FCC RF Test Report

APPLICANT	**:**	**Lenovo(Shanghai) Electronics Technology Co., Ltd.**
EQUIPMENT	**:**	**Portable Tablet Computer**
BRAND NAME	**:**	**Lenovo**
MODEL NAME	**:**	**Lenovo TB-X505L**
FCC ID	**:**	**O57TBX505L**
STANDARD	**:**	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	**:**	**(DSS) Spread Spectrum Transmitter**

The product was received on Jan. 25, 2019 and testing was completed on Apr. 18, 2019. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

James Huang

NVLAP TESTING
NVLAP LAB CODE 600155-0

Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR912504-01A	Rev. 01	Initial issue of report	Apr. 29, 2019

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(1)	Number of Channels	≥ 15Chs	Pass	1
-	15.247(a)(1)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	1
-	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec in 31.6sec period	Pass	1
-	15.247(a)(1)	20dB Bandwidth	NA	Pass	1
-	-	99% Bandwidth	-	Pass	1
-	15.247(b)(1)	Peak Output Power	≤ 125 mW	Pass	1
-	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	1
-	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	1
3.1	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 19.37 dB at 39.700 MHz
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 10.04 dB at 0.497 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-
Remark 1: Test items are performed on original report which can be referred to Sporton report number FR912606A.					

1 General Description

1.1 Applicant

Lenovo(Shanghai) Electronics Technology Co., Ltd.
NO.68 BUILDING, 199 FENJU RD, Pilot Free Trade Zone, 200131, China

1.2 Manufacturer

Lenovo PC HK Limited
23/F, Lincoln House, Taikoo Place,979 King's Road, Quarry Bay, Hong Kong

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Portable Tablet Computer
Brand Name	Lenovo
Model Name	Lenovo TB-X505L
FCC ID	O57TBX505L
EUT supports Radios application	GPRS/EGPRS/WCDMA/HSPA/ DC-HSDPA/HSPA+(16QAM uplink is not supported)/ LTE WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR / EDR / LE FM Receiver/GNSS
IMEI Code	Conduction: 865781040011057 Radiation:865781040012733
HW Version	Lenovo Tablet TB-X505L
SW Version	TB-X505L_RF01_190118
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are seven types of EUT, the differences of them described on operate description submitted separately. According to the difference, we choose the sample 1 to full test.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Antenna Type / Gain	FPC Antenna typewith gain 1.30 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : π /4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Re-use of Measured Data

1.6.1 Introduction Section

This application re-uses data collected on a similar device. The subject device of this application (Model: Lenovo TB-X505L, FCC ID: O57TBX505L) is electrically identical to the reference device (Model: Lenovo TB-X505F, FCC ID: O57TBX505F) for the portions of the circuitry corresponding to the data being re-used, as treated by KDB Publication 484596 D01.

1.6.2 Difference Section

For details concerning the similarity with respect to component placement, mechanical/electrical design etc., please refer to the Product Equality Declaration.

The re-used RF data includes the following bands provided in Appendix E (Sporton RF Report No. FR912606A for the reference device Model: Lenovo TB-X505F, FCC ID: O57TBX505F).

1.6.3 Reference detail Section:

Equipment Class	Reference FCC ID	Folder Test	Report Title/Section
DSS (BT)	O57TBX505F	Part15C(FR912606A)	All sections applicable except AC Conducted Emission and RSE
DTS (BLE)	O57TBX505F	Part15C(FR912606B)	All sections applicable except AC Conducted Emission and RSE
DTS (WLAN)	O57TBX505F	Part15C(FR91260C)	All sections applicable except AC Conducted Emission and RSE

1.6.4 Spot Check Verification Data Section

In order to confirm hardware similarity of the subject device with the reference device, spot check measurements were performed on the subject device for the following test items, the test result were consistent with FCC ID: O57TBX505F.

Assertions concerning the similarity of these devices are based on representations by the applicant. The applicant accepts full responsibility for the validity of the similarity claim, and for the determination that verification test data are sufficient to support it.

Test Item	Mode	O57TBX505F Worst Result	O57TBX505L Worst Result	Difference (dB)
Peak Conducted Power (dBm)	Bluetooth BR(1Mbps)	9.45	9.18	0.27
	Bluetooth EDR (2Mbps)	9.54	9.31	0.23
	Bluetooth EDR (3Mbps)	9.78	9.55	0.23

1.7 Testing Location

Sporton International (Kunshan) Inc is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0).

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China TEL : 86-512-57900158 FAX : 86-512-57900958		
Test Site No.	**Sporton Site No.**	**FCC designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH05-KS	CN5013	630927

1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r01
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

1.9 Specification of Accessory

Specification of Accessory				
AC Adapter 1(US)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-41
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(EU)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-42
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(UK)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-43
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(IN)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-44
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(AU)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-45
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(AR)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-46
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 1(KR)	**Brand Name**	Lenovo (Salom)	**Model Name**	SC-49
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 2(US)	**Brand Name**	Lenovo (Acbel)	**Model Name**	SC-41
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 2(EU)	**Brand Name**	Lenovo (Acbel)	**Model Name**	SC-42
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 2(UK)	**Brand Name**	Lenovo (Acbel)	**Model Name**	SC-43
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 2(AU)	**Brand Name**	Lenovo (Acbel)	**Model Name**	SC-45
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
AC Adapter 2(AR)	**Brand Name**	Lenovo (Acbel)	**Model Name**	SC-46
	Power Rating	I/P: 100-240 Vac, 0.3A, O/P: 5Vdc,2A		
Battery 1	**Brand Name**	Lenovo (NVT+ATL)	**Model Name**	L18D1P32
	Power Rating	3.85Vdc,4850mAh	**Type**	Li-ion, Polymer
Battery 2	**Brand Name**	Lenovo (Suwnoda + Liwnon)	**Model Name**	L18D1P32
	Power Rating	3.85Vdc,4850mAh	**Type**	Li-ion, Polymer
USB Cable 1	**Brand Name**	Lenovo (LiQI)	**Model Name**	Lqc0350083
	Signal Line Type	0.7 meter, shielded cable, without ferrite core		
USB Cable 2	**Brand Name**	Lenovo (JIEYE)	**Model Name**	JY-C003-292
	Signal Line Type	0.7 meter, shielded cable, without ferrite core		

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	27	2429	54	2456
	1	2403	28	2430	55	2457
	2	2404	29	2431	56	2458
	3	2405	30	2432	57	2459
	4	2406	31	2433	58	2460
	5	2407	32	2434	59	2461
	6	2408	33	2435	60	2462
	7	2409	34	2436	61	2463
	8	2410	35	2437	62	2464
	9	2411	36	2438	63	2465
	10	2412	37	2439	64	2466
	11	2413	38	2440	65	2467
	12	2414	39	2441	66	2468
	13	2415	40	2442	67	2469
	14	2416	41	2443	68	2470
	15	2417	42	2444	69	2471
	16	2418	43	2445	70	2472
	17	2419	44	2446	71	2473
	18	2420	45	2447	72	2474
	19	2421	46	2448	73	2475
	20	2422	47	2449	74	2476
	21	2423	48	2450	75	2477
	22	2424	49	2451	76	2478
	23	2425	50	2452	77	2479
	24	2426	51	2453	78	2480
	25	2427	52	2454	-	-
	26	2428	53	2455	-	-

2.2 Test Mode

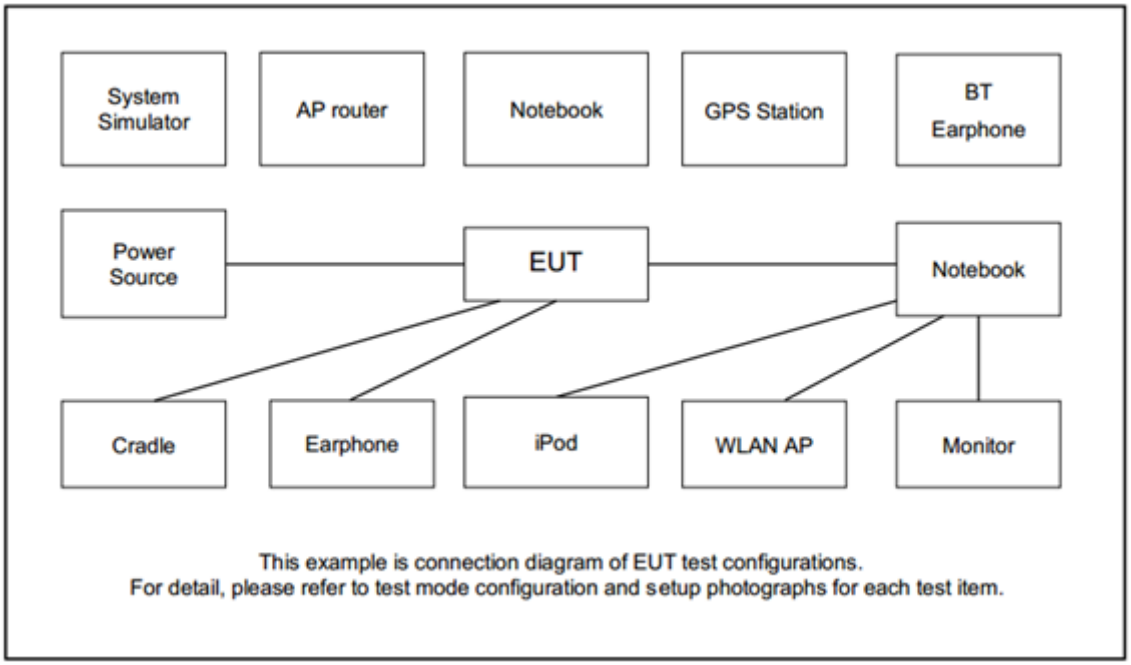
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report, and the worst mode of radiated spurious emissions is Bluetooth 3Mbps mode, and recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Radiated Test Cases	**Bluetooth EDR 3Mbps 8-DPSK**
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz
AC Conducted Emission	Mode 1 : GSM 850 Idle + Bluetooth Link + WLAN Link (2.4G) + USB Cable 1(Charging from Adapter 1) + Earphone
Remark: 1. For radiated test cases, the worst mode data rate 3Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and no other significantly frequencies found in conducted spurious emission. 2. For Radiated Test Cases, The tests were performed with Adapter 1, Earphone and USB Cable 1.	

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded,1.8m
2.	WLAN AP	D-link	DIR-855	KA2DIR855A2	N/A	Unshielded,1.8m
3.	Notebook	Lenovo	G480	N/A	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
4.	Earphone	Lenovo	P121	N/A	Unshielded,1.2m	N/A
5.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
6.	BT Base Station	R&S	CBT	N/A	N/A	Unshielded,1.8m

2.5 EUT Operation Test Setup

For Bluetooth function, the engineering test program was provided and enabled to make EUT connect with Bluetooth base station to continuous transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
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

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

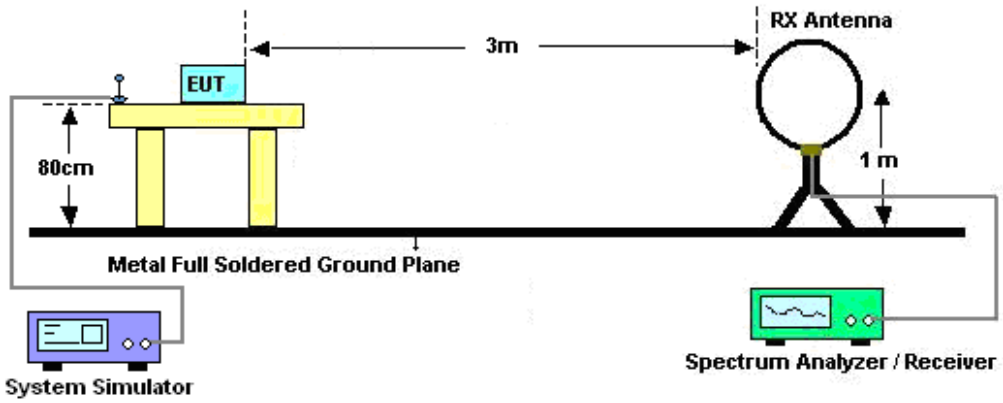
3.1.3 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

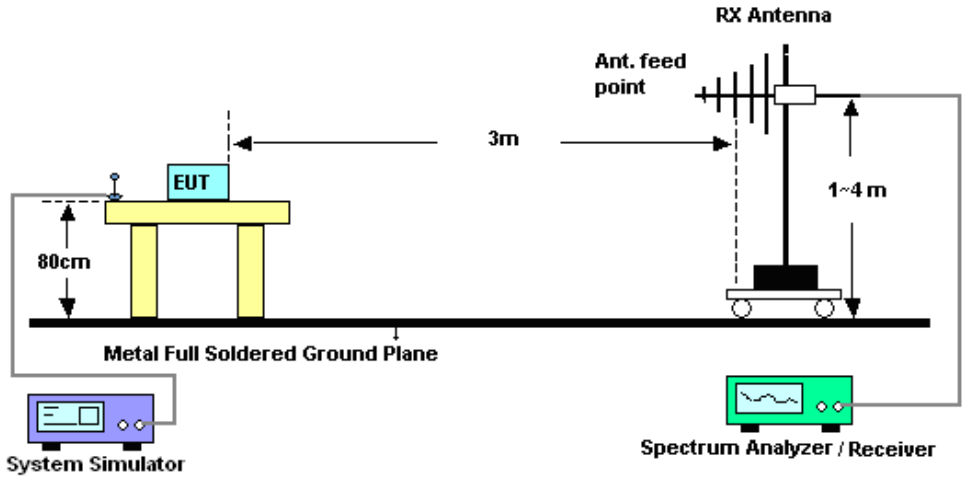
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

3.1.4 Test Setup

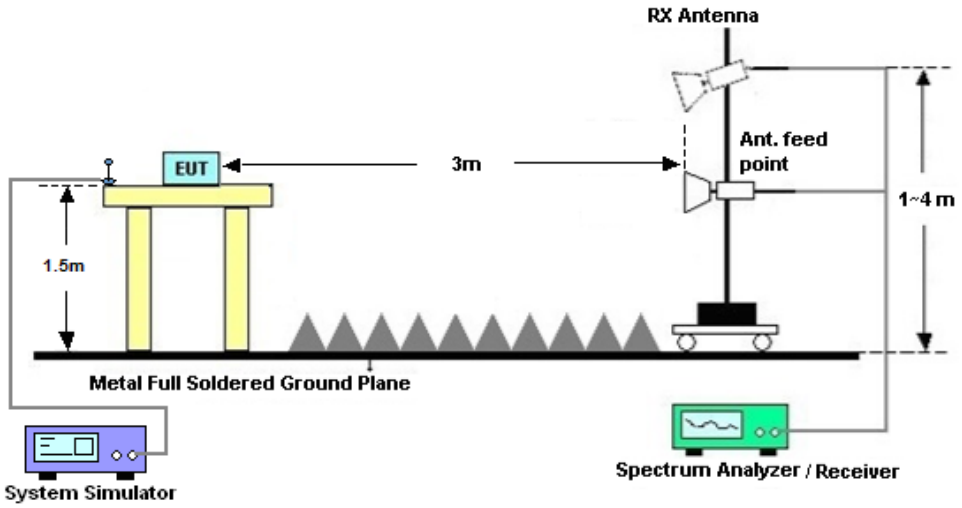
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.1.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix B.

3.1.8 Duty cycle correction factor for average measurement

Please refer to Appendix C.

3.2 AC Conducted Emission Measurement

3.2.1 Limit of AC Conducted Emission

For equipment 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 or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

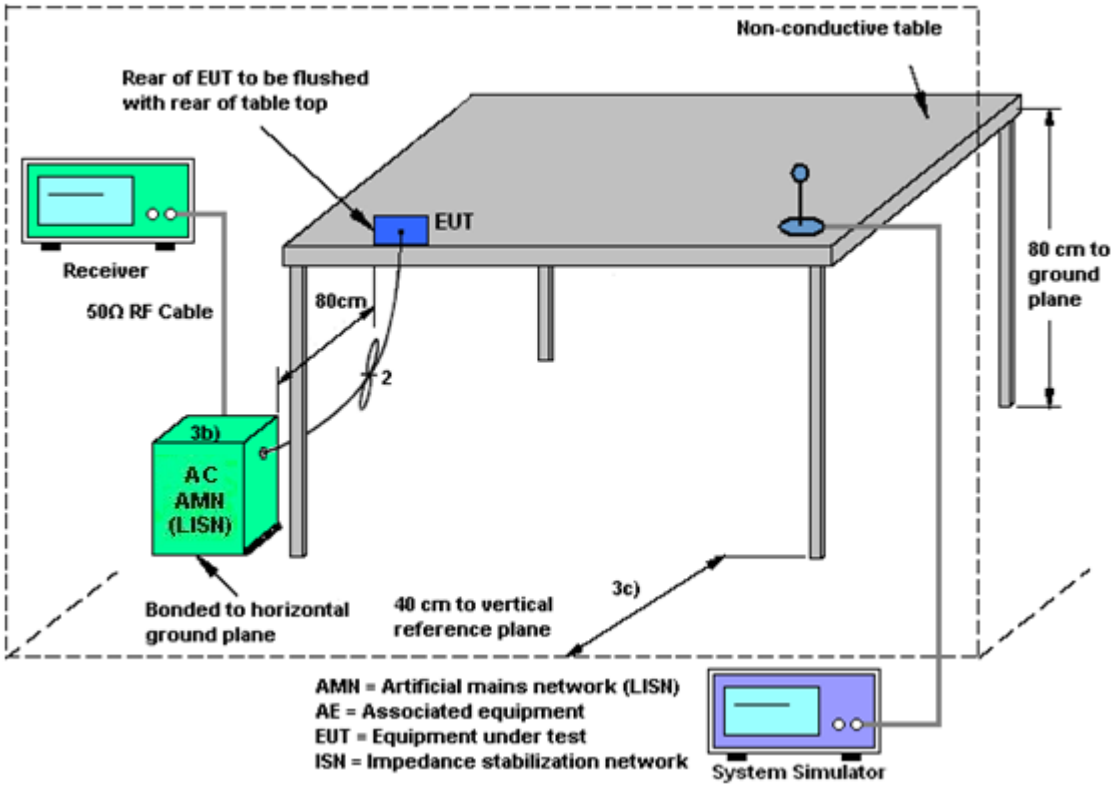
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.2.4 Test Setup



3.2.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A	MY57290151	3Hz~8.5GHz;Max 30dBm	Jun. 25, 2018	Mar. 30, 2019~ Apr. 18, 2019	Jun. 24, 2019	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57471084	10Hz-44GHz	Jun. 25, 2018	Mar. 30, 2019~ Apr. 18, 2019	Jun. 24, 2019	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 19, 2018	Mar. 30, 2019~ Apr. 18, 2019	Oct. 18, 2019	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	Jun. 12, 2018	Mar. 30, 2019~ Apr. 18, 2019	Jun. 11, 2019	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Jan. 27, 2019	Mar. 30, 2019~ Apr. 18, 2019	Jan. 26, 2020	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2019	Mar. 30, 2019~ Apr. 18, 2019	Jan. 04, 2020	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Aug. 06, 2018	Mar. 30, 2019~ Apr. 18, 2019	Aug. 05, 2019	Radiation (03CH05-KS)
Amplifier	MITEQ	TTA1840-35-HG	2014749	18~40GHz	Jan. 14, 2019	Mar. 30, 2019~ Apr. 18, 2019	Jan. 13, 2020	Radiation (03CH05-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 12, 2018	Mar. 30, 2019~ Apr. 18, 2019	Oct. 11, 2019	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Mar. 30, 2019~ Apr. 18, 2019	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Mar. 30, 2019~ Apr. 18, 2019	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Mar. 30, 2019~ Apr. 18, 2019	NCR	Radiation (03CH05-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 19, 2018	Mar. 24, 2019	Apr. 18, 2019	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 12, 2018	Mar. 24, 2019	Oct. 11, 2019	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Nov. 19, 2018	Mar. 24, 2019	Nov. 18, 2019	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2018	Mar. 24, 2019	Oct. 11, 2019	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.9 dB**

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

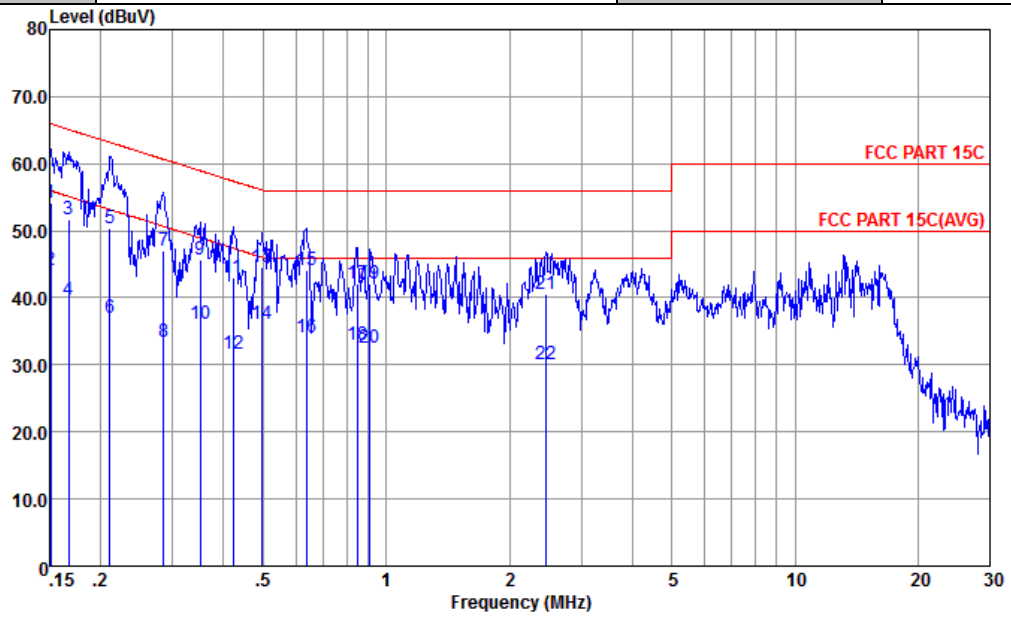
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0 dB**

Appendix A. AC Conducted Emission Test Results

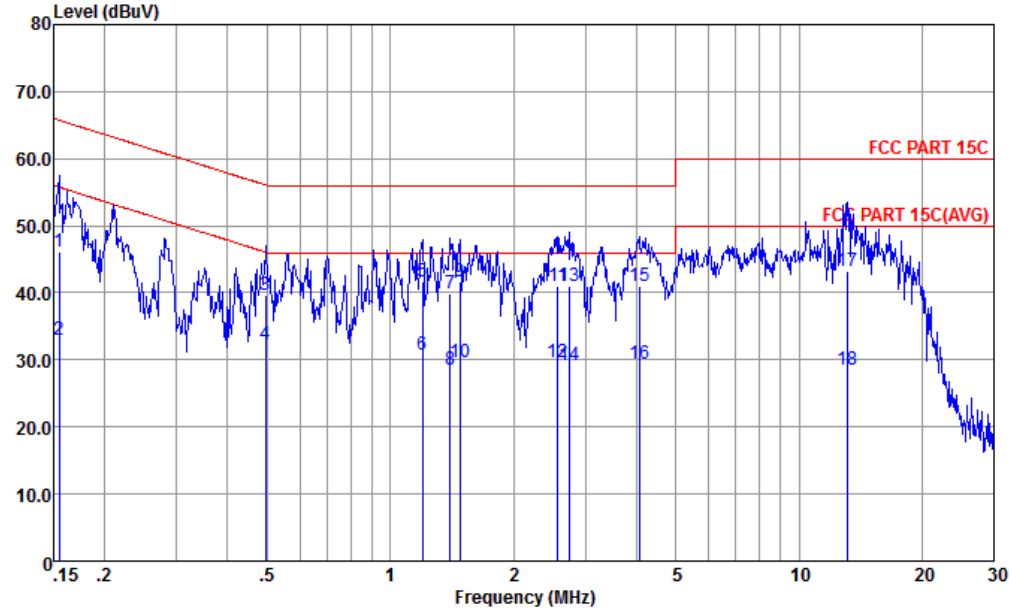
Test Engineer :	Amos Zhang	**Temperature :**	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line



Site : CO01-KS
Condition : FCC PART 15C LISN-L-181119-060105 LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.151	54.17	-11.79	65.96	43.60	0.09	10.48	QP
2		0.151	44.07	-11.89	55.96	33.50	0.09	10.48	Average
3		0.167	51.64	-13.48	65.12	41.10	0.10	10.44	QP
4		0.167	39.74	-15.38	55.12	29.20	0.10	10.44	Average
5		0.211	50.38	-12.80	63.18	39.90	0.12	10.36	QP
6		0.211	37.08	-16.10	53.18	26.60	0.12	10.36	Average
7		0.285	47.05	-13.63	60.68	36.60	0.14	10.31	QP
8		0.285	33.35	-17.33	50.68	22.90	0.14	10.31	Average
9		0.350	45.64	-13.32	58.96	35.20	0.15	10.29	QP
10		0.350	36.04	-12.92	48.96	25.60	0.15	10.29	Average
11		0.421	43.02	-14.40	57.42	32.60	0.16	10.26	QP
12		0.421	31.72	-15.70	47.42	21.30	0.16	10.26	Average
13		0.497	44.61	-11.44	56.05	34.20	0.17	10.24	QP
14	*	0.497	36.01	-10.04	46.05	25.60	0.17	10.24	Average
15		0.637	44.22	-11.78	56.00	33.80	0.18	10.24	QP
16		0.637	34.02	-11.98	46.00	23.60	0.18	10.24	Average
17		0.848	42.03	-13.97	56.00	31.59	0.20	10.24	QP
18		0.848	33.03	-12.97	46.00	22.59	0.20	10.24	Average
19		0.914	42.03	-13.97	56.00	31.59	0.20	10.24	QP
20		0.914	32.53	-13.47	46.00	22.09	0.20	10.24	Average
21		2.461	40.66	-15.34	56.00	30.20	0.23	10.23	QP
22		2.461	30.06	-15.94	46.00	19.60	0.23	10.23	Average

Test Engineer :	Amos Zhang	Temperature :	25.3~26.2℃
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : FCC PART 15C LISN-N-181119-060105 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.155	46.15	-19.59	65.74	35.50	0.18	10.47	QP
2	0.155	32.95	-22.79	55.74	22.30	0.18	10.47	Average
3	0.494	39.58	-16.52	56.10	29.19	0.15	10.24	QP
4 *	0.494	32.28	-13.82	46.10	21.89	0.15	10.24	Average
5	1.197	41.57	-14.43	56.00	31.20	0.14	10.23	QP
6	1.197	30.67	-15.33	46.00	20.30	0.14	10.23	Average
7	1.403	39.97	-16.03	56.00	29.60	0.14	10.23	QP
8	1.403	28.57	-17.43	46.00	18.20	0.14	10.23	Average
9	1.480	41.57	-14.43	56.00	31.20	0.14	10.23	QP
10	1.480	29.57	-16.43	46.00	19.20	0.14	10.23	Average
11	2.567	40.99	-15.01	56.00	30.59	0.16	10.24	QP
12	2.567	29.69	-16.31	46.00	19.29	0.16	10.24	Average
13	2.736	41.00	-15.00	56.00	30.60	0.16	10.24	QP
14	2.736	29.30	-16.70	46.00	18.90	0.16	10.24	Average
15	4.070	41.03	-14.97	56.00	30.61	0.17	10.25	QP
16	4.070	29.33	-16.67	46.00	18.91	0.17	10.25	Average
17	13.127	43.31	-16.69	60.00	32.79	0.14	10.38	QP
18	13.127	28.41	-21.59	50.00	17.89	0.14	10.38	Average

Appendix B. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH 00 2402MHz		2361.87	51.56	-22.44	51.01	74	32.07	5.43	36.95	310	227	P	H
	*	2361.87	26.77	-27.23	54	-	-	-	-	-	-	A	H
		2402	104.17	-	-	74	32	5.48	36.96	310	227	P	H
		2402	79.38	-	-	-	-	-	-	-	-	A	H
		2361.74	51.16	-22.84	50.61	74	32.07	5.43	36.95	297	133	P	V
	*	2361.74	26.37	-27.63	54	-	-	-	-	-	-	A	V
		2402	101.46	-	-	74	32	5.48	36.96	297	133	P	V
		2402	76.67	-	-	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		2499.65	51.35	-22.65	50.57	74	32.2	5.55	36.97	398	166	P	H
	*	2499.65	26.56	-27.44	54	-	-	-	-	-	-	A	H
		2480	97.12	-	-	74	32.27	5.55	36.97	398	166	P	H
		2480	72.33	-	-	-	-	-	-	-	-	A	H
		2499.65	51.35	-22.65	50.57	74	32.2	5.55	36.97	398	166	P	V
	*	2499.65	26.56	-27.44	54	-	-	-	-	-	-	A	V
		2480	97.12	-	-	74	32.27	5.55	36.97	398	166	P	V
		2480	72.33	-	-	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4806	39.92	-34.08	59.75	74	34.2	8.1	62.13	150	360	P	H
		4806	39.92	-34.08	59.75	74	34.2	8.1	62.13	150	360	P	V
BT CH 39 2441MHz		4884	39.03	-34.97	58.94	74	34.13	8.07	62.11	100	360	P	H
		7320	42.44	-31.56	58.86	74	36.6	9.75	62.77	100	360	P	H
		4884	39.68	-34.32	59.59	74	34.13	8.07	62.11	100	360	P	V
		7320	43.16	-30.84	59.58	74	36.6	9.75	62.77	100	360	P	V
BT CH 78 2480MHz		4962	38.55	-35.45	58.48	74	34.1	8.05	62.08	150	360	P	H
		7440	41.97	-32.03	58.51	74	36.4	9.84	62.78	150	360	P	H
		4962	38.55	-35.45	58.48	74	34.1	8.05	62.08	150	360	P	V
		7440	41.97	-32.03	58.51	74	36.4	9.84	62.78	150	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz T (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz BT LF		167.74	15.81	-27.69	43.5	30.22	16.01	1.51	31.93	-	-	P	H
		227.88	22.02	-23.98	46	35.27	16.92	1.76	31.93	-	-	P	H
		288.99	23.77	-22.23	46	34.89	18.98	1.95	32.05	-	-	P	H
		515.97	22.59	-23.41	46	28.47	23.83	2.58	32.29	-	-	P	H
		690.57	24.04	-21.96	46	28.35	25.02	3.01	32.34	-	-	P	H
		744.89	24.17	-21.83	46	27.49	25.81	3.13	32.26	100	20	P	H
		39.7	20.63	-19.37	40	33.79	18.1	0.7	31.96	100	20	P	V
		180.35	20.59	-22.91	43.5	35.24	15.73	1.54	31.92	-	-	P	V
		239.52	19.52	-26.48	46	32.06	17.59	1.82	31.95	-	-	P	V
		289.96	21.41	-24.59	46	32.51	19	1.96	32.06	-	-	P	V
		651.77	24.14	-21.86	46	28.49	25.1	2.91	32.36	-	-	P	V
		834.13	24.19	-21.81	46	26.42	26.34	3.32	31.89	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **not under limit 6dB**.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

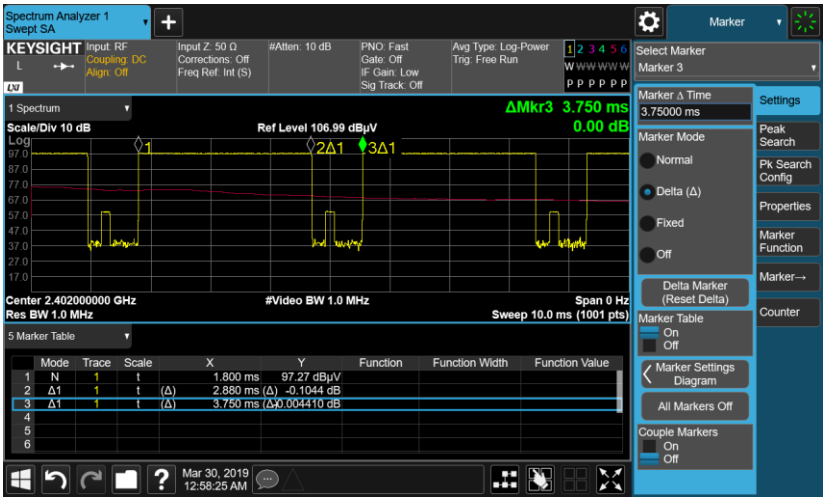
= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

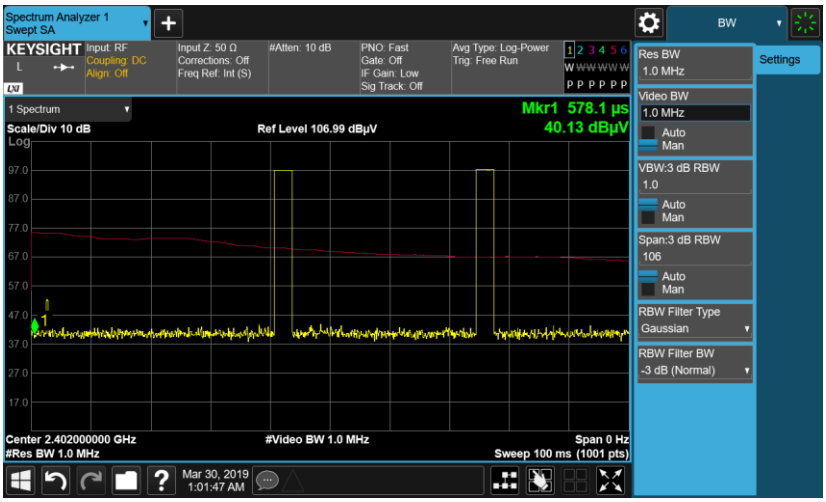
Both peak and average measured complies with the limit line, so test result is “PASS”.

Appendix C. Duty Cycle Plots

3DH5 on time (One Pulse) Plot on Channel 39



3DH5 on time (Count Pulses) Plot on Channel 39



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
3. 3DH5 has the highest duty cycle worst case and is reported.

Appendix E. Reference Report

Please refer to Sporton report number FR912606A which is issued separately.