EMC
TEST REPORT

Report No.: TS12100099-EME
Model No.: 7RC04-CF000007
Issued Date: Nov. 23, 2012

Applicant: **Pan-World Control Technologies, Inc.**
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Test Method/ Standard: **47 CFR FCC Part 15.249 & ANSI C63.4 2003**

Test By: **Intertek Testing Services Taiwan Ltd.**
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Summary of Tests

Test Item	Reference	Results
Radiated Emission test	15.249(c), 15.209	Pass
Emission on the Band Edge	15.249(d)	Pass
Calculation of Average Factor	15.35	Pass
20dB Bandwidth	15.215(c)	Pass
Conducted Emission test	15.207	N/A

1. General information

1.1 Identification of the EUT

Product:	Remote control for ceiling fan
Model No.:	7RC04-CF000007
FCC ID.:	R8Y7RC04-CF000007
Frequency Range:	2407 MHz, 2440 MHz, 2475 MHz
Channel Number:	3 channels
Frequency of Each Channel:	2407 MHz, 2440 MHz, 2475 MHz
Type of Modulation:	GFSK
Rated Power:	DC 3 V from battery
Power Cord:	N/A
Data Cable:	N/A
Sample Received:	Oct. 17, 2012
Test Date(s):	Oct. 17, 2012~Oct. 25, 2012
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Antenna description

The EUT uses a permanently connected antenna.

Antenna Gain	: 4 dBi
Antenna Type	: Mono pole antenna
Connector Type	: Fixed type

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band was all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT is supplied with DC 3 V from battery and is continuously transmitting during all the tests.

The signal is maximized through rotation and placement in the three orthogonal axes.

X axis

Y axis

Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at Y axis. The final test data was executed under this configuration.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde&schwarz	ESCS30	833364/011	2012/6/15	2013/6/15
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2011/12/6	2012/12/4
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2012/6/25	2013/6/25
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2012/2/6	2013/2/5
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2012/9/3	2014/9/3
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2012/9/5	2014/9/5
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/7/25
Pre-Amplifier	MITEQ	AFS44-00102650 --42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--2 7-8A	828825	2012/9/18	2014/9/18
Power Meter	Anritsu	ML2495A	0844001	2012/10/9	2013/10/9
Power Senor	Anritsu	MA2411B	0738452	2012/10/9	2013/10/9

Note: The above equipments are within the valid calibration period.

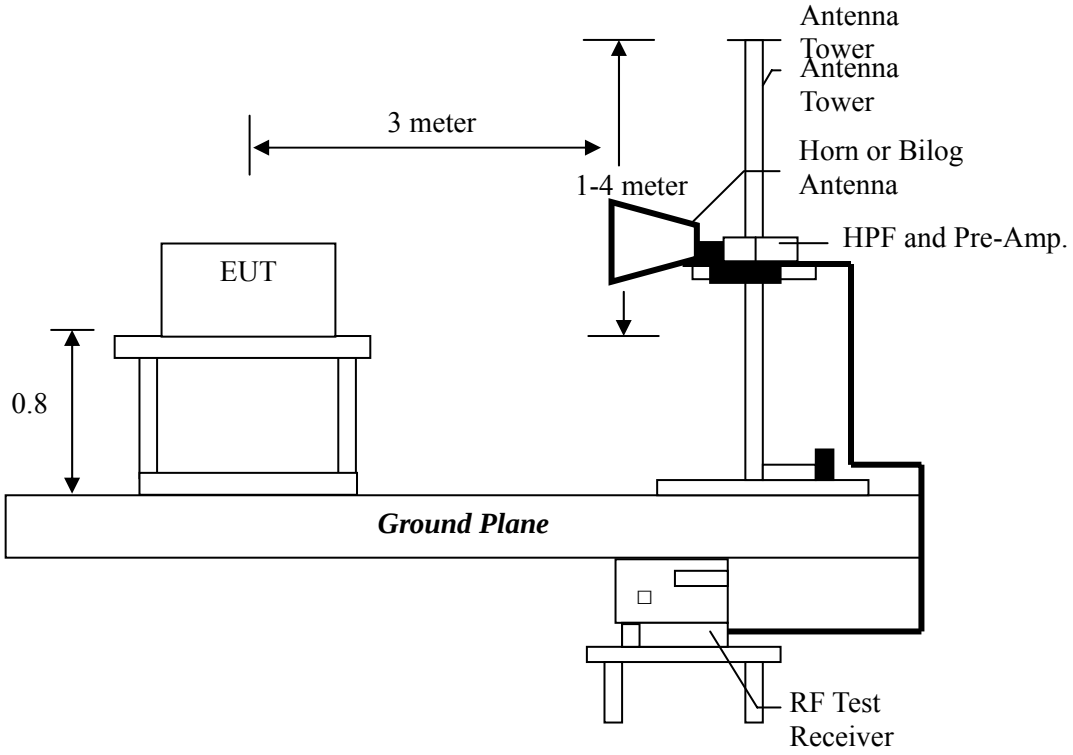
3. Radiated emission test FCC 15.249 (C)

3.1 Operating environment

Temperature:	22	℃
Relative Humidity:	56	%
Atmospheric Pressure	1008	hPa

3.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 1MHz VBW record peak reading. (15.209 paragraphs), the average reading is equal to peak reading plus average factor.
The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

3.3 Emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m@3m)	(dBuV/m@3m)	(uV/m@3m)	(dBuV/m@3m)
2407~2475	50000	93.9794	5000	73.9794

3.3.2 General radiated emission limits

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

Frequency MHz	Limits (dBμV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Measurement uncertainty was calculated in accordance with TR 100 028-1.

Parameter	Uncertainty
Radiated Emission	± 5.10 dB
Conducted Emission	± 2.786 dB

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

3.4 Radiated spurious emission test data

3.4.1 Measurement results: Fundamental and harmonics emission

EUT : 7RC04-CF000007
Test Condition : Tx at Y axis

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
2407	PK	H	32.22	60.88	93.10	93.9794	-0.88
2440	PK	H	32.35	60.86	93.21	93.9794	-0.77
2475	PK	H	32.47	61.21	93.68	93.9794	-0.30

Remark:
1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor
3. Average value = peak value + average factor

3.4.2 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under continuously transmitting mode. Low (2407MHz), middle (2440MHz) and high (2475MHz) channels were verified.

EUT : 7RC04-CF000007
Worst Case : Tx at low channel (2407MHz)

Polarization (circle) (H/V)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Calculated (dBuV/m)	Limit (dBuV/m)	Margin (dB)
V	55.22	QP	12.90	7.07	19.96	40.00	-20.04
V	148.34	QP	14.27	6.65	20.92	43.50	-22.58
V	551.86	QP	19.53	7.55	27.08	46.00	-18.92
V	627.52	QP	21.53	7.26	28.79	46.00	-17.21
V	734.22	QP	22.74	7.97	30.71	46.00	-15.29
V	885.54	QP	24.35	8.51	32.85	46.00	-13.15
H	43.58	QP	14.20	8.37	22.57	40.00	-17.43
H	142.52	QP	13.24	8.11	21.34	43.50	-22.16
H	429.64	QP	18.12	6.86	24.98	46.00	-21.02
H	598.42	QP	20.84	8.20	29.03	46.00	-16.97
H	691.54	QP	22.48	7.41	29.89	46.00	-16.11
H	827.34	QP	24.04	7.43	31.46	46.00	-14.54

Remark:
1. Calculated = Reading + Corr. Factor
2. Margin= Calculated – Limit

3.4.3 Measurement results: frequency above 1GHz

EUT : 7RC04-CF000007
Test Condition : Tx at low channel (2407MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4814	PK	V	35.1	38.54	68.17	-	71.61	74	-2.39
4814	AV	V	35.1	38.54	39.13	-29.04	42.57	54	-11.43
7221	PK	V	33.0	44.60	44.42	-	56.02	74	-17.98
7221	AV	V	33.0	44.60	15.38	-29.04	26.98	54	-27.02
4814	PK	H	35.1	38.54	62.17	-	65.61	74	-8.39
4814	AV	H	35.1	38.54	33.13	-29.04	36.57	54	-17.43
7221	PK	H	33.0	44.60	50.50	-	62.10	74	-11.90
7221	AV	H	33.0	44.60	21.46	-29.04	33.06	54	-20.94

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

EUT : 7RC04-CF000007
Test Condition : Tx at middle channel (2440MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4880	PK	V	35.1	38.54	70.06	-	73.50	74	-0.50
4880	AV	V	35.1	38.54	41.02	-29.04	44.46	54	-9.54
7320	PK	V	33.0	44.60	49.69	-	61.29	74	-12.71
7320	AV	V	33.0	44.60	20.65	-29.04	32.25	54	-21.75
4880	PK	H	35.1	38.54	61.75	-	65.19	74	-8.81
4880	AV	H	35.1	38.54	32.71	-29.04	36.15	54	-17.85
7320	PK	H	33.0	44.60	47.35	-	58.95	74	-15.05
7320	AV	H	33.0	44.60	18.31	-29.04	29.91	54	-24.09

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

EUT : 7RC04-CF000007
Test Condition : Tx at high channel (2475MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4950	PK	V	35.1	38.54	69.24	-	72.68	74	-1.32
4950	AV	V	35.1	38.54	40.20	-29.04	43.64	54	-10.36
7425	PK	V	33.0	44.60	51.69	-	63.29	74	-10.71
7425	AV	V	33.0	44.60	22.65	-29.04	34.25	54	-19.75
4950	PK	H	35.1	38.54	60.97	-	64.41	74	-9.59
4950	AV	H	35.1	38.54	31.93	-29.04	35.37	54	-18.63
7425	PK	H	33.0	44.60	51.09	-	62.69	74	-11.31
7425	AV	H	33.0	44.60	22.05	-29.04	33.65	54	-20.35

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

4. Radiated emission on the band edge FCC 15.249(d)

4.1 Method of Measurement:

The frequency range from 30 MHz to 1000 MHz using Bilog Antenna.
The frequency range over 1 GHz using Horn Antenna.

The frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 1MHz VBW record peak reading. (15.209 paragraphs), the average reading is equal to peak reading plus average factor.

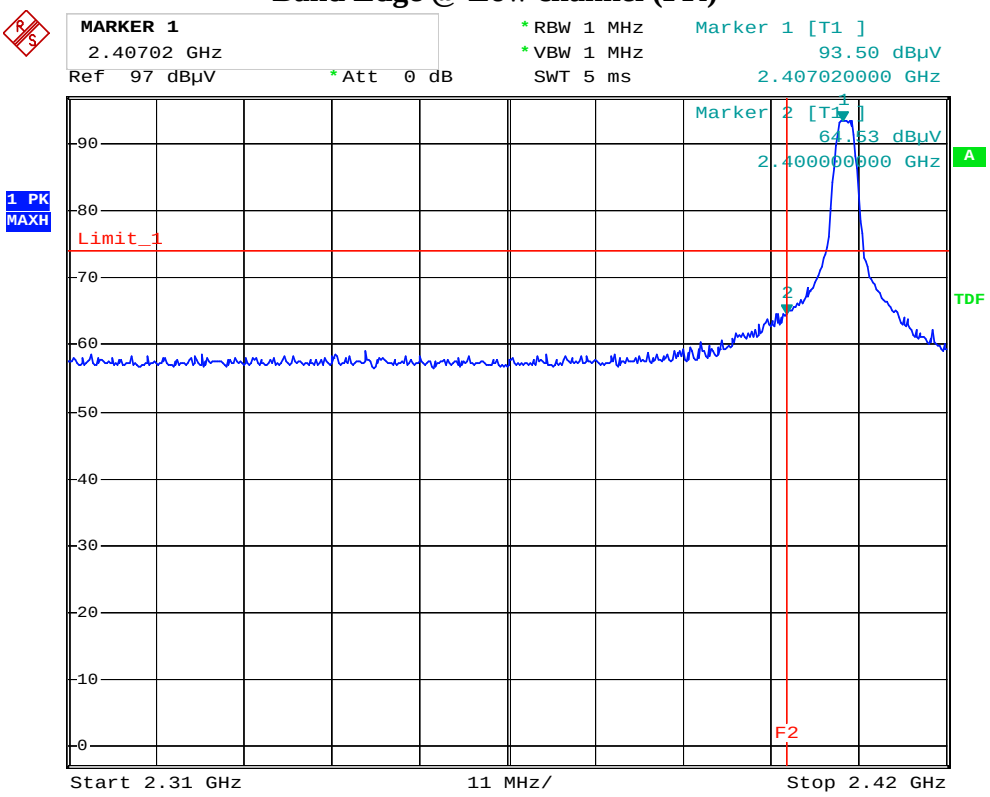
4.2 Measurement results

Channel	Measurement Freq. Band (MHz)	Detector	Average Factor (dB)	The Max. Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
1 (Low)	2310-2415	PK	-	64.53	74	-9.47
		AV	-29.04	35.49	54	-18.51
11 (High)	2464-2500	PK	-	61.30	74	-12.70
		AV	-29.04	32.26	54	-21.74

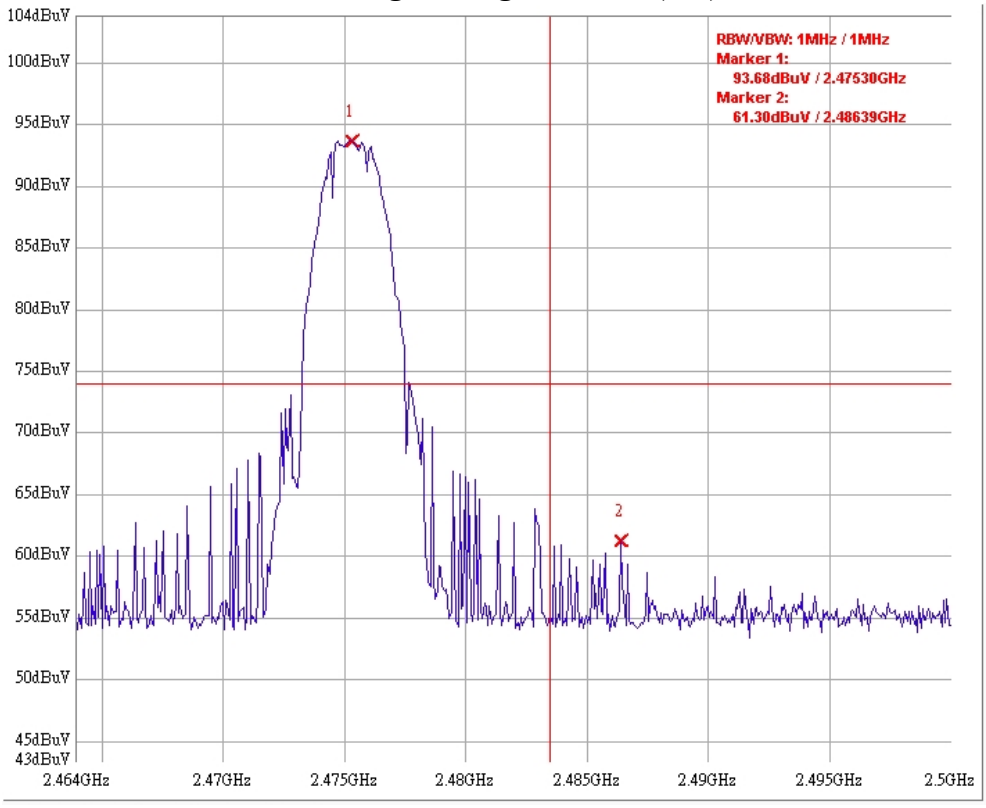
Remark: Average Value = Peak Value + Average Factor

Please see the plots below.

Band Edge @ Low channel (PK)



Band Edge @ High channel (PK)



5. Calculation of Average Factor

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

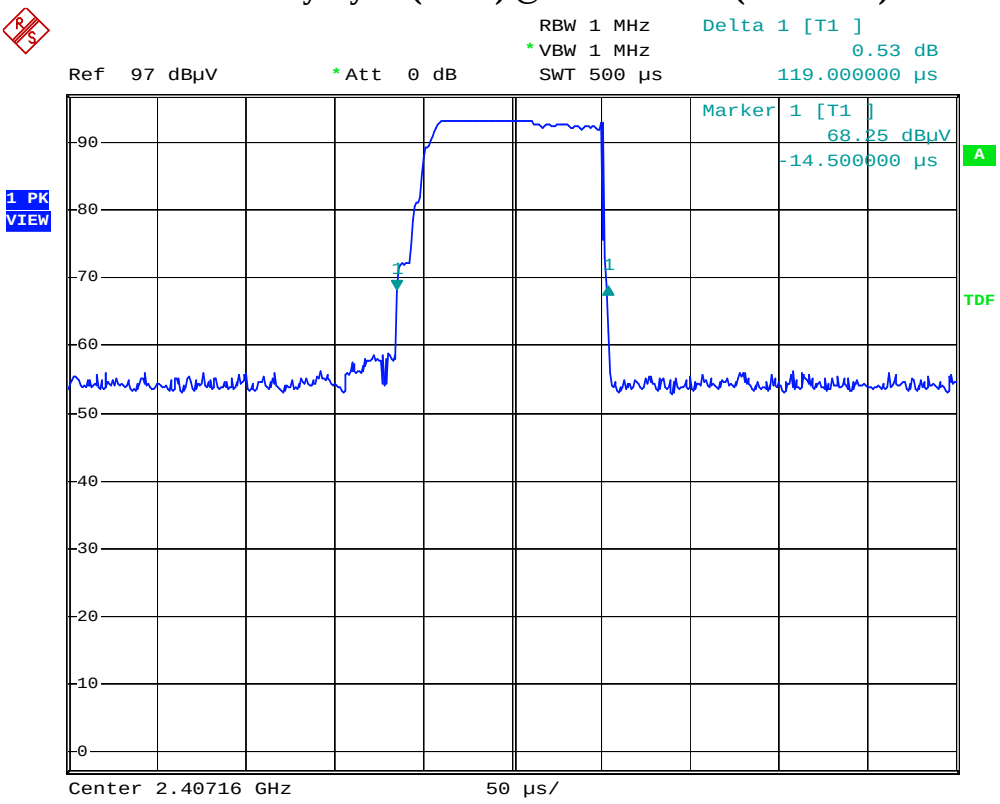
The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer in zero span mode.

Channel	Frequency (MHz)	Pulse time (ms)	Time period (ms)	Duty cycle %	Duty cycle correction factor
1	2407	0.11900	3.41900	3.48	-29.17
7	2440	0.11900	3.40950	3.49	-29.14
11	2475	0.12038	3.41038	3.53	-29.04

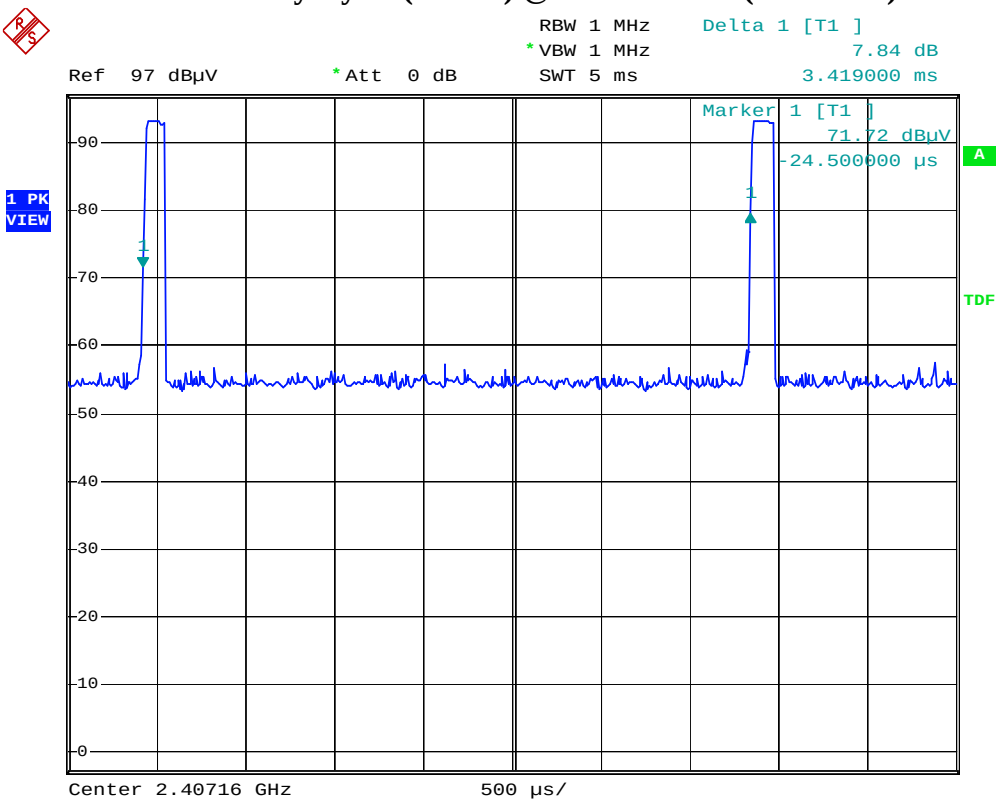
Remark:
Duty cycle correction factor in dB = 20 $\log_{10}$ (on-time/100ms) or 20 $\log_{10}$ (on-time/period)
If period is less than 100ms.
Therefore,
duty cycle correction factor of 2407MHz= 20 $\log_{10}$ (0.119/3.419) = -29.17 dB;
duty cycle correction factor of 2440MHz= 20 $\log_{10}$ (0.119/3.4095) = -29.14 dB;
duty cycle correction factor of 2475MHz= 20 $\log_{10}$ (0.12038/3.41038) = -29.04 dB

Please see the plot below.

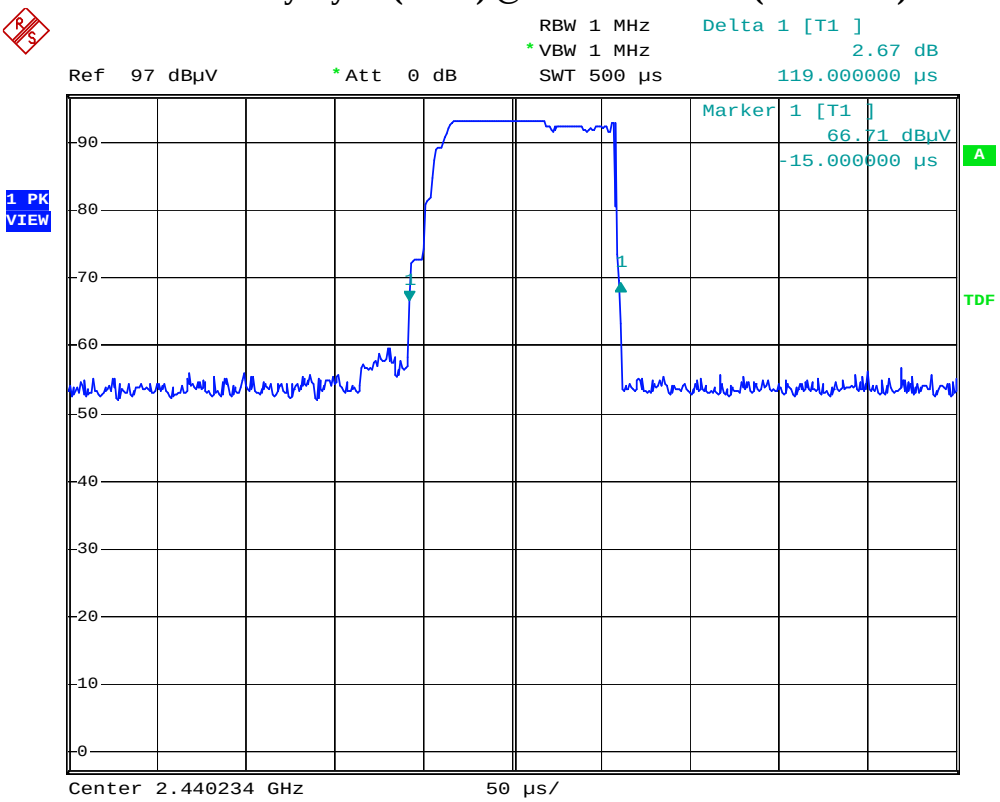
Duty Cycle (Pulse) @ Low channel (2407MHz)



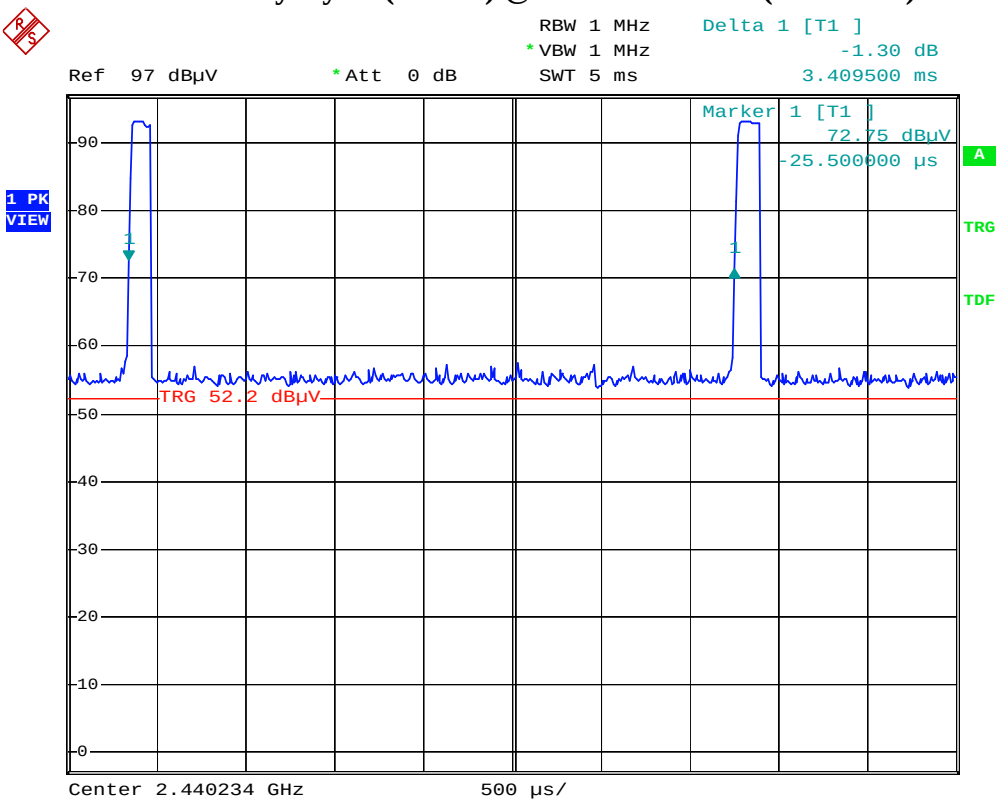
Duty Cycle (Period) @ Low channel (2407MHz)



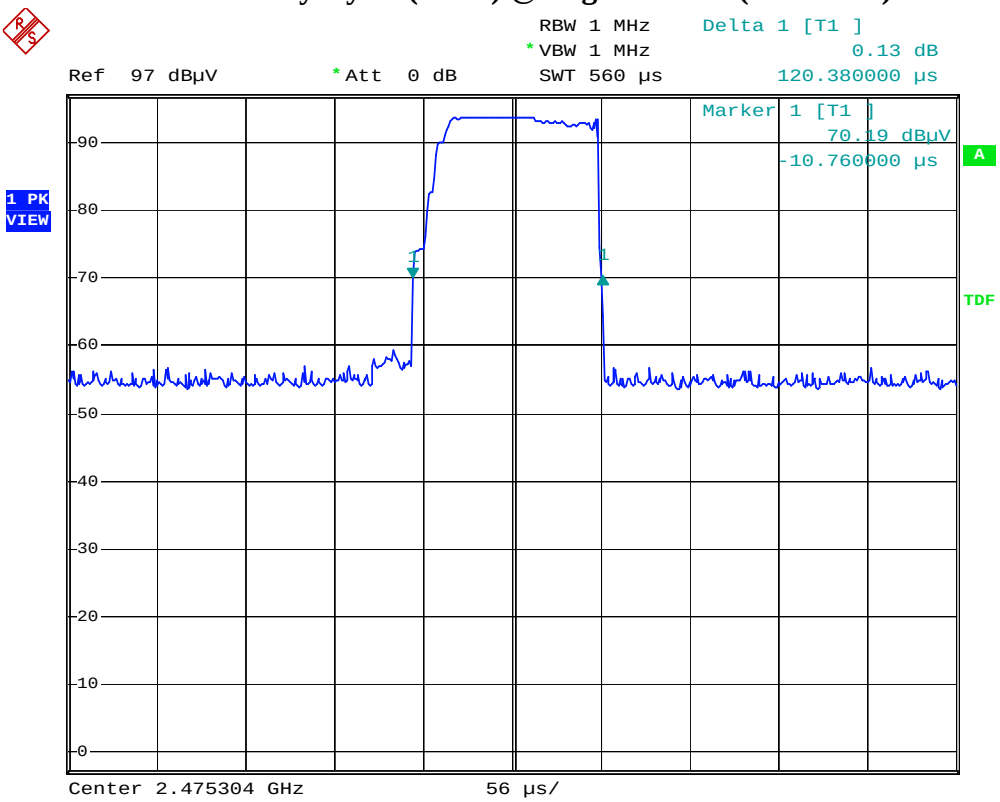
Duty Cycle (Pulse) @ Middle channel (2440MHz)



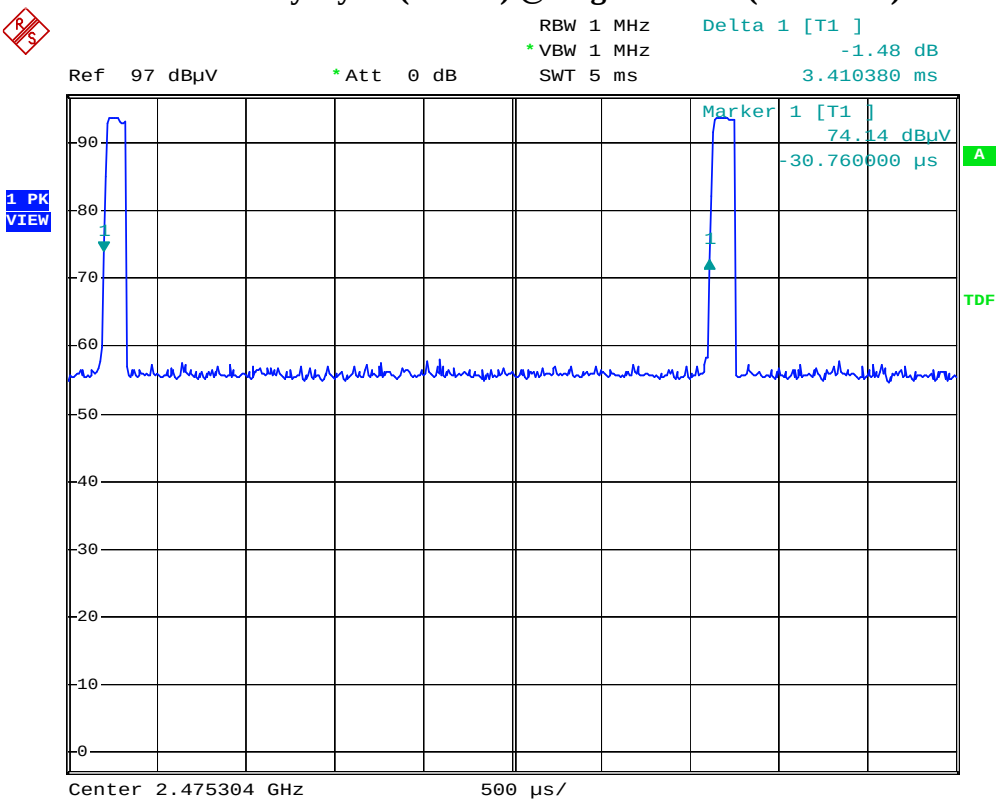
Duty Cycle (Period) @ Middle channel (2440MHz)



Duty Cycle (Pulse) @ High channel (2475MHz)



Duty Cycle (Period) @ High channel (2475MHz)



6. 20dB Bandwidth test

6.1 Operating environment

Temperature:	22	℃
Relative Humidity:	56	%
Atmospheric Pressure:	1008	hPa

6.2 Test setup & procedure

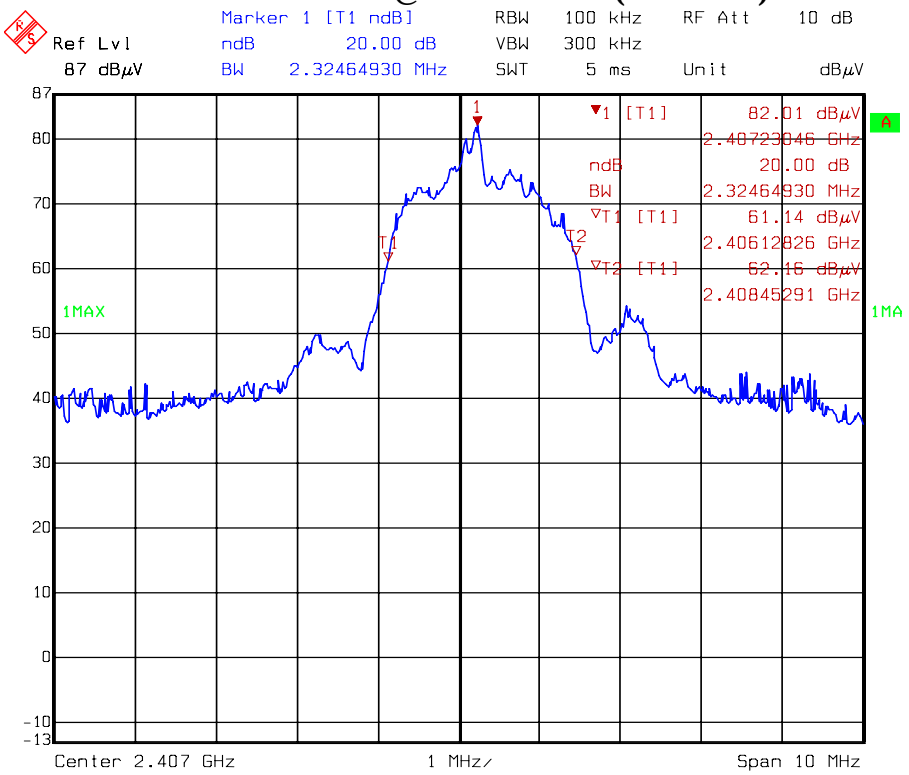
The 20dB bandwidth was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth=300kHz, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The test was performed at 3 channels (lowest, middle and highest channel). The maximum 20dB modulation bandwidth is in the following Table.

6.3 Measured data of modulated bandwidth test results

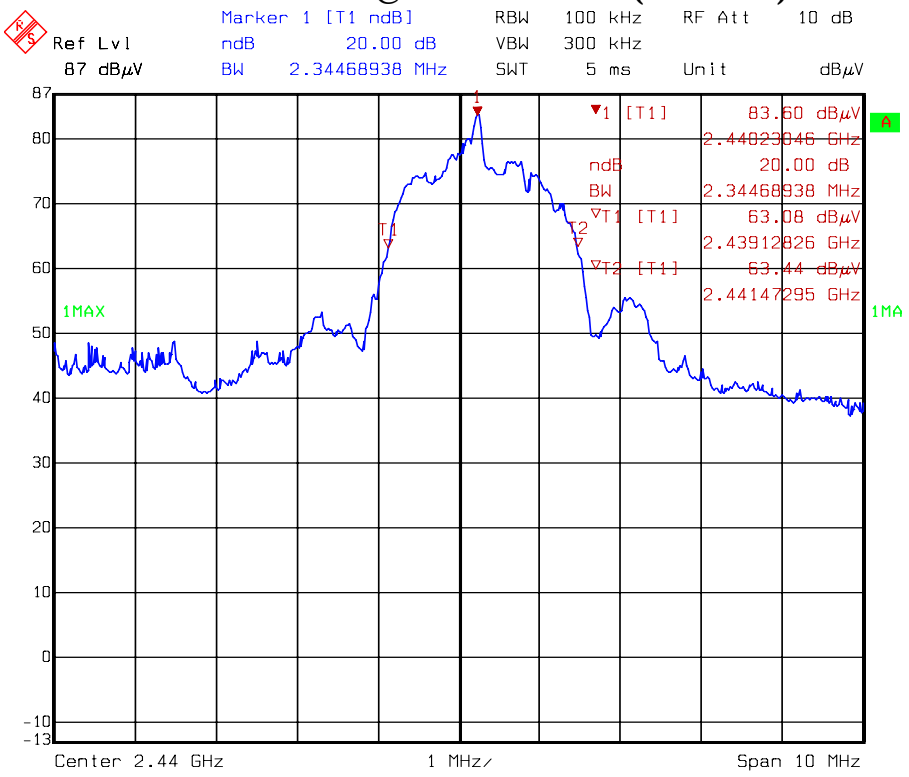
Channel	Frequency (MHz)	Bandwidth (MHz)
1 (Low)	2407	2.32
7 (Middle)	2440	2.34
11 (High)	2475	2.36

Please see the plot below.

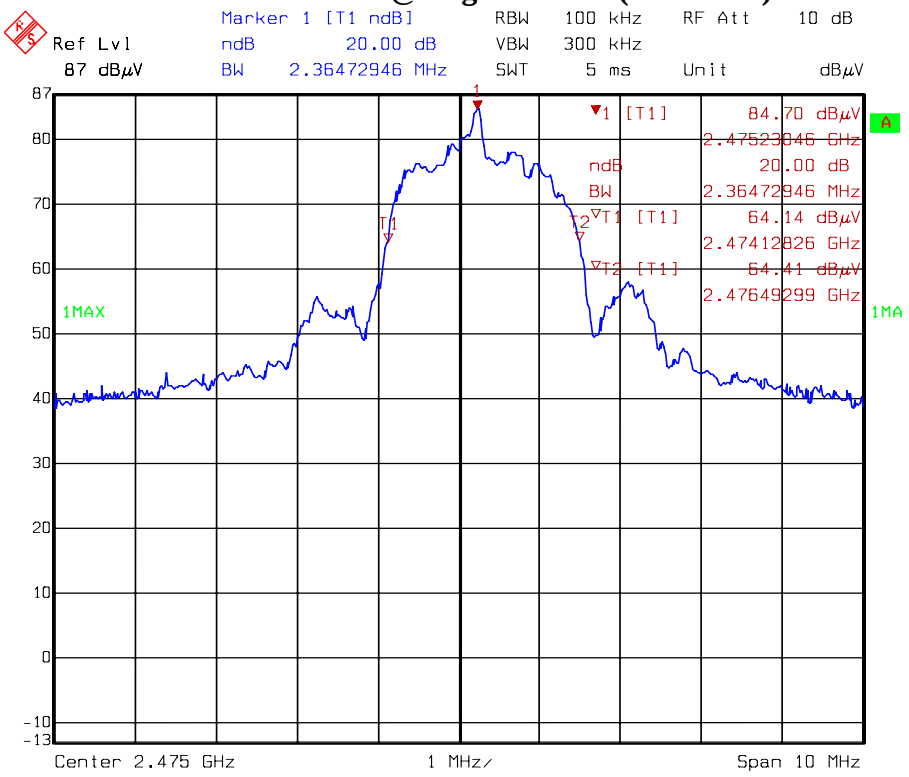
20 dB Bandwidth @ Low channel (2407MHz)



20 dB Bandwidth @ Middle channel (2440MHz)



20 dB Bandwidth @ High channel (2475MHz)



7. Conducted emission FCC 15.207

According to FCC 15.207, the EUT only employs battery power for operation and does not operate from the AC power lines. Therefore, the test can be exempted.