



TEST REPORT

Date: 2013-07-09

Report No.: 68.870.13.024.01F

Applicant: Elgato Systems LLC
900 Kearny St. #750, San Francisco, CA 94133

Description of Samples: Model name: Smart Key
Brand name: Elgato
Model no.: 2SK309901000
FCCID: SNE-SMA-001

Date Samples Received: 2013-06-20

Date Tested: 2009-06-21 to 2009-07-08

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:-

Jim Huang
Project Engineer
Wireless & Telecom departmen

John Zhi
Project Manager
Wireless & Telecom department

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Appendix A

Photos of Test Setup

Appendix B

External EUT Photos

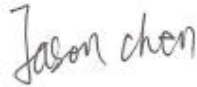
Appendix C

Internal EUT Photos

1.0 General Details

1.1 Test Laboratory

NTEK Testing Technology co., Ltd.
Building E, Fenda Science Park, Sanwei Community, Xixiang
Street, Bao'an District, Shenzhen P. R. China
EMC Laboratory registered by FCC with
FCC Registration Number: 238937
Tested by:



-

Jason Chen

1.2 Applicant Details
Applicant

Elgato Systems LLC
900 Kearny St. #750, San Francisco, CA 94133

Manufacturer

Zhongshan E-Tek Co., Ltd.
.
No.8-10GuanChengroad,Xiaolan,ZhongShan,
Guangdong, P.R.China

1.3 Equipment Under Test [EUT]

Description of EUT

Product Description:	Smart Key
Model No.:	2SK309901000
Brand Name:	Elgato
FCCID:	SNE-SMA-001
Rating:	DC 3.7V(Li-ion button cell)
Antenna Type:	Integral
Operated Frequency:	2400 -2483.5 MHz
No. of Channel:	79
Accessories and Auxiliary Equipments:	IPhone 4S

General Operation of EUT

The EUT is a 2.4 GHz band FHSS device system. EUT named Smart Key operate with app control software.

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: 2012 and ANSI C63.4: 2003 for FCC Verification

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"/>
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 type="checkbox"/>	<input checked="" type="checkbox"/>
RF Exposure	Section 15.247 (i)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Antenna Requirement	Section 15.203	<input checked="" type="checkbox"/> See note 1	<input type="checkbox"/>

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.

*On a standard emission test site with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

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:

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

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: 2013-07-03
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

Result: PASS

Measured Result :

Number of Channels = 79

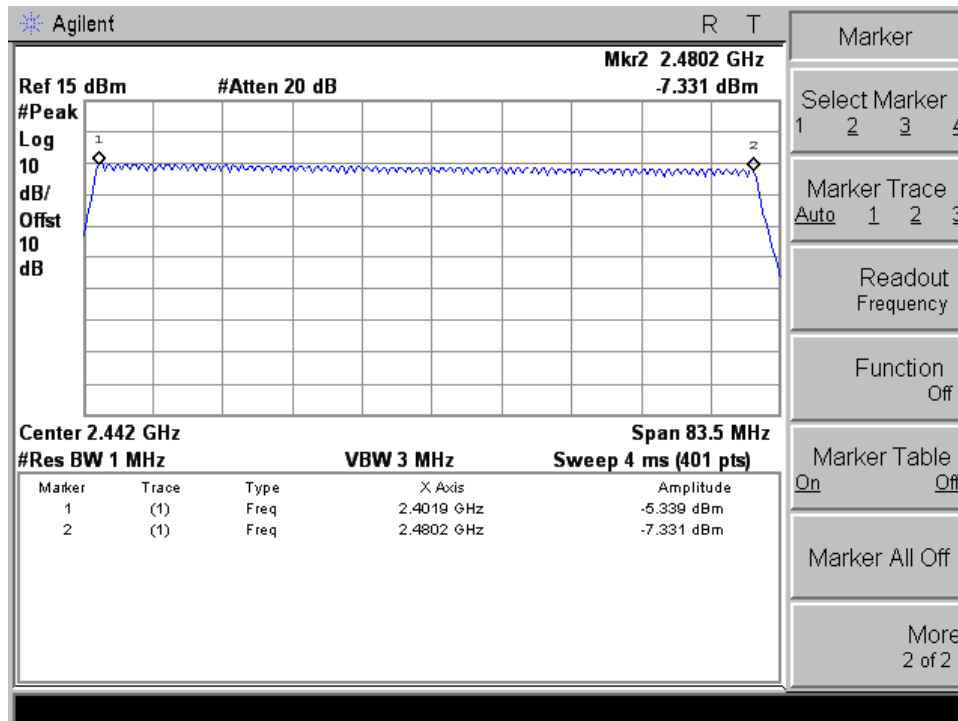
Channel Frequency(MHz) in sequence:

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.

Figure 1 – Result data graph shows the number of operation channels:



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4.2 20dB Bandwidth Measurement

Test Requirement: FCC part 15 section 15.247 (a1)
 Test Date: 2013-07-02
 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 (KHz)
Lowest : 1	2407.0	376.370
Middle: 40	2443.9	380.393
Highest : 79	2475.3	371.681

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

Figure 2 – Result data graph shows 20 dB bandwidth, CF = 2.402GHz, BW = 376.370KHz

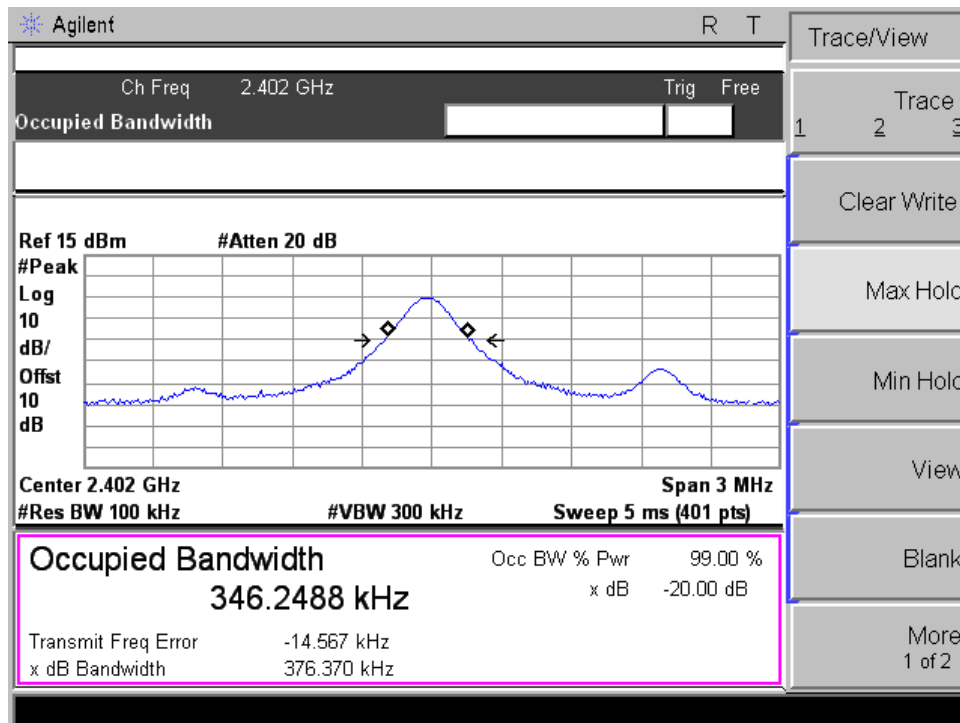


Figure 3 – Result data graph shows 20 dB bandwidth, CF = 2.441GHz, BW = 380.393KHz

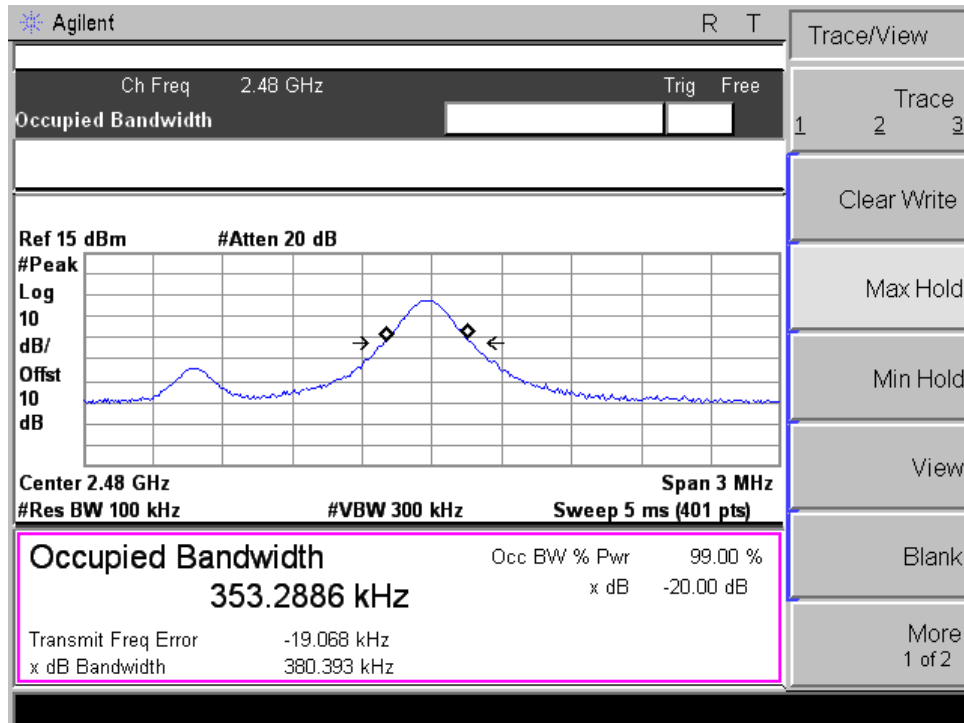
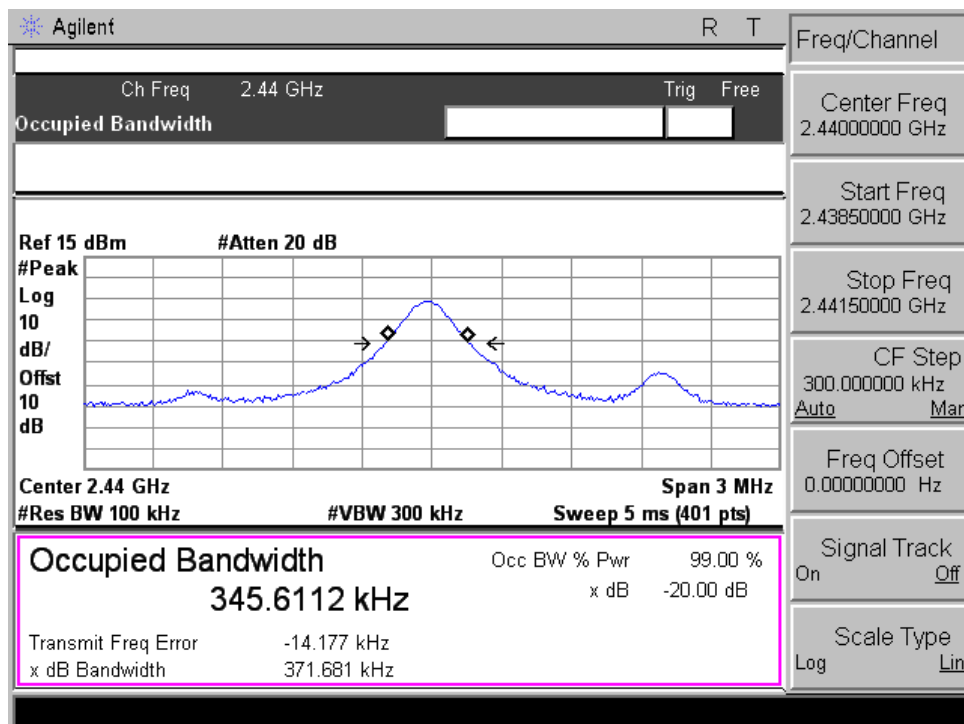


Figure 4 – Result data graph shows 20 dB bandwidth, CF = 2.480GHz, BW = 371.681KHz



4.3 Hopping Channel Carrier Frequency Separation

Test Requirement:	FCC part 15 section 15.247 (a1)
Test Date:	2013-07-03
Mode of Operation:	Transmitting mode.
Detector Function:	Max Hold

Result: PASS

Measured Result :

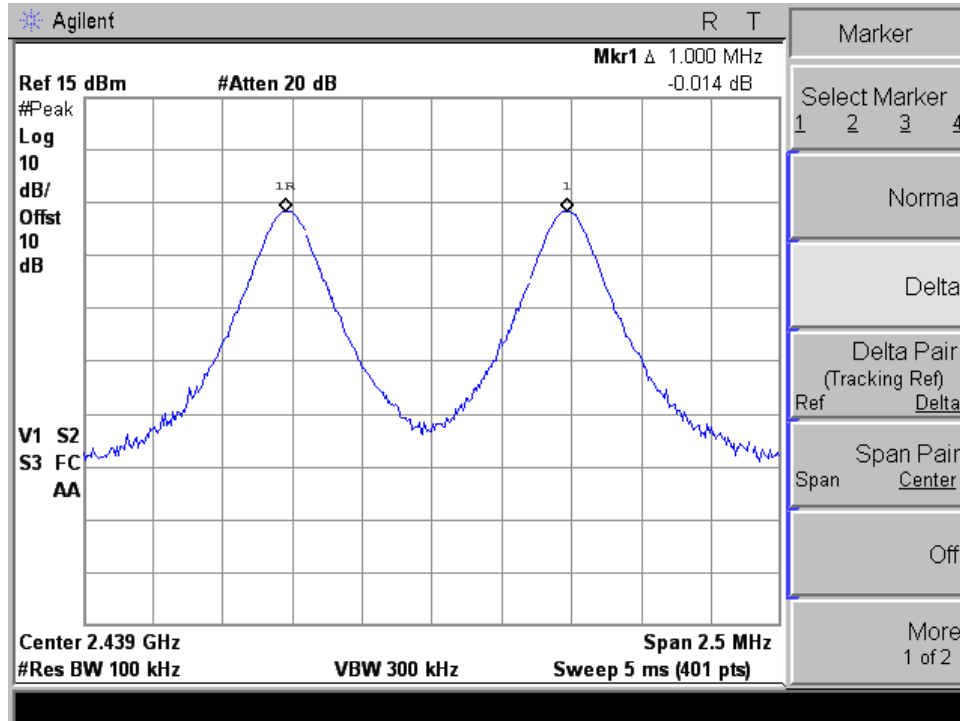
Refer to the delta marker, the frequency separation between two adjacent channels is 1.000MHz, therefore requirement of channel separated by a minimum of the 20dB bandwidth of the hopping channel is applied.

According to the test result shown in section 4.2, the maximum 20dB bandwidth is 380.393KHz, 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.

Figure 5 – 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: 2013-07-03
Mode of Operation: Transmitting mode.
Detector Function: Zero span

Result : PASS

Measured Result :

Dwell time = time slot length * hop rate / number of hopping channels * Observing period

Hop rate=1600/s

Number of hopping channels=79

Observing period = number of hopping channels x 0.4s = 79 x 0.4s=31.6s

Time slot length:

For the worst case of DH1 under Low, Mid and High frequency, time slot length has been measured at below data graph accordingly.

Therefore, dwell time can be obtained, and the final dwell time result table is stated below.

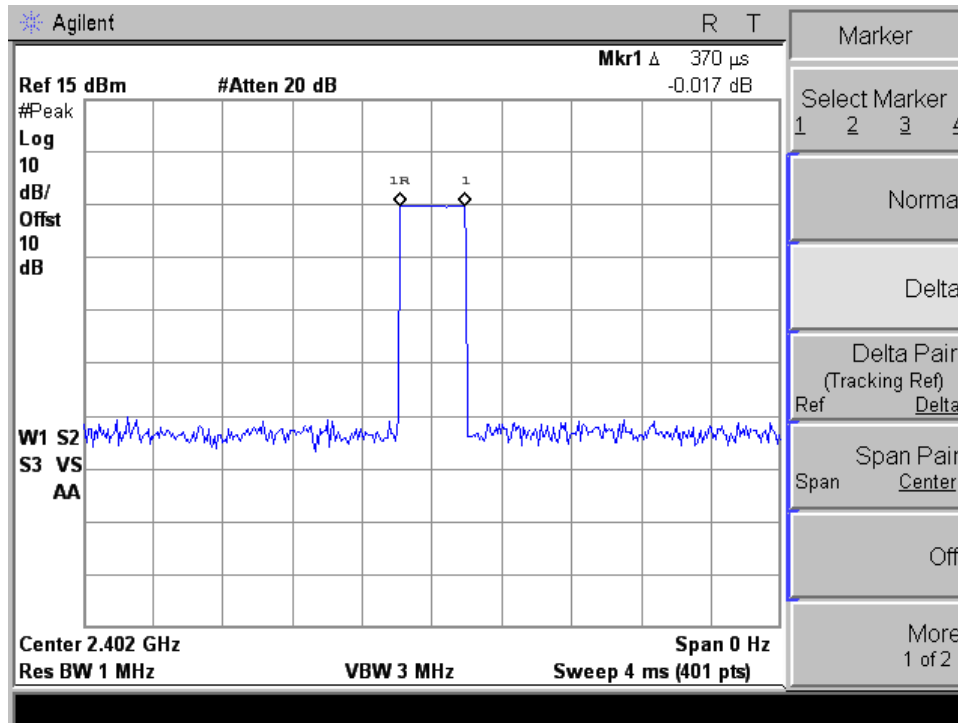
Frequency (MHz)	Pulse Duration (ms)	Dwell time (ms)	Limit (ms)
2402	0.370	0.119	400
2441	0.380	0.122	400
2480	0.380	0.122	400

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

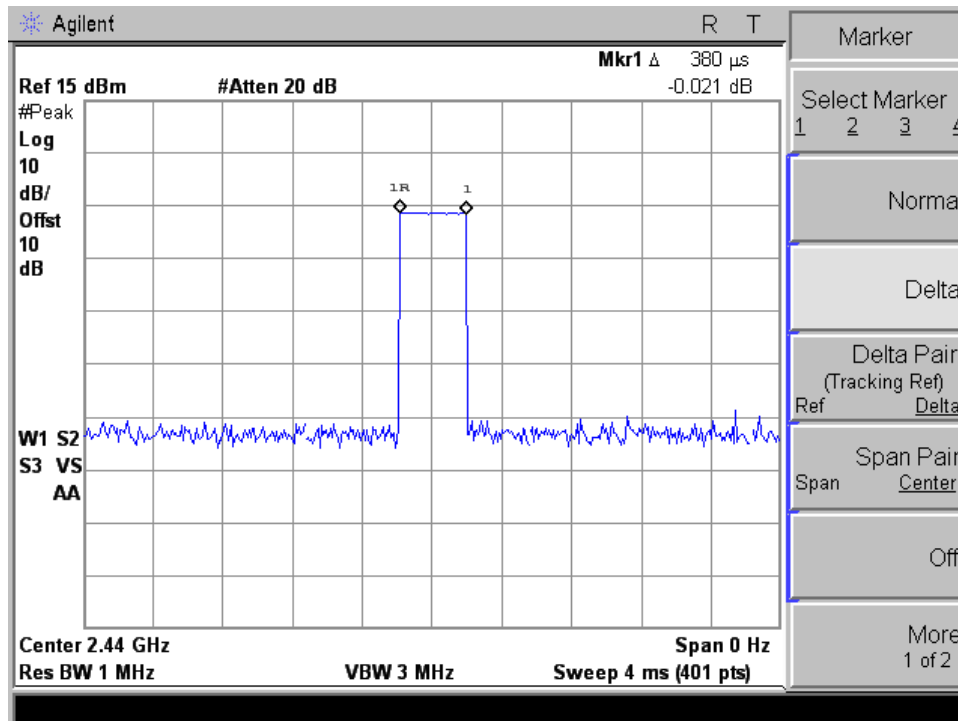
The average time of occupancy on any channel shall not be greater than 0.4 second within a period of 0.4 seconds multiplied by the number of hopping channels employed.

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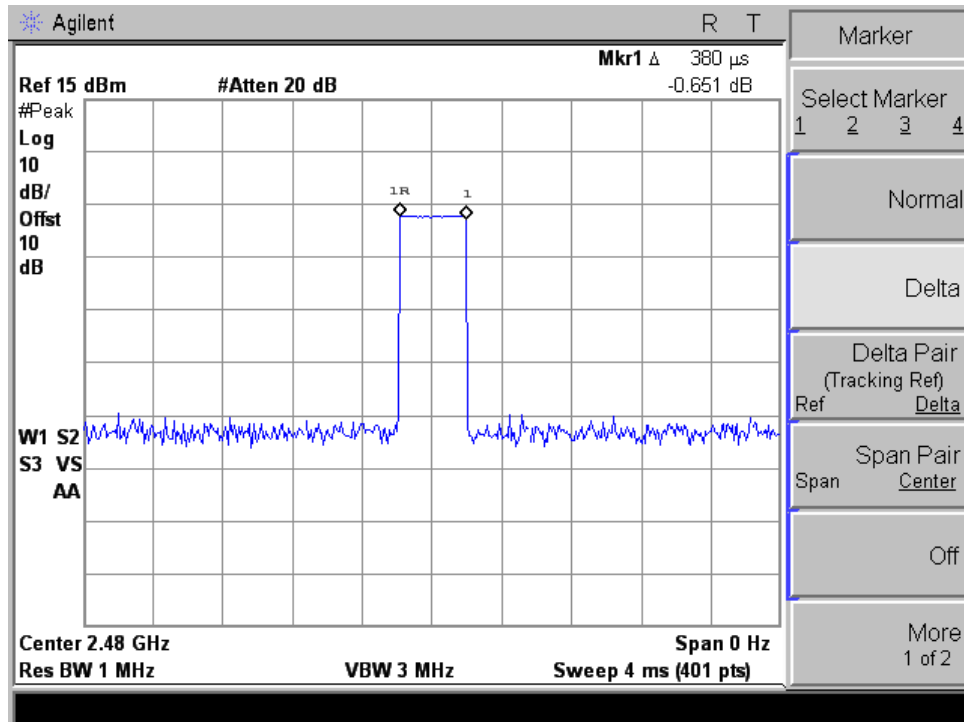
Result data graph shows the pulses duration of low channel 2402MHz



Result data graph shows the pulse duration of middle channel 2441MHz



Result data graph shows the pulses duration of high channel



4.5 Band Edge Measurement

Test Requirement: FCC part 15 section 15.247
 Test Date: 2013-07-03
 Mode of Operation: Transmitting mode.
 Detector Function: Max Hold

Result: PASS

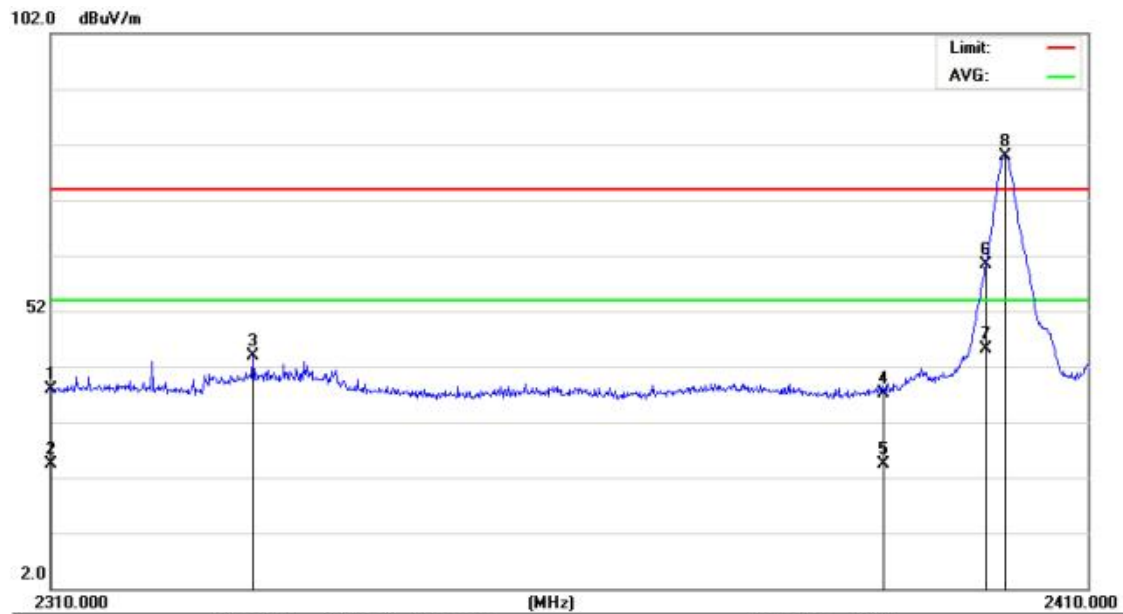
Measured Result :

Refer to the data graph as follow for the detail.

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

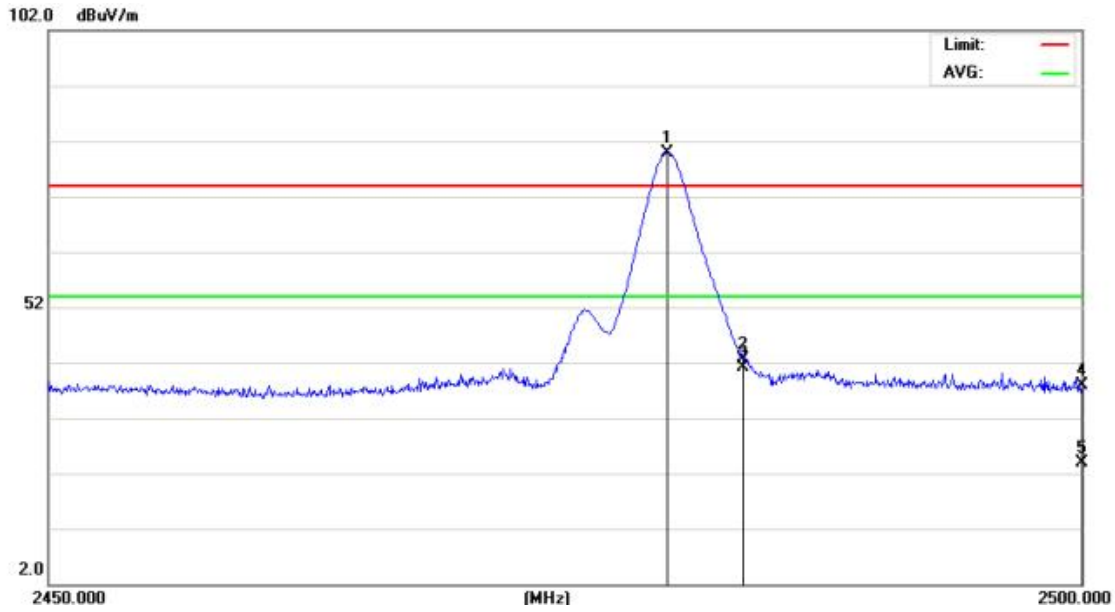
The carrier frequencies should operate within 2400-2483.5MHz.

Result data graph shows the frequency of lowest channel.



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		2310.000	50.71	-12.89	37.82	74.00	-36.18			peak
2		2310.000	37.25	-12.89	24.36	54.00	-29.64			AVG
3		2329.169	56.92	-13.10	43.82	74.00	-30.18			peak
4		2390.000	50.28	-13.06	37.22	74.00	-36.78			peak
5		2390.000	37.32	-13.06	24.26	54.00	-29.74			AVG
6		2400.000	73.40	-12.99	60.41	74.00	-13.59			peak
7		2400.000	58.01	-12.99	45.02	54.00	-8.98			AVG
8	*	2401.843	92.83	-12.99	79.84	74.00	5.84			peak

Result data graph shows the frequency of highest channel.



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	
1	*	2479.829	92.69	-12.79	79.90	74.00	5.90	peak		
2		2483.500	55.33	-12.78	42.55	74.00	-31.45	peak		
3		2483.500	53.87	-12.78	41.09	54.00	-12.91	AVG		
4		2500.000	50.64	-12.72	37.92	74.00	-36.08	peak		
5		2500.000	36.67	-12.72	23.95	54.00	-30.05	AVG		

4.6 Maximum Output Power

Test Requirement:	FCC part 15 section 15.247 (a1)
Test Method:	ANSI C63.4:2003
Test Date:	2013-07-03
Mode of Operation:	Transmitting mode.
Detector Function:	Peak
Measurement BW:	RBW 1MHz ; VBW 3MHz

Test Procedure :

According to section 15.247(b)-power output of the DA-00-705A1 (2000), the measurement procedure Peak Output Power was used, the following is the measurement procedure.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

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Result : PASS

Frequency MHz	Output Power dBm	Output Power W	Limit W
2402	-5.079	0.00031	1
2441	-5.821	0.00026	1
2480	-6.477	0.00023	1

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

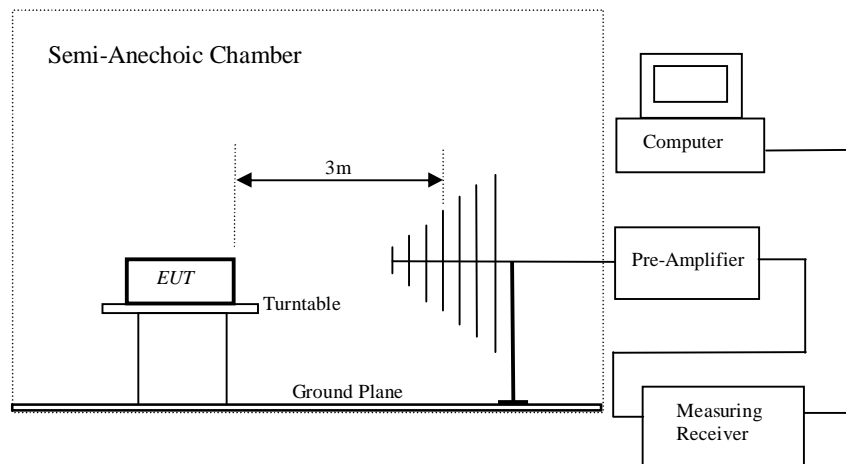
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4.7 Out of Band Emissions and Emissions in Restricted Bands

Test Requirement: FCC part 15 section 15.247 (d)
Test Method: ANSI C63.4:2003
Test Date: 2013-07-03
Mode of Operation: Transmit mode.

Detector Function: Peak
Measurement BW: RBW 100KHz ; VBW 300KHz

Test Setup:



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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 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 [$\mu\text{V}/\text{m}$]	Field Strength [dB $\mu\text{V}/\text{m}$]
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.

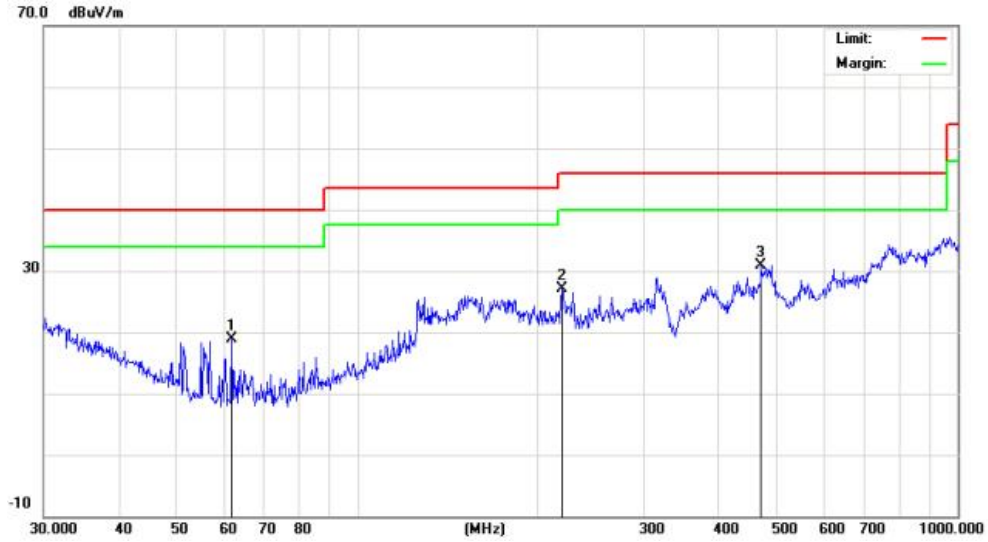
Report No.: 68.870.13.024.01F

Result : PASS

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

Below 1GHz emissions

Horizontal Polarity



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Detector	Comment
1		61.7781	13.57	5.31	18.88	40.00	-21.12			peak	
2		219.0753	16.83	10.27	27.10	46.00	-18.90			peak	
3	*	470.5232	11.14	19.73	30.87	46.00	-15.13			peak	

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Result : PASS

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

Below 1GHz emissions
Vertical Polarity



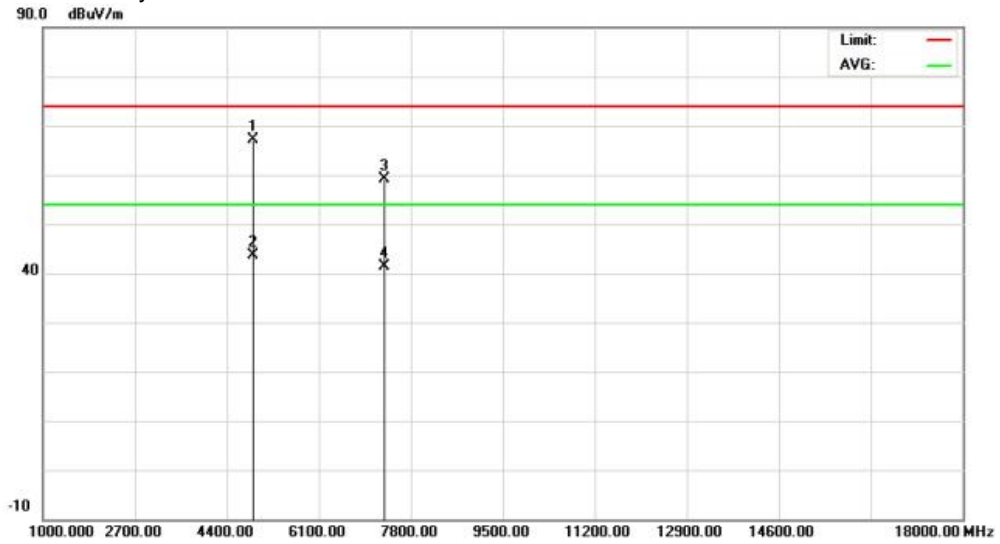
No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		45.6948	14.71	10.23	24.94	40.00	-15.06			peak
2		50.5860	16.64	7.99	24.63	40.00	-15.37			peak
3		194.4534	13.82	8.97	22.79	43.50	-20.71			peak
4	*	593.0497	8.68	22.52	31.20	46.00	-14.80			peak

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Result : PASS

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

Above 1GHz emissions
Horizontal Polarity



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree	Comment
1	*	4882.000	70.87	-3.68	67.19	74.00	-6.81	peak			
2		4882.000	47.29	-3.68	43.61	74.00	-30.39	peak			
3		7323.000	59.95	-0.82	59.13	74.00	-14.87	peak			
4		7323.000	42.25	-0.82	41.43	54.00	-12.57	AVG			

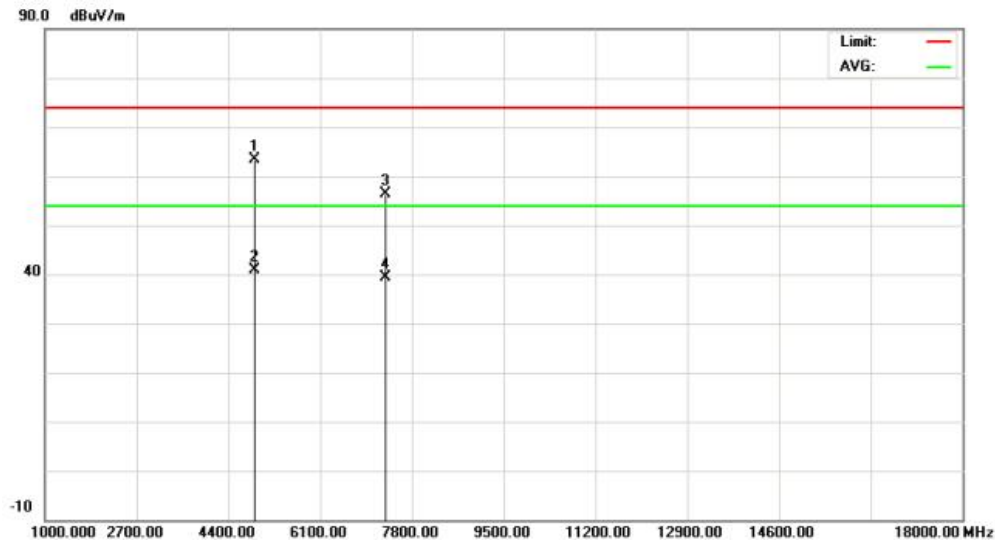
Remark: Only background noise was measured from 18GHz-26GHz.

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Result : PASS

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

Above 1GHz emissions
Vertical Polarity



No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree	Comment
1 *	4882.000	67.13	-3.68	63.45	74.00	-10.55	peak			
2	4882.000	44.67	-3.68	40.99	54.00	-13.01	AVG			
3	7323.000	57.31	-0.82	56.49	74.00	-17.51	peak			
4	7323.000	40.11	-0.82	39.29	54.00	-14.71	AVG			

Remark: Only background noise was measured from 18GHz-26GHz.

Result Summary:

- 1) Communication mode: All other emissions are more than 20dB below FCC part 15.209 limits.
- 2) No further spurious emissions found between 30 MHz and lowest internal used/generated frequency and from 30MHz to 1GHz.
- 3) Test data is base on the worst case highest channel's emission data graph from 30MHz-26GHz.

Remarks:

1. " * " Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
2. Emission level with more than 20dB below the FCC required limit is not mentioned in table.
3. Delta to Limit = Field strength (dBuV/m) – Limit (dBuV/m).
4. Calculated measurement uncertainty: 9kHz -30MHz: 4.89dB.
30MHz -1GHz: 4.89dB.
1GHz -18GHz: 4.89dB.

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: ---
Mode of Operation: ---
Detector Function: CISPR Quasi Peak
Measurement BW: 100 kHz
Worst Case Channel: --

Results: N/A

-For device do not connect to AC Mains, this test is not required.

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.

5.0 RF Exposure Compliance Requirement

Test Requirement: FCC part 15 section 15.247 (i)
 Test Method: FCC part 1 section 1.1307 (b1)
 OET Bulletin 65, Edition 01-01
 KDB 447498v05

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,

The EUT is considered as a portable device according to OET Bulletin 65, Edition 01-01, As per user manual, distance to human body of min. 5mm is determined.

Frequency Band:	2.400GHz ~2.4835GHz
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 Transmit Power	0.31mW
Antenna Gain	dBi (Numeric gain:1)
Evaluation Applied:	<input type="checkbox"/> MPE Evaluation <input checked="" type="checkbox"/> SAR Exempt <input type="checkbox"/> SAR Evaluation

MPE calculation:

The maximum radiated power (EIRP) = the maximum output power+ antenna gain
 = -5.079dBm+0dBi
 =-5.079dBm
 =0.31mW

According to KDB 447498 D01 V05 Clause 4.3.1

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}]$

=0.31/5*1.55=0.10<3.0

So there is no need to perform the SAR testing.

6.0 List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
1	Bilog Antenna	TESEQ	CBL61 1D	312 6	05 Jul,2013	Jul. 06, 2014
2	EMI Test Receiver	R&S	ESCI	101160	05 Jul,2013	Jul. 06, 2014
3	Antenna Mast	EM	SC100_1	N/A	N/A	N/A
4	Turn Table	EM	SC100	060531	N/A	N/A
5	50Ω Switch	Anritsu Corp	MP59B	6200983705	05 Jul,2013	Jul. 06, 2014
6	Spectrum Analyzer	Agilent	E4407B	160400005	05 Jul,2013	Jul. 06, 2014
7	Horn Antenna	EM	EM-AH-10180	2011071402	05 Jul,2013	Jul. 06, 2014
8	Amplifier	EM	EM-30180	060538	05 Jul,2013	Jul. 06, 2014

Conducted Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
1	LISN	R&S	ESH2-Z5	101313	05 Jul,2013	Jul. 06, 2014
2	Pulse Limiter	SCHWARZBEC K	VTSD 9561F	9716	05 Jul,2013	Jul. 06, 2014
3	EMI Test Receiver	R&S	ESCI	101160	05 Jul,2013	Jul. 06, 2014

Remarks:

CM Corrective Maintenance
 N/A Not Applicable or Not Available