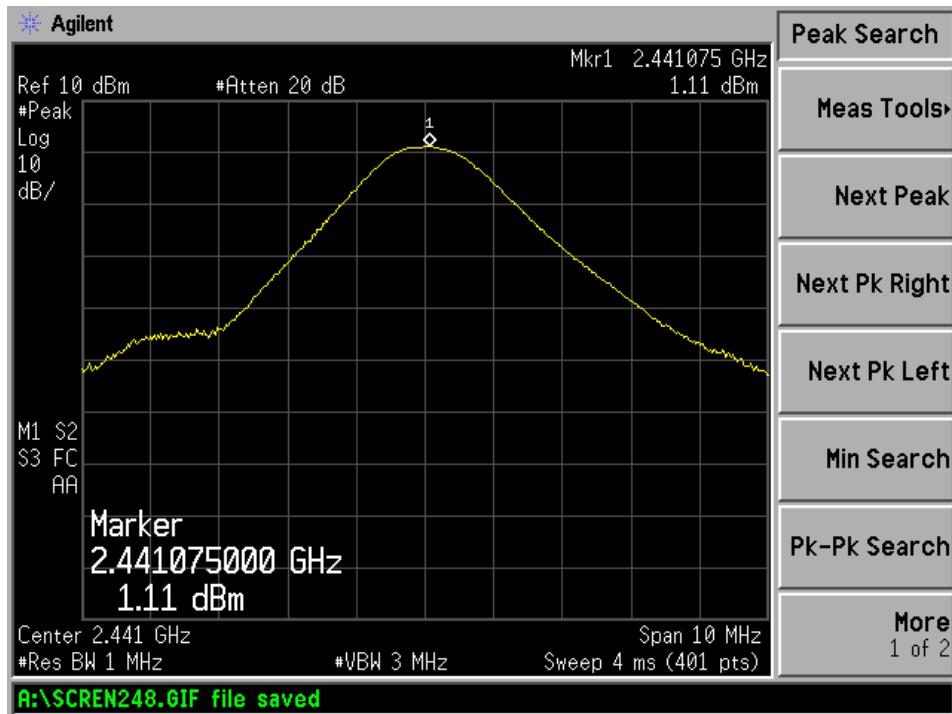
For frequency hopping systems employing at least 75 hopping channels: 1 Watt
 For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts



Result data graph shows the frequency of lowest channel 1Mbps.

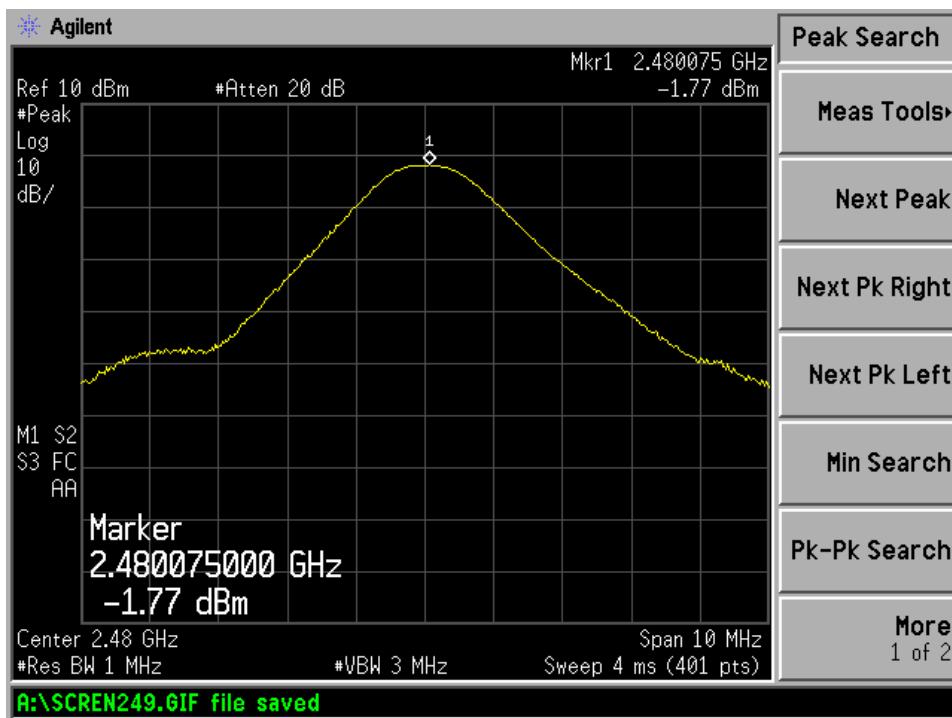


Result data graph shows the frequency of middle channel 1Mbps.





Result data graph shows the frequency of highest channel 1Mbps.

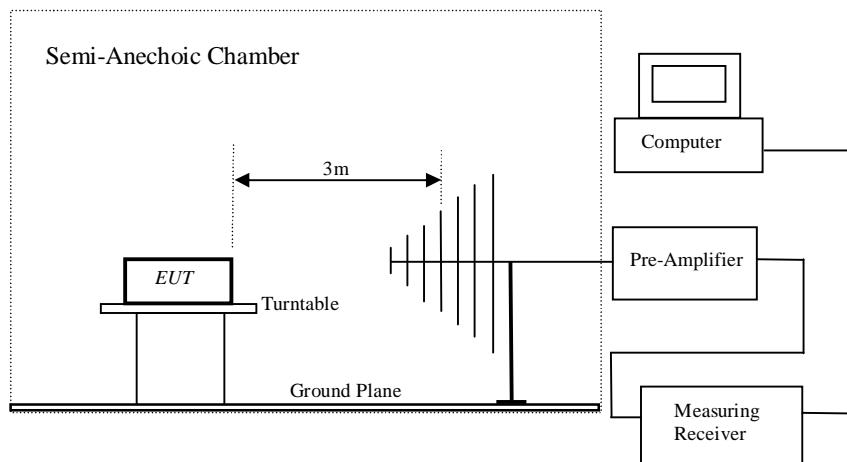




4.7 Out of Band Emissions and Emissions in Restricted Bands

Test Requirement: FCC part 15 section 15.247 (d)
Test Method: ANSI C63.4:2003
Test Date: 2012-05-31
Mode of Operation: Transmitting mode
Detector Function: Peak
Measurement BW: RBW 100KHz ; VBW 300KHz

Test Setup:





Result : PASS

Out of Frequency Band Emissions:

For out of band emissions that are close to or exceed 20dB attenuation requirement, and emission falls into restricted band, radiated emission was performed in order to show compliance with the general radiated emission requirement.

Result Summary:

Refer to the data graph for the emission data graph, result shows that the significant emissions detected are with more than 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

Limits for Out of Frequency Band Emission [Section 15.247 (d)]:

In any 100kHz 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 100kHz bandwidth within the band that contains the highest level of the desired power. Attenuation below the general limits specified in Section 15.209(a) is not required.

Limit for Radiated Emission Falling in Restricted Bands [Section 15.209]:

Frequency (MHz)	Field Strength [μ V/m]	Field Strength [dB μ V/m]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

Radiated emissions, which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209.

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.



Result : PASS

All Emission and Emissions Fall into Restricted Band were recorded as below:

1M bps

Radiated Emissions							
	Emissions Frequency MHz	E-Field Polarity	Reading dBuV/m	System Factor dB	Field strength at 3m dBuV/m	Limit dBuV/m	Delta to Limit dBuV/m
Lowest Channel							
PK	4806.00	V	60.86	-3.92	56.94	74.00	-17.06
AV		V	43.57	-3.92	39.65	54.00	-14.35
Middle Channel							
PK	4872.00	V	60.78	-3.74	57.04	74.00	-16.96
AV		V	43.06	-3.74	39.32	54.00	-14.68
Highest Channel							
PK	4960.00	V	57.54	-3.48	54.06	74.00	-19.94
PK		V	42.04	-3.48	38.56	54.00	-15.44
Spurious Emissions							
QP	30.00	V	22.30	8.04	30.34	40.00	-9.66
QP	46.02	V	20.59	7.85	28.44	40.00	-11.56
QP	374.62	V	21.45	10.63	32.08	46.00	-13.92
QP	32.41	H	24.88	8.44	33.32	40.00	-6.68
QP	203.52	H	26.86	4.87	31.73	43.50	-11.77
QP	755.39	H	16.85	17.48	34.33	46.00	-11.67

- Refer to the data graph shows the worst case channel's emission data graph from 30MHz-1GHz.
- Only background noise was measured from 1GHz-26GHz except related to the operation frequency.

Result Summary:

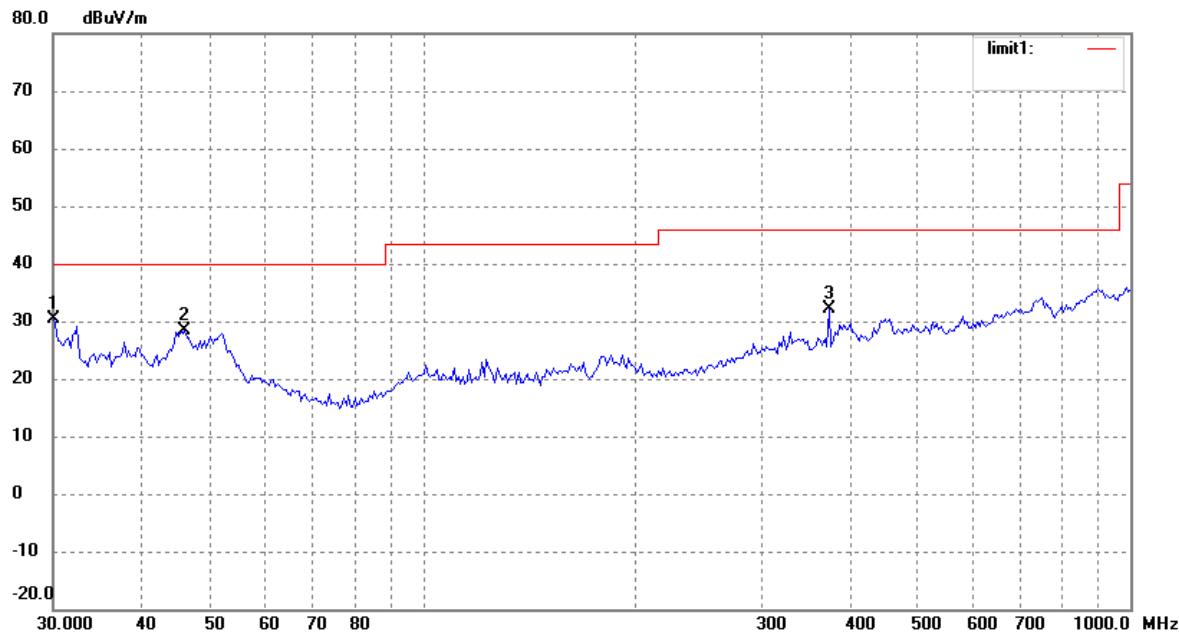
- Communication mode: All other emissions are more than 20dB below FCC part 15.209 limit.
- No further spurious emissions found between 30 MHz and lowest internal used/generated frequency and from 30MHz to 1GHz.

Remarks:

- " * " Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
- Emission level with more than 20dB below the FCC required limit is not mentioned in table.
- Delta to Limit = Field strength (dB μ V/m) – Limit (dB μ V/m).
- Calculated measurement uncertainty: 9kHz -30MHz: 1.8dB.
30MHz -1GHz: 5.2dB.
1GHz -18GHz: 5.1dB.

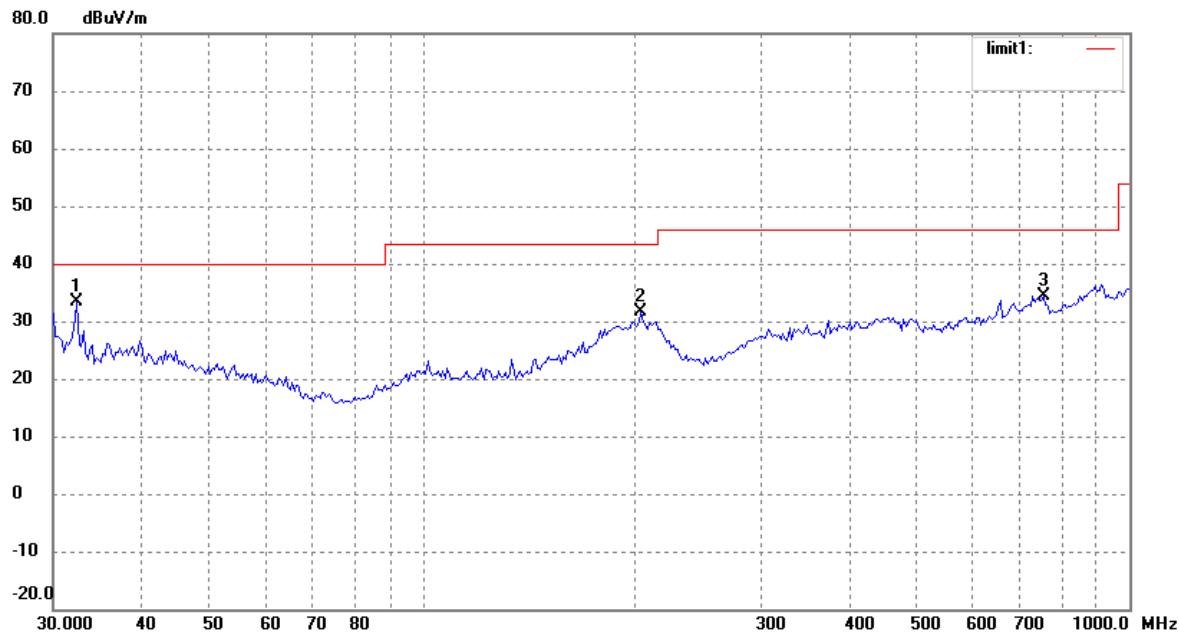


Radiated emission data graph (Vertical polarization, 30MHz-1GHz)



Remark: Only background noise was measured from 1GHz-26GHz except related to the operation frequency.

Radiated emission data graph (Horizontal polarization, 30MHz-1GHz)



Remark: Only background noise was measured from 1GHz-26GHz except related to the operation frequency.



4.8 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement: FCC part 15 Section 15.207 Class B
Test Method: ANSI C63.4:2003
Test Date: 2012-05-31
Mode of Operation: Charging mode
Detector Function: CISPR Quasi Peak
Measurement BW: 5 kHz

Results: PASS

Refer the result table and data graph.

Limits for Conducted Emission [Section 15.207]:

Frequency Range [MHz]	Quasi-Peak Limit [dB μ V]	Average Limit [dB μ V]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

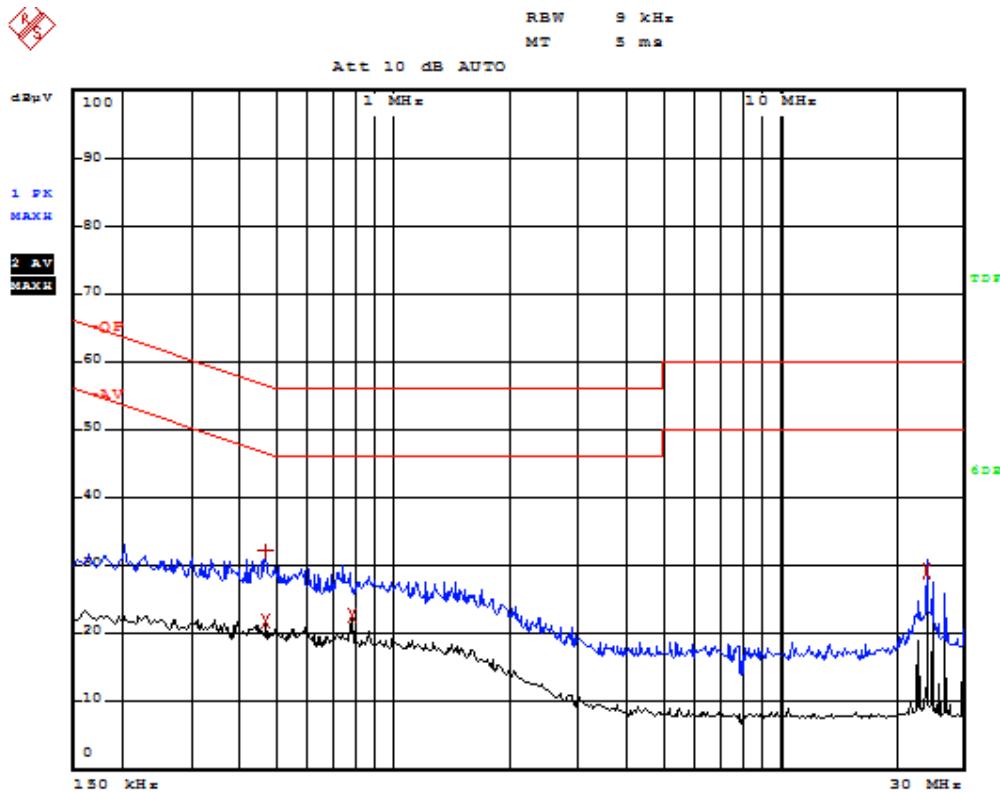
* Decreases with the logarithm of the frequency.

Remarks:

Calculated measurement uncertainty: ± 2.8 dB



Result data graph shows the conducted emission (Live).

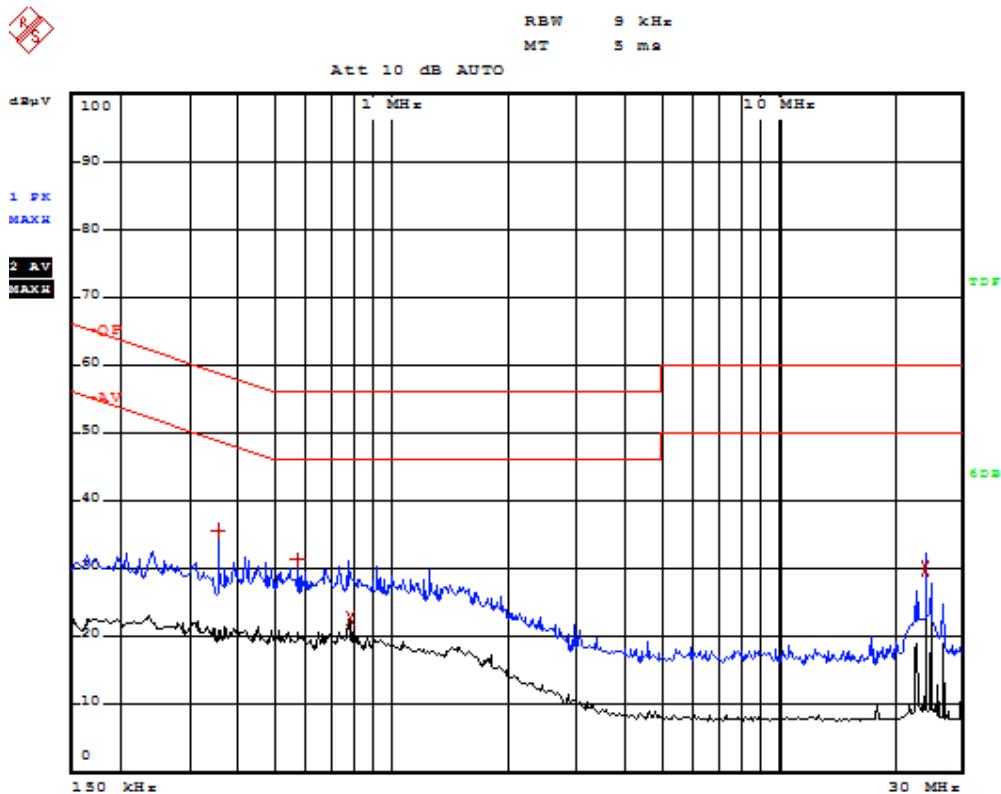


Refer to the following table for the result details:

Frequency (MHz)	Detector (QP/AV)	Phase	Result (dB μ V)	Limit (dB μ V)	Margin
0.466	QP	L	32.03	56.58	-24.55
0.466	AV	L	21.87	46.58	-24.71
0.778	AV	L	22.67	46.00	-23.33
23.982	AV	L	29.28	50.00	-20.72



Result data graph shows the conducted emission (Neutral).



Refer to the following table for the result details:

Frequency (MHz)	Detector (QP/AV)	Phase	Result (dB μ V)	Limit (dB μ V)	Margin
0.354	QP	N	35.58	58.86	-23.28
0.574	QP	N	31.36	56.00	-24.64
0.778	AV	N	22.62	46.00	-23.38
23.982	AV	N	30.09	50.00	-19.91



5.0 RF Exposure Compliance Requirement

Test Requirement: FCC part 15 section 15.247 (i)
 Test Method: FCC part 15 section 1.1307 (b1)
 OET Bulletin 65, Edition 01-01

Results: PASS

Systems operation under the provision of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guideline,

Frequency Band:	2.402GHz ~2.480GHz
Device Category:	<input checked="" type="checkbox"/> Portable (< 20cm separation) <input type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others :
Exposure Classification:	<input type="checkbox"/> Occupational/ Controlled exposure <input checked="" type="checkbox"/> General Population / Uncontrolled exposure
Max. Output Power	0.0019W
Antenna Gain	0.5 dBi (Numeric gain: 1.12)
Evaluation Applied:	<input type="checkbox"/> MPE Evaluation <input checked="" type="checkbox"/> SAR Evaluation

SAR Evaluation :

Output Power \leq 60 / f(GHz) mW

For 2.480 GHz device requirement:
 Output Power \leq 24.2mW

Therefore, no SAR evaluation required since the transmitter power is below < 24mW



6.0 List of Measurement Equipment

Radiated Emission and Bandwidth Emissions

Description	Manufacturer	Model no.	Serial no.	CAL due
Spectrum Analyzer	Agilent	E4402B	US41192821	27 Mar 2013
Moisture Test Chamber	GONGWEN	GDS-150	SEMT-0013	15 Jul 2012
DC Power Supply	LW	APR-3003	N/A	15 Jul 2012
Spectrum Analyzer	Agilent	E4402B	US41192821	27 Mar 2013
Moisture Test Chamber	GONGWEN	GDS-150	SEMT-0013	15 Jul 2012
Spectrum Analyzer	R & S	FSP30	836079/035	27 Mar 2013
Positioning Controller	C & C	CC-C-1F	N/A	19 Dec 2012
RF Switch	EM	EMSW18	SW060023	19 Dec 2012
Pre-amplifier	Agilent	8447F	3113A06717	27 Mar 2013
Pre-amplifier	Compliance Direction	PAP-1G18	24002	27 Mar 2013
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	24 Feb 2013
Horn Antenna	ETS	3117	00086197	24 Feb 2013
Anechoic chamber	Albatross Project	MCDC	---	19 Mar 2013

Line Conducted

Description	Manufacturer	Model no.	Serial no.	CAL due
EMI TEST RECEIVER	Rohde & Schwarz	ESPI	101611	27 Mar 2013
L.I.S.N	Schwarzbeck	NSLK8126	8126-224	27 Mar 2013
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	27 Mar 2013
AMN	EMCO	3825/2	11967C	27 Mar 2013

N/A Not Applicable or Not Available