

TEST REPORT

Reference No...... : WTS14S1120628E
FCC ID : 2AAKGRCWDS30-1T
Applicant..... : Sky Success Asia Limited.
Address..... : Unit1,8/F,Wah Yiu Industial Centre,30-32 Au Pui Wan Street,Fo Tan,NT,H.K.
Manufacturer : Sky Success Asia Limited.
Address..... : Unit1,8/F,Wah Yiu Industial Centre,30-32 Au Pui Wan Street,Fo Tan,NT,H.K.
Product Name..... : 2.4G Wireless Digital Security Camera System
Model No...... : RCWDS30-1T
Standards..... : FCC CFR47 Part 15 Section 15.247:2014
Date of Receipt sample : Nov.28, 2014
Date of Test : Nov.29, 2014~Dec.05, 2014
Date of Issue..... : Dec.23, 2014
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:

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2 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
Conduct Emission	15.207	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

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4 General Information

4.1 General Description of E.U.T.

Product Name	: 2.4G Wireless Digital Security Camera System
Model No.	: RCWDS30-1T
Operation Frequency	: 2408MHz ~ 2468MHz, 16 channels in total
Type of Modulation	: GFSK
The lowest oscillator	: 32.768kHz
Antenna installation	: Internal permanent antenna
Antenna Gain	: 2dBi

4.2 Details of E.U.T.

Technical Data	: DC 12V
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4.3 Channel List

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2408	2	2412	3	2416	4	2420
5	2424	6	2428	7	2432	8	2436
9	2440	10	2444	11	2448	12	2452
13	2456	14	2460	15	2464	16	2468

4.4 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 7760A-1**

Waltek Services(Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, July 12, 2012.

- **FCC Test Site 1#– Registration No.: 880581**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 880581, April 29, 2014.

- **FCC Test Site 2#– Registration No.: 328995**

Waltek Services(Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 328995, December 3, 2014.

4.5 Test Location

All the tests were performed at:

Waltek Services (Shenzhen) Co., Ltd. at 1/F, Fukangtai Building, West Baima Rd., Songgang Street, Baoan District, Shenzhen, China

5 Equipment Used during Test

5.1 Equipments List

Conducted Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1.	EMI Test Receiver	R&S	ESCI	101155	Sep.15,2014	Sep.14,2015
2.	LISN	SCHWARZBECK	NSLK 8128	8128-289	Sep.15,2014	Sep.14,2015
3.	Limiter	York	MTS-IMP-136	261115-001-0024	Sep.15,2014	Sep.14,2015
4.	Cable	LARGE	RF300	-	Sep.15,2014	Sep.14,2015
3m Semi-anechoic Chamber for Radiation Emissions						
Item	Equipment	Manufacturer	Model No.	Serial No.	Last Calibration Date	Calibration Due Date
1	EMC Analyzer	Agilent	E7405A	MY45114943	Sep.15,2014	Sep.14,2015
2	Active Loop Antenna	Beijing Dazhi	ZN30900A	-	Sep.15,2014	Sep.14,2015
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9163	336	Apr.19,2014	Apr.18,2015
4	Coaxial Cable (below 1GHz)	Top	TYPE16(13M)	-	Sep.15,2014	Sep.14,2015
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	667	Apr.19,2014	Apr.18,2015
6	Broadband Preamplifier	COMPLIANCE DIRECTION	PAP-1G18	2004	Mar.17,2014	Mar.16,2015
7	Coaxial Cable (above 1GHz)	Top	1000MHZ-25GHZ	EW02014-7	Apr.10,2014	Apr.09,2015
8	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	Apr.19,2014	Apr.18,2015

5.2 Measurement Uncertainty

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-6}$
RF Power	± 1.0 dB
RF Power Density	± 2.2 dB
Radiated Spurious Emissions test	± 5.03 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Conducted Spurious Emissions test	± 3.64 dB (AC mains 150KHz~30MHz)

5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R.China.

6 Conducted Emission

Test Requirement:	FCC CFR 47 Part 15 Section 15.207
Test Method:	ANSI C63.4:2003
Test Result:	PASS
Frequency Range:	150kHz to 30MHz
Class/Severity:	Class B
Limit:	66-56 dB μ V between 0.15MHz & 0.5MHz 56 dB μ V between 0.5MHz & 5MHz 60 dB μ V between 5MHz & 30MHz
Detector:	Peak for pre-scan (9kHz Resolution Bandwidth)

6.1 E.U.T. Operation

Operating Environment :

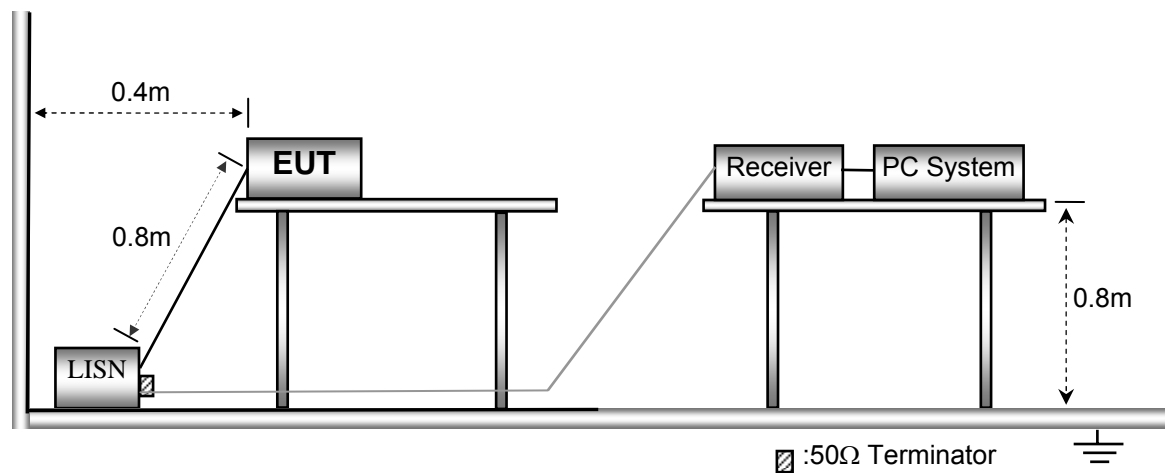
Temperature:	25.5 °C
Humidity:	51 % RH
Atmospheric Pressure:	101.2kPa

EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

6.2 EUT Setup

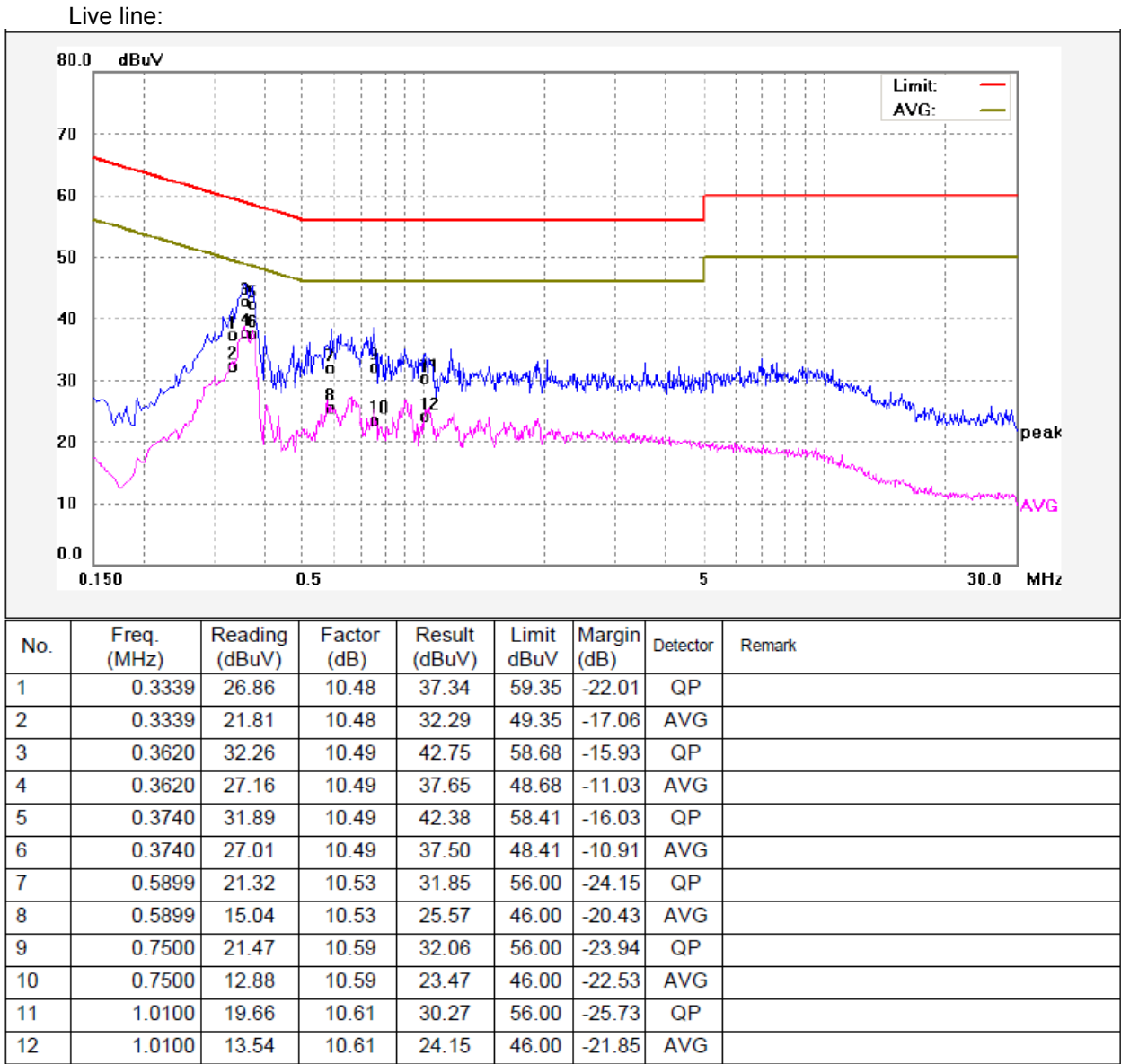
The EUT was placed on the test table in shielding room.



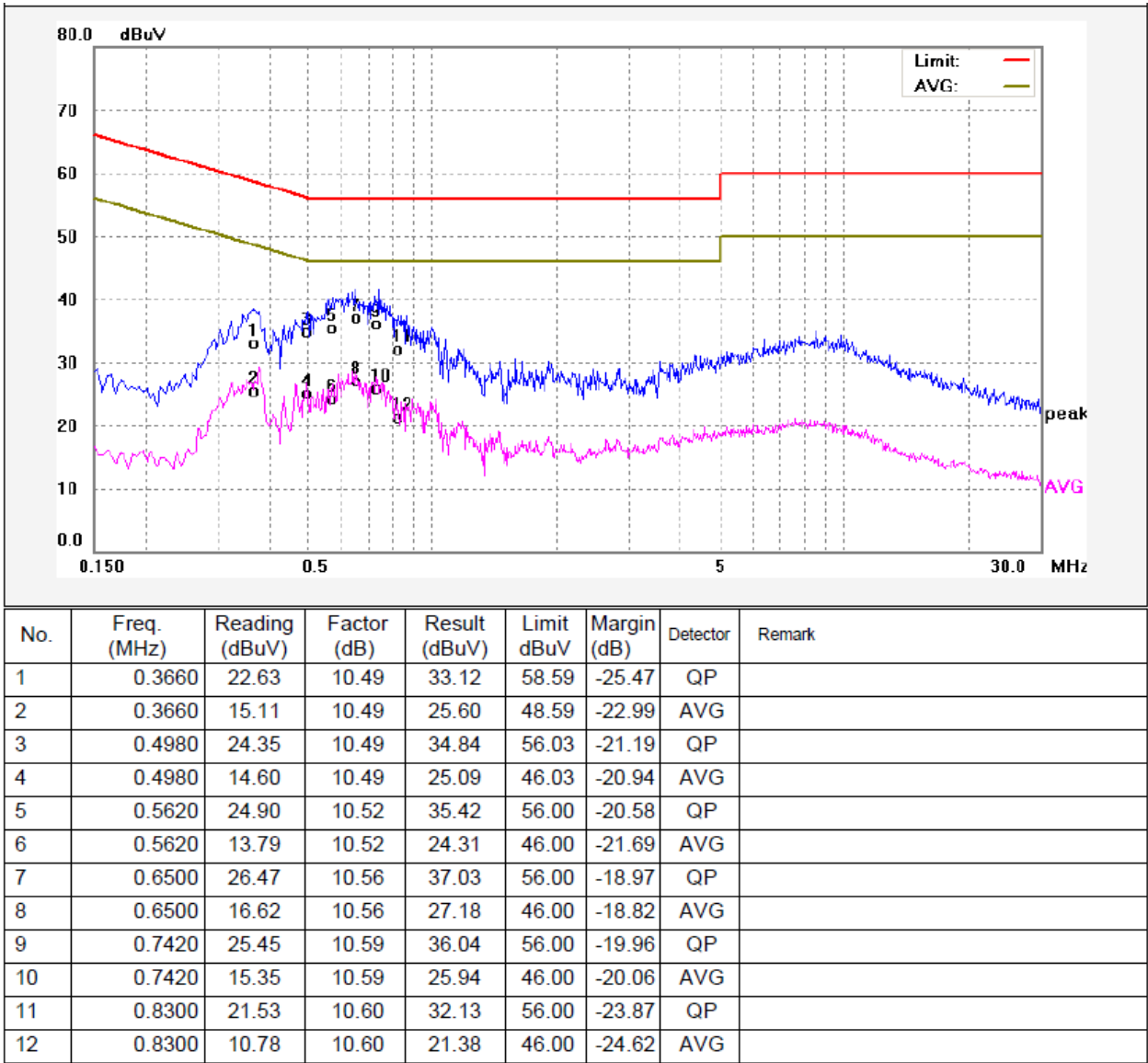
6.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.4 Conducted Emission Test Result



Neutral line:



7 Radiated Spurious Emissions

Test Requirement: FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method: DA 00-705

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.1 EUT Operation

Operating Environment :

Temperature: 23.5 °C

Humidity: 51.1 % RH

Atmospheric Pressure: 101.2kPa

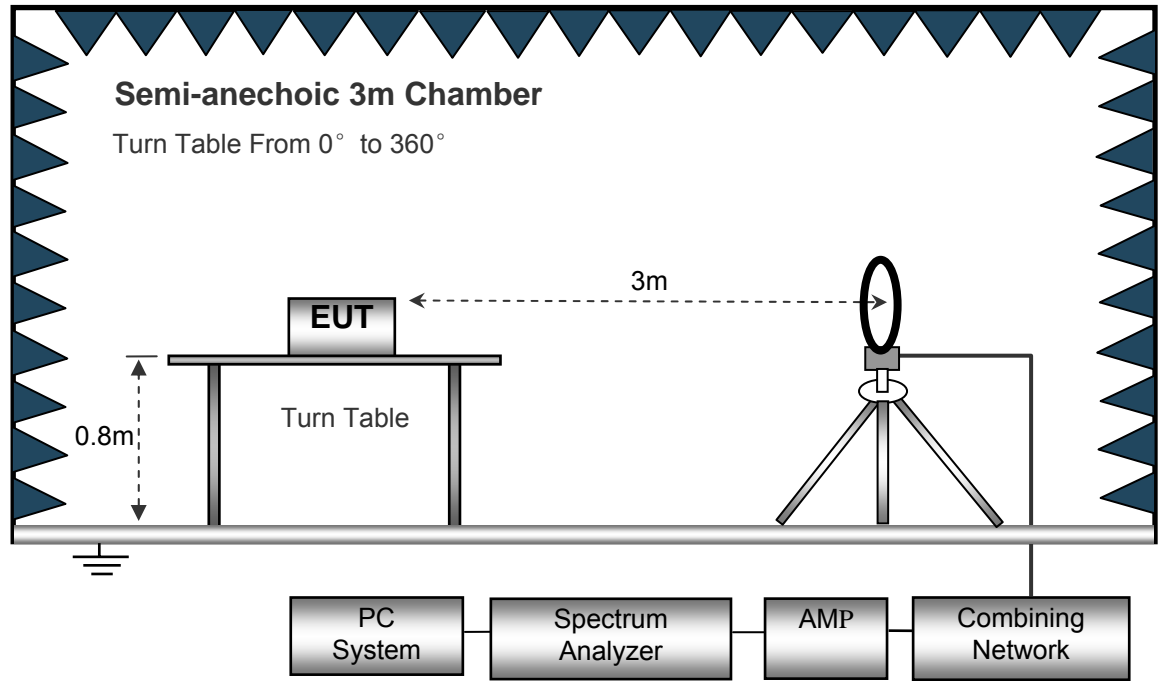
EUT Operation :

The test was performed in transmitting mode, the test data were shown in the report.

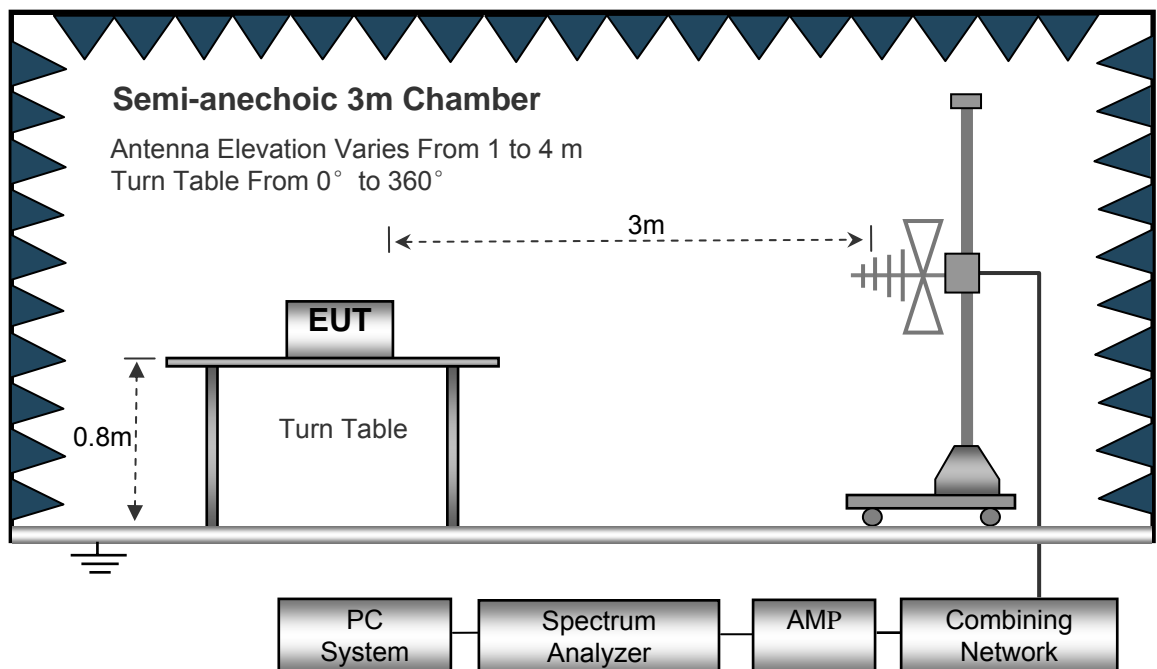
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.4: 2003.

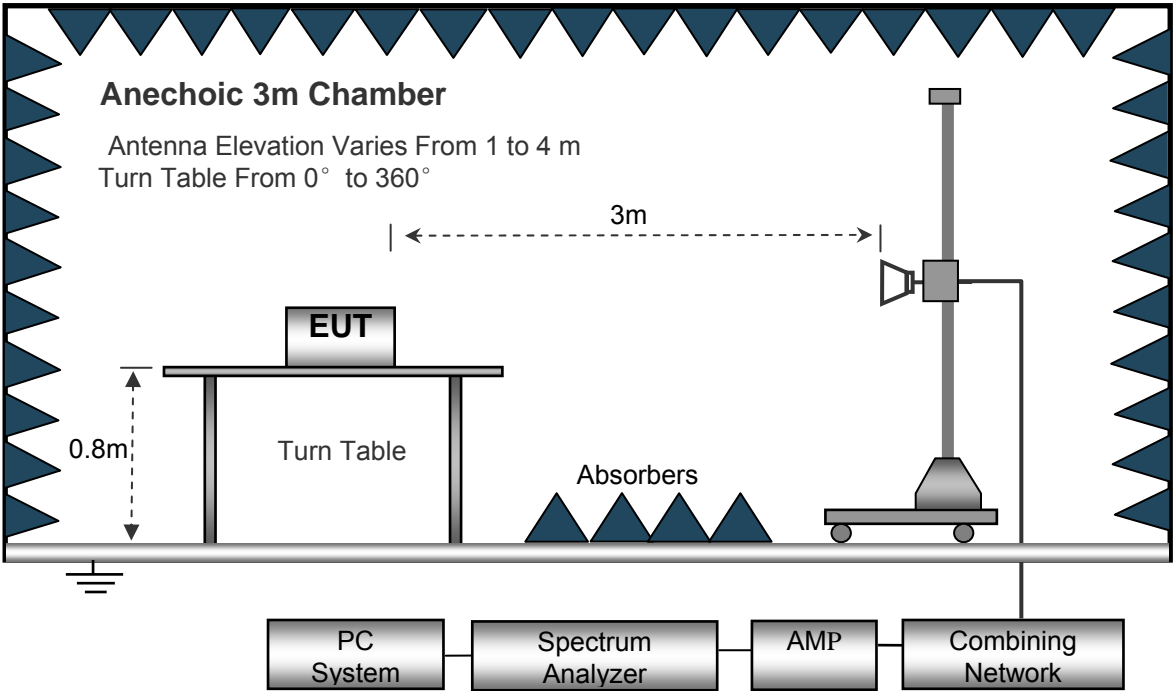
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



7.3 Spectrum Analyzer Setup

Below 30MHz

- Sweep Speed Auto
- IF Bandwidth.....10kHz
- Video Bandwidth.....10kHz
- Resolution Bandwidth.....10kHz

30MHz ~ 1GHz

- Sweep Speed Auto
- DetectorPK
- Resolution Bandwidth.....100kHz
- Video Bandwidth.....300kHz

Above 1GHz

- Sweep Speed Auto
- DetectorPK
- Resolution Bandwidth.....1MHz
- Video Bandwidth.....3MHz
- DetectorAve.
- Resolution Bandwidth.....1MHz
- Video Bandwidth.....10Hz

7.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.

7.5 Summary of Test Results

Test Frequency: Below 30MHz

The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~ 18GHz

Test mode: transmitting mode

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Low Channel									
168.52	21.54	QP	160	1.9	H	11.13	32.67	43.50	-10.83
168.52	21.30	QP	240	1.8	V	11.13	32.43	43.50	-11.07
4804.00	52.56	PK	206	1.3	V	-1.06	51.50	74.00	-22.50
4804.00	43.06	Ave	206	1.3	V	-1.06	42.00	54.00	-12.00
7206.00	42.32	PK	177	1.0	H	1.33	43.65	74.00	-30.35
7206.00	37.99	Ave	177	1.0	H	1.33	39.32	54.00	-14.68
2335.78	45.98	PK	52	1.6	V	-13.19	32.79	74.00	-41.21
2335.78	39.24	Ave	52	1.6	V	-13.19	26.05	54.00	-27.95
2389.66	42.89	PK	262	1.0	H	-13.14	29.75	74.00	-44.25
2389.66	38.09	Ave	262	1.0	H	-13.14	24.95	54.00	-29.05
2495.78	43.92	PK	145	1.6	V	-13.08	30.84	74.00	-43.16
2495.78	36.94	Ave	145	1.6	V	-13.08	23.86	54.00	-30.14

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
Middle Channel									
168.52	23.36	QP	112	1.9	H	11.13	34.49	43.50	-9.01
168.52	22.42	QP	46	1.7	V	11.13	33.55	43.50	-9.95
4880.00	54.17	PK	128	1.5	V	-0.62	53.55	74.00	-20.45
4880.00	43.61	Ave	128	1.5	V	-0.62	42.99	54.00	-11.01
7320.00	41.24	PK	358	1.9	H	2.21	43.45	74.00	-30.55
7320.00	36.96	Ave	358	1.9	H	2.21	39.17	54.00	-14.83
2319.88	46.39	PK	77	1.2	V	-13.19	33.20	74.00	-40.80
2319.88	38.37	Ave	77	1.2	V	-13.19	25.18	54.00	-28.82
2367.22	42.28	PK	7	1.2	H	-13.14	29.14	74.00	-44.86
2367.22	35.56	Ave	7	1.2	H	-13.14	22.42	54.00	-31.58
2496.37	44.93	PK	179	1.5	V	-13.08	31.85	74.00	-42.15
2496.37	36.32	Ave	179	1.5	V	-13.08	23.24	54.00	-30.76

Frequency	Receiver Reading	Detector	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dB μ V)	(PK/QP/Ave)	Degree	(m)	(H/V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
High Channel									
168.52	22.37	QP	317	1.0	H	11.13	33.50	43.50	-10.00
168.52	20.85	QP	155	1.2	V	11.13	31.98	43.50	-11.52
4960.00	53.55	PK	69	1.2	V	-0.24	53.31	74.00	-20.69
4960.00	43.51	Ave	69	1.2	V	-0.24	43.27	54.00	-10.73
7440.00	41.63	PK	192	1.6	H	2.84	44.47	74.00	-29.53
7440.00	36.72	Ave	192	1.6	H	2.84	39.56	54.00	-14.44
2348.00	45.61	PK	110	1.8	V	-13.19	32.42	74.00	-41.58
2348.00	39.58	Ave	110	1.8	V	-13.19	26.39	54.00	-27.61
2351.35	42.78	PK	249	1.5	H	-13.14	29.64	74.00	-44.36
2351.35	37.15	Ave	249	1.5	H	-13.14	24.01	54.00	-29.99
2498.42	43.62	PK	284	1.0	V	-13.08	30.54	74.00	-43.46
2498.42	37.24	Ave	284	1.0	V	-13.08	24.16	54.00	-29.84

Test Frequency :Above 18GHz

The measurements were more than 20 dB below the limit and not reported

8 Band Edge Measurement

Test Requirement:	Section 15.247(d) In addition, 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(a) (see Section 15.205(c)).
Test Method:	DA 00-705
Test Mode:	Transmitting and Hopping

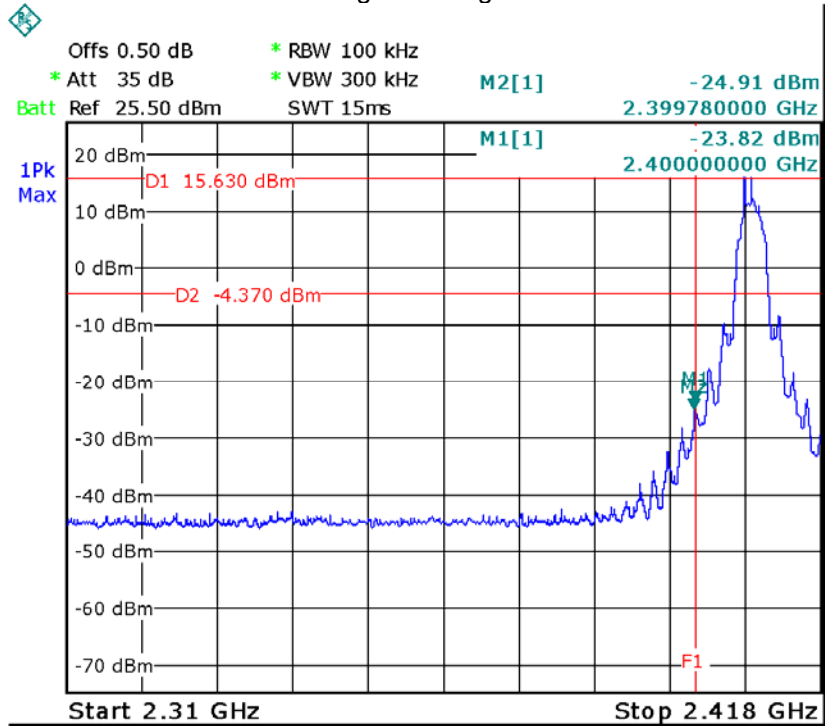
8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

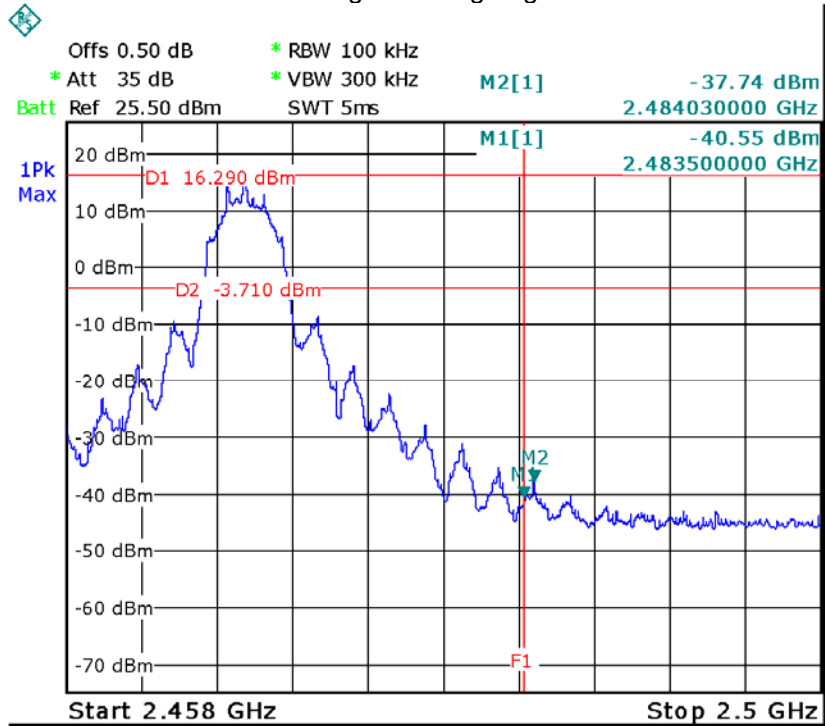
8.2 Test Result

Test plots

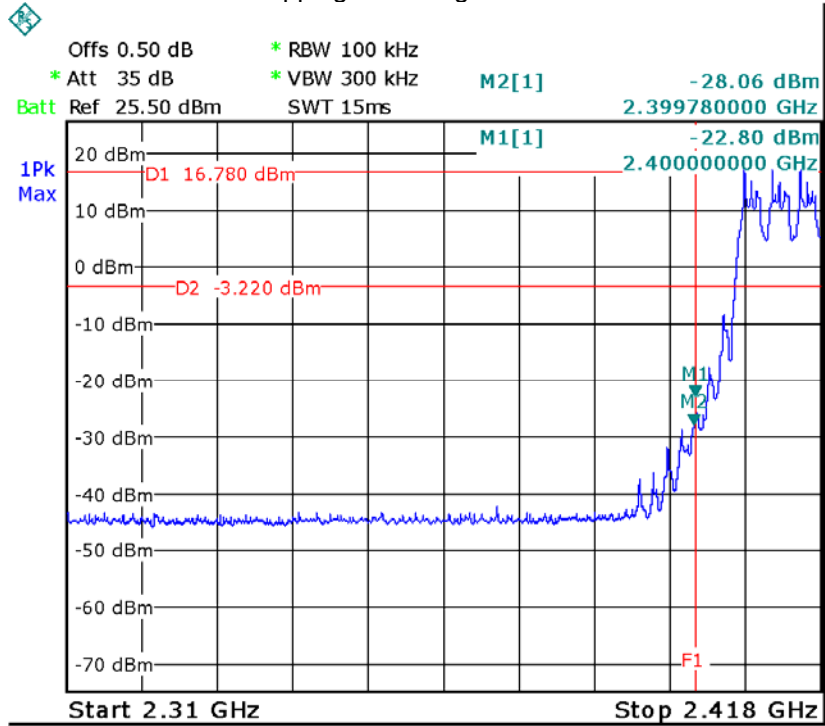
Transmitting Band edge-left side



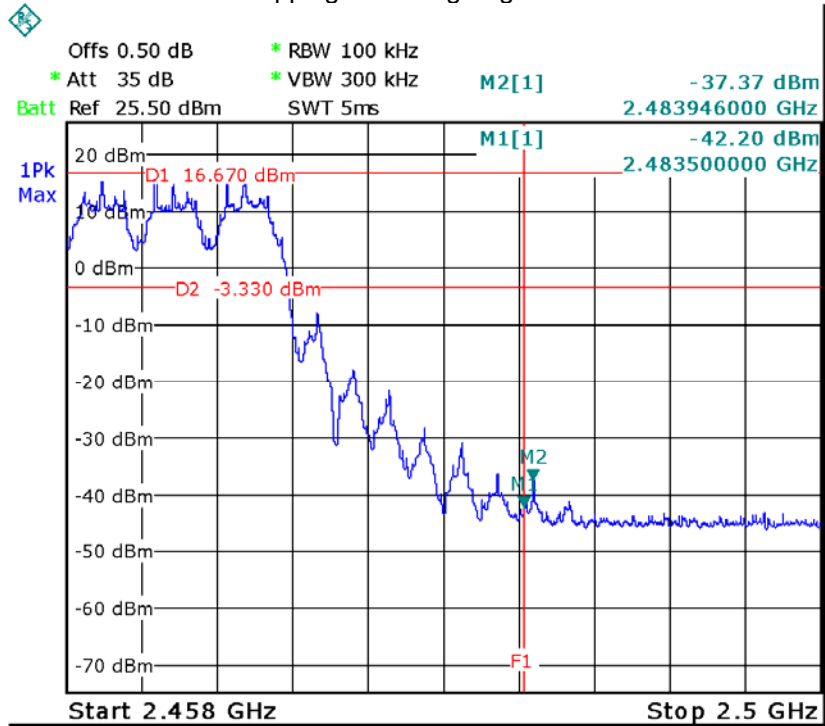
Transmitting Band edge-right side



Hopping Band edge-left side



Hopping Band edge-right side



9 20 dB Bandwidth Measurement

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Mode:	Test in fixing operating frequency at low, Middle, high channel.

9.1 Test Procedure

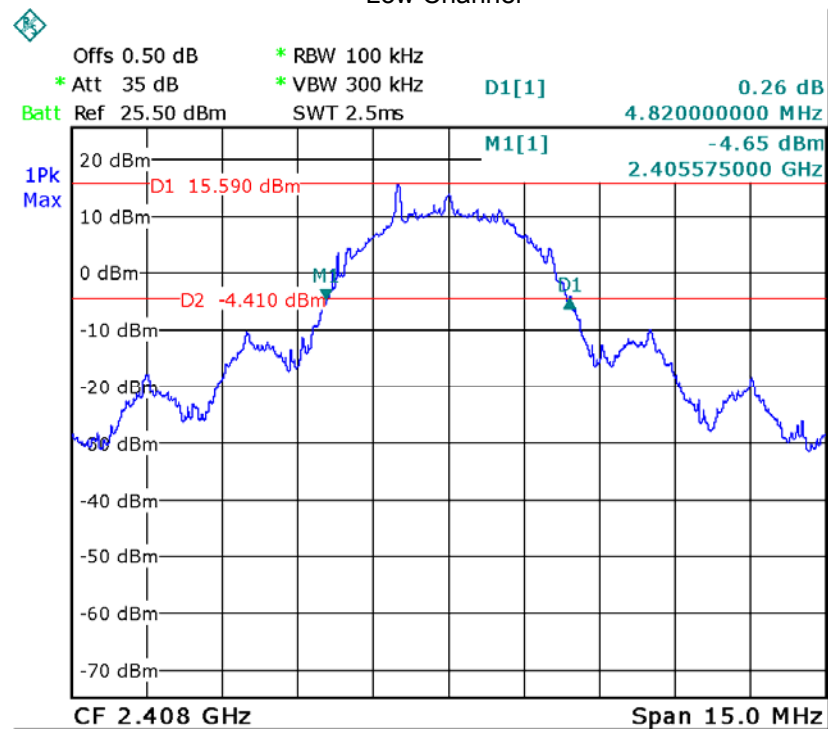
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

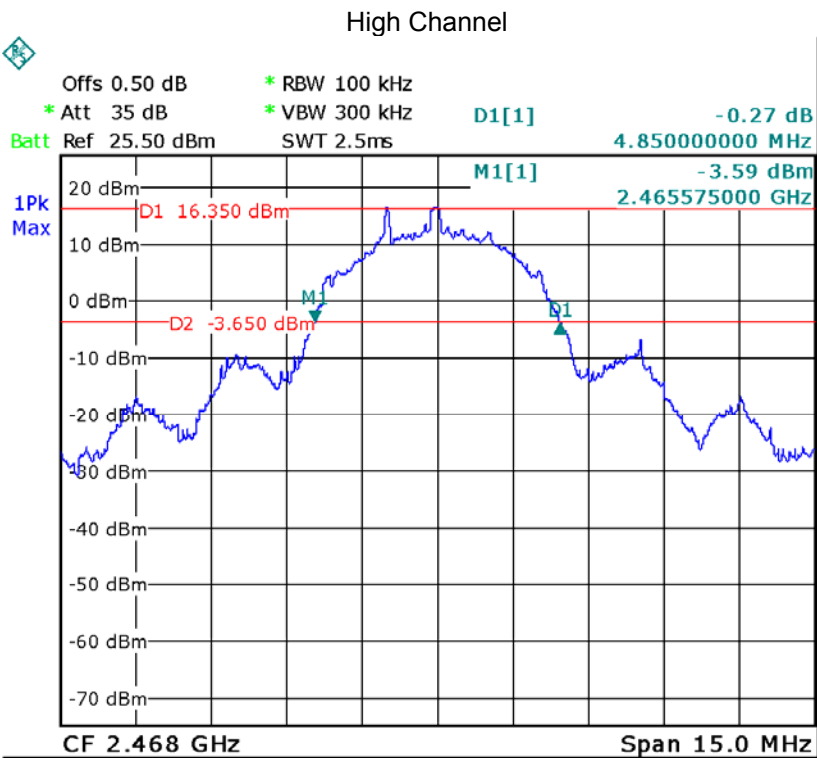
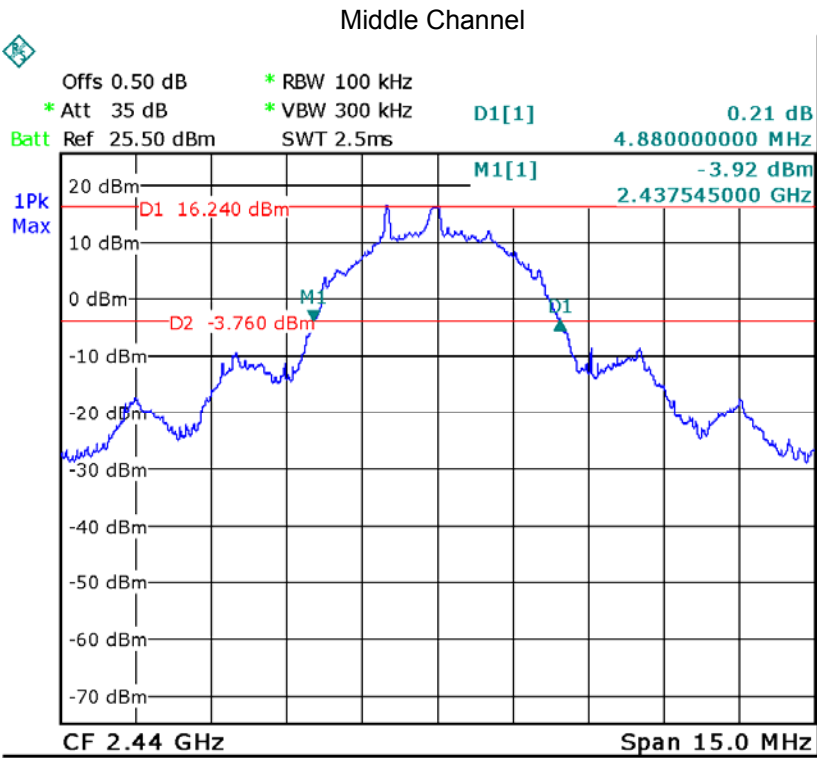
9.2 Test Result

Test Channel	Bandwidth
Low	4.820MHz
Middle	4.880MHz
High	4.850MHz

Test plots

Low Channel





10 Maximum Peak Output Power

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247 (b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Number of Hopping Frequency" of this document. The 0.125watts (20.97 dBm) limit applies.
Test mode:	Test in fixing frequency transmitting mode.

10.1 Test Procedure

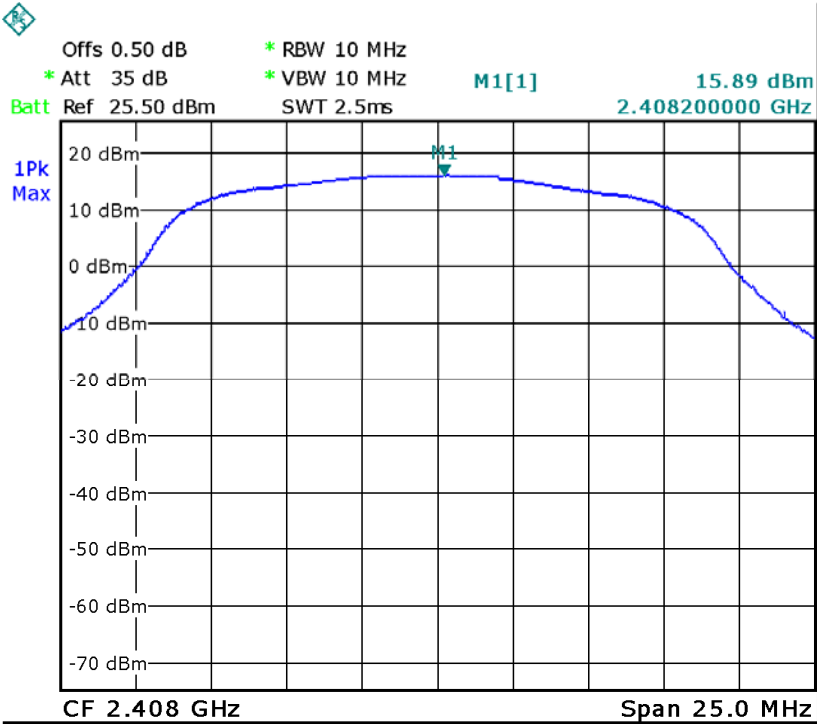
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 10MHz. VBW = 10MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.2 Test Result

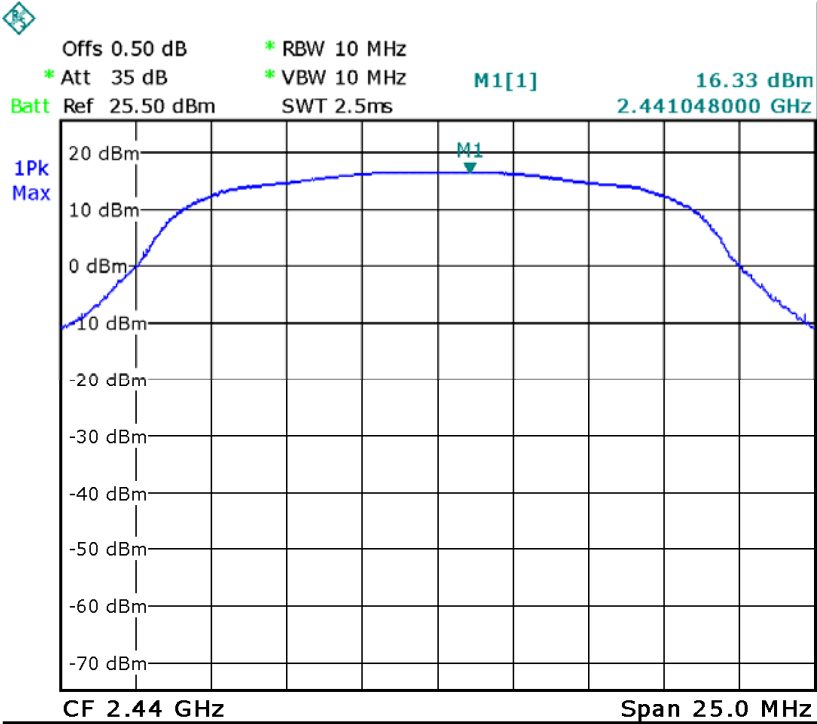
Test Channel	Output Power (dBm)	Limit (dBm)
Low	15.89	20.97
Middle	16.33	20.97
High	16.39	20.97

Test plots

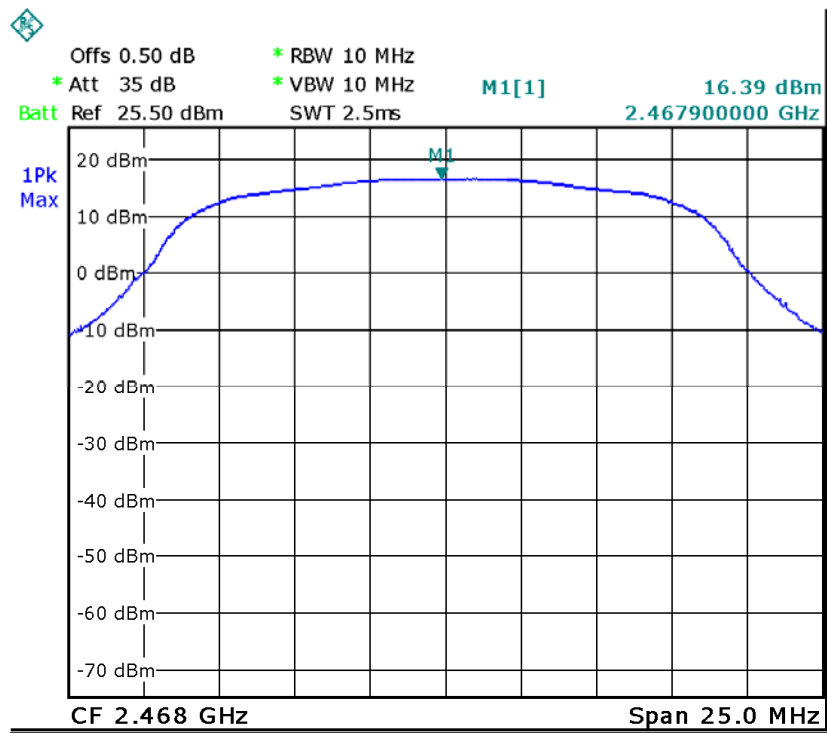
Low Channel



Middle Channel



High Channel



11 Hopping Channel Separation

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247(a)(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 1W.
Test Mode:	Test in hopping transmitting operating mode.

11.1 Test Procedure

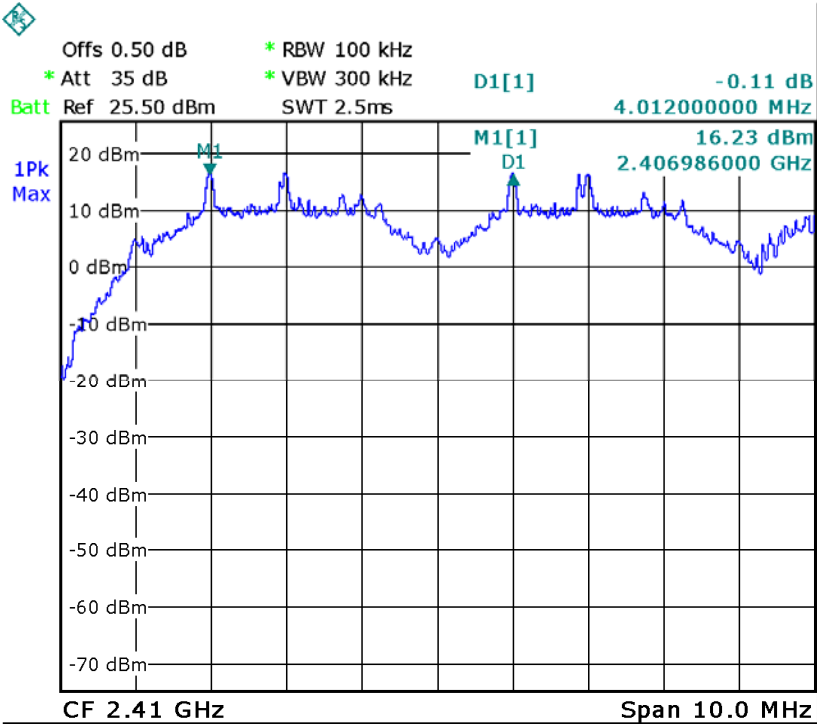
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz , Span = 10.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

11.2 Test Result

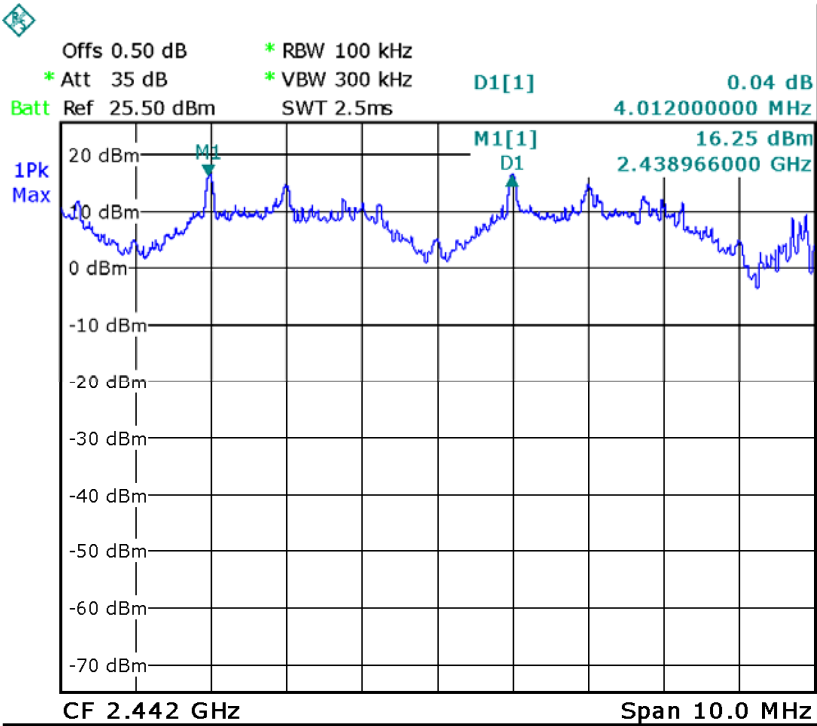
Test Channel	Separation (MHz)	Result
Low	4.012	PASS
Middle	4.012	PASS
High	4.012	PASS

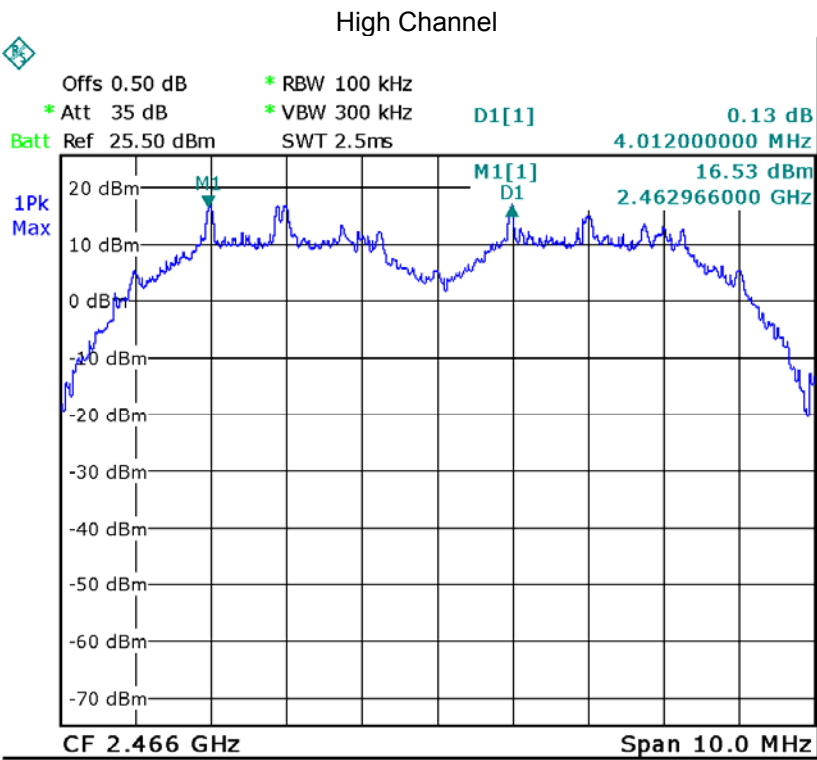
Test plots

Low Channel



Middle Channel





13 Dwell Time

Test Requirement:	FCC CFR47 Part 15 Section 15.247
Test Method:	DA 00-705
Test Limit:	Regulation 15.247(a)(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.
Test Mode:	Test in hopping transmitting operating mode.

13.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

13.2 Test Result

The test period: $T = 0.4(s) * 16 = 6.4 (s)$

So, the Dwell Time can be calculated as follows:

Low channel: Dwell Time = $10(\text{times}) * 37.08(\text{ms}) = 0.37(s)$

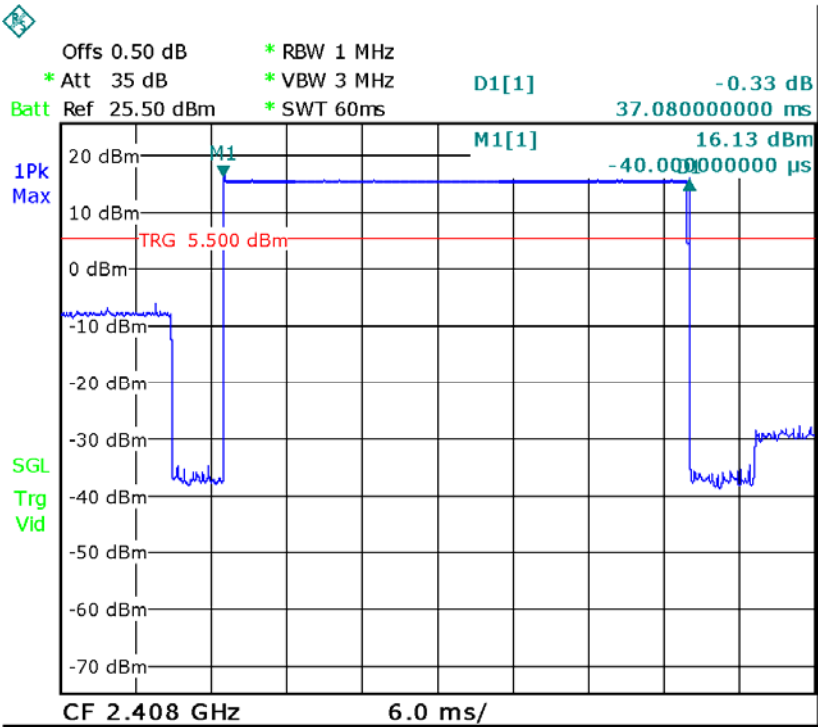
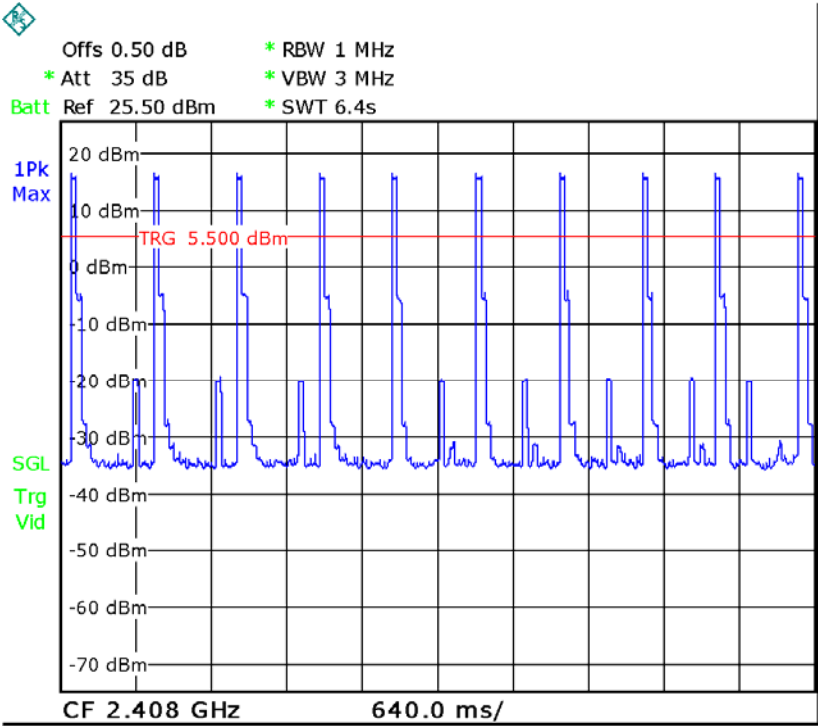
Middle Channel: Dwell Time = $10(\text{times}) * 37.04(\text{ms}) = 0.37(s)$

High Channel: Dwell Time = $10(\text{times}) * 37.06(\text{ms}) = 0.37(s)$

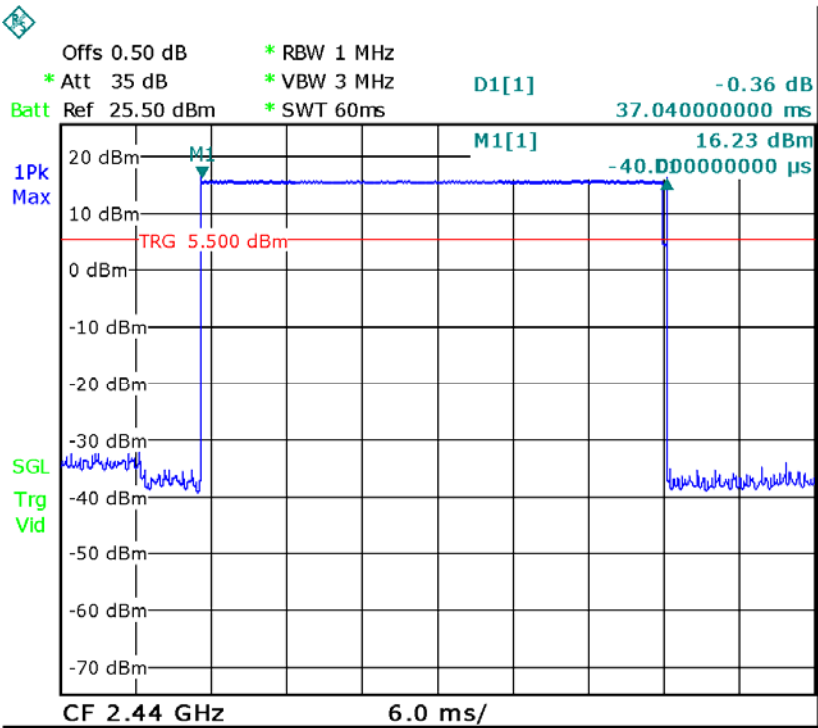
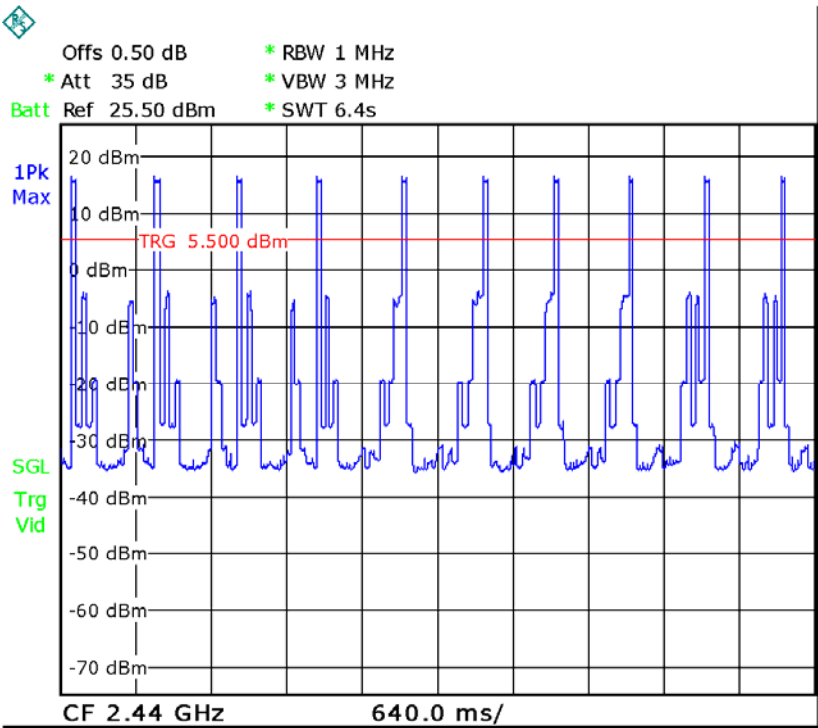
Frequency	Mkr Delta(ms)	Dwell Time(s)	Limits(s)	Result
2408MHz	40.0	0.37	0.400	Pass
2440 MHz	40.0	0.37	0.400	Pass
2468MHz	40.0	0.37	0.400	Pass

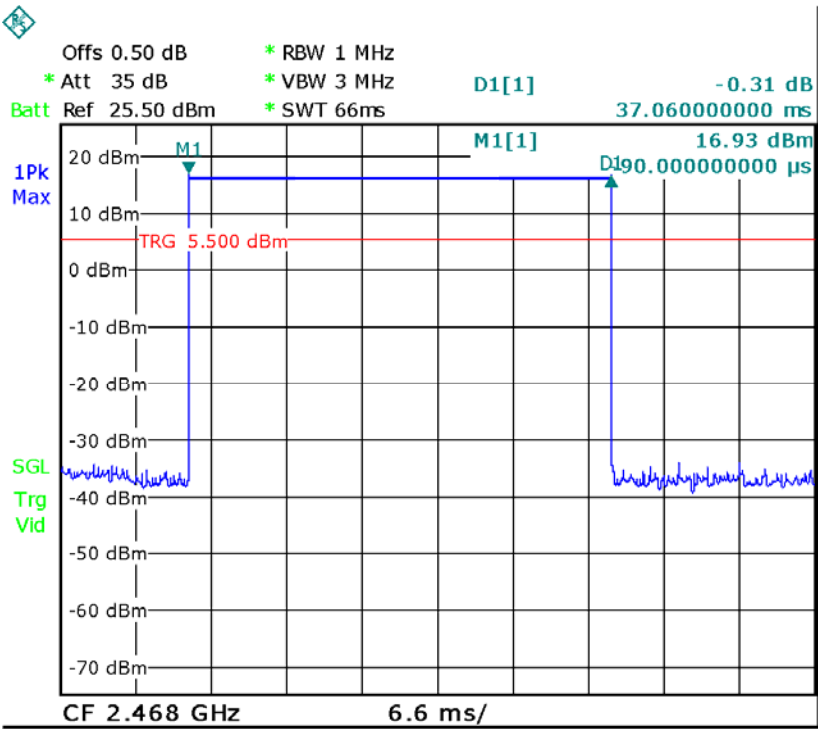
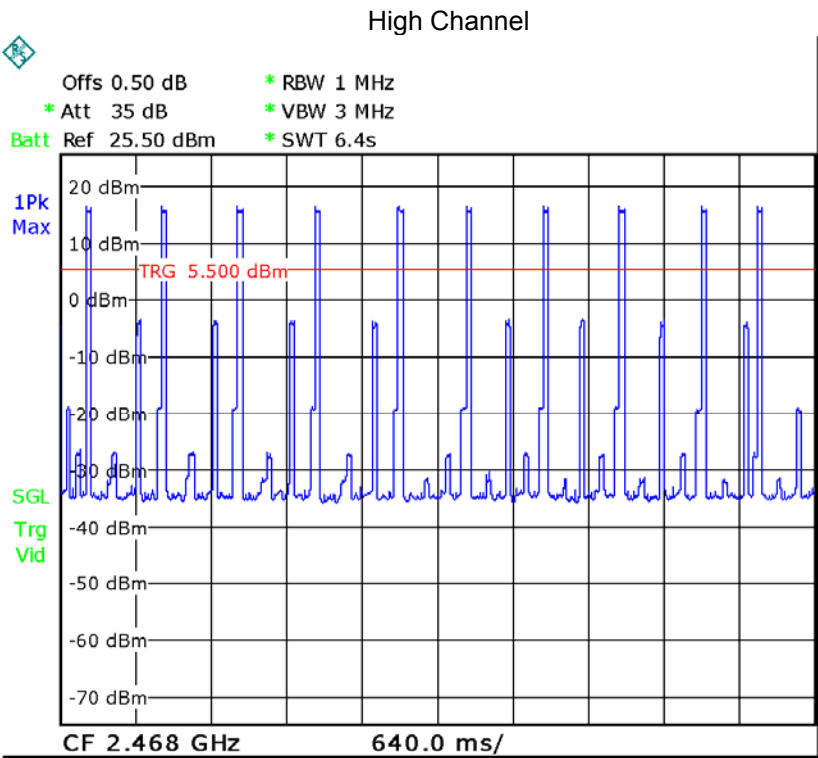
Test Plots

Low Channel



Middle Channel





14 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a Internal permanent antenna (The whorl is non-standard, it only apply to this model), fulfil the requirement of this section.

15 RF Exposure

Test Requirement: FCC Part 1.1307

Evaluation Method: FCC Part 2.1091

15.1 Requirements

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

15.2 The procedures / limit

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

15.3 MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

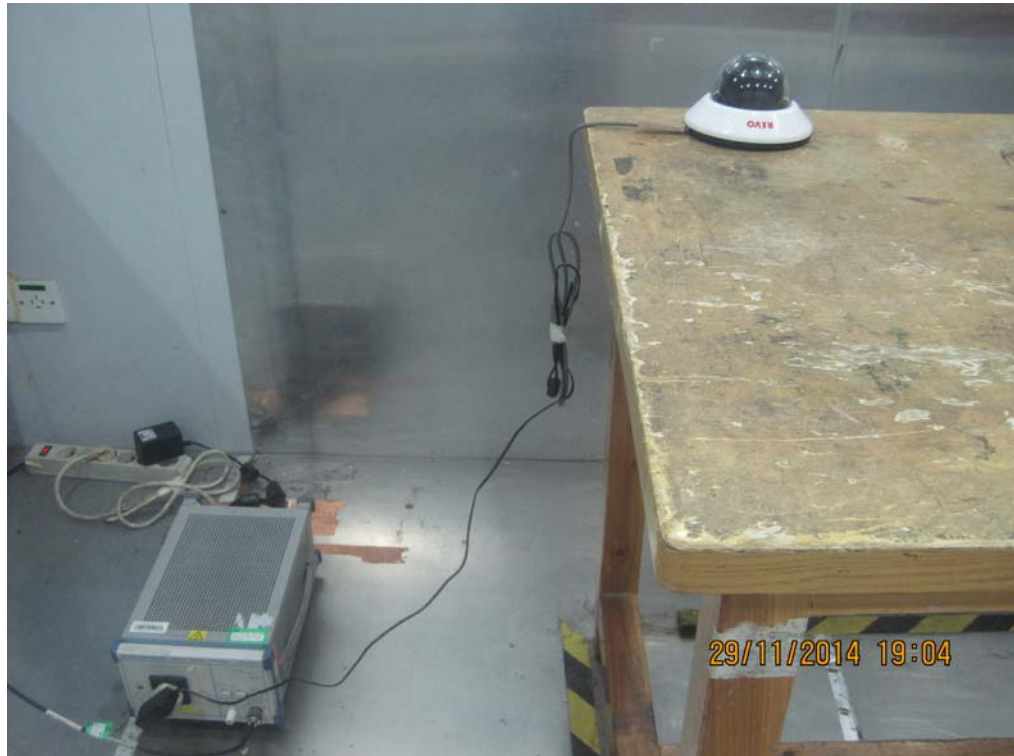
$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1.585	16.39	45.551	0.014	1

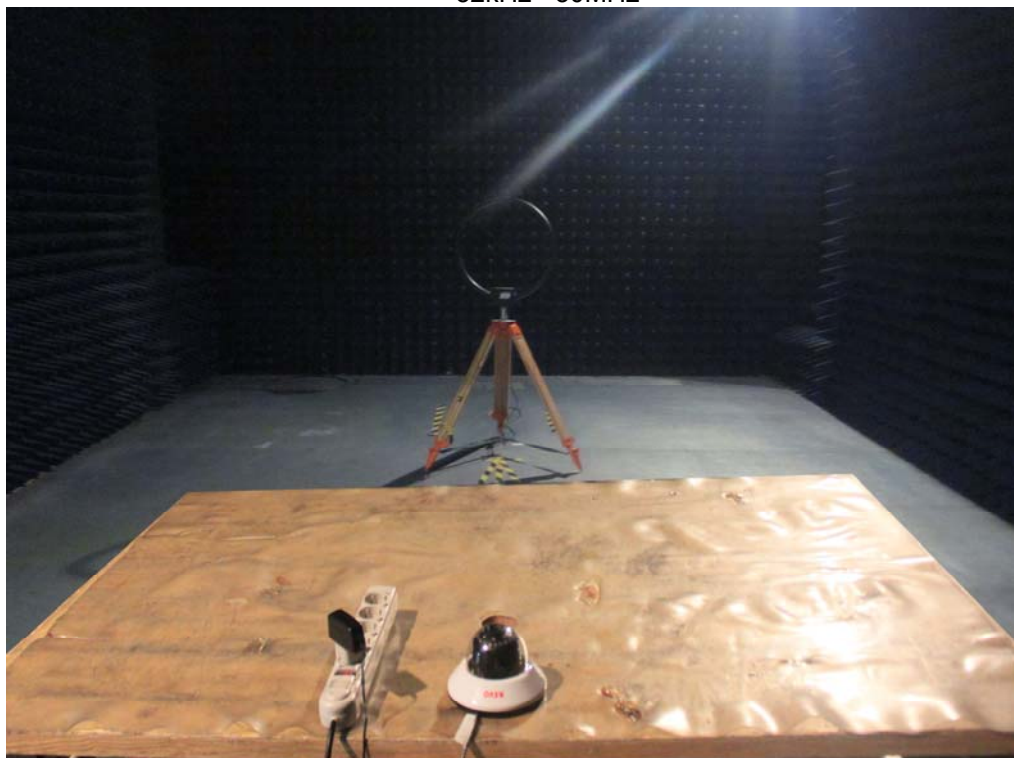
16 Photographs – Model RCWDS30-1T Test Setup

16.1 Photograph – Conducted Emission Test Setup

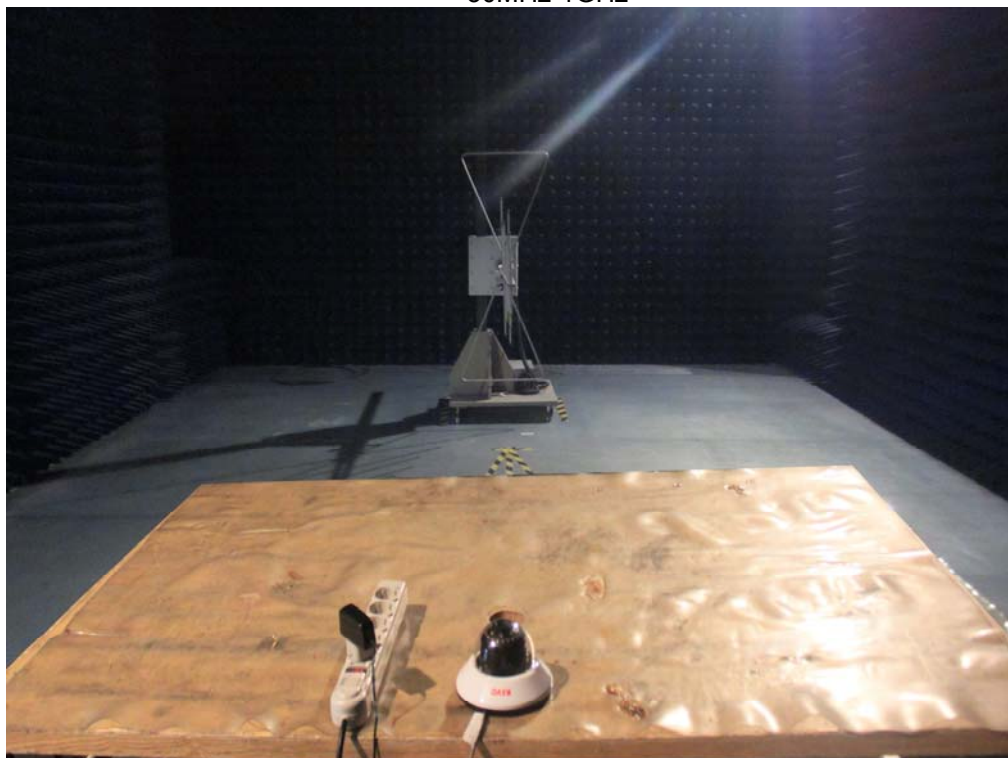


16.2 Photograph – Radiation Spurious Emission Test Setup

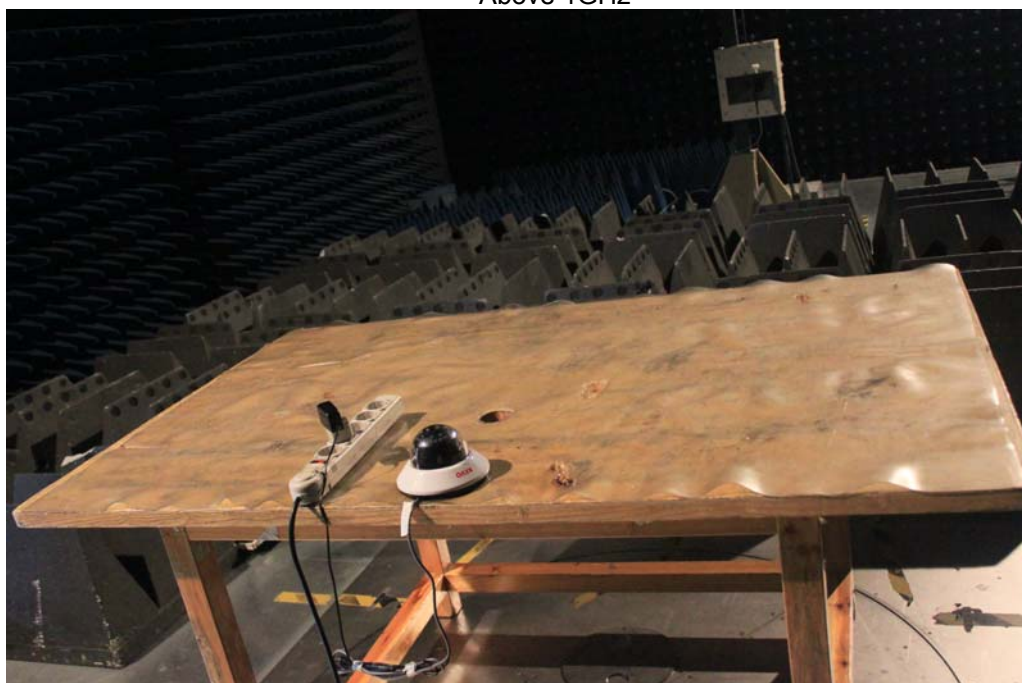
32kHz - 30MHz



30MHz-1GHz



Above 1GHz



17 Photographs - Constructional Details

17.1 Model RCWDS30-1T External View

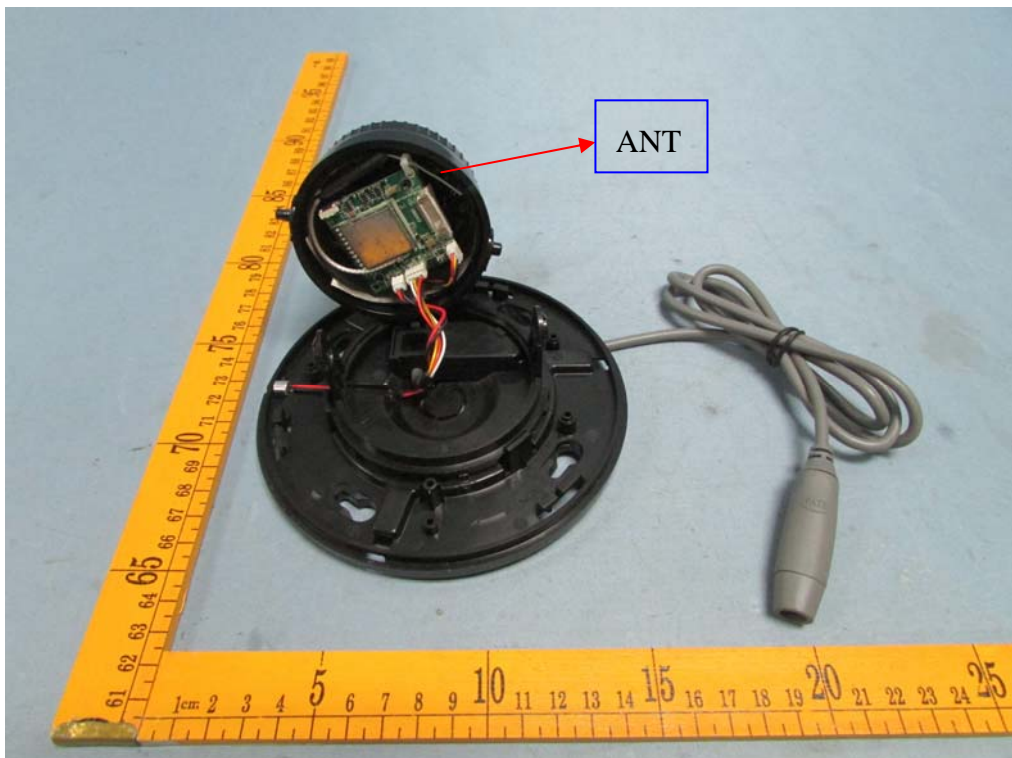


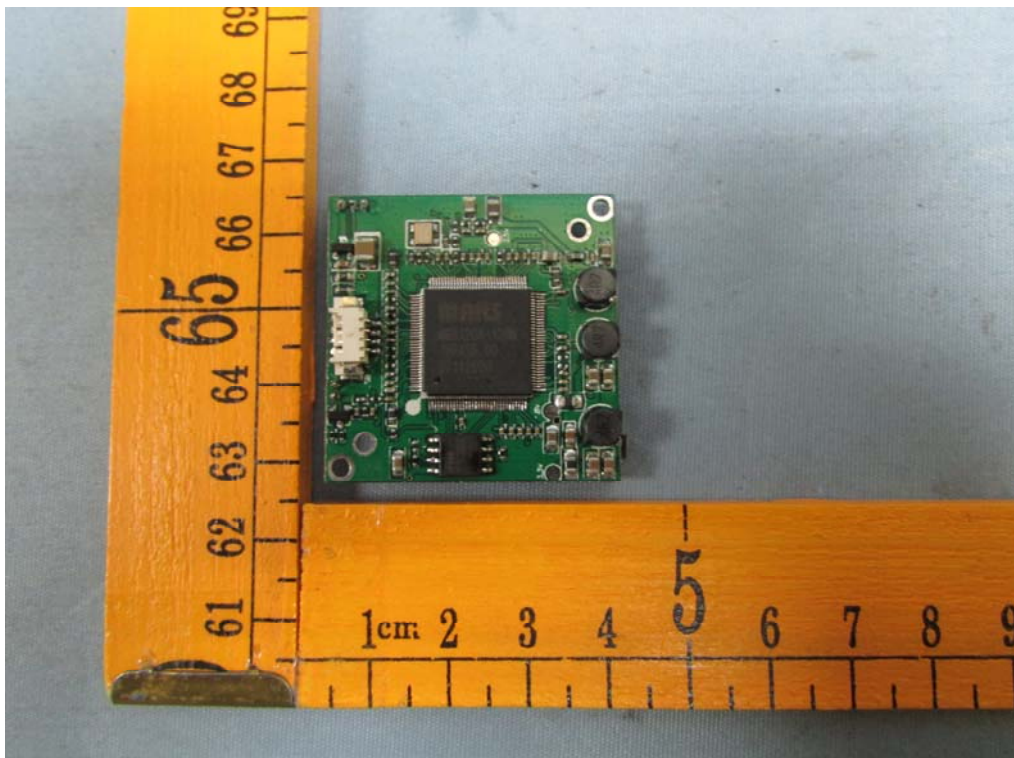
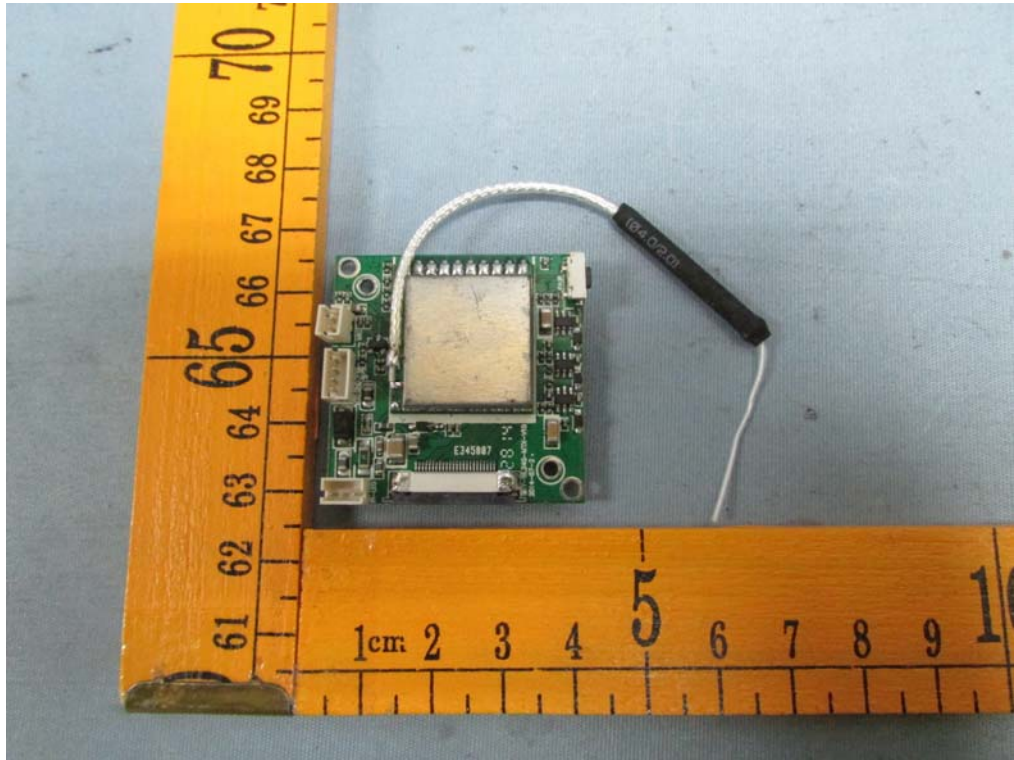


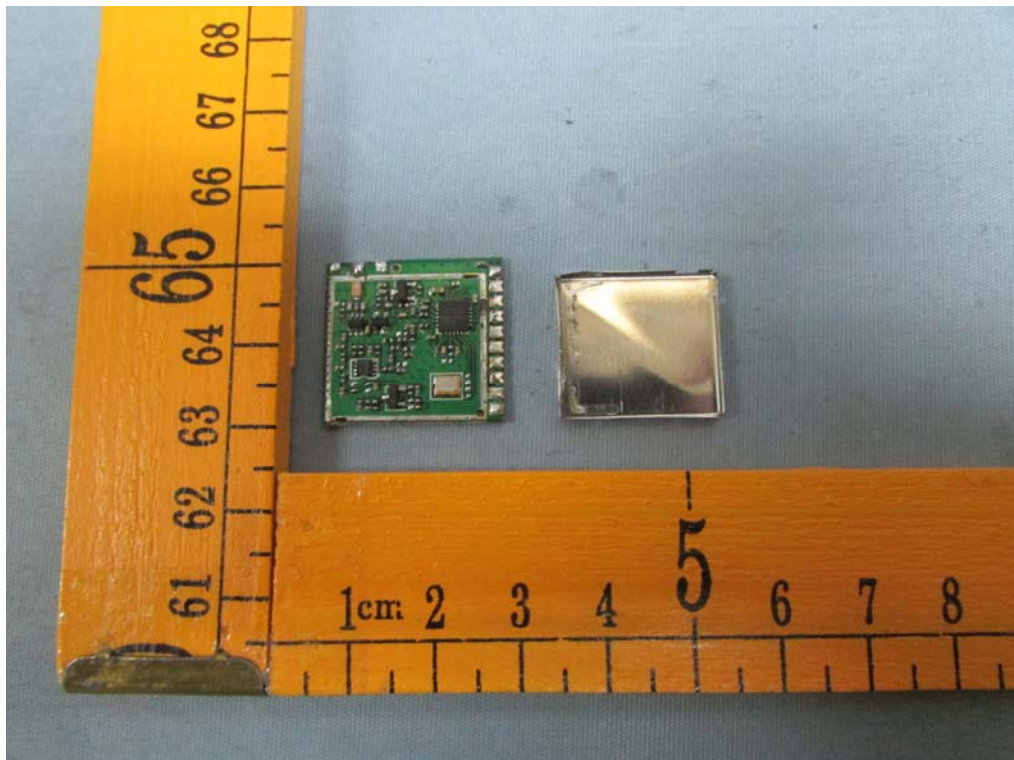
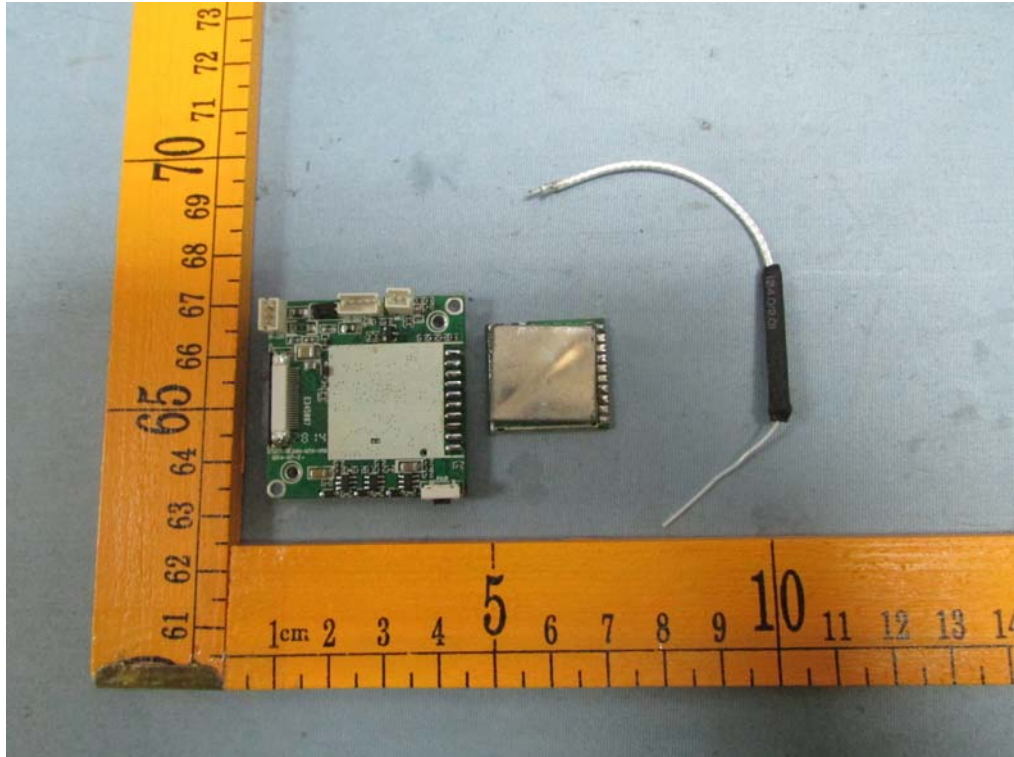


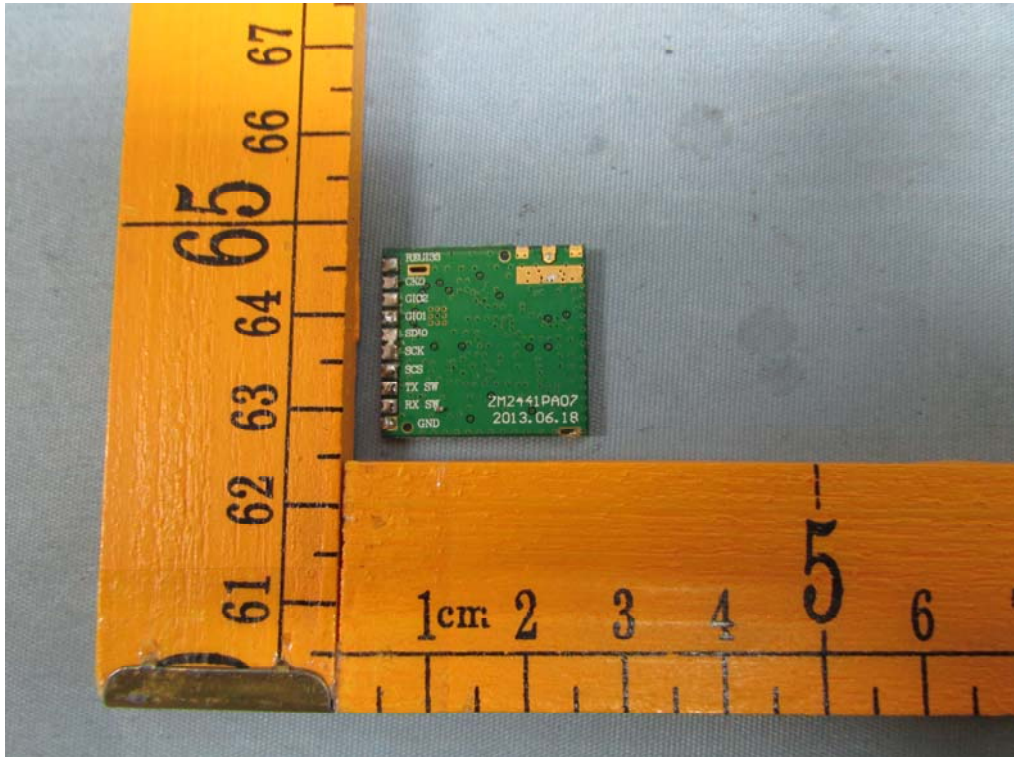


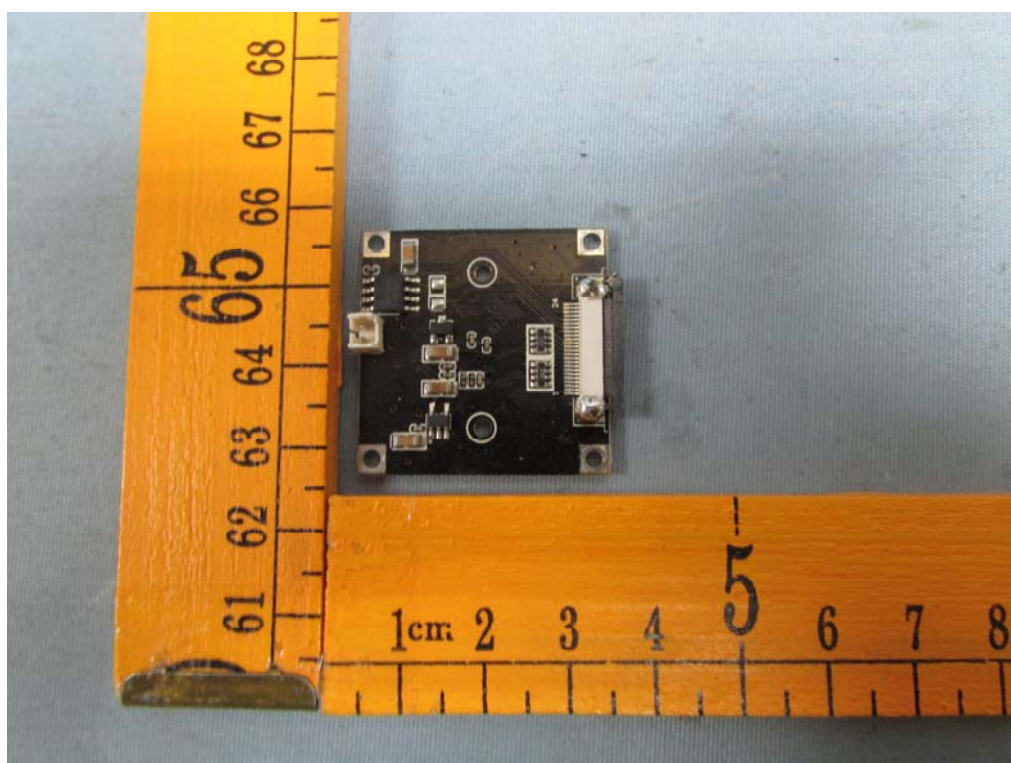
Model RCWDS30-1T Internal View

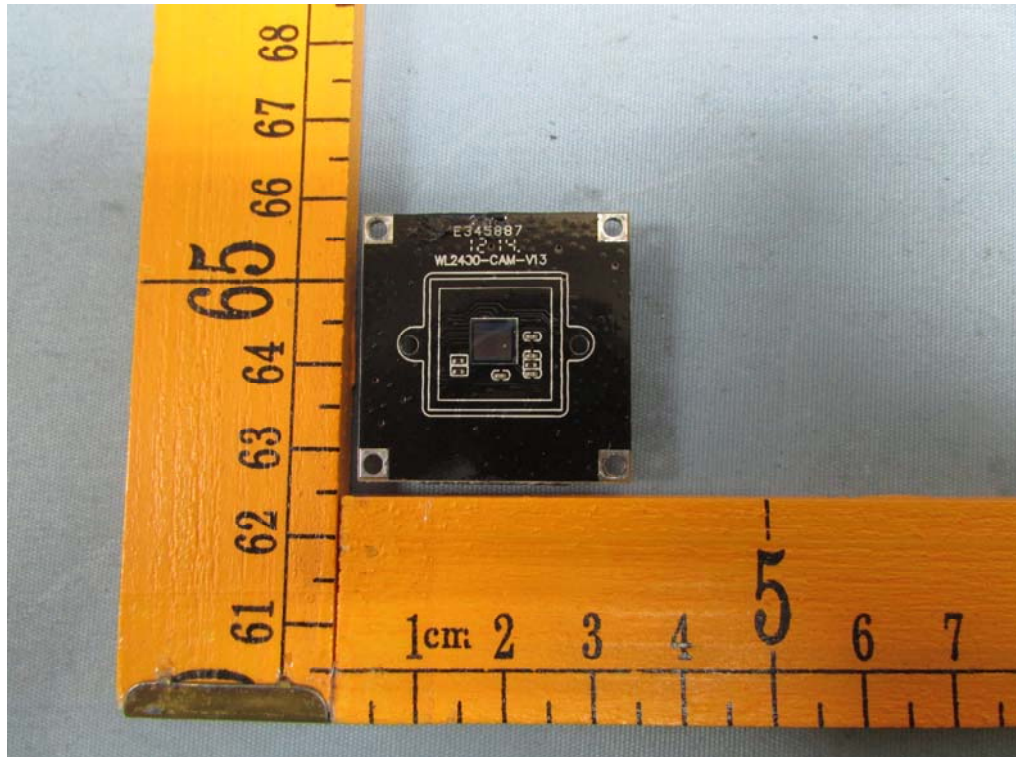












===== End of Report =====