FCC TEST REPORT

Product	:	Wireless Flash
Trade mark	:	Cactus
Model/Type reference	:	RF60, RF60X
FCC ID	:	VAAFLARF60X
Report Number	:	EED32H000771
Date	:	Jun. 15, 2015
Regulations	:	See below

Test Standards	Results
☒ 47 CFR FCC Part 15 Subpart C 15.249: 2014	PASS

Prepared for

Harvest One Limited
9D On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fo Tan, N.T., Hong Kong

Prepared by

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Tested by: _____ Reviewed by: _____

Approved by: _____ Date: Jun. 15, 2015

Jimmy Li
Lab manager

Check No.: 1022587892

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(Note: N/A means not applicable)

1. GENERAL INFORMATION

Applicant: Harvest One Limited
9D On Shing Industrial Building, 2-16 Wo Liu Hang Road, Fo Tan, N.T.,Hong Kong

FCC ID: VAAFLARF60

Product: Wireless Flash

Trade mark: Cactus

Model/Type reference: RF60, RF60X

Serial Number: N/A

Report Number: EED32H000771

Sample Received Date: Jun. 03, 2015

Sample tested Date: Jun. 03, 2015 to Jun. 15, 2015

The above equipment was tested by Centre Testing International for compliance with the requirements set forth in the FCC Rules and Regulations Part 15 and the measurement procedure according to ANSI C63.4:2009.

2. TEST SUMMARY

The complete list of measurements is given below:

No.	Test Item	Rule	Result
1	20dB Bandwidth	FCC 15.215(c)	**PASS**
2	Radiated Emission	FCC 15.209	**PASS**
3	Out of Band Emission	FCC 15.249 (d)	**PASS**
4	Antenna Requirements *	FCC 15.203	**PASS**
5	Conducted Emission (CE)	FCC 15.207	**PASS**

*: According to Section 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 EUT has a built in antenna which is a short wire solder on the PCB, this is permanently attached antenna and meets the requirements of this section.

3. MEASUREMENT UNCERTAINTY

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Measurement items	Uncertainty
Conducted Emission Test	3.2 dB
Radiated Emissions / Bandedge Emission	4.5 dB

4. TEST EQUIPMENT LIST

Equipment	Manufacturer	Model Number	Serial Number	Due Date
3M Chamber & Accessory Equipment	ETS-LINDGREN	FACT-3	3510	07/12/2016
Spectrum Analyzer	Agilent	E4443A	MY45300910	01/18/2016
Receiver	R&S	ESCI	100435	07/19/2015
TRILOG Broadband Antenna	schwarzbeck	VULB 9163	618	06/25/2015
Multi device Controller	ETS-LINGREN	2090	00057230	N/A
Horn Antenna	ETS-LINGREN	3117	00057407	07/19/2015
Receiver	R&S	ESCI	100009	07/19/2015
LISN	R&S	ENV216	100098	07/19/2015

5. SUPPORT EQUIPMENT LIST

No.	Device Type	Brand	Model	Series No.	Data Cable	Remark
1.	Notebook	DELL	Vostro 3400	GYQTVP1	N/A	FCC DOC
2.	Mouse	L.Selectron	M004	02284699	Un-shielded 1.2M	FCC DOC

6. PRODUCT INFORMATION

Items	Description
Rating	DC 6V
Intentional Transceiver	Intentional Transceiver
Modulation	MSK
Frequency Range	2.445796783～2.480988190GHz
Channel Number	12
Frequency list	2.445796783GHz, 2.448996002GHz, 2.452195221GHz, 2.455394440GHz, 2.458593658GHz, 2.461792877GHz, 2.464992096GHz, 2.468191315GHz, 2.471390533GHz, 2.474589752GHz, 2.477788971GHz, 2.480988190GHz
Type	PCB Antenna
Antenna gain	0dBi
Connector	fixed on board

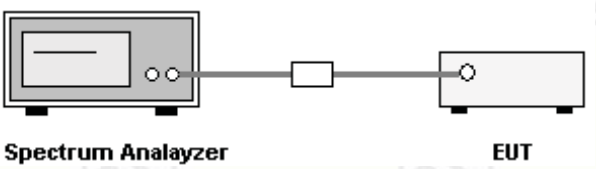
The two models are same just different model names and appearance, the test model is RF60, and test results are applicable to other.

7. 20DB BANDWIDTH MEASUREMENT

7.1 LIMITS

None

7.2 BLOCK DIAGRAM OF TEST SETUP



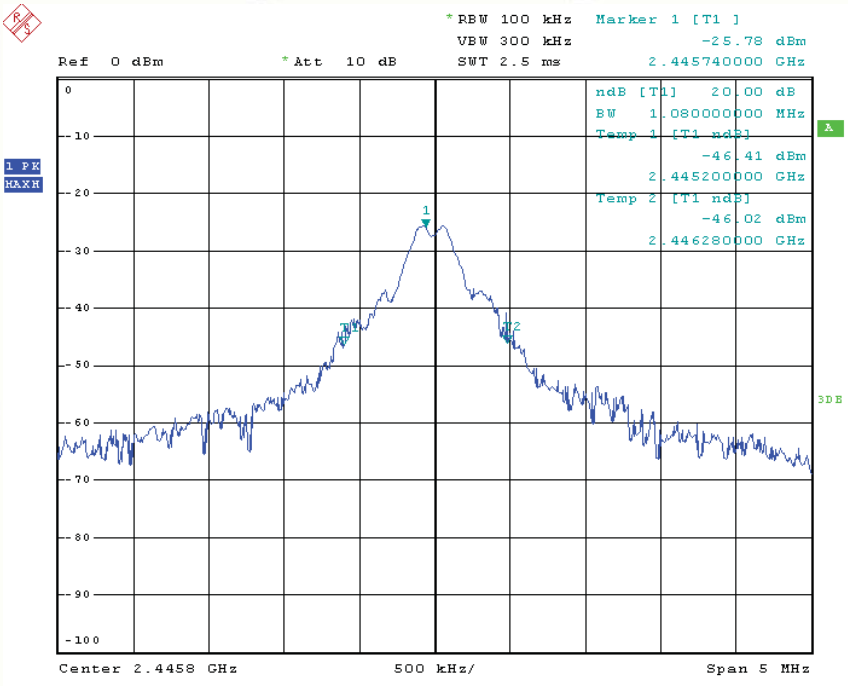
7.3 TEST PROCEDURE

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. Set spectrum analyzer's RBW and VBW to applicable value with Peak in Max Hold.
3. A PEAK output reading and 20dB BW function in spectrum analyzer were taken.

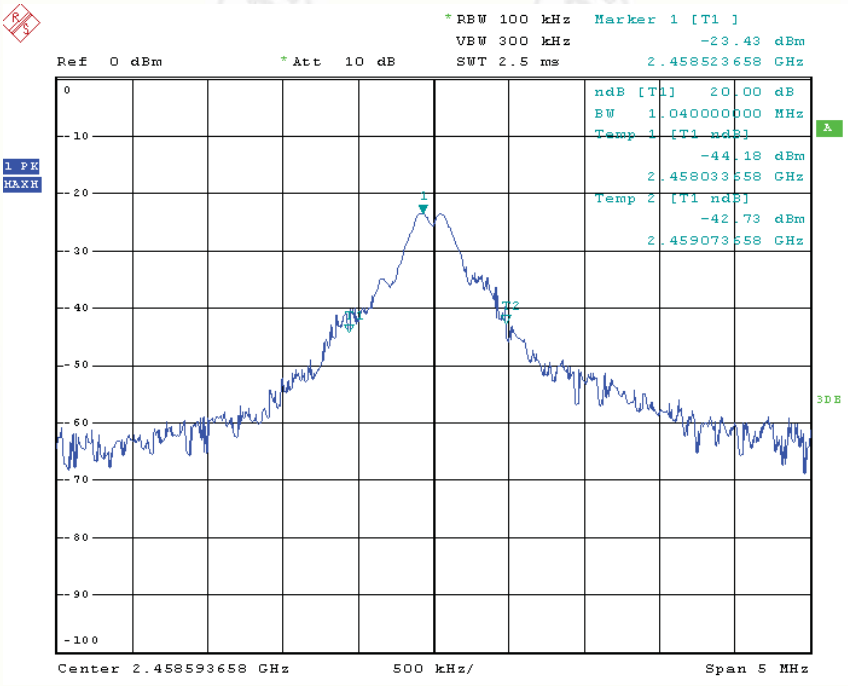
7.4 TEST RESULT

20dB Bandwidth:

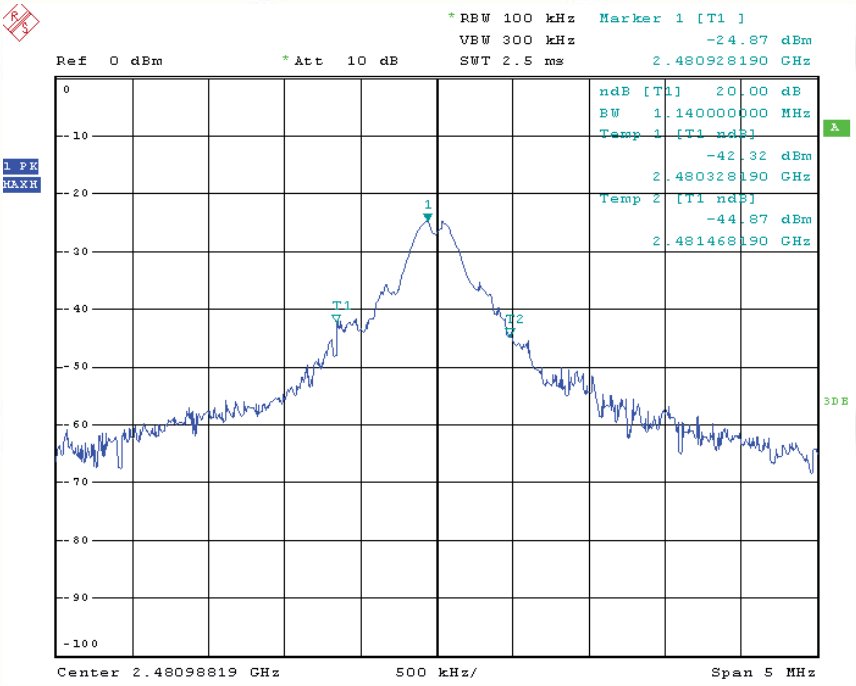
Channel	Frequency (GHz)	20 dB BW (MHz)
Low	2.445796783	1.08
Middle	2.458593658	1.04
High	2.480988190	1.14



Channel low



Channel middle



Channel high

8. RADIATED EMISSIONS MEASUREMENT

8.1 LIMITS

(1) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/ meter)	Field strength of harmonics (microvolts/ meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

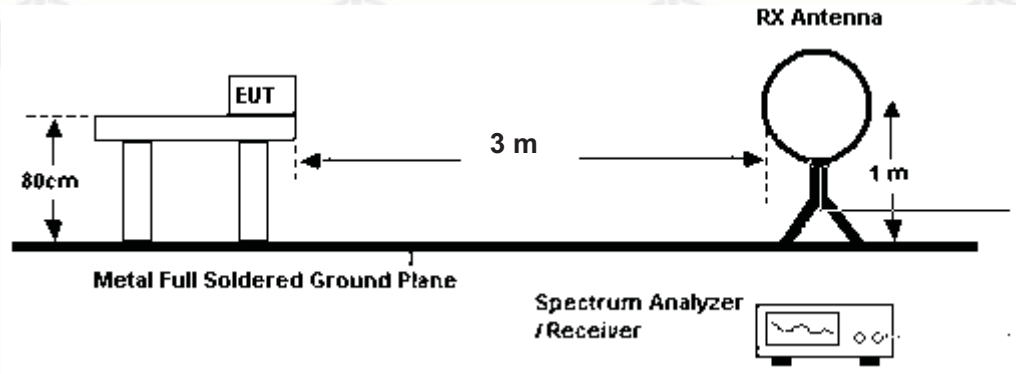
(2) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209 as the following , whichever is the lesser attenuation.

Frequency (MHz)	Field strength (mV/m)	Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/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

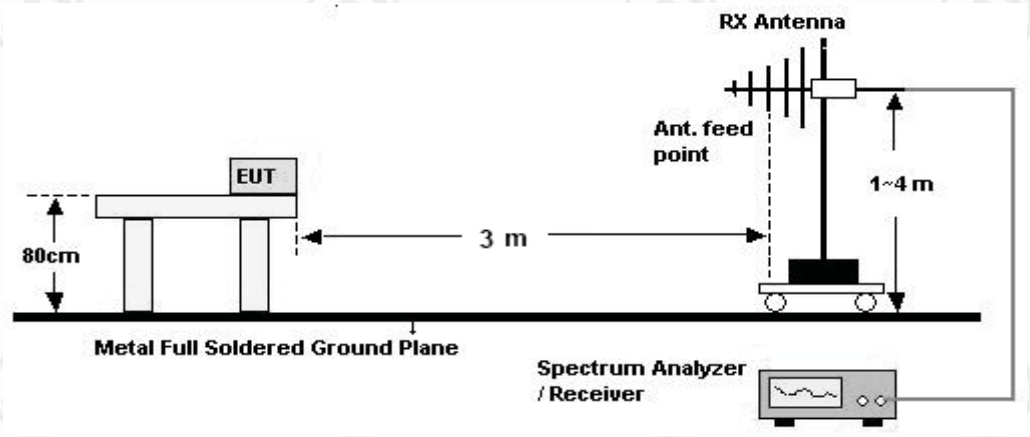
Note: the tighter limit applies at the band edges.

8.2 BLOCK DIAGRAM OF TEST SETUP

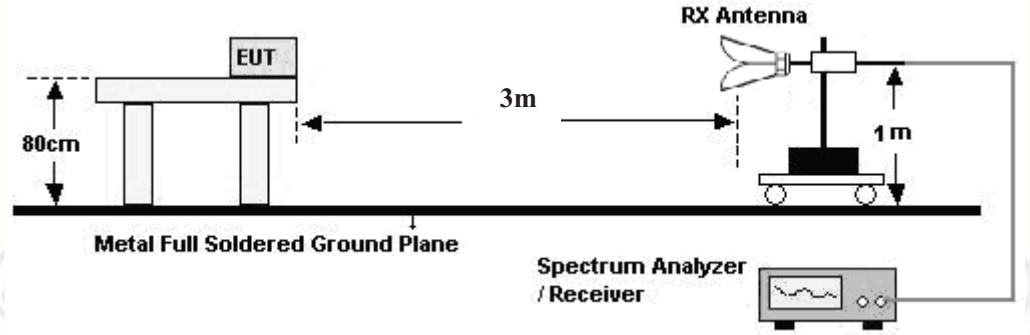
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30 – 1000MHz



For radiated emissions from 1GHz to 25GHz



8.3 TEST PROCEDURE

Below 30MHz

a. The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 1 meter away from the antenna (loop antenna). The maximum values of the field strength are recorded by adjusting the polarizations of the test antenna and rotating the turntable.

b. For each suspected emission, the EUT was arranged to its worst case and then turn table was turned from 0 degrees to 360 degrees to find the maximum reading.

c. The test frequency analyzer system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

30MHz ~ 1GHz:

a. The Product was placed on the non-conductive turntable 0.8m above the ground at a chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 100 kHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied between 1~4 m in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its QP value (120 kHz RBW): vary the antenna's height and rotate the turntable from 0 to 360

degrees to find the height and degree where Product radiated the maximum emission, then set the test frequency analyzer/receiver to QP Detector and specified bandwidth with Maximum Hold Mode, and record the maximum value.

Above 1GHz:

a. The product was placed on the non-conductive turntable 0.8m above the ground at a chamber.

b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, set 1MHz RBW. Record the maximum PK field strength in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where product radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

8.4 TEST RESULT

Note: Limit dBμV/m @3m = Limit dBμV/m @300m+ 80
Limit dBμV/m @3m = Limit dBμV/m @30m + 40

Remark：The radiation measurements are performed in X, Y, Z axis positioning， only the test worst case mode is recorded in the report.

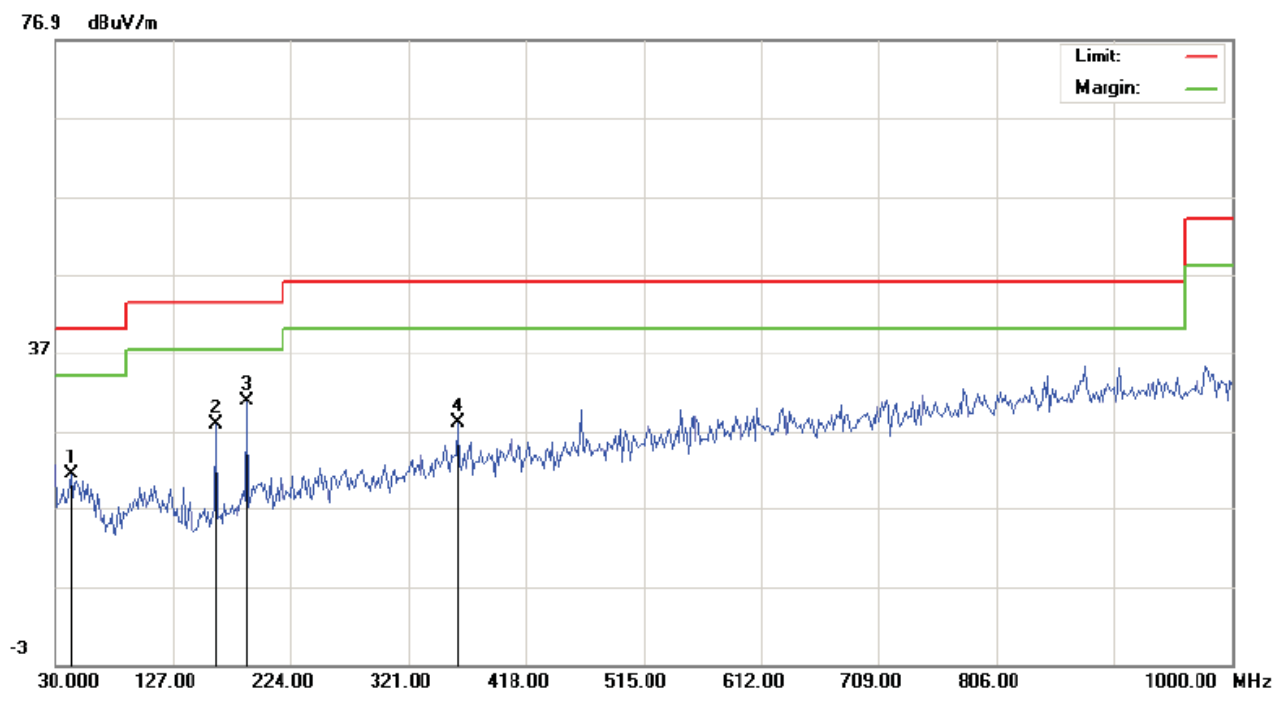
A. Below 30MHz:

The test data below 30MHz are very low, so they are not recorded.

B. 30MHz ～ 1GHz:

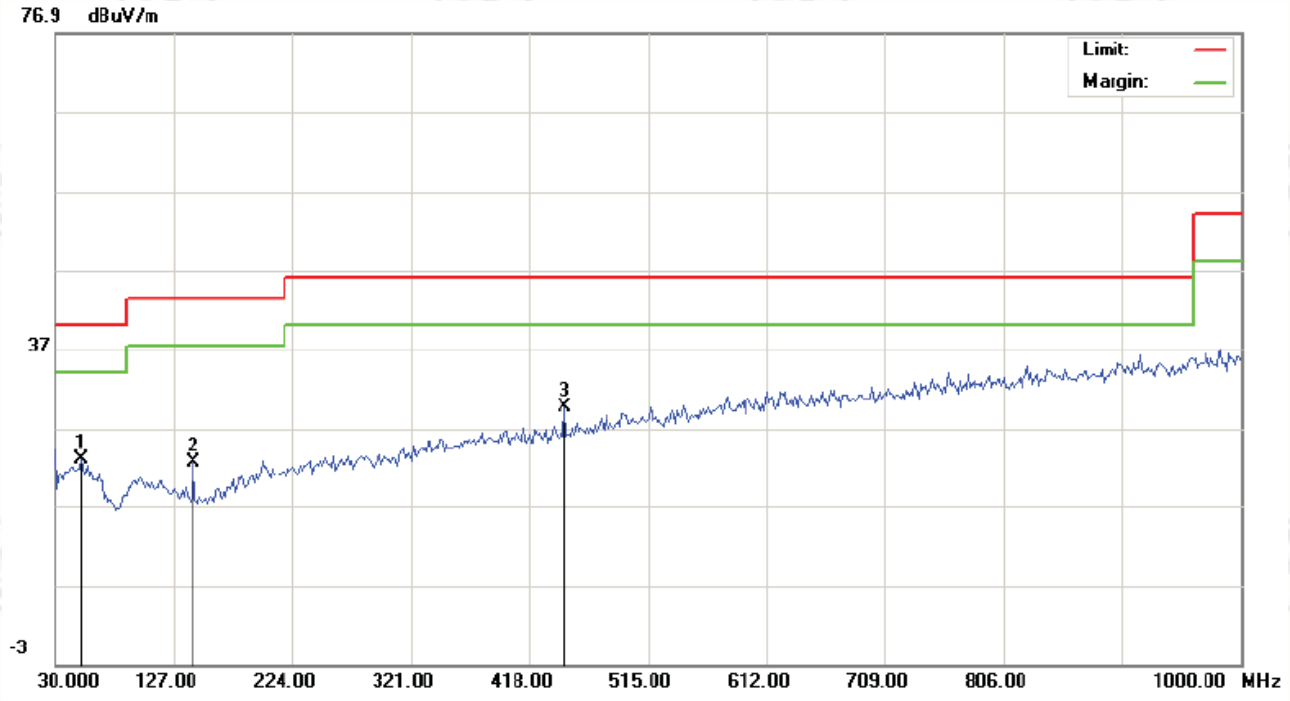
The test data of low channel, middle channel and high channel are almost same in frequency bands 30MHz to 1GHz, and the data of low channel are chosen as representative in below:

H:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV/m)			Limit (dBuV/m)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	42.9333	6.44			14.89	21.33			40.00		-18.67		P	
2	162.5667	16.38			11.43	27.81			43.50		-15.69		P	
3	188.4333	17.68			13.14	30.82			43.50		-12.68		P	
4	361.4167	10.08			17.86	27.94			46.00		-18.06		P	

V:



No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV/m)			Limit (dBuV/m)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	51.0167	7.55			15.45	23.00			40.00		-17.00		P	
2	143.1667	11.63			11.05	22.68			43.50		-20.82		P	
3	447.1000	10.52			19.06	29.58			46.00		-16.42		P	

Above 1GHz:

Test Results-(Measurement Distance: 3m)_Channel low							
Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2445.8*	93.02	---	---	114	94	H	P
4891.6	45.12	---	---	74	54	H	P
7337.4	39.69	---	---	74	54	H	P
2445.8*	92.21	---	---	114	94	V	P
4891.6	44.13	---	---	74	54	V	P
7337.4	30.23	---	---	74	54	V	P

*: fundamental frequency

Test Results-(Measurement Distance: 3m)_Channel middle							
Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2458.6*	90.24	---	---	114	94	H	P
4917.2	41.27	---	---	74	54	H	P
7375.8	38.21	---	---	74	54	H	P
2458.6*	89.36	---	---	114	94	V	P
4917.2	40.19	---	---	74	54	V	P

*: fundamental frequency

Test Results-(Measurement Distance: 3m)_Channel high							
Frequency (GHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2481.0*	90.63	---	---	114	94	H	P
4962.0	44.21	---	---	74	54	H	P
7443.0	36.98	---	---	74	54	H	P
2481.0*	90.22	---	---	114	94	V	P
4962.0	42.63	---	---	74	54	V	P
7443.0	35.68	---	---	74	54	V	P

*: fundamental frequency

Remark:

1. For above 1GHz, except fundamental frequency:

PK detector: RBW=1MHz, VBW=1MHz

For above 1GHz, fundamental frequency:

PK detector: RBW=3MHz, VBW=3MHz

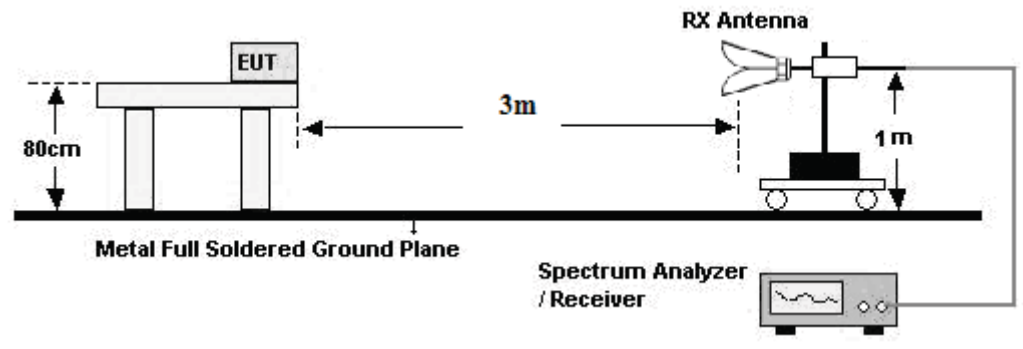
2. According to the emissions below 18GHz, the data curve is lower than the limit, and the data between 18GHz to 25GHz will be lower than the limit, so they are not recorded in the report.

9. BAND EDGE EMISSION MEASUREMENT

9.1 LIMITS

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § FCC 15.209 & , whichever is the lesser attenuation.

9.2 BLOCK DIAGRAM OF TEST SETUP



9.3 TEST PROCEDURE

a. The EUT was placed on the non-conductive turntable 0.8 m above the ground at a chamber.

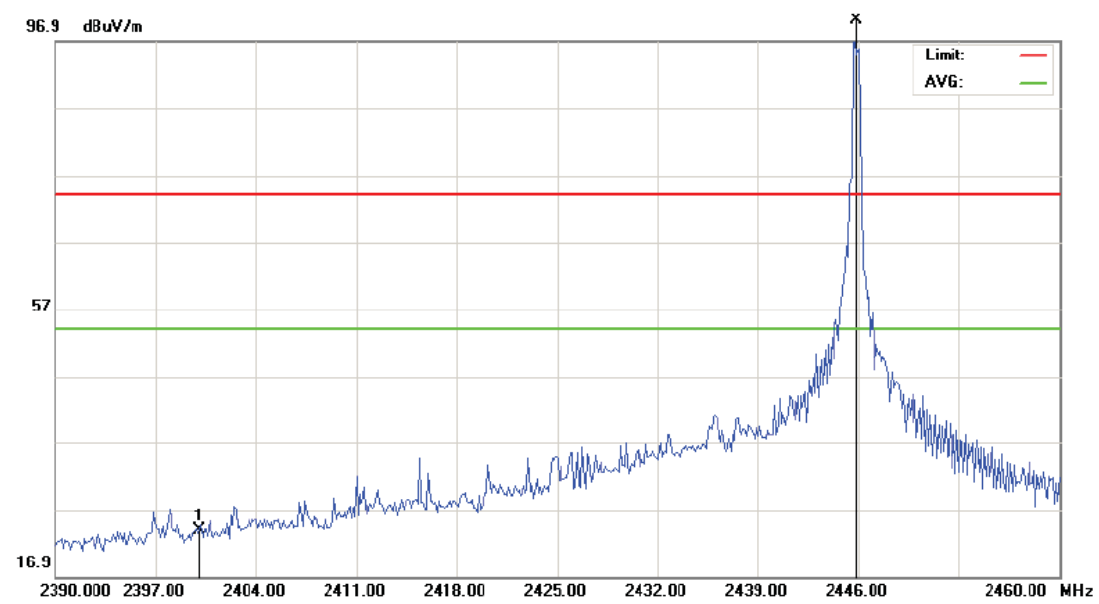
b. Set the spectrum analyzer/receiver in Peak detector, Max Hold mode, and 1MHz RBW. Record the maximum field strength of all the pre-scan process in the full band when the antenna is varied in both horizontal and vertical, and the turntable is rotated from 0 to 360 degrees.

c. For each frequency whose maximum record was higher or close to limit, measure its AV value: rotate the turntable from 0 to 360 degrees to find the degree where EUT radiated the maximum emission, then set the test frequency analyzer/receiver to AV value and specified bandwidth with Maximum Hold Mode, and record the maximum value.

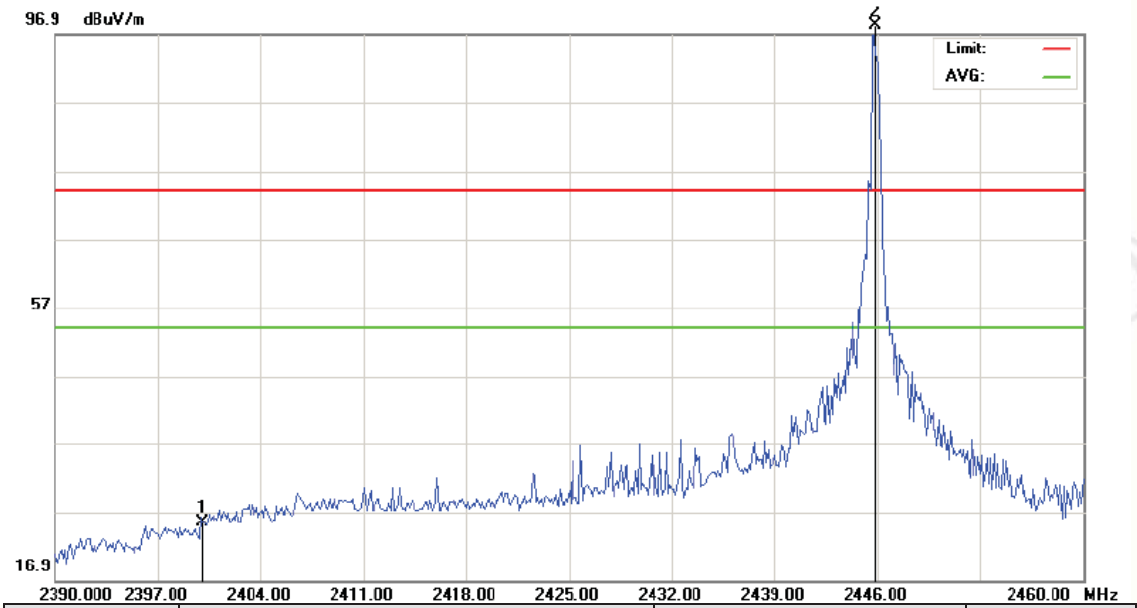
9.4 TEST RESULT

PASS

2.445796783GHz:

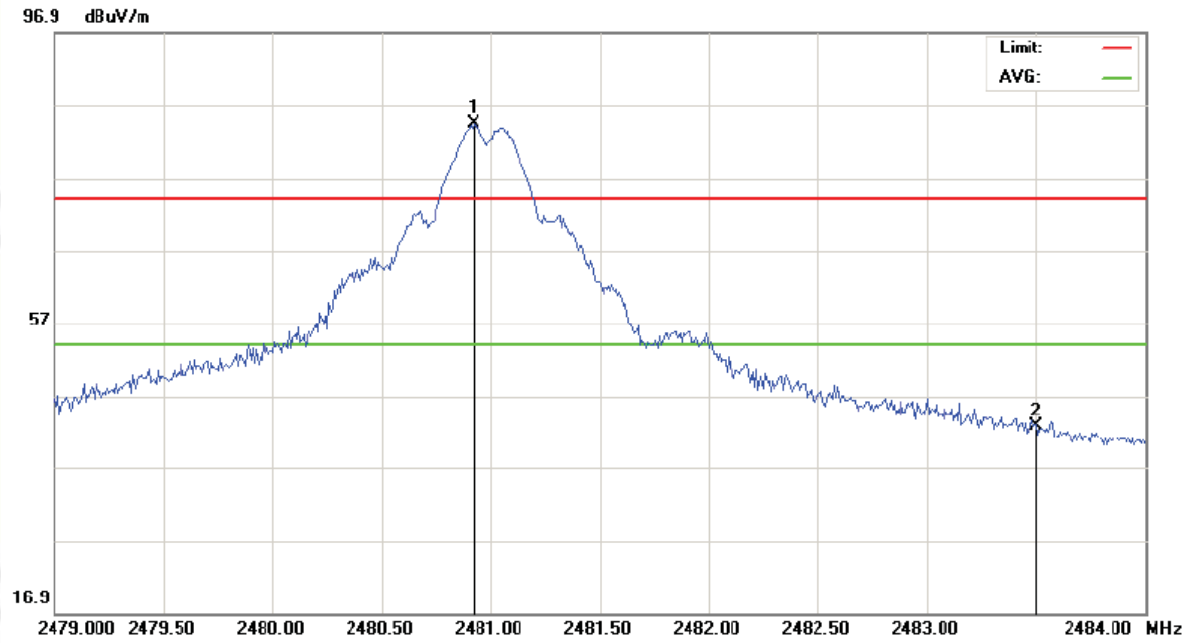


Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2400.000	23.86	---	---	74	54	H	P
2390.000	21.91	---	---	74	54	H	P

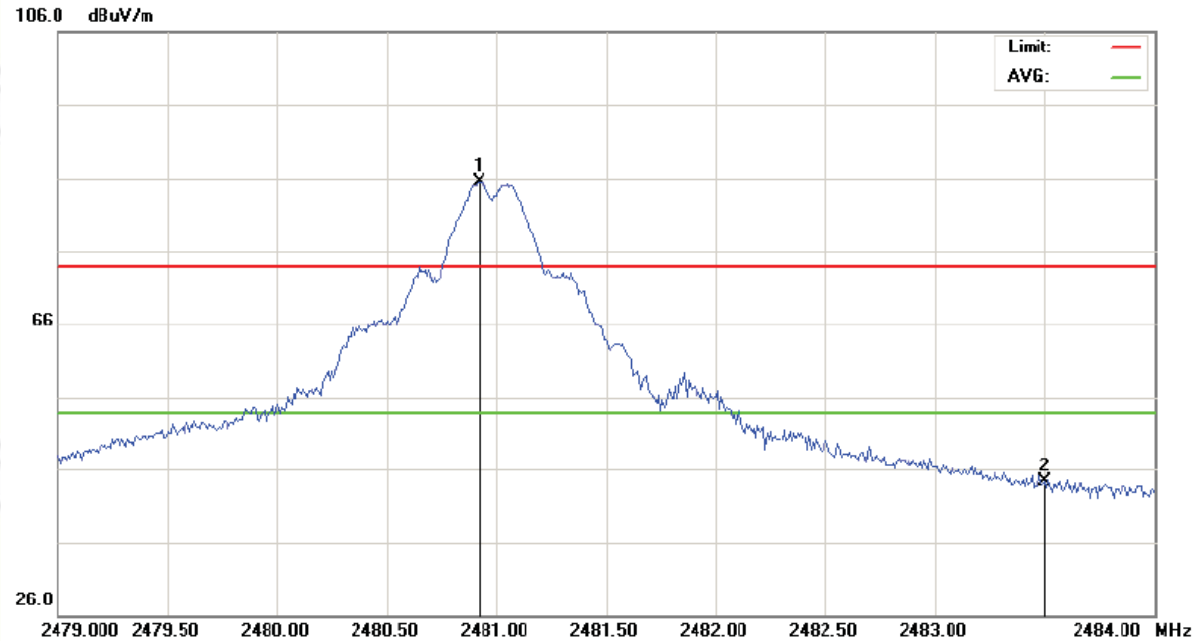


Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2400.000	25.34	---	---	74	54	V	P
2390.000	23.11	---	---	74	54	V	P

2.480988190GHz:



Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2483.500	42.90	---	---	74	54	H	P



Frequency (MHz)	Measurement value			Limit		Antenna	Result
	PK (dBμV/m)	AV factor (dB)	AV (dBμV/m)	PK (dBμV/m)	AV (dBμV/m)	(H/V)	(P/F)
2483.500	44.33	---	---	74	54	V	P

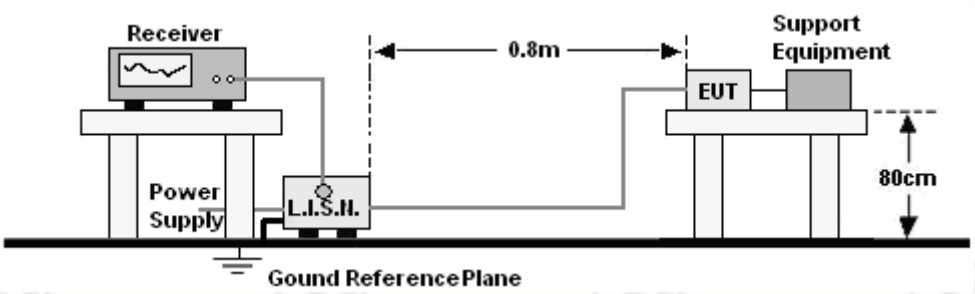
10. CONDUCTED EMISSION TEST

10.1 LIMITS

Frequency range (MHz)	Limits dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

10.2 BLOCK DIAGRAM OF TEST SETUP



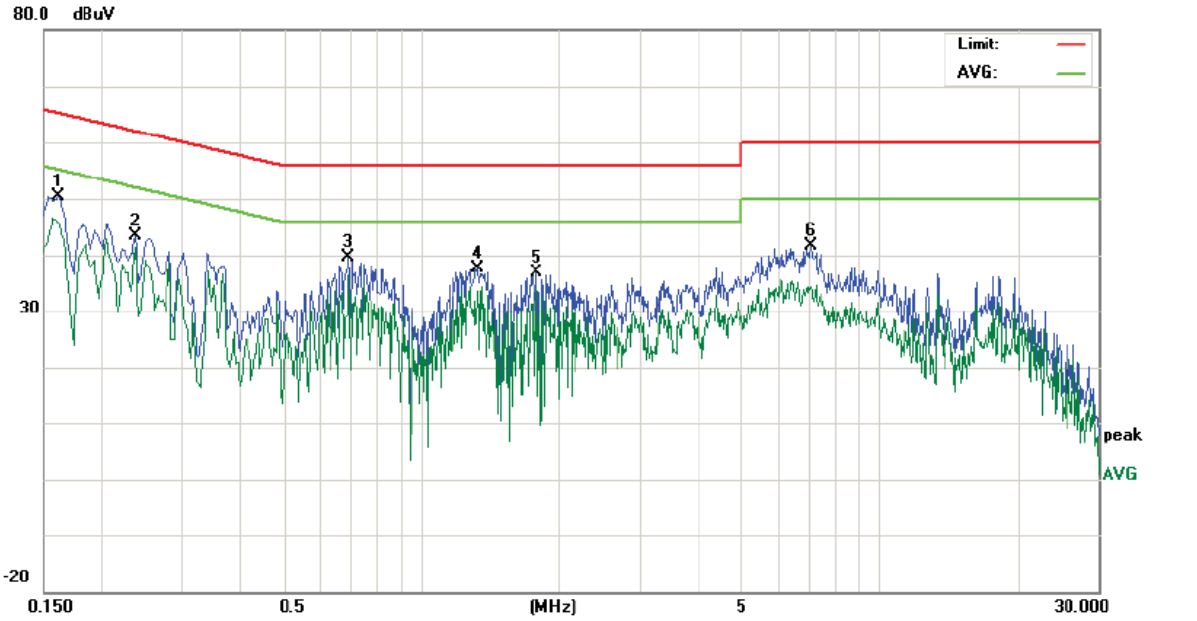
10.3 PROCEDURE OF CONDUCTED EMISSION TEST

a. The Product was placed on a nonconductive table above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).

b. The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.

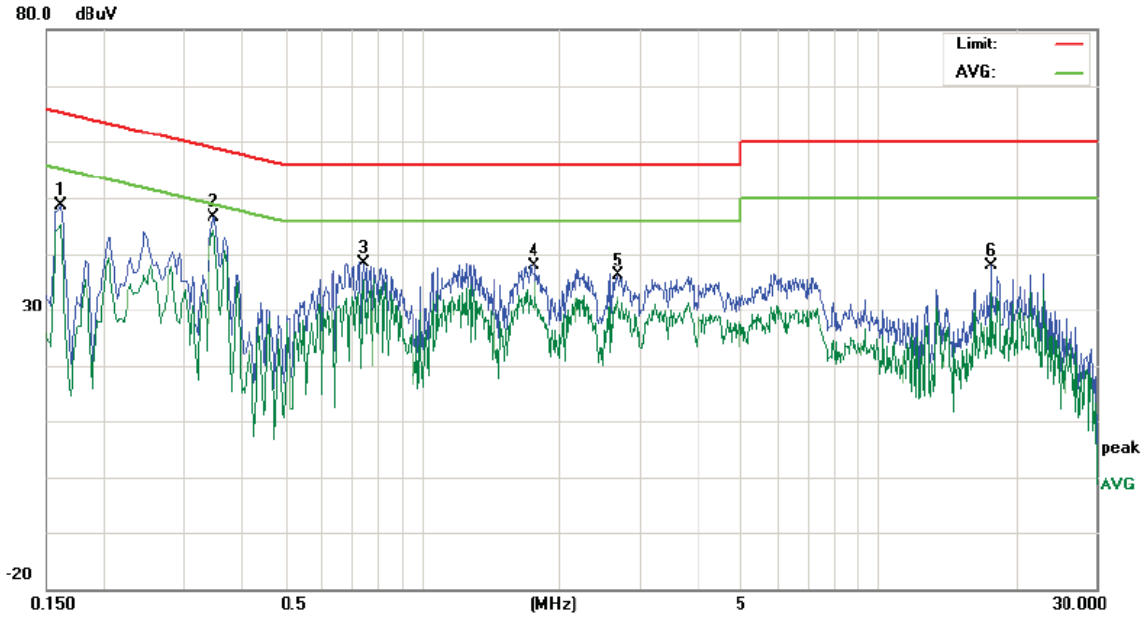
c. For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

10.4 GRAPHS AND DATA



Site site #1 Phase: L1 Temperature: 18
Limit: FCC CE Power: AC 120V/60Hz Humidity: 51 %
EUT: Wireless Flash
M/N: RF60
Mode: Keeping TX
Note:

No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1620	40.63		36.09	9.76	50.39		45.85	65.36	55.36	-14.97	-9.51	P	
2	0.2380	33.56		31.58	9.80	43.36		41.38	62.16	52.16	-18.80	-10.78	P	
3	0.6940	29.86		26.53	9.80	39.66		36.33	56.00	46.00	-16.34	-9.67	P	
4	1.3260	27.85		23.67	9.83	37.68		33.50	56.00	46.00	-18.32	-12.50	P	
5	1.7900	27.01		24.39	9.88	36.89		34.27	56.00	46.00	-19.11	-11.73	P	
6	7.0700	31.67		24.43	10.00	41.67		34.43	60.00	50.00	-18.33	-15.57	P	



Site site #1 Phase: N Temperature: 18
Limit: FCC CE Power: AC 120V/60Hz Humidity: 51 %
EUT: Wireless Flash
M/N: RF60
Mode: Keeping TX
Note:

No.	Freq.	Reading_Level (dBuV)			Correct Factor	Measurement (dBuV)			Limit (dBuV)		Margin (dB)			
	MHz	Peak	QP	AVG	dB	peak	QP	AVG	QP	AVG	QP	AVG	P/F	Comment
1	0.1620	38.85		35.40	9.76	48.61		45.16	65.36	55.36	-16.75	-10.20	P	
2	0.3500	36.91		34.37	9.80	46.71		44.17	58.96	48.96	-12.25	-4.79	P	
3	0.7460	28.67		25.66	9.80	38.47		35.46	56.00	46.00	-17.53	-10.54	P	
4	1.7660	28.02		24.98	9.88	37.90		34.86	56.00	46.00	-18.10	-11.14	P	
5	2.7060	26.31		22.42	9.92	36.23		32.34	56.00	46.00	-19.77	-13.66	P	
6	17.6940	27.62		22.83	10.26	37.88		33.09	60.00	50.00	-22.12	-16.91	P	

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

TEST SETUP OF CONDUCTED EMISSION

TEST SETUP OF RADIATED EMISSION (30MHz～1GHz)

TEST SETUP OF RADIATED EMISSION (Above1GHz)

APPENDIX 2 PHOTOGRAPHS OF EUT

View of external EUT-1 (RF60X)

View of external EUT-2 (RF60X)

View of external EUT-1 (RF60)

View of external EUT-2 (RF60)

View of external EUT-3 (RF60)

View of external EUT-4 (RF60)

View of external EUT-5 (RF60)

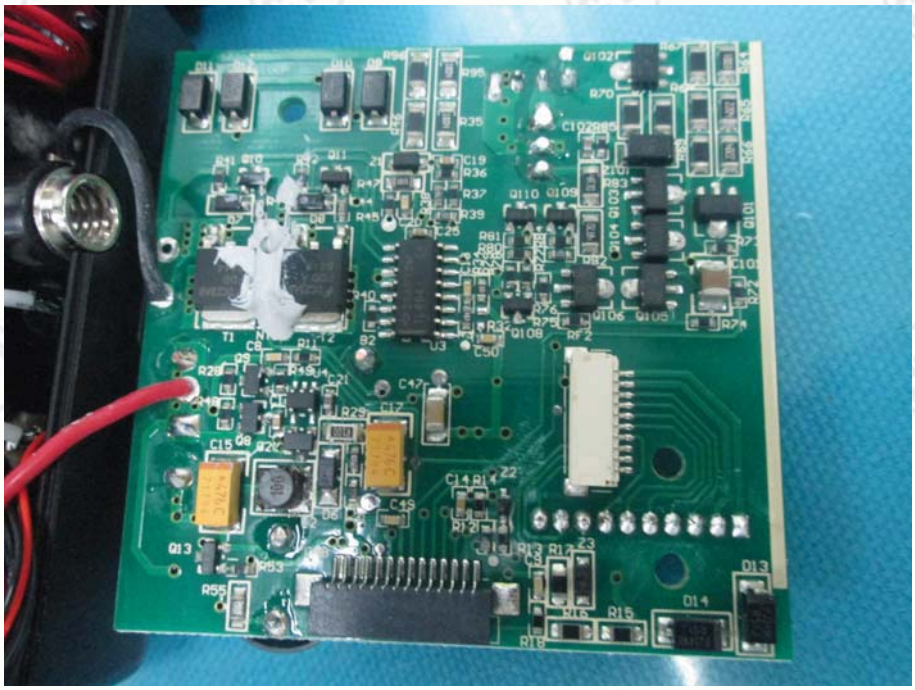
View of external EUT-6 (RF60)

View of internal EUT-1 (RF60)

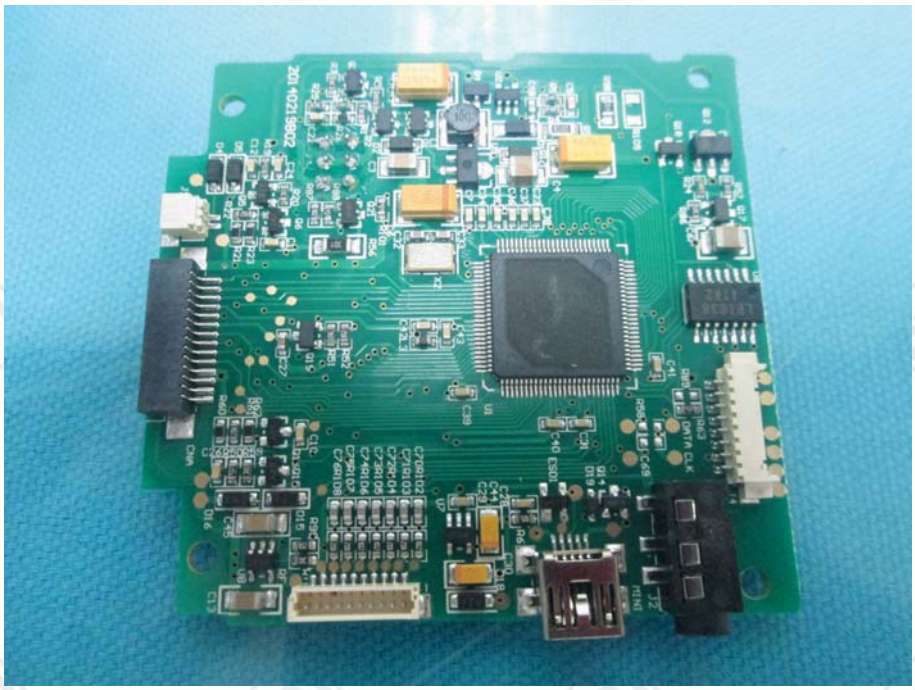
View of internal EUT-2 (RF60)

View of internal EUT-3 (RF60)

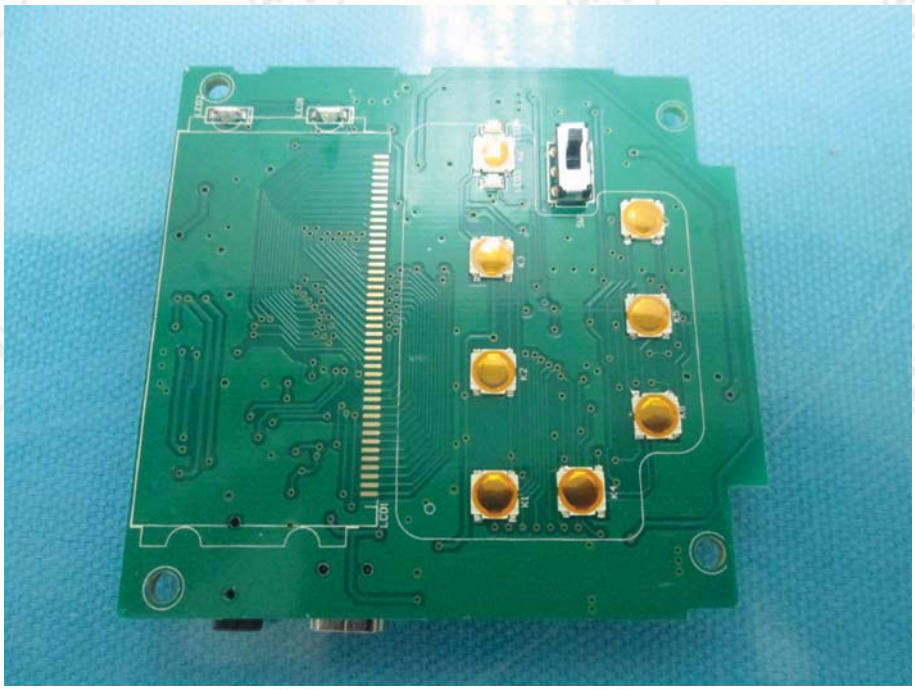
View of internal EUT-4 (RF60)



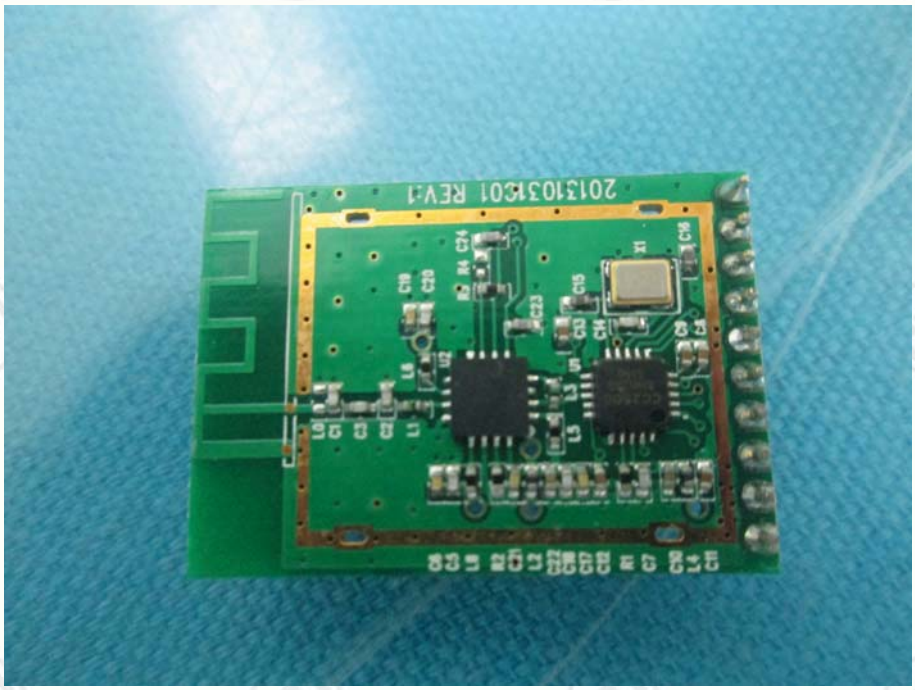
View of internal EUT-5 (RF60)



View of internal EUT-6 (RF60)



View of internal EUT-7 (RF60)



View of internal EUT-8 (RF60)

View of internal EUT-9 (RF60)

*** End of Report ***

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