



REPORT No.: SZ15030100W04

FCC RF TEST REPORT

APPLICANT : SZ DJI TECHNOLOGY CO., LTD

PRODUCT NAME : Thumb Controller

MODEL NAME : RONIN TC

TRADE NAME : DJI

BRAND NAME : DJI

FCC ID : SS3-800TC1504

STANDARD(S) : 47 CFR Part 15 Subpart C

ISSUE DATE : 2015-4-22



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd.

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Change History		
Issue	Date	Reason for change
1.0	2015-4-22	First edition



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TEST REPORT DECLARATION

Applicant	SZ DJI TECHNOLOGY CO., LTD
Applicant Address	14th floor, West Wing, Skyworth Semiconductor Design Building NO.18 Gaoxin South 4th Ave, Nanshan District, Shenzhen, China
Manufacturer	SZ DJI TECHNOLOGY CO., LTD
Manufacturer Address	14th floor, West Wing, Skyworth Semiconductor Design Building NO.18 Gaoxin South 4th Ave, Nanshan District, Shenzhen, China
Product Name	Thumb Controller
Model Name	RONIN TC
Brand Name	DJI
HW Version	V1.0
SW Version	V1.0
Test Standards	47 CFR Part 15 Subpart C
Test Date	2015-3-30 to 2015-4-17
Test Result	PASS

Tested by : Zou Jian
Zou Jian(Test Engineer)

Reviewed by : Qiu Xiaojun
Qiu Xiaojun(RF Manager)

Approved by : Zeng Dexin
Zeng Dexin(Chief Engineer)



1. TECHNICAL INFORMATION

Note: Provide by applicant.

1.1 Applicant Information

Company:	SZ DJI TECHNOLOGY CO., LTD
Address:	14th floor, West Wing, Skyworth Semiconductor Design Building NO.18 Gaoxin South 4th Ave, Nanshan District, Shenzhen, China

1.2 Equipment under Test (EUT) Description

Brand Name:	DJI
Trade Name:	DJI
Model Name:	RONIN TC
Frequency Range:	The frequency range used is 2415MHz - 2454MHz (40 channels, at intervals of 1MHz);
Modulation Type:	GFSK
Antenna Type:	FPC Antenna
Antenna Gain:	1.69dBi

NOTE:

The EUT is a Thumb Controller, it operate at 2.4GHz ISM band; the frequencies allocated f is $F(\text{MHz})=2415+1*n$ ($0 \leq n \leq 39$). The lowest, middle, highest channel numbers of the Thumb Controller used and tested in this report are separately 0 (2415MHz), 19 (2434MHz) and 39 (2454MHz).

For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

1.2.1 Identification of all used EUTs

The EUT identity consists of numerical and letter characters, the letter character indicates the test sample, and the following two numerical characters indicate the software version of the test sample.

EUT Identity	Hardware Version	Software Version
A01	V1.0	V1.0



1.3 Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (2.4GHz ISM band radiators) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15 (10-1-13 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Result
1	15.203	Antenna Requirement	<u>PASS</u>
2	15.247(b)	Peak Output Power	<u>PASS</u>
3	15.247(a)	Bandwidth	<u>PASS</u>
4	15.247(d)	Conducted Spurious Emission and Band Edge	<u>PASS</u>
5	15.247(d)	Restricted Frequency Bands	<u>PASS</u>
6	15.207	Conducted Emission	<u>PASS</u>
7	15.209 ,15.247(d)	Radiated Emission	<u>PASS</u>
8	15.247(e)	Power spectral density (PSD)	<u>PASS</u>
9	15.247(i),1.1307& 2.1093	RF exposure evaluation	<u>PASS</u>

The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.4 2009.

These RF tests were performed according to the method of measurements prescribed in KDB558074 D01 v03r02 (05/06/2014).

1.3.1 Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86-106

2. 47 CFR PART 15C REQUIREMENTS

2.1 Antenna requirement

2.1.1 Applicable Standard

According to FCC 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 use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

2.1.2 Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2 On time, duty cycle and measurement methods

2.2.1 Limits

None; For reporting purposes only.

2.2.2 Test description

KDB 558074 Section 6.0 was used in order to prove compliance.

A. Test set



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

B. Equipments List:

Please reference ANNEX A(1.4).

2.2.3 Test result

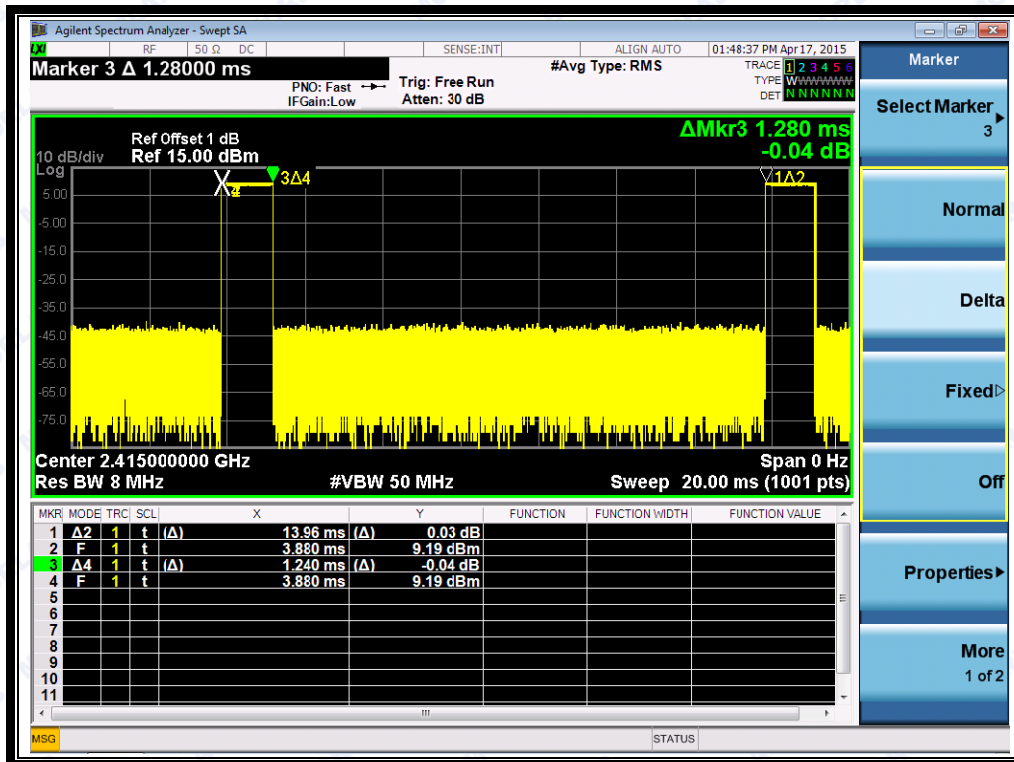
A. Test verdict:

Channel	Frequency (MHz)	On Time (msec)	Period (msec)	Duty Cycle x(linear)	Duty Cycle (%)	Refer to Plot
0	2415	1.24	13.96	0.0888	8.88	Plot A
19	2434	1.24	13.96	0.0888	8.88	Plot B
39	2454	1.24	13.96	0.0888	8.88	Plot C

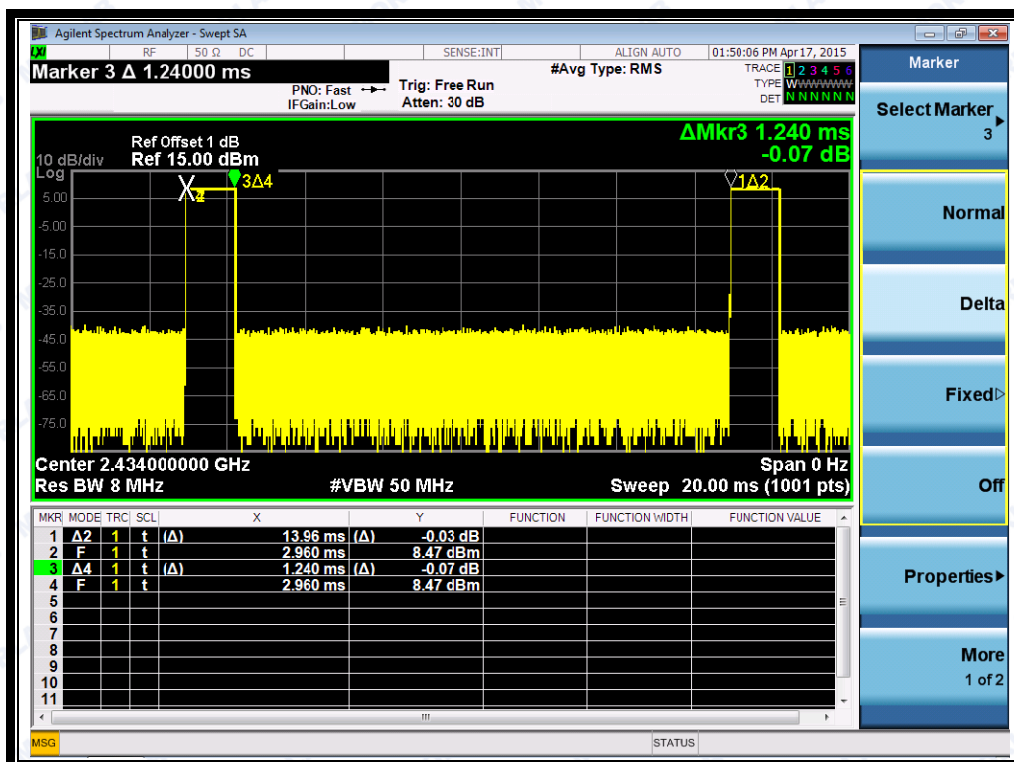
B. Test plots



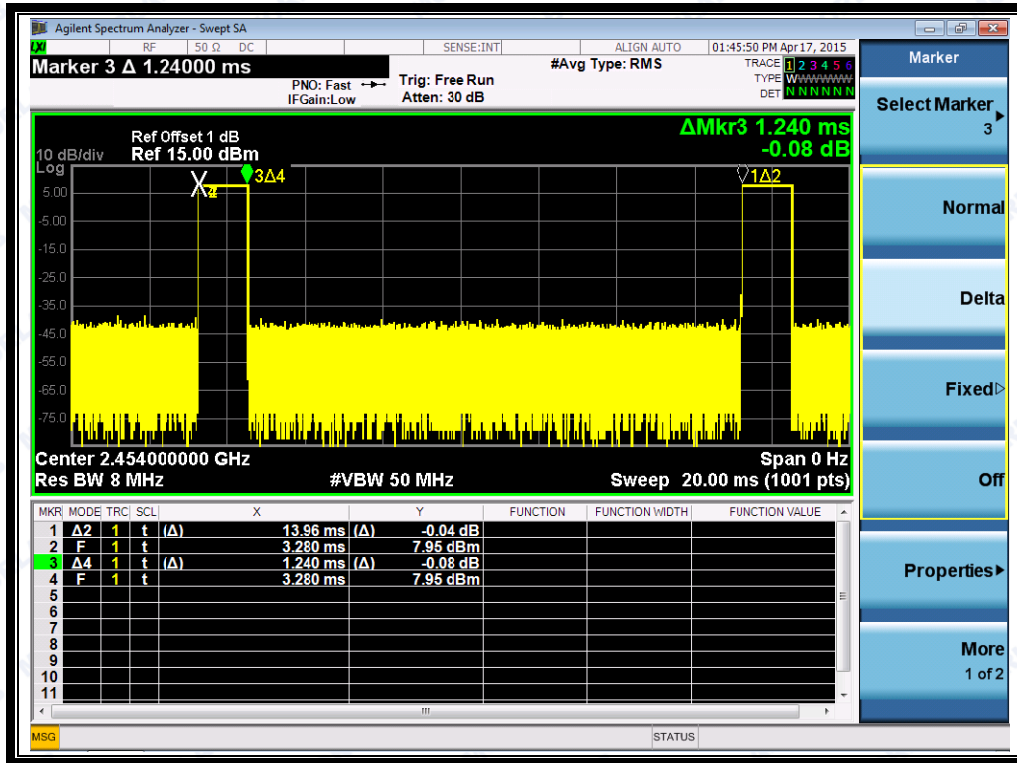
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(Plot A: Channel 0: 2415MHz)



(Plot B: Channel 19: 2434 MHz)



(Plot C: Channel 39: 2454MHz)

2.3 Maximum conducted (average) Output Power

2.3.1 Requirement

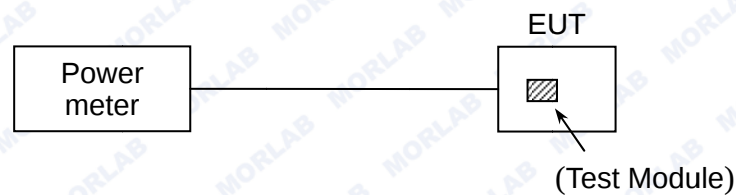
According to FCC section 15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: The maximum peak conducted output power of the intentional radiator shall not exceed 1 Watt.

2.3.2 Test Description

KDB 558074 Section 9.2.3.1 was used in order to prove compliance.

The measured output power was calculated by the reading of the Power Meter and calibration.

A. Test Setup:





The EUT (Equipment under the test) which is coupled to the Power Meter; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in power meter.

B. Equipments List:

Please reference ANNEX A (1.4).

2.3.3 Test Result

The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output (average) power of the EUT.

A. Test Verdict:

Channel	Frequency (MHz)	Measured Output (average) Power(dBm)	10log(1/x)	Maximum Conducted Output (average) Power		Limit		Verdict
				dBm	W	dBm	W	
0	2415	-2.03	10.52	8.49	0.007063	30	1	PASS
19	2434	-2.66	10.52	7.86	0.006109			PASS
39	2454	-3.48	10.52	7.04	0.005058			PASS

Note: x refers to duty cycle.

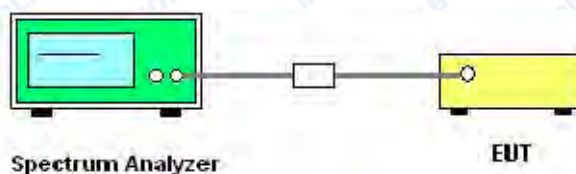
2.4 6dB Bandwidth

2.4.1 Requirement

According to FCC section 15.247(a) (2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.4.2 Test Description

A. Test Set:



The EUT which is powered by the battery, is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In



order to make an accurate measurement, set the span greater than RBW.

B. Equipments List:

Please reference ANNEX A(1.4).

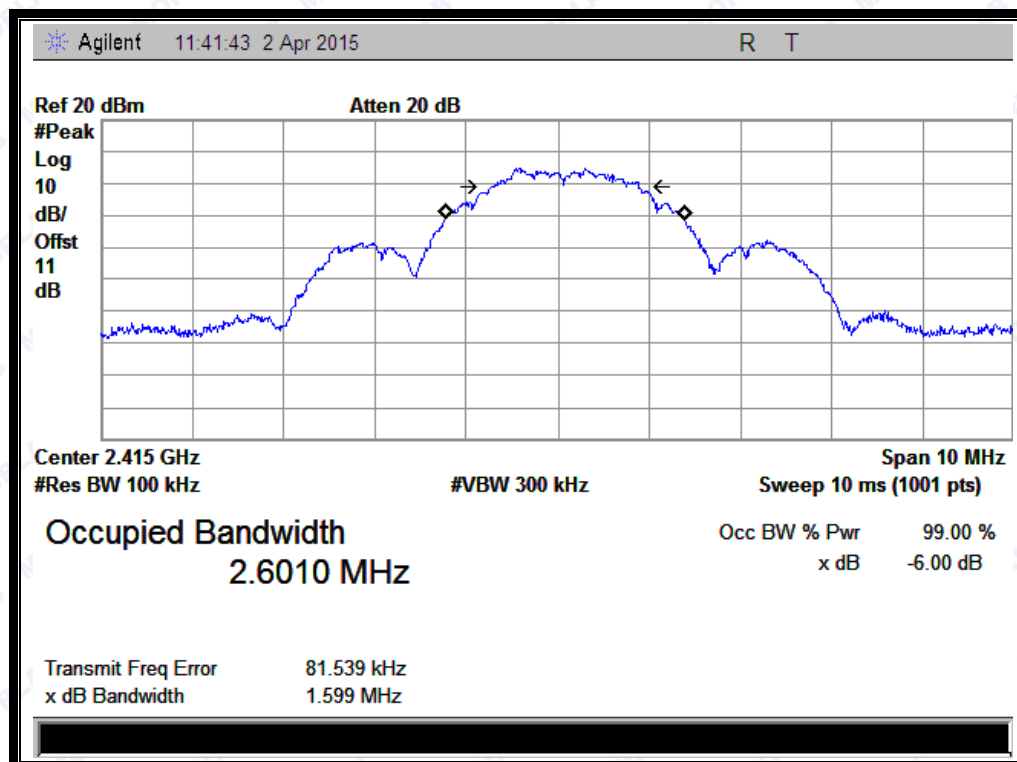
2.4.3 Test Result

The lowest, middle and highest channels are selected to perform testing to record the 6 dB bandwidth of the EUT.

A. Test Verdict:

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Refer to Plot	Limits(kHz)	Result
0	2415	1.599	Plot A	≥500	PASS
19	2434	1.599	Plot B	≥500	PASS
39	2454	1.601	Plot C	≥500	PASS

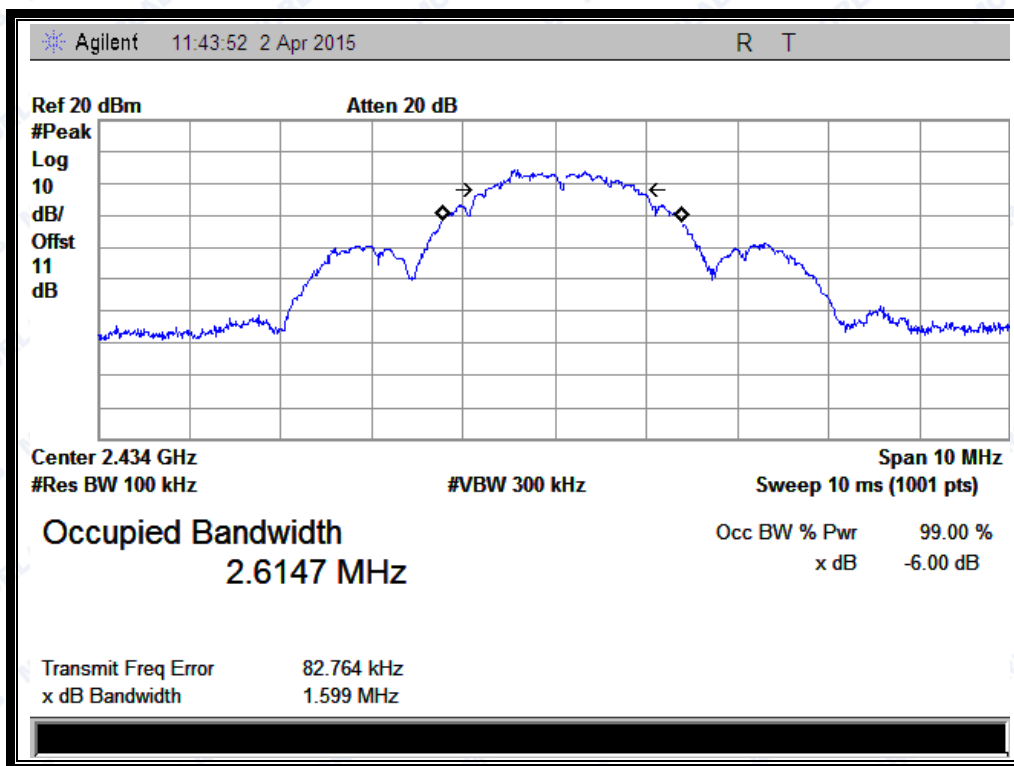
B. Test Plots:



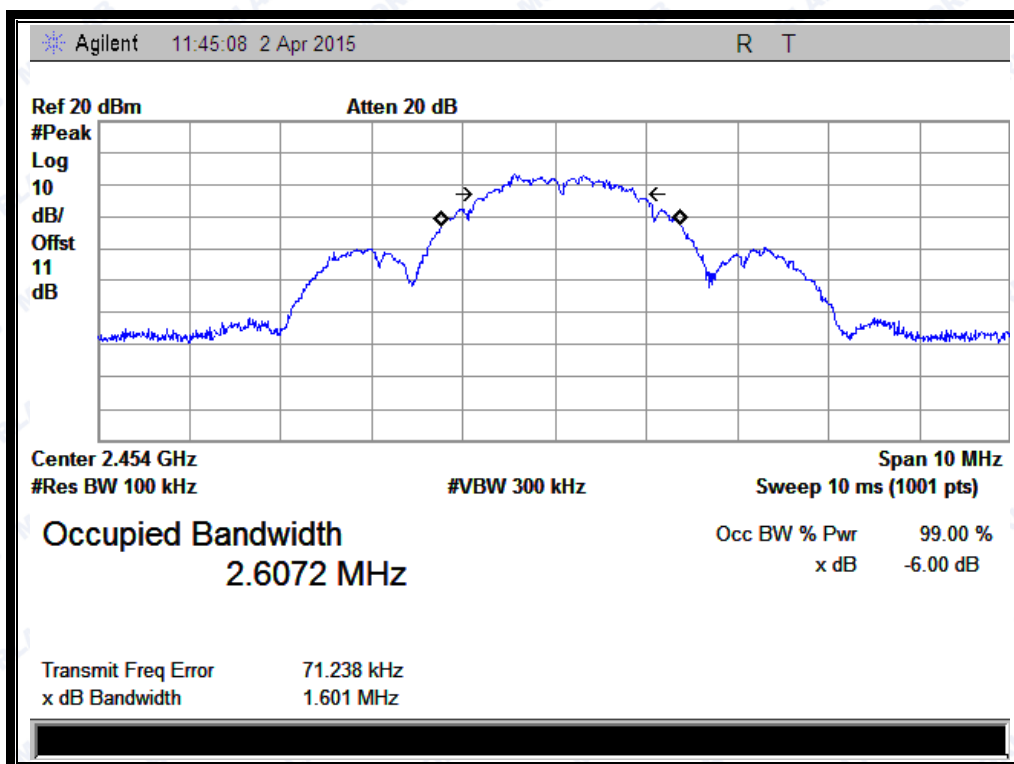
(Plot A: Channel 0: 2415MHz)



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(Plot B: Channel 19: 2434 MHz)



(Plot C: Channel 39: 2454MHz)

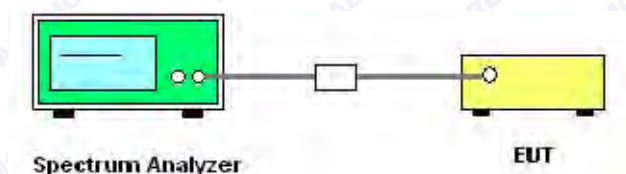
2.5 Conducted Spurious Emissions and Band Edge

2.5.1 Requirement

According to FCC 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

2.5.2 Test Description

A. Test Set:



The EUT which is powered by the battery, is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

B. Equipments List:

Please reference ANNEX A (1.4).

2.5.3 Test Result

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

A. Test Verdict:

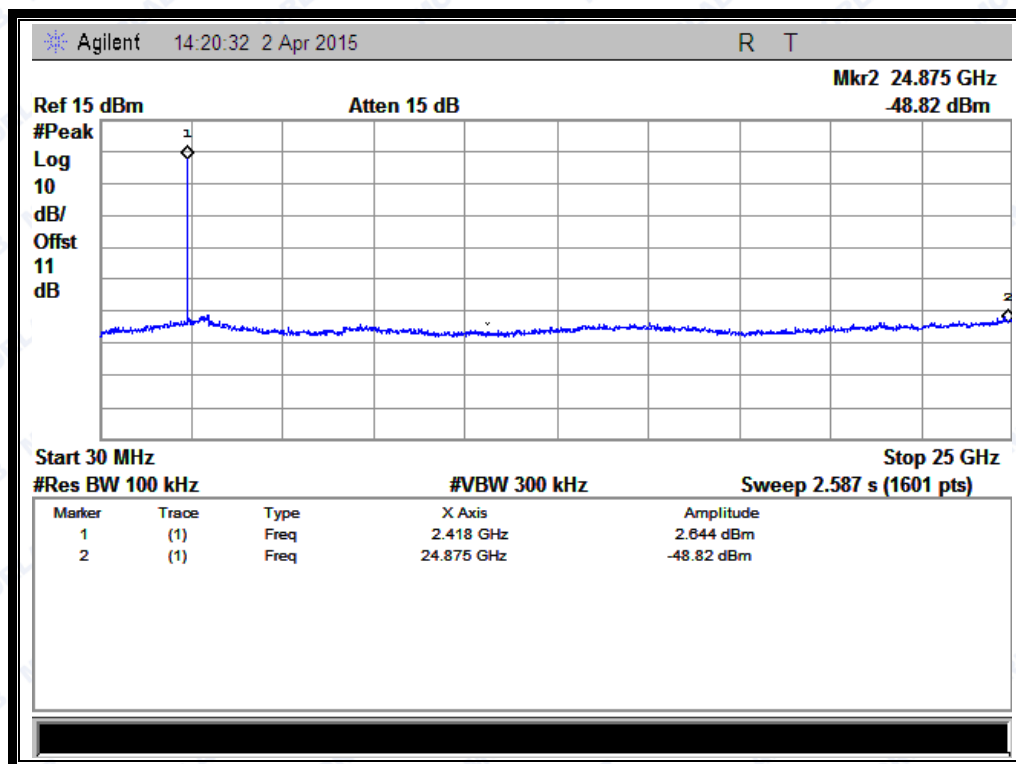
Channel	Frequency (MHz)	Measured Max. Out of Band Emission (dBm)	Refer to Plot	Limit (dBm)		Verdict
				Carrier Level	Calculated -20dBc Limit	
0	2415	-48.82	Plot A.1	2.644	-17.356	PASS
19	2434	-48.17	Plot B.1	2.451	-17.549	PASS
39	2454	-38.33	Plot C.1	7.211	-12.789	PASS

B. Test Plots:

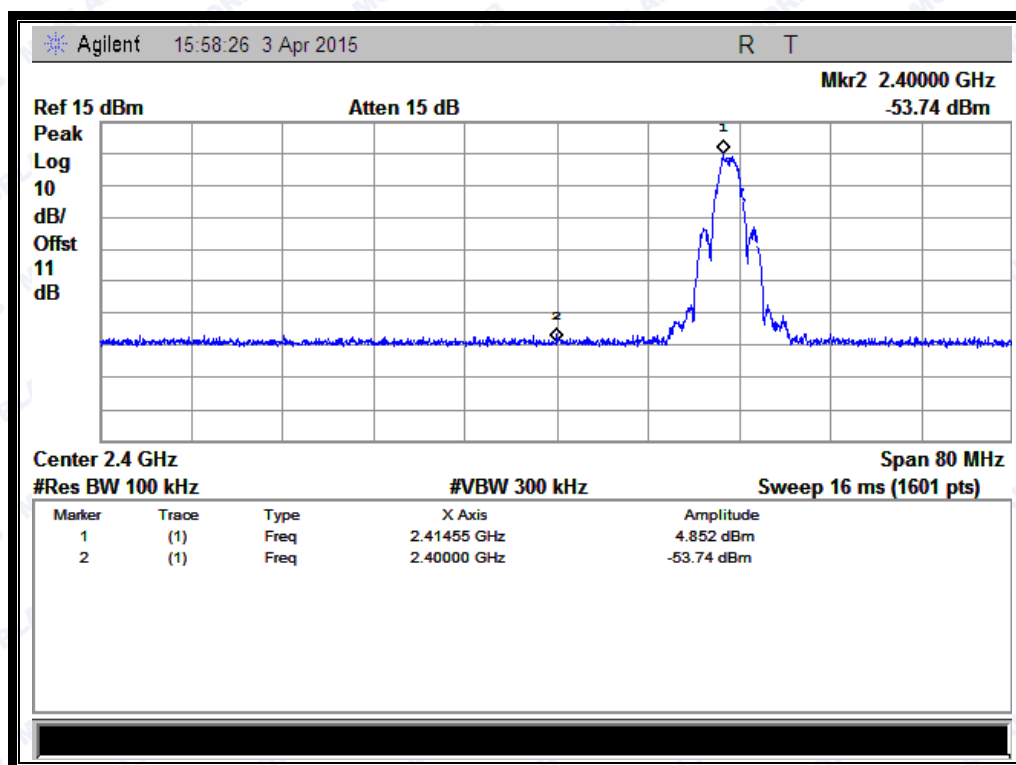
Note: the power of the Module transmitting frequency should be ignored.



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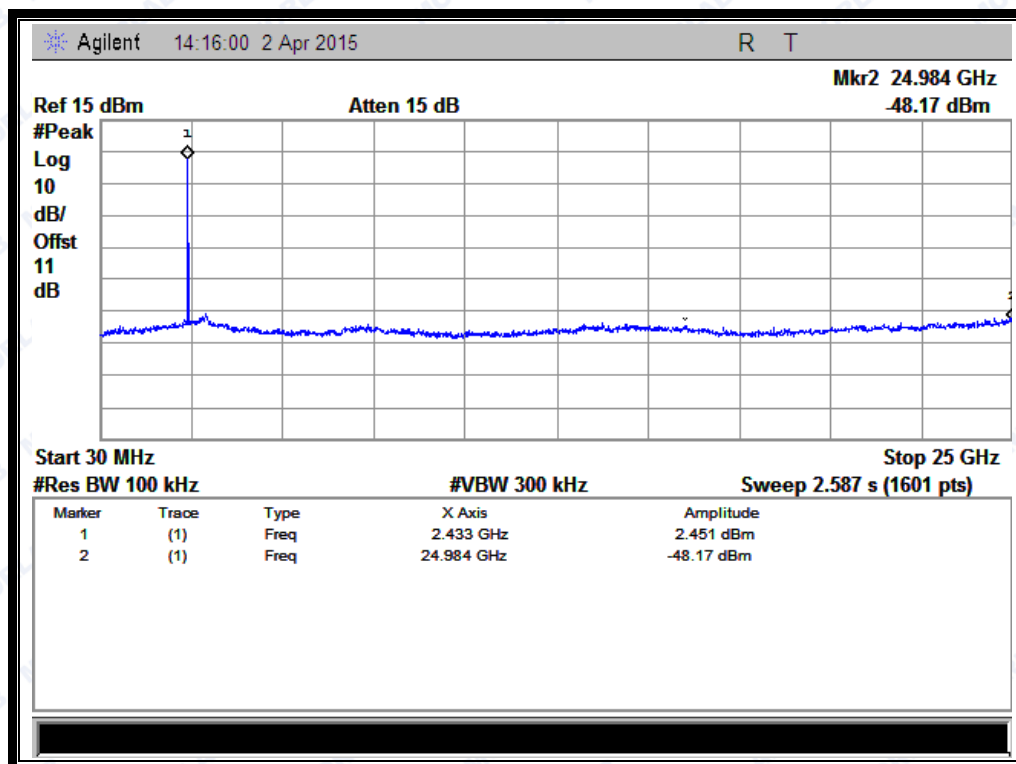
(Plot A.1: Channel = 0, 30MHz to 25GHz)



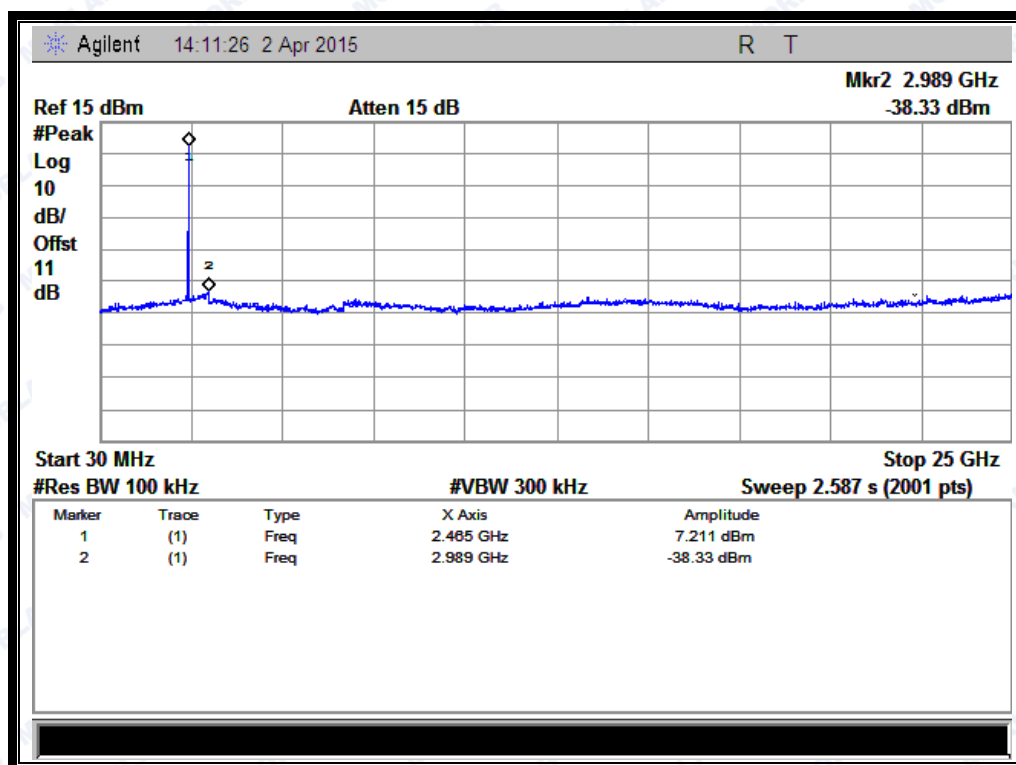
(Band Edge@ Channel = 0)



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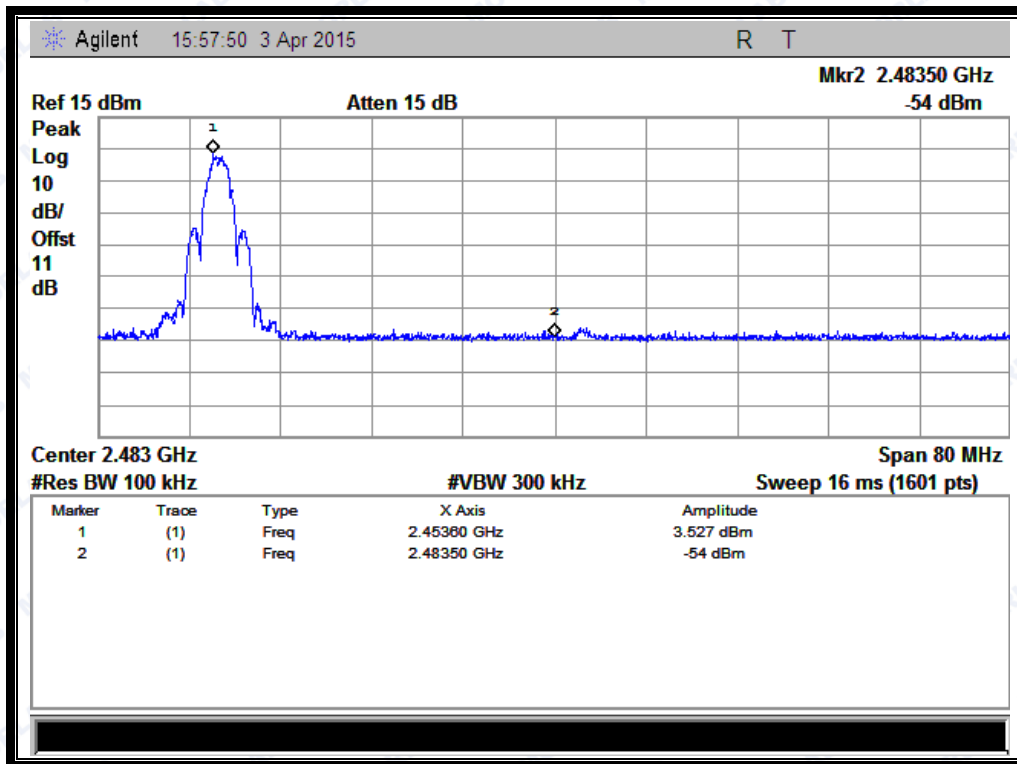
(Plot B.1: Channel = 19, 30MHz to 25GHz)



(Plot C.1: Channel = 39, 30MHz to 25GHz)



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(Band Edge@ Channel = 39)

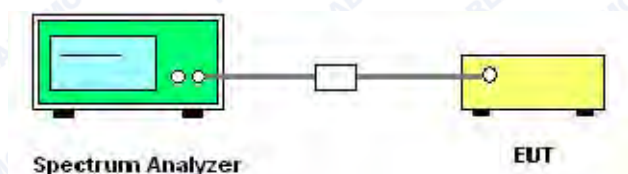
2.6 Power spectral density (PSD)

2.6.1 Requirement

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

2.6.2 Test Description

A. Test Set:



The EUT which is powered by the battery, is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

B. Equipments List:

Please reference ANNEX A (1.4).

2.6.3 Test Result

The lowest, middle and highest channels are tested.

A. Test Verdict:

Spectral power density (dBm/3kHz)							
Channel	Frequency (MHz)	Measured PSD (dBm/3kHz)	10log(1/x)	Average PSD (dBm/3kHz)	Refer to Plot	Limit (dBm/3kHz)	Verdict
0	2415	-2.878	10.52	7.642	Plot A	8	PASS
19	2434	-4.995	10.52	5.525	Plot B	8	PASS
39	2454	-5.653	10.52	4.867	Plot C	8	PASS
Measurement uncertainty: $\pm 1.3\text{dB}$							
Note: x refers to duty cycle.							

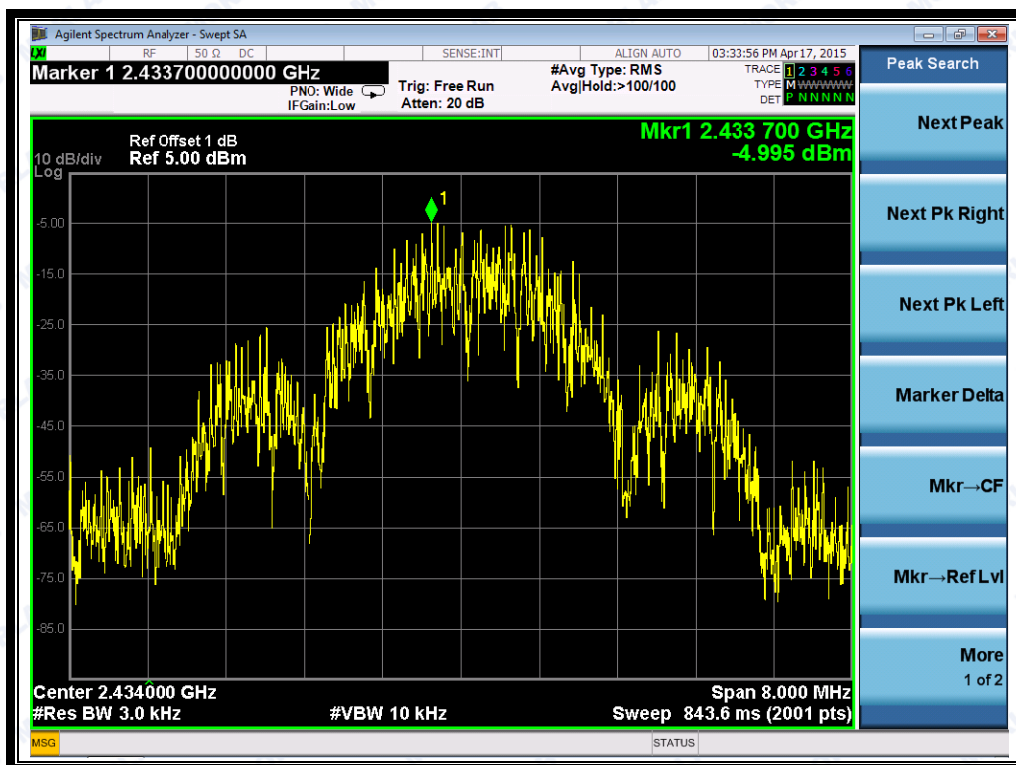
B. Test Plots:



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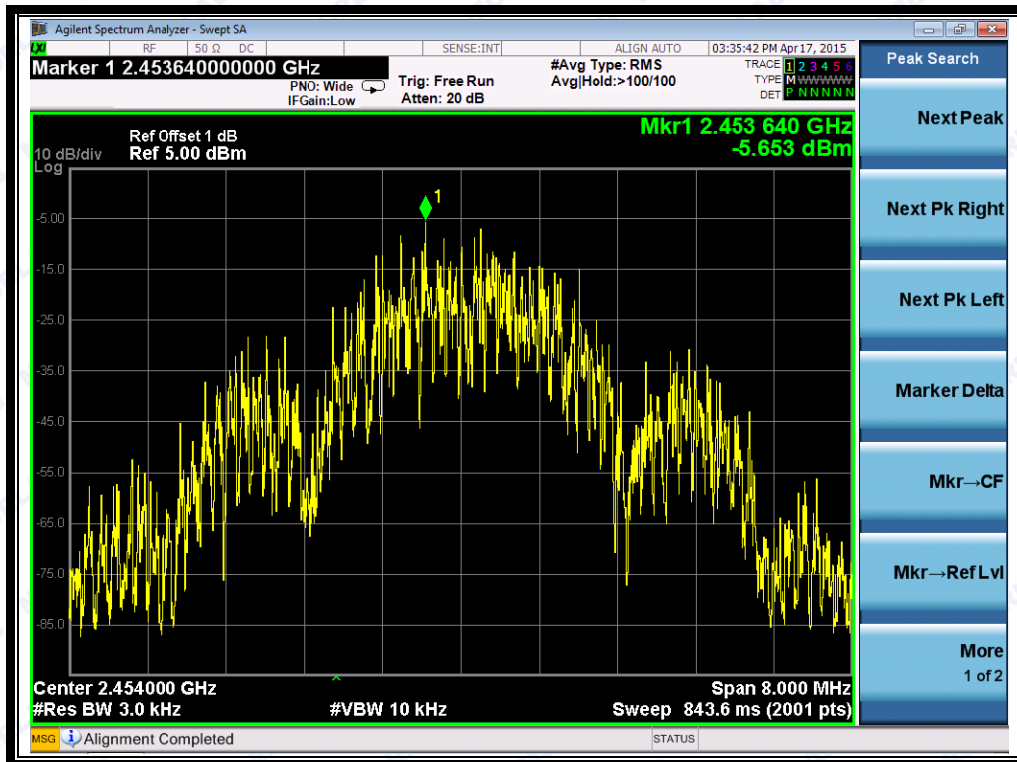
(Plot A: Channel = 0)



(Plot B: Channel = 19)



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(Plot C: Channel = 39)

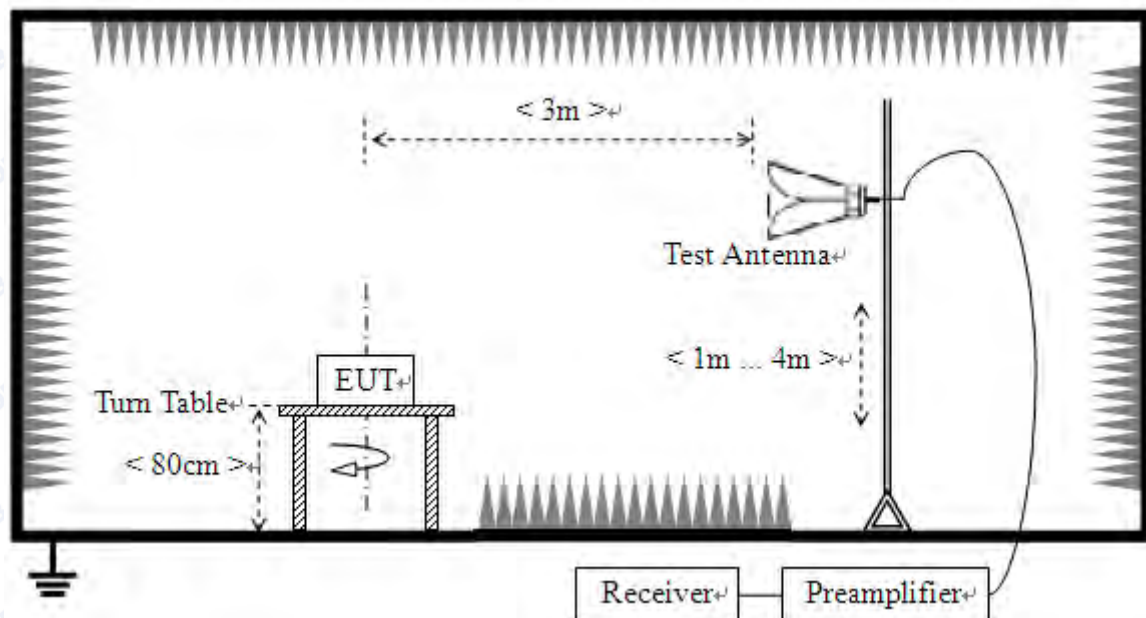
2.7 Restricted Frequency Bands

2.7.1 Requirement

According to FCC 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

2.7.2 Test Description

A. Test Setup



The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

B. Equipments List:

Please reference ANNEX A(1.4).



2.7.3 Test Result

The lowest and highest channels are tested to verify the Restricted Frequency Bands.

The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V/m]} = U_R + A_T + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

Note: 1. Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

2. All radiated emission tests were performed in X, Y, Z axis direction, and only the worst axis test condition was recorded in this test report.

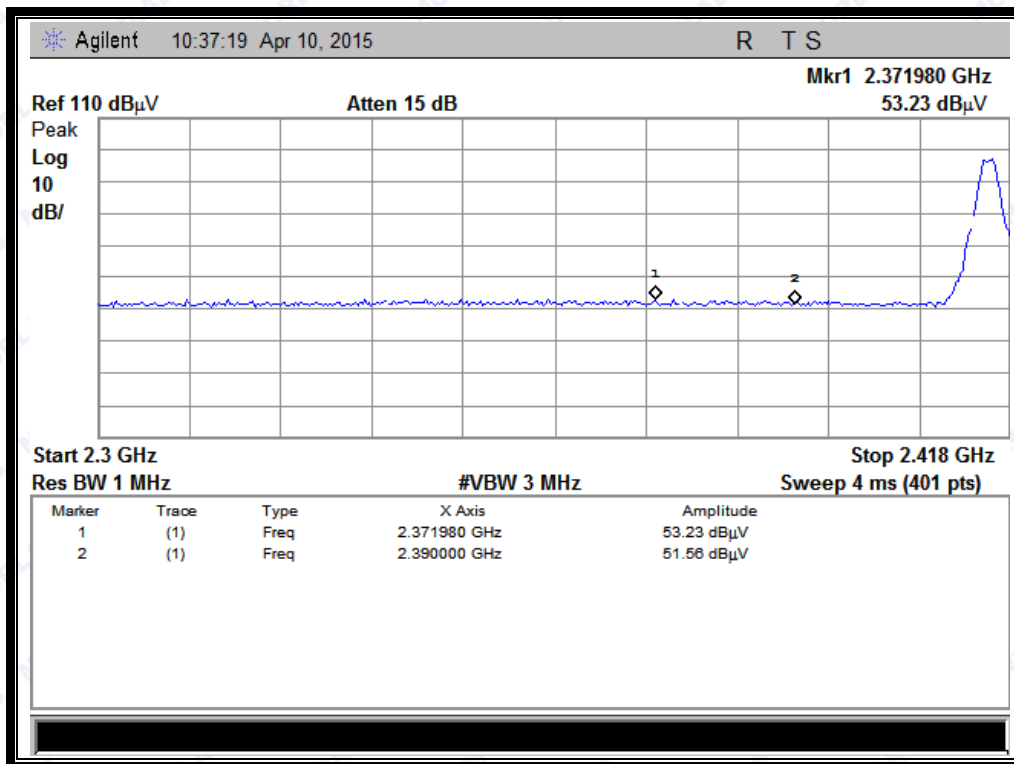
A. Test Verdict:

Channel	Frequency (MHz)	Detector	Receiver Reading U_R (dBuV)	A_T (dB)	A_{Factor} (dB@3m)	Max. Emission E (dB μ V/m)	Limit (dB μ V/m)	Verdict
		PK/ AV						
0	2371.98	PK	53.23	-33.63	32.56	52.16	74	Pass
0	2353.98	AV	41.70	-33.63	32.56	40.63	54	Pass
39	2496.53	PK	52.85	-33.18	32.5	52.17	74	Pass
39	2496.17	AV	41.56	-33.18	32.5	40.88	54	Pass

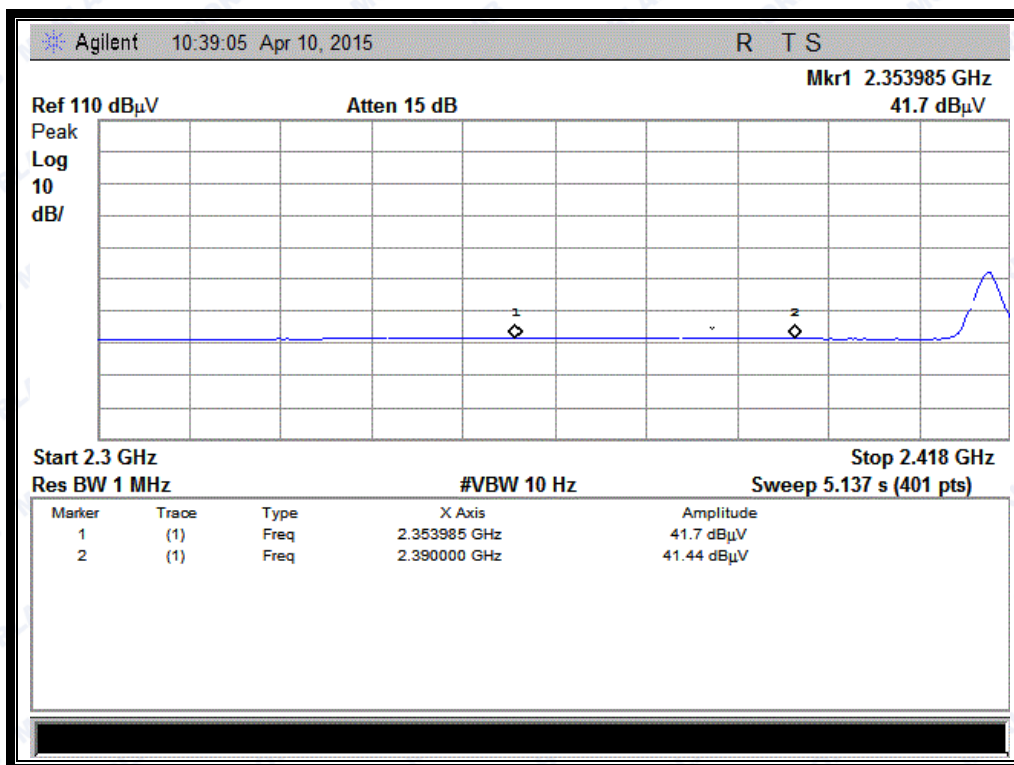
B. Test Plots:



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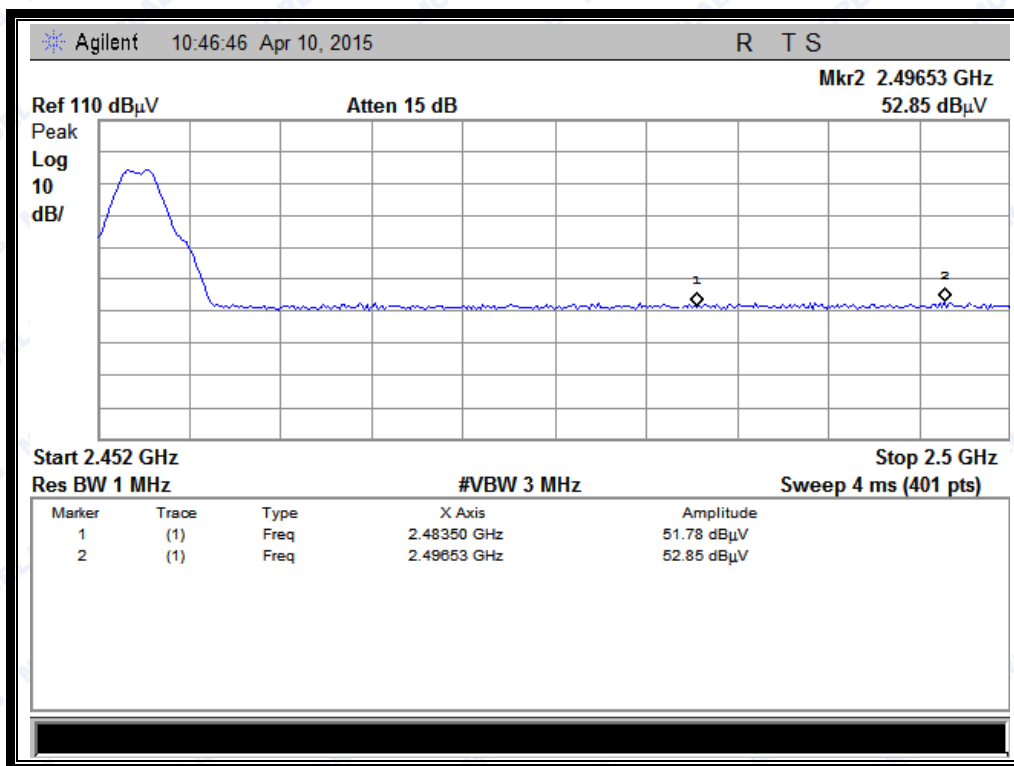
(Plot A1: Channel = 0 PEAK)



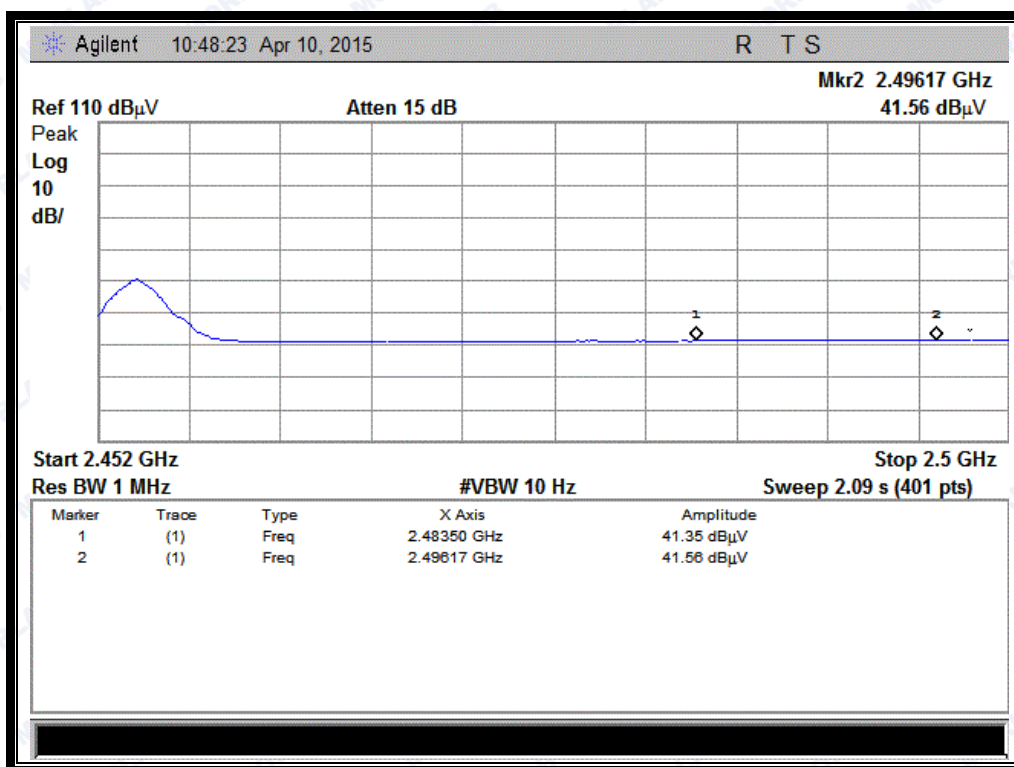
(Plot A2: Channel = 0 AVG)



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(Plot B1: Channel = 39 PEAK)



(Plot B2: Channel = 39 AVG)

2.8 Conducted Emission

2.8.1 Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

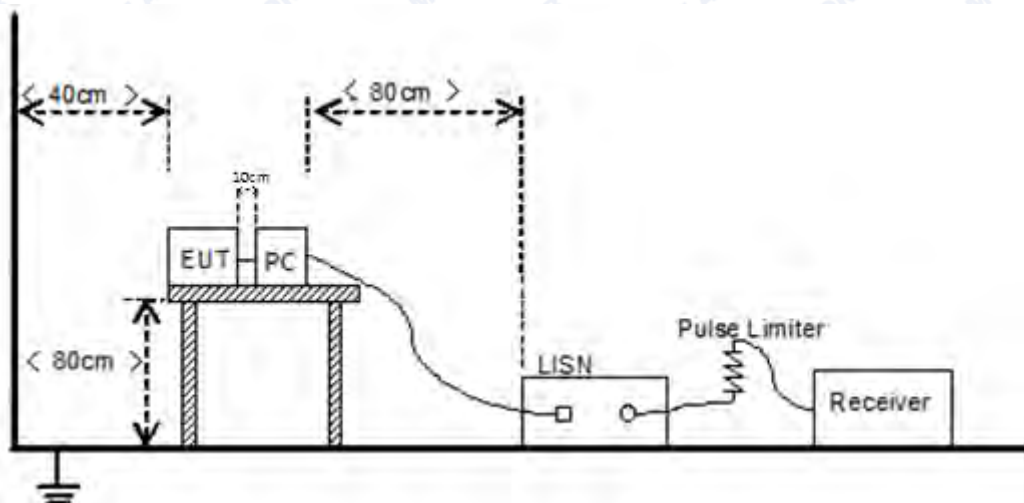
Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE: (a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.8.2 Test Description

A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.4:2009

Note: The power strip or extension cord has been investigated to make sure that the LISN integrity in maintained with respect to the impedance characteristics as prescribed in ANSI C63.10-2009 at Clause 4.3.

B. Equipments List:

Please reference ANNEX A(1.4).



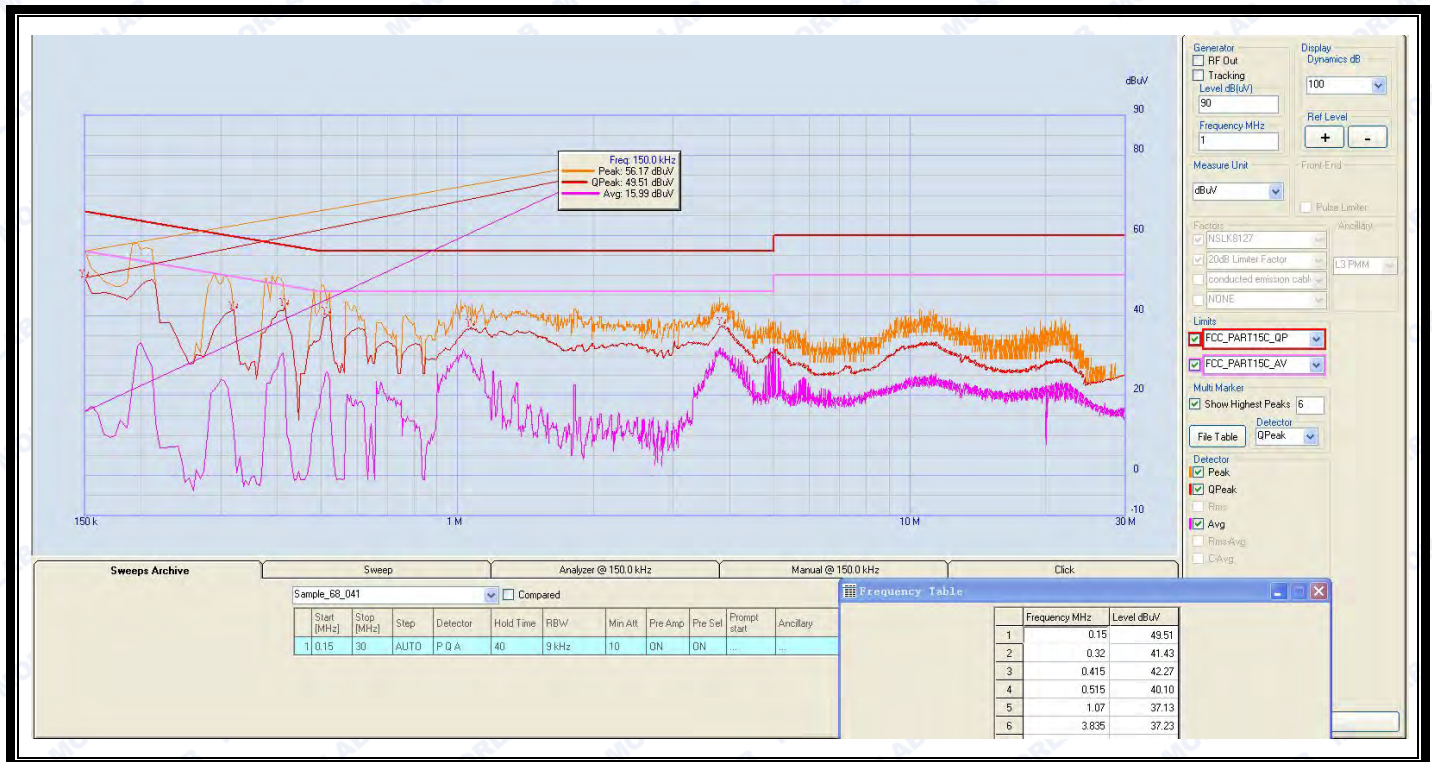
2.8.3 Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

A. Test setup:

The EUT configuration of the emission tests is EUT + Link.

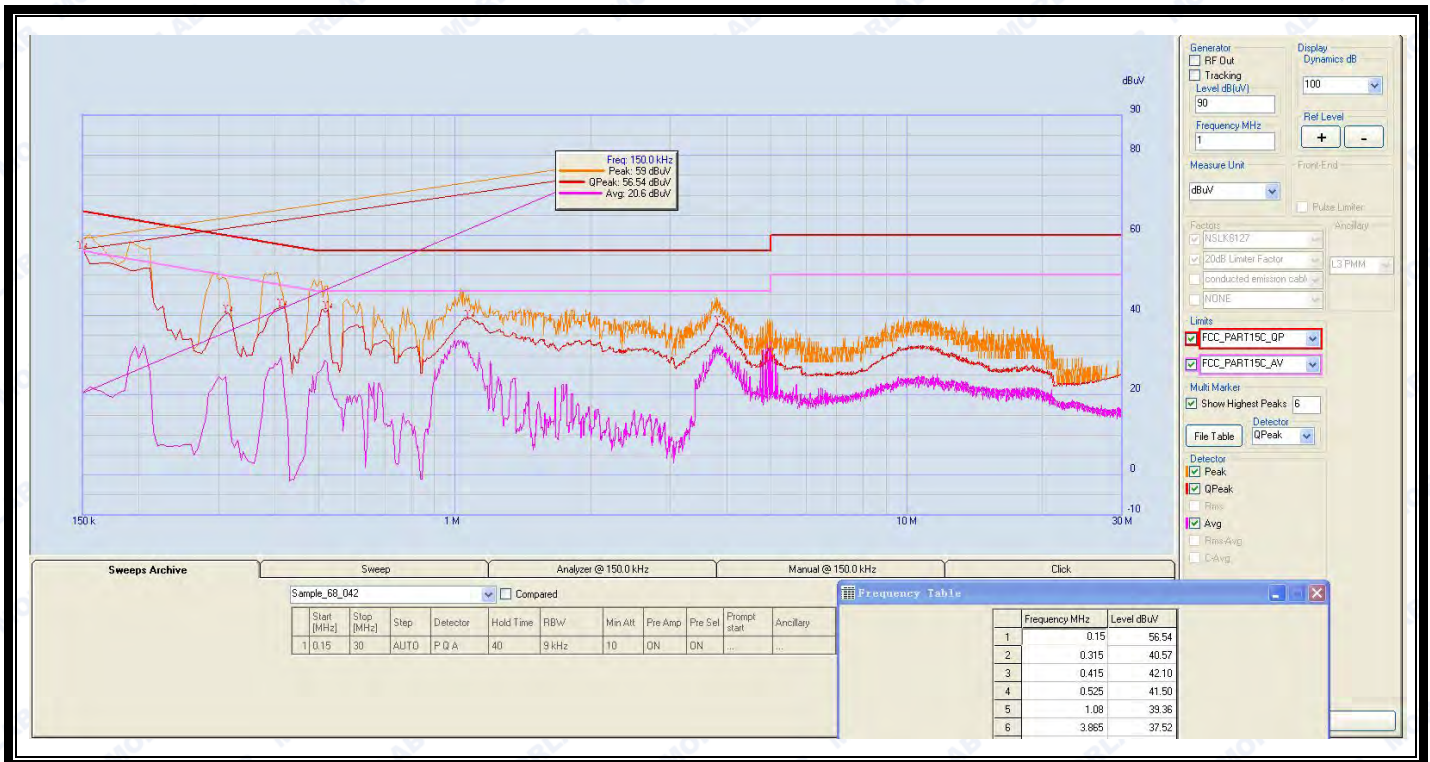
B. Test Plots:



(Plot A: L Phase)



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(Plot B: N Phase)



2.9 Radiated Emission

2.9.1 Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement 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:

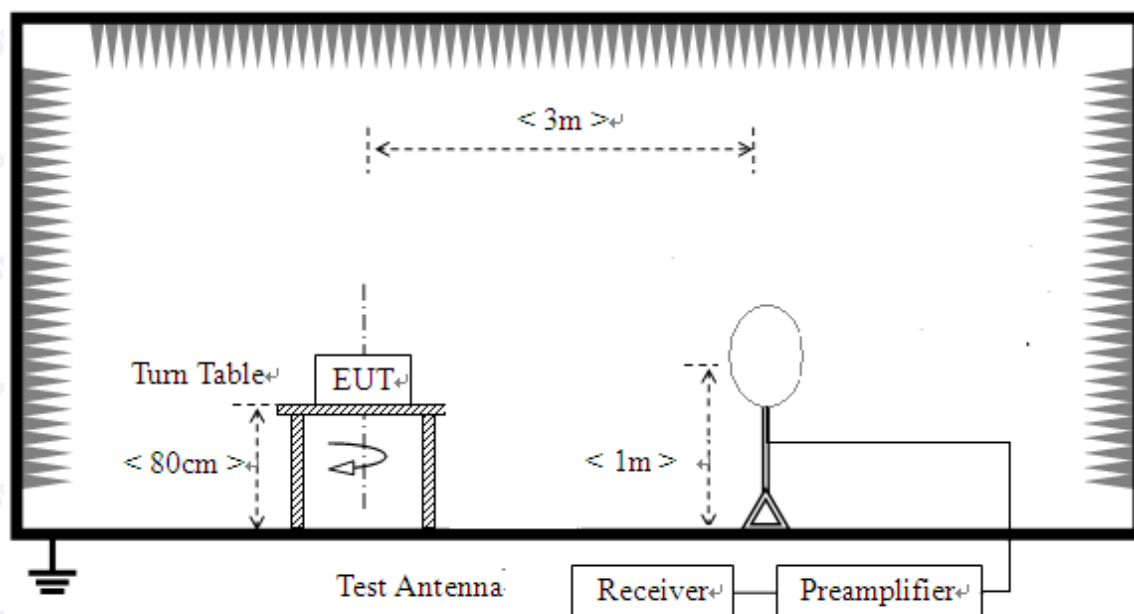
1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
2. For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)

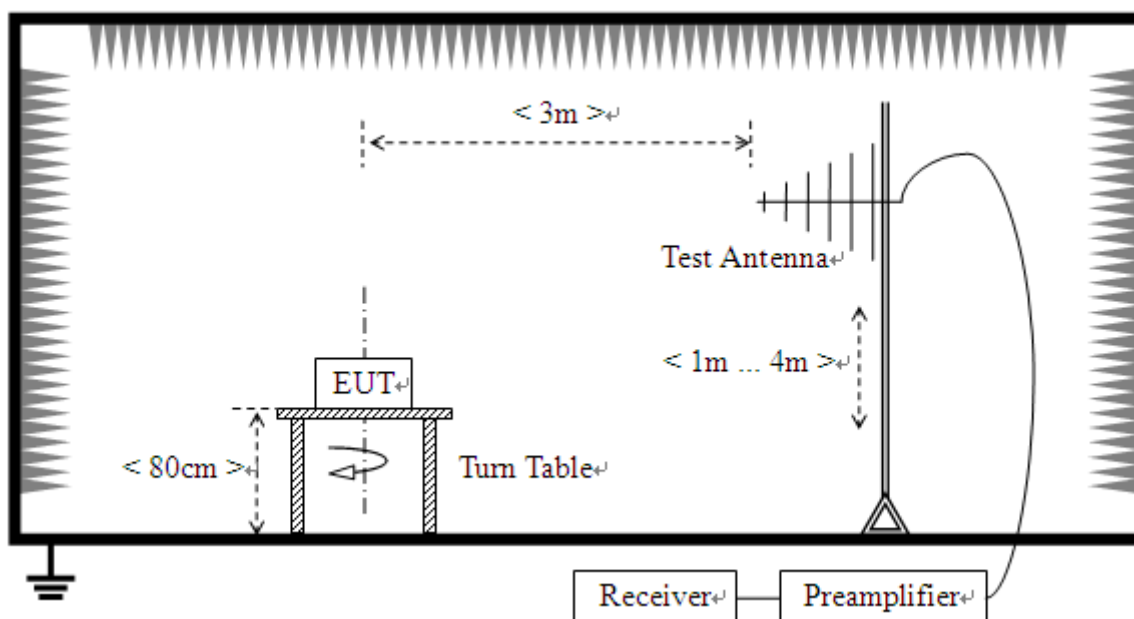
2.9.2 Test Description

A. Test Setup:

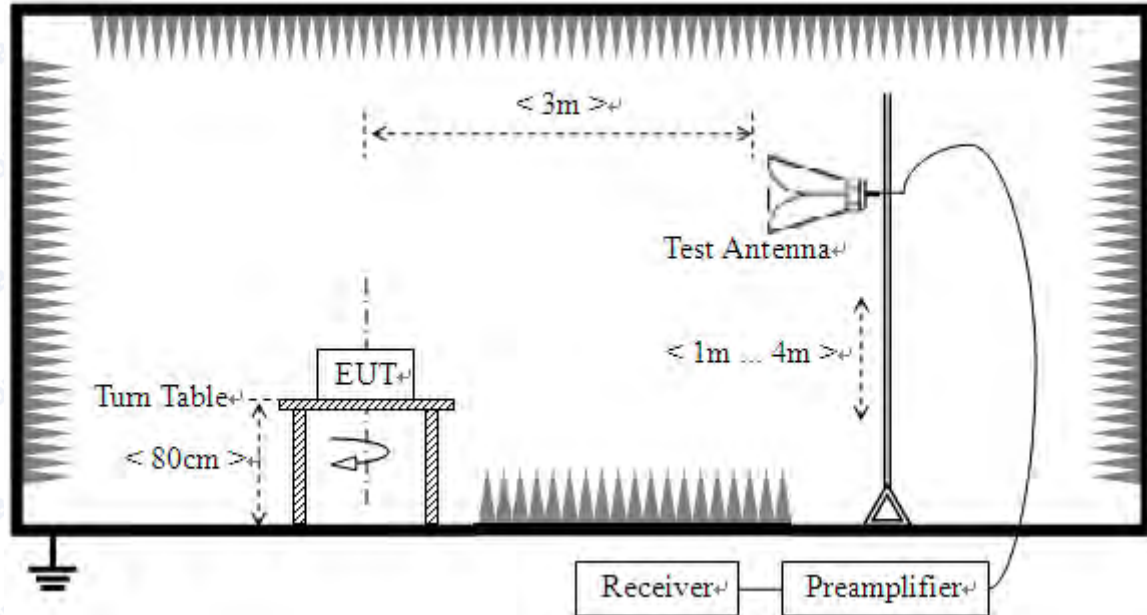
- 1) For radiated emissions from 9kHz to 30MHz



- 2) For radiated emissions from 30MHz to 1GHz



3) For radiated emissions above 1GHz



The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.4 (2009). The EUT was set-up on insulator 80cm above the Ground Plane. The set-up and test methods were according to ANSI C63.4.

The Module is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

- In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

B. Equipments List:

Please reference ANNEX A(1.4).



2.9.3 Test Result

According to ANSI C63.4 selection 4.2.2, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V/m]} = U_R + A_T + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$$

A_T : Total correction Factor except Antenna

U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

A_{Factor} : Antenna Factor at 3m

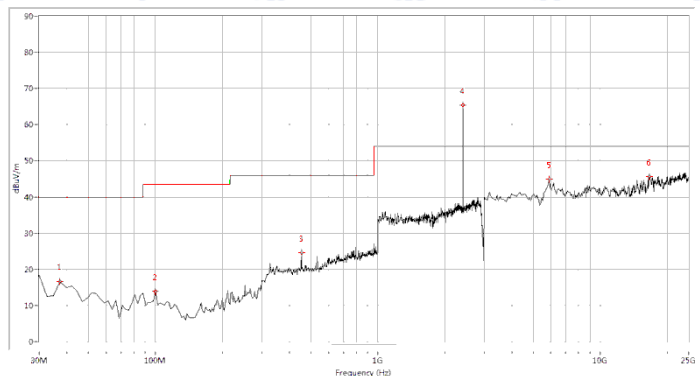
During the test, the total correction Factor A_T and A_{Factor} were built in test software.

Note: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

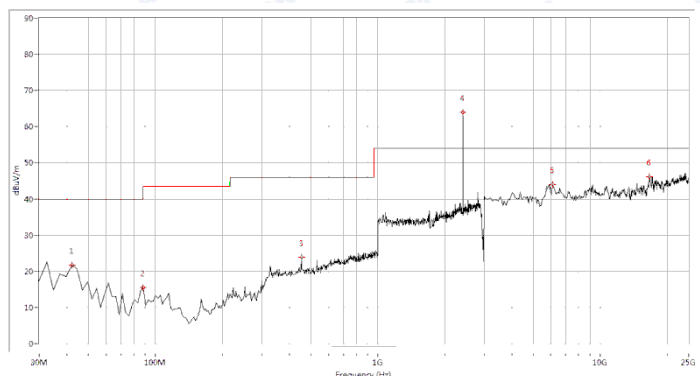
**A. Test Plots for the Whole Measurement Frequency Range:**

Plots for Channel = 0



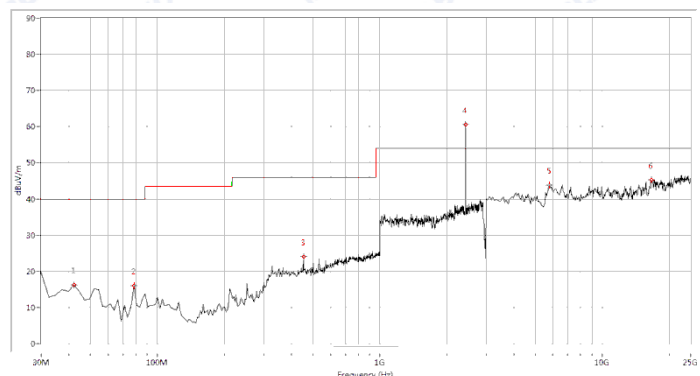
Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
37.257	16.50	N.A	N.A	N.A	40.0	N.A	Horizontal	PASS
100.150	13.84	N.A	N.A	N.A	43.5	N.A	Horizontal	PASS
453.317	24.55	N.A	N.A	N.A	46.0	N.A	Horizontal	PASS
2415.000	65.42	N.A	N.A	N.A	N.A	N.A	Horizontal	N.A
5907.731	44.83	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
16605.985	45.60	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



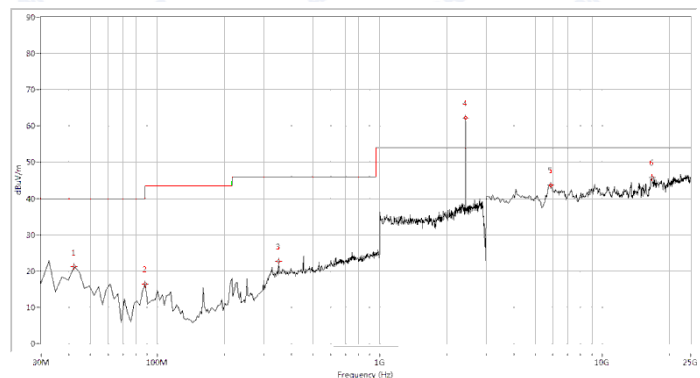
Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
42.095	21.67	N.A	N.A	N.A	40.0	N.A	Vertical	PASS
88.055	15.54	N.A	N.A	N.A	43.5	N.A	Vertical	PASS
453.317	23.90	N.A	N.A	N.A	46.0	N.A	Vertical	PASS
2415.000	63.94	N.A	N.A	N.A	N.A	N.A	Vertical	N.A
6127.182	44.02	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
16660.848	46.08	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 19

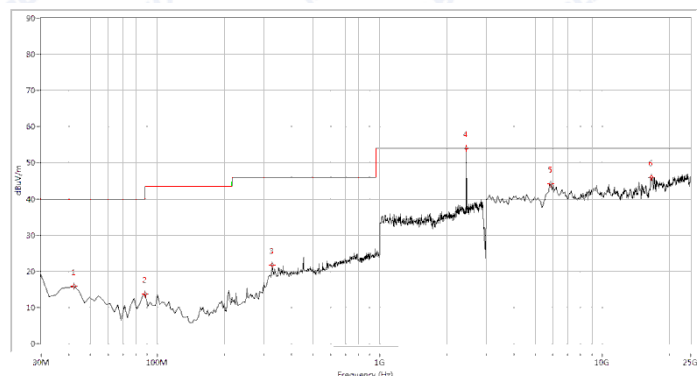
Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
42.095	16.15	N.A	N.A	N.A	40.0	N.A	Horizontal	PASS
78.379	16.08	N.A	N.A	N.A	40.0	N.A	Horizontal	PASS
453.317	24.04	N.A	N.A	N.A	46.0	N.A	Horizontal	PASS
2434.000	60.63	N.A	N.A	N.A	N.A	N.A	Horizontal	N.A
5798.005	43.83	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
16605.985	45.24	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



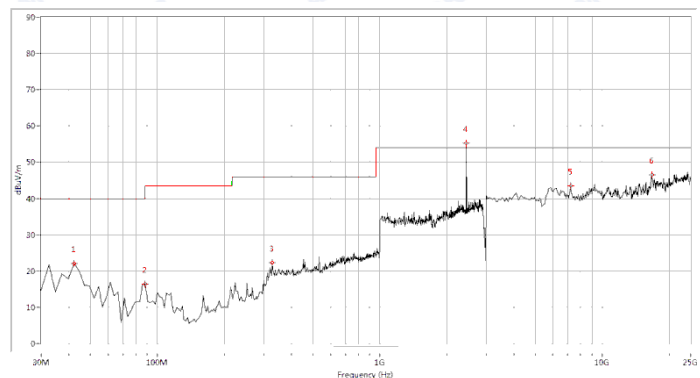
Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
42.095	21.23	N.A	N.A	N.A	40.0	N.A	Vertical	PASS
88.055	16.33	N.A	N.A	N.A	43.5	N.A	Vertical	PASS
349.302	22.72	N.A	N.A	N.A	46.0	N.A	Vertical	PASS
2434.000	62.29	N.A	N.A	N.A	N.A	N.A	Vertical	N.A
5852.868	43.59	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
16715.711	45.88	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)

Plot for Channel = 39

Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
42.095	15.89	N.A	N.A	N.A	40.0	N.A	Horizontal	PASS
88.055	13.73	N.A	N.A	N.A	43.5	N.A	Horizontal	PASS
327.531	21.70	N.A	N.A	N.A	46.0	N.A	Horizontal	PASS
2454.000	53.91	N.A	N.A	N.A	N.A	N.A	Horizontal	N.A
5852.868	44.24	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS
16605.985	45.97	N.A	N.A	74.0	N.A	54.0	Horizontal	PASS

(Antenna Horizontal, 30MHz to 25GHz)



Fre. (MHz)	Pk	QP	AV	Limit-PK	Limit-QP	Limit-AV	Antenna	Verdict
42.095	22.04	N.A	N.A	N.A	40.0	N.A	Vertical	PASS
88.055	16.41	N.A	N.A	N.A	43.5	N.A	Vertical	PASS
327.531	22.22	N.A	N.A	N.A	46.0	N.A	Vertical	PASS
2454.000	55.19	N.A	N.A	N.A	N.A	N.A	Vertical	N.A
7224.439	43.56	N.A	N.A	74.0	N.A	54.0	Vertical	PASS
16715.711	46.44	N.A	N.A	74.0	N.A	54.0	Vertical	PASS

(Antenna Vertical, 30MHz to 25GHz)



2.10 RF exposure evaluation

2.10.1 Requirement and test result

According to § 1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of Commission's guideline.

According to § 2.1093(b), the Thumb Controller is a portable device. And it only incorporates a transmitter, so standalone SAR evaluation is required for the Thumb Controller and simultaneous SAR is not required.

Standalone transmission SAR evaluation

According to KDB 447498 section 4.3.1, the 1-g SAR test exclusion thresholds at test separation Distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$

The maximum tune-up limit power is **7.08mW @ 2.415GHz**

When the Thumb Controller is operated, **5mm** was used as the most conservative minimum test separation distance,

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] = 2.2 \leq 3.0$$

2.10.2 Conclusion

SAR Evaluation is excluded based on the maximum tune-up power.



ANNEX A GENERAL INFORMATION

1.1 Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Department:	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China
Responsible Test Lab Manager:	Mr. Su Feng
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

1.2 Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, Guangdong Province, P. R. China

1.3 Test Equipments Utilized

1.3.1 Conducted Test Equipments

Conducted Test Equipment						
No.	Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
1	Spectrum Analyzer	MY45101810	E4407B	Agilent	2015.02.26	2016.02.25
2	Power Splitter	NW521	1506A	Weinschel	2015.02.26	2016.02.25
3	Attenuator 1	(n.a.)	10dB	Resnet	2015.02.26	2016.02.25
4	Attenuator 2	(n.a.)	3dB	Resnet	2015.02.26	2016.02.25
5	USB Wideband Power Sensor	MY52280010	U2021XA	Agilent	2015.02.26	2016.02.25
6	EXA Signal Analyzer	MY51440152	N9010A	Agilent	2015.02.26	2016.02.25
7	RF cable	CB01	RF01	Morlab	N/A	N/A
8	Coaxial cable	CB02	RF02	Morlab	N/A	N/A
9	SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A



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1.3.2 Conducted Emission Test Equipments

Conducted Emission Test Equipments

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal. Due
1	Receiver	US44210471	E7405A	Agilent	2015.02.26	2016.02.25
2	LISN	812744	NSLK 8127	Schwarzbeck	2015.02.26	2016.02.25
3	Service Supplier	100448	CMU200	R&S	2015.02.26	2016.02.25
4	Pulse Limiter (20dB)	9391	VTSD 9561-D	Schwarzbeck	2015.02.26	2016.02.25
5	Coaxial cable(BNC)	CB01	EMC01	Morlab	N/A	N/A

1.3.3 Radiated Test Equipments

Radiated Test Equipments

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal. Date	Cal.Due Date
1	Receiver	US44210471	E7405A	Agilent	2015.02.26	2016.02.25
2	Test Antenna - Bi-Log	9163-274	9m*6m*6m	Albatross	2015.02.26	2016.02.25
3	Test Antenna - Horn	9120D-963	VULB 9163	Schwarzbeck	2015.02.26	2016.02.25
4	Test Antenna - Horn	71688	BBHA 9120D	Schwarzbeck	2015.02.26	2016.02.25
5	Test Antenna - Loop	1519-022	HL050S7	R&S	2015.02.26	2016.02.25
6	Reject Filter	(n.a.)	BRM50702	Micro-Tronics	2015.02.26	2016.02.25
7	Coaxial cable (N male)	CB02	EMC02	Morlab	N/A	N/A
8	Coaxial cable (N male)	CB03	EMC03	Morlab	N/A	N/A

1.3.4 Climate Chamber

Climate Chamber

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Climate Chamber	2004012	HL4003T	Yinhe	2015.02.26	2016.02.25

1.3.5 Vibration Table

Vibration Table

No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Vibration Table	N/A	ACT2000- S015L	CMI-COM	2015.02.26	2016.02.25



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1.3.6 Anechoic Chamber

Anechoic Chamber						
No.	Equipment Name	Serial No.	Type	Manufacturer	Cal.Date	Cal.Due Date
1	Anechoic Chamber	N/A	9m*6m*6m	Albatross	2015.02.26	2016.02.25

***** END OF REPORT *****