FCC RF Test Report

APPLICANT	:	Thundercomm Technology Co., Ltd
EQUIPMENT	:	Cellular Module
BRAND NAME	:	TurboX
MODEL NAME	:	CM6125
FCC ID	:	2AOHHTURBOXCM6125
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DSS) Spread Spectrum Transmitter
TEST DATE(S)	:	Sep. 30, 2022 ~ Oct. 31, 2022

We, Sporton International Inc. (Shenzhen), 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 Inc. (Shenzhen), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

Sporton International Inc. (ShenZhen)

1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055

People's Republic of China

TABLE OF CONTENTS

REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR232517-01A	Rev. 01	Initial issue of report	Nov. 17, 2022

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 9.99 dB at 4804.00 MHz
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 9.40 dB at 0.51 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Note: This is a variant report. The change note could be referred to the Class II Permissive Change letter which is exhibit separately. The cellular module remains the same as the original module, only the antenna is different, so the conducted power is reused from the original report. Based on the similarity between current and previous project, only the related cases of two new antennas were tested and shown in this report, all the other test results are referred to the original report FR232517A.

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Applicant

Thundercomm Technology Co., Ltd
No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122

1.2 Manufacturer

Thundercomm Technology Co., Ltd
No. 107, Middle Datagu Road, Xiantao Street, Yubei District, Chongqing, China, 401122

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Cellular Module
Brand Name	TurboX
Model Name	CM6125
IMEI Code	Conducted: 869835050001758/869835050002558 Conduction: 869835050002210/869835050003010 Radiation: 869835050002210/869835050003010
FCC ID	2AOHHTURBOXCM6125
HW Version	V03
SW Version	Turbox-CM6125_xx.xx_la1.0.V.userdebug.20220509.0843
EUT Stage	Identical Prototype

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
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 12.63 dBm (0.0183 W) Bluetooth EDR (2Mbps) : 11.69 dBm (0.0148 W) Bluetooth EDR (3Mbps) : 11.95 dBm (0.0157 W)
Antenna Type / Gain	<Ant.1>: Dipole Antenna with gain 2.90 dBi <Ant.2>: PIFA Antenna with gain 3.50 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) :π/4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

Remark: The conducted power refer to the original report FR232507A.

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-SZ	CN1256	421272

Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	101, 1st Floor, Block B, Building 1, No. 2, Tengfeng 4th Road, Fenghuang Community, Fuyong Street, Baoan District, Shenzhen City Guangdong Province China 518103 TEL: +86-755-33202398		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	03CH03-SZ	CN1256	421272

1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24
2.	CO01-SZ	AUDIX	E3	6.120613b

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 v05r02
- 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.

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 1Mbps mode, and recorded in this report.

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

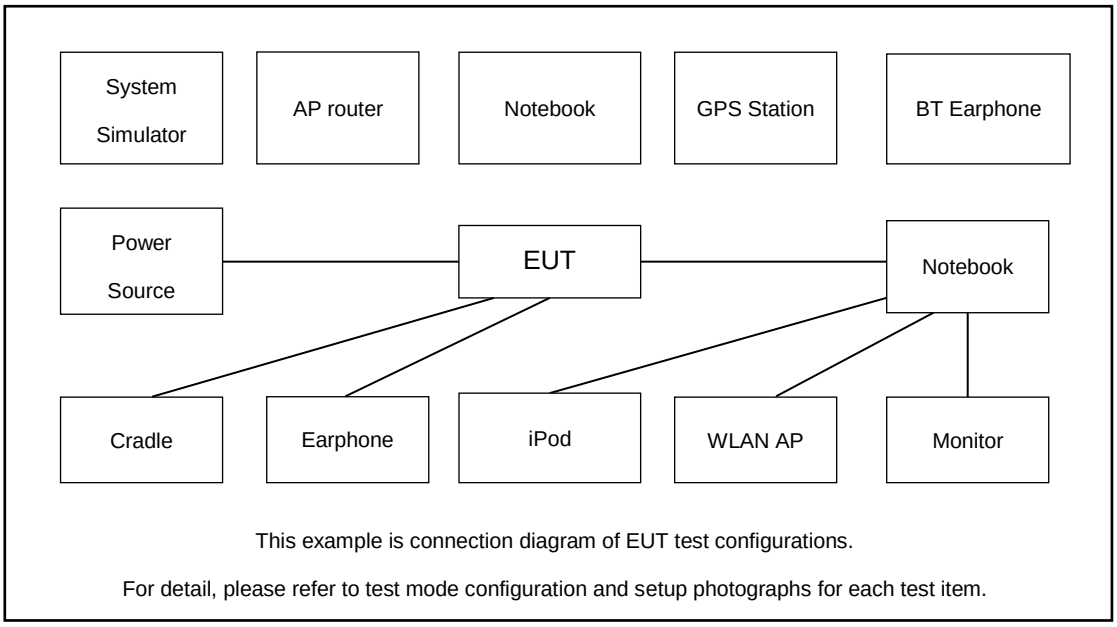
The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases			
Test Item	**Data Rate / Modulation**		
	Bluetooth BR 1Mbps GFSK	**Bluetooth EDR 2Mbps π/4-DQPSK**	**Bluetooth EDR 3Mbps 8-DPSK**
Radiated Test Cases	**Bluetooth BR 1Mbps GFSK**		
	Ant. 1/ Ant. 2		
	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz		
AC Conducted Emission	Mode 1 : WCDMA Band V Idle + Bluetooth Link + WLAN Link(2.4G) + Adapter + Ant. 1 Mode 2 : WCDMA Band V Idle + Bluetooth Link + WLAN Link(2.4G) + Adapter + Ant. 2		

Remark:

1. For radiated test cases, the worst mode data rate 1Mbps 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.

2.3 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8m
2.	BT Base Station	R&S	CBT	N/A	N/A	Unshielded, 1.8 m
3.	WLAN AP	Dlink	DIR-820L	KA2IR820LA1	N/A	Unshielded, 1.8m
4.	Notebook	Lenovo	E540	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Bluetooth Earphone	Samsung	EO-MG900	PYAHS-107W	N/A	N/A
6.	Test Jig	N/A	N/A	N/A	N/A	N/A
7.	Antenna 1	N/A	N/A	N/A	N/A	N/A
8.	Antenna 2	N/A	N/A	N/A	N/A	N/A
9.	WWAN Antenna	N/A	N/A	N/A	N/A	N/A
10.	Adapter	N/A	N/A	N/A	N/A	N/A

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.

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.

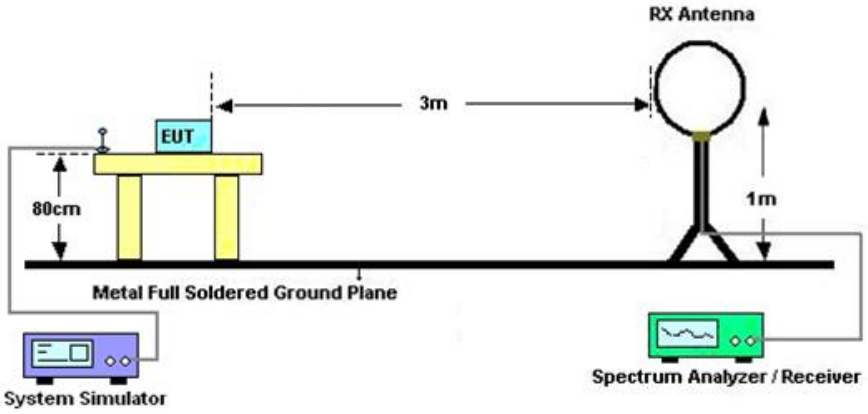
3.1.3 Test Procedures

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.
1. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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)
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. 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.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak 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.

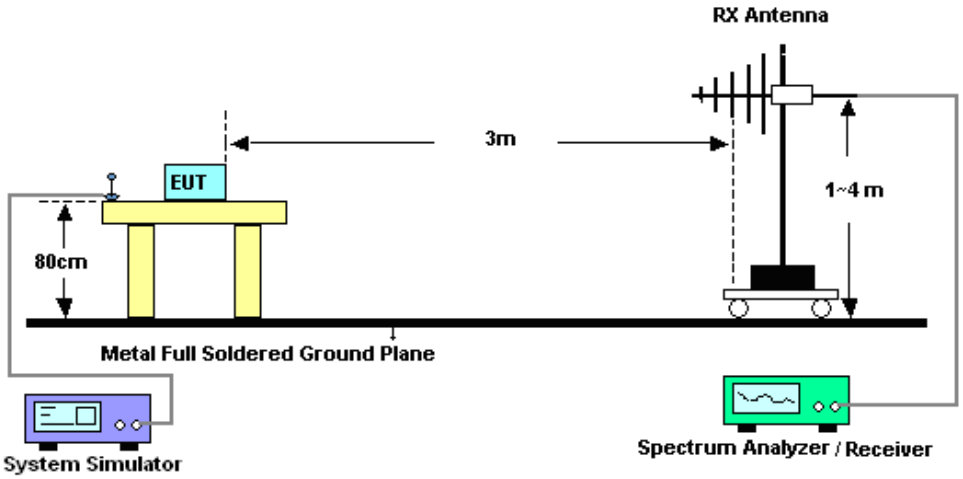
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent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

3.1.4 Test Setup

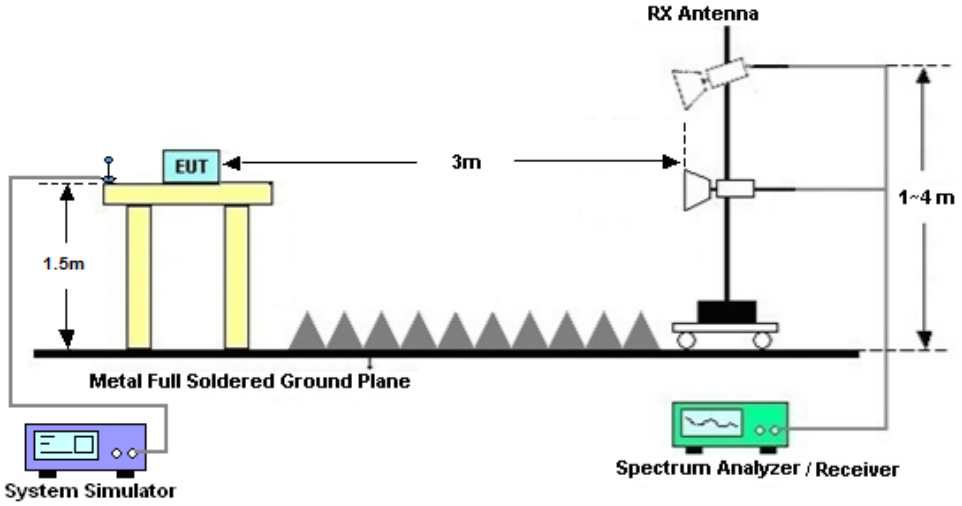
For radiated emissions below 30MHz



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 or 40GHz, whichever is lower)

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.

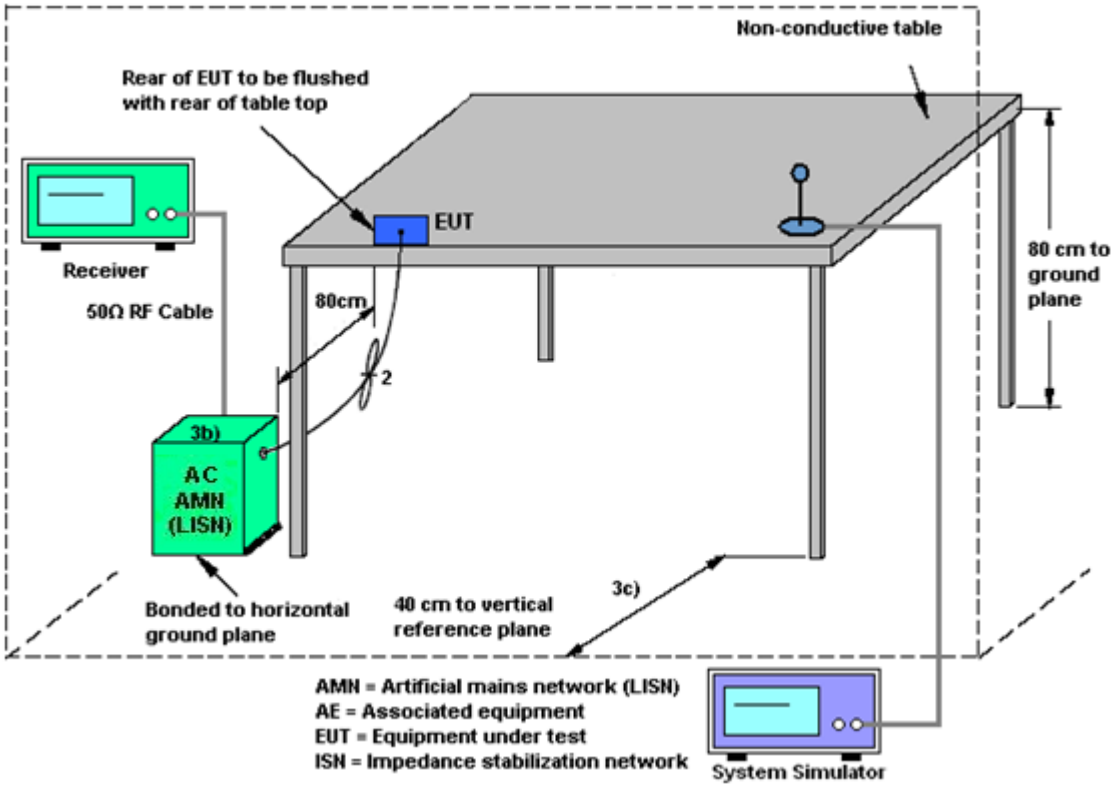
3.2.2 Measuring Instruments

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&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	Apr. 06, 2022	Oct. 14, 2022~ Oct. 31, 2022	Apr. 05, 2023	Radiation (03CH03-SZ)
EXA Spectrum Anaiyzer	KEYSIGHT	N9010A	MY55150246	10Hz~44GHz;	Apr. 06, 2022	Oct. 14, 2022~ Oct. 31, 2022	Apr. 05, 2023	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	Jul. 28, 2022	Oct. 14, 2022~ Oct. 31, 2022	Jul. 27, 2024	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz-2GHz	Aug. 09, 2022	Oct. 14, 2022~ Oct. 31, 2022	Aug. 08, 2023	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1355	1GHz~18GHz	Apr. 08, 2022	Oct. 14, 2022~ Oct. 31, 2022	Apr. 07, 2023	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Oct. 22, 2021	Oct. 14, 2022~ Oct. 31, 2022	Oct. 21, 2022	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Oct. 21, 2022		Oct. 20, 2023	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18Ghz-40GHz	Apr. 10, 2022	Oct. 14, 2022~ Oct. 31, 2022	Apr. 09, 2023	Radiation (03CH03-SZ)
Amplifier	Burgeon	BPA-530	102211	0.01Hz ~3000MHz	Oct. 22, 2021	Oct. 14, 2022~ Oct. 31, 2022	Oct. 21, 2022	Radiation (03CH03-SZ)
Amplifier	Burgeon	BPA-530	102211	0.01Hz ~3000MHz	Oct. 21, 2022		Oct. 20, 2023	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 22, 2021	Oct. 14, 2022~ Oct. 31, 2022	Oct. 21, 2022	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 21, 2022		Oct. 20, 2023	Radiation (03CH03-SZ)
Amplifier	Agilent Technologies	83017A	MY39501302	500MHz~26.5GHz	Dec. 27, 2021	Oct. 14, 2022~ Oct. 31, 2022	Dec. 26, 2022	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010001985	N/A	NCR	Oct. 14, 2022~ Oct. 31, 2022	NCR	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Oct. 14, 2022~ Oct. 31, 2022	NCR	Radiation (03CH03-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Oct. 14, 2022~ Oct. 31, 2022	NCR	Radiation (03CH03-SZ)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Jul. 07, 2022	Sep. 30, 2022	Jul. 06, 2023	Conduction (CO01-SZ)
AC LISN	R&S	ENV216	100063	9kHz~30MHz	Sep. 15, 2022	Sep. 30, 2022	Sep. 14, 2023	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	EMCO	3816/2SH	00103892	9kHz~30MHz	Oct. 29, 2021	Sep. 30, 2022	Oct. 28, 2022	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 07, 2022	Sep. 30, 2022	Jul. 06, 2023	Conduction (CO01-SZ)

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))	**2.2dB**

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

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

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.9dB**

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

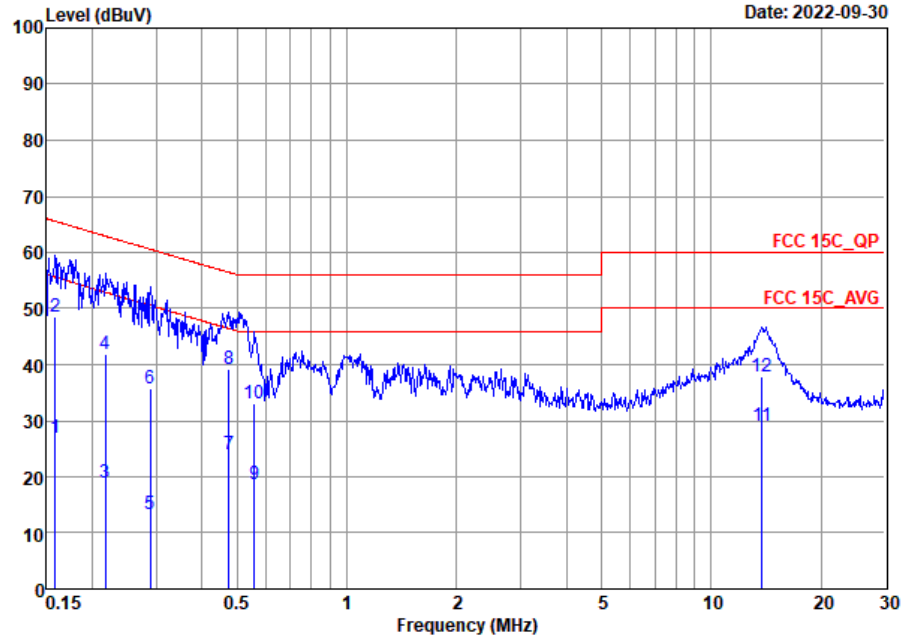
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.0dB**

---------- THE END ----------

Appendix A. AC Conducted Emission Test Results

Mode 1(Ant. 1):

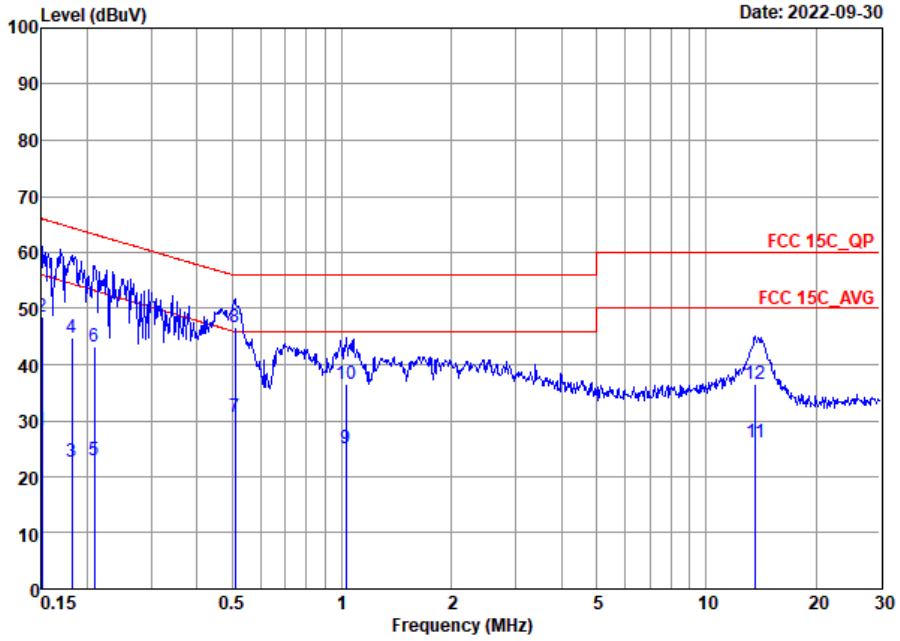
Test Engineer :	Lily Qiu	**Temperature :**	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20220811_ L LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.16	26.93	-28.63	55.56	6.00	10.20	10.73	Average
2	*	0.16	48.43	-17.13	65.56	27.50	10.20	10.73	QP
3		0.22	18.91	-34.01	52.92	-1.60	10.19	10.32	Average
4		0.22	41.91	-21.01	62.92	21.40	10.19	10.32	QP
5		0.29	13.41	-37.13	50.54	-7.60	10.16	10.85	Average
6		0.29	35.71	-24.83	60.54	14.70	10.16	10.85	QP
7		0.47	23.98	-22.47	46.45	2.09	10.12	11.77	Average
8		0.47	39.28	-17.17	56.45	17.39	10.12	11.77	QP
9		0.56	18.60	-27.40	46.00	-3.10	10.11	11.59	Average
10		0.56	33.00	-23.00	56.00	11.30	10.11	11.59	QP
11		13.77	29.00	-21.00	50.00	8.91	9.76	10.33	Average
12		13.77	37.90	-22.10	60.00	17.81	9.76	10.33	QP

Test Engineer :	Lily Qiu	**Temperature :**	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	**Phase :**	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

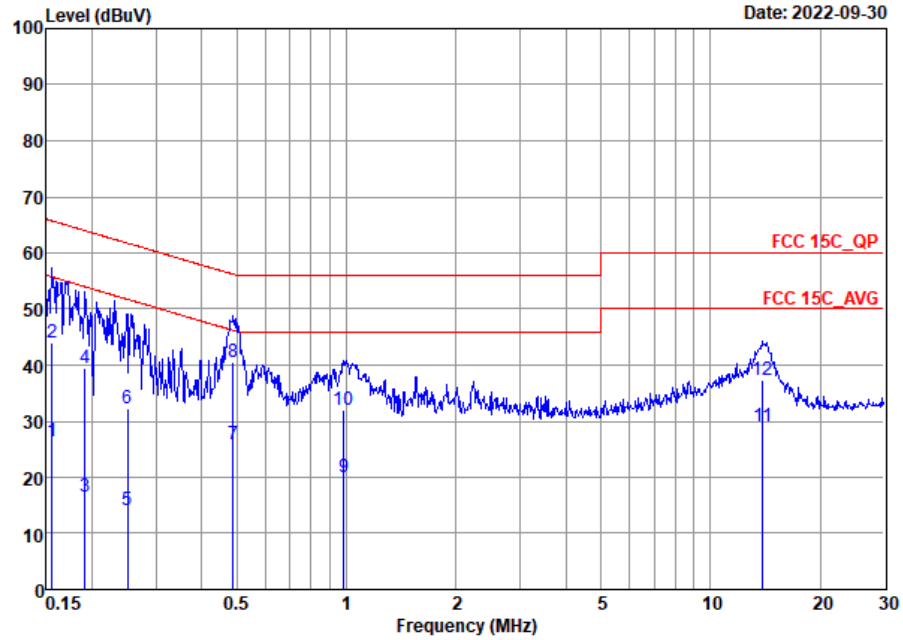


Site : CO01-SZ
Condition: FCC 15C_QP LISN_20220811_ N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.15	28.26	-27.74	56.00	7.10	10.31	10.85	Average
2		0.15	48.56	-17.44	66.00	27.40	10.31	10.85	QP
3		0.18	22.59	-31.83	54.42	1.90	10.30	10.39	Average
4		0.18	44.69	-19.73	64.42	24.00	10.30	10.39	QP
5		0.21	22.81	-30.42	53.23	2.30	10.27	10.24	Average
6		0.21	43.31	-19.92	63.23	22.80	10.27	10.24	QP
7		0.51	30.60	-15.40	46.00	8.60	10.20	11.80	Average
8	*	0.51	46.60	-9.40	56.00	24.60	10.20	11.80	QP
9		1.03	24.95	-21.05	46.00	4.50	10.22	10.23	Average
10		1.03	36.65	-19.35	56.00	16.20	10.22	10.23	QP
11		13.62	26.03	-23.97	50.00	5.80	9.90	10.33	Average
12		13.62	36.43	-23.57	60.00	16.20	9.90	10.33	QP

Mode 2(Ant. 2):

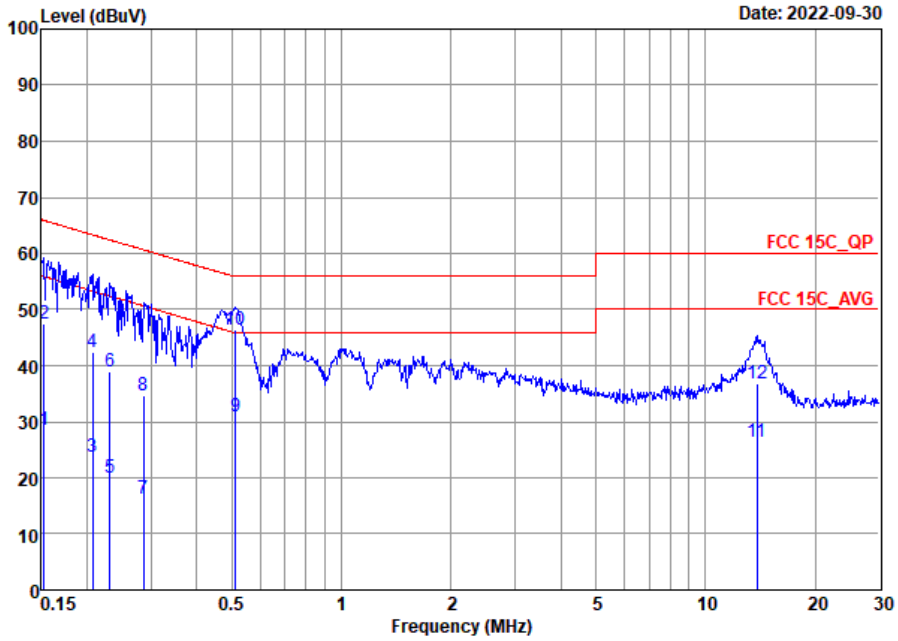
Test Engineer :	Lily Qiu	**Temperature :**	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20220811_ L LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.16	26.27	-29.42	55.69	5.30	10.20	10.77	Average
2		0.16	43.87	-21.82	65.69	22.90	10.20	10.77	QP
3		0.19	16.55	-37.43	53.98	-3.90	10.20	10.25	Average
4		0.19	39.45	-24.53	63.98	19.00	10.20	10.25	QP
5		0.25	14.15	-37.58	51.73	-6.60	10.18	10.57	Average
6		0.25	32.25	-29.48	61.73	11.50	10.18	10.57	QP
7		0.49	25.93	-20.26	46.19	4.00	10.12	11.81	Average
8	*	0.49	40.43	-15.76	56.19	18.50	10.12	11.81	QP
9		0.98	19.89	-26.11	46.00	-0.50	10.12	10.27	Average
10		0.98	31.89	-24.11	56.00	11.50	10.12	10.27	QP
11		13.91	29.19	-20.81	50.00	9.10	9.76	10.33	Average
12		13.91	37.29	-22.71	60.00	17.20	9.76	10.33	QP

Test Engineer :	Lily Qiu	Temperature :	22~25℃
		Relative Humidity :	50~55%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-SZ
Condition: FCC 15C_QP LISN_20220811_ N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.15	28.42	-27.45	55.87	7.30	10.31	10.81	Average
2		0.15	47.42	-18.45	65.87	26.30	10.31	10.81	QP
3		0.21	23.80	-29.52	53.32	3.29	10.28	10.23	Average
4		0.21	42.40	-20.92	63.32	21.89	10.28	10.23	QP
5		0.23	19.98	-32.41	52.39	-0.70	10.26	10.42	Average
6		0.23	38.98	-23.41	62.39	18.30	10.26	10.42	QP
7		0.29	16.15	-34.48	50.63	-4.90	10.22	10.83	Average
8		0.29	34.65	-25.98	60.63	13.60	10.22	10.83	QP
9		0.51	31.00	-15.00	46.00	9.00	10.20	11.80	Average
10	*	0.51	46.40	-9.60	56.00	24.40	10.20	11.80	QP
11		13.84	26.43	-23.57	50.00	6.21	9.89	10.33	Average
12		13.84	36.83	-23.17	60.00	16.61	9.89	10.33	QP

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix B. Radiated Spurious Emission

For Ant. 1:

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path 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 CH00 2402MHz		2366.805	45.02	-28.98	74	41.68	32.15	4.87	33.68	296	350	P	H
		2366.805	20.23	-33.77	54	-	-	-	-	296	350	A	H
		2402	105.63	-	-	102.14	32.25	4.9	33.66	296	350	P	H
	*	2402	80.84	-	-	-	-	-	-	296	350	A	H
		2359.875	45.92	-28.08	74	42.59	32.14	4.87	33.68	354	253	P	V
		2359.875	21.13	-32.87	54	-	-	-	-	354	253	A	V
		2402	105.68	-	-	102.19	32.25	4.9	33.66	354	253	P	V
	*	2402	80.89	-	-	-	-	-	-	354	253	A	V
BT CH 78 2480MHz		2480	106	-	-	102.22	32.45	4.95	33.62	221	1	P	H
	*	2480	81.21	-	-	-	-	-	-	221	1	A	H
		2483.96	55.71	-18.29	74	51.92	32.46	4.95	33.62	221	1	P	H
		2483.96	30.92	-23.08	54	-	-	-	-	221	1	A	H
		2480	105.17	-	-	101.39	32.45	4.95	33.62	364	302	P	V
	*	2480	80.38	-	-	-	-	-	-	364	302	A	V
		2483.64	57.84	-16.16	74	54.05	32.46	4.95	33.62	364	302	P	V
		2483.64	33.05	-20.95	54	-	-	-	-	364	302	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)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4804	43.99	-30.01	74	54.26	34.68	7.98	52.93	-	-	P	H
		4804	19.2	-34.8	54	-	-	-	-	-	-	A	H
		4804	44.37	-29.63	74	54.64	34.68	7.98	52.93	-	-	P	V
		4804	19.58	-34.42	54	-	-	-	-	-	-	A	V
BT CH 39 2441MHz		4882	44.91	-29.09	74	55.1	34.65	8	52.84	-	-	P	H
		4882	20.12	-33.88	54	-	-	-	-	-	-	A	H
		7323	46.09	-27.91	74	54.42	36.42	9.36	54.11	-	-	P	H
		7323	21.3	-32.7	54	-	-	-	-	-	-	A	H
		4882	45.25	-28.75	74	55.44	34.65	8	52.84	-	-	P	V
		4882	20.46	-33.54	54	-	-	-	-	-	-	A	V
		7323	45.58	-28.42	74	53.91	36.42	9.36	54.11	-	-	P	V
		7323	20.79	-33.21	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4960	44.63	-29.37	74	54.73	34.62	8.02	52.74	-	-	P	H
		4960	19.84	-34.16	54	-	-	-	-	-	-	A	H
		7440	46.73	-27.27	74	54.72	36.54	9.51	54.04	-	-	P	H
		7440	21.94	-32.06	54	-	-	-	-	-	-	A	H
		4960	44.9	-29.1	74	55	34.62	8.02	52.74	-	-	P	V
		4960	20.11	-33.89	54	-	-	-	-	-	-	A	V
		7440	46.83	-27.17	74	54.82	36.54	9.51	54.04	-	-	P	V
		7440	22.04	-31.96	54	-	-	-	-	-	-	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 (LF @ 3m)

BT	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 78 2480MHz		30	24.32	-15.68	40	30.33	25.86	0.53	32.4	-	-	P	H
		80.44	18.15	-21.85	40	36.04	13.72	0.89	32.5	-	-	P	H
		293.84	22.42	-23.58	46	32.57	19.78	1.78	31.71	-	-	P	H
		547.98	28.68	-17.32	46	31.26	25.89	2.45	30.92	-	-	P	H
		856.44	31.76	-14.24	46	31.24	28.87	3.06	31.41	-	-	P	H
		989.33	34.31	-19.69	54	31.81	30.33	3.29	31.12	-	-	P	H
		30	25.87	-14.13	40	31.88	25.86	0.53	32.4	-	-	P	V
		66.86	21.77	-18.23	40	40.95	12.4	0.82	32.4	-	-	P	V
		119.24	19.3	-24.2	43.5	32.66	17.72	1.12	32.2	-	-	P	V
		421.88	24.14	-21.86	46	30.81	22.55	2.14	31.36	-	-	P	V
		754.59	31.59	-14.41	46	31.29	28.56	2.86	31.12	-	-	P	V
		949.56	33.35	-12.65	46	30.48	31.14	3.23	31.5	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

For Ant. 2:

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path 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 CH00 2402MHz		2378.46	44.58	-29.42	74	41.31	32.18	4.77	33.68	331	218	P	H
		2378.46	19.79	-34.21	54	-	-	-	-	331	218	P	H
	*	2402	93.35	-	-	89.95	32.25	4.81	33.66	331	218	P	H
	*	2402	68.56	-	-	-	-	-	-	331	218	A	H
		2381.295	45.44	-28.56	74	42.16	32.19	4.77	33.68	400	120	P	V
		2381.295	20.65	-33.35	54	-	-	-	-	400	120	P	V
	*	2402	95.44	-	-	92.04	32.25	4.81	33.66	400	120	P	V
	*	2402	70.65	-	-	-	-	-	-	400	120	A	V
BT CH 78 2480MHz	*	2480	96.51	-	-	92.76	32.45	4.92	33.62	344	227	P	H
	*	2480	71.72	-	-	-	-	-	-	344	227	P	H
		2483.52	51.06	-22.94	74	47.3	32.46	4.92	33.62	344	227	P	H
		2483.52	26.27	-27.73	54	-	-	-	-	344	227	A	H
	*	2480	94.64	-	-	90.89	32.45	4.92	33.62	400	132	P	V
	*	2480	69.85	-	-	-	-	-	-	400	132	P	V
		2483.88	48.46	-25.54	74	44.7	32.46	4.92	33.62	400	132	P	V
		2483.88	23.67	-30.33	54	-	-	-	-	400	132	A	V
Remark	3. No other spurious found. 4. 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)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
BT CH 00 2402MHz		4804	44.01	-29.99	74	54.51	34.68	7.75	52.93	-	-	P	H
		4804	19.22	-34.78	54	-	-	-	-	-	-	A	H
		4804	44.01	-29.99	74	54.51	34.68	7.75	52.93	-	-	P	V
		4804	44.01	-9.99	54	-	-	-	-	-	-	A	V
BT CH 39 2441MHz		4882	46.38	-27.62	74	56.79	34.65	7.78	52.84	-	-	P	H
		4882	21.59	-32.41	54	-	-	-	-	-	-	P	H
		7323	44.98	-29.02	74	53.72	36.42	8.95	54.11	-	-	P	H
		7323	20.19	-33.81	54	-	-	-	-	-	-	A	H
		4882	45.21	-28.79	74	55.62	34.65	7.78	52.84	-	-	P	V
		4882	20.42	-33.58	54	-	-	-	-	-	-	P	V
		7323	45.37	-28.63	74	54.11	36.42	8.95	54.11	-	-	P	V
		7323	20.58	-33.42	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4960	46.62	-27.38	74	56.93	34.62	7.81	52.74	-	-	P	H
		4960	21.83	-32.17	54	-	-	-	-	-	-	P	H
		7440	45.8	-28.2	74	54.11	36.54	9.19	54.04	-	-	P	H
		7440	21.01	-32.99	54	-	-	-	-	-	-	A	H
		4960	45.42	-28.58	74	55.73	34.62	7.81	52.74	-	-	P	V
		4960	20.63	-33.37	54	-	-	-	-	-	-	P	V
		7440	47.49	-26.51	74	55.8	36.54	9.19	54.04	-	-	P	V
		7440	22.7	-31.3	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					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		30	24.32	-15.68	40	30.33	25.86	0.53	32.4	-	-	P	H
		80.44	18.15	-21.85	40	36.04	13.72	0.89	32.5	-	-	P	H
		293.84	22.42	-23.58	46	32.57	19.78	1.78	31.71	-	-	P	H
		547.98	28.68	-17.32	46	31.26	25.89	2.45	30.92	-	-	P	H
		856.44	31.76	-14.24	46	31.24	28.87	3.06	31.41	-	-	P	H
		989.33	34.31	-19.69	54	31.81	30.33	3.29	31.12	-	-	P	H
		30	25.87	-14.13	40	31.88	25.86	0.53	32.4	-	-	P	V
		66.86	21.77	-18.23	40	40.95	12.4	0.82	32.4	-	-	P	V
		119.24	19.3	-24.2	43.5	32.66	17.72	1.12	32.2	-	-	P	V
		421.88	24.14	-21.86	46	30.81	22.55	2.14	31.36	-	-	P	V
		754.59	31.59	-14.41	46	31.29	28.56	2.86	31.12	-	-	P	V
		949.56	33.35	-12.65	46	30.48	31.14	3.23	31.5	-	-	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 **Margin** line.
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:

BT	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					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)
BT CH 00 2402MHz		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

3. Margin (dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path 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. Margin (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) + Path 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. Margin (dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

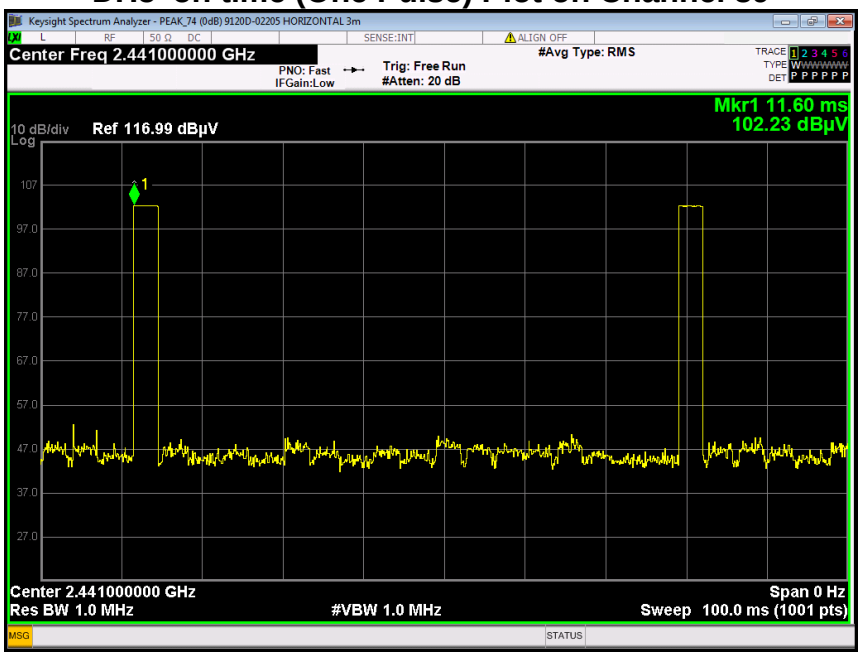
= -10.46(dB)

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

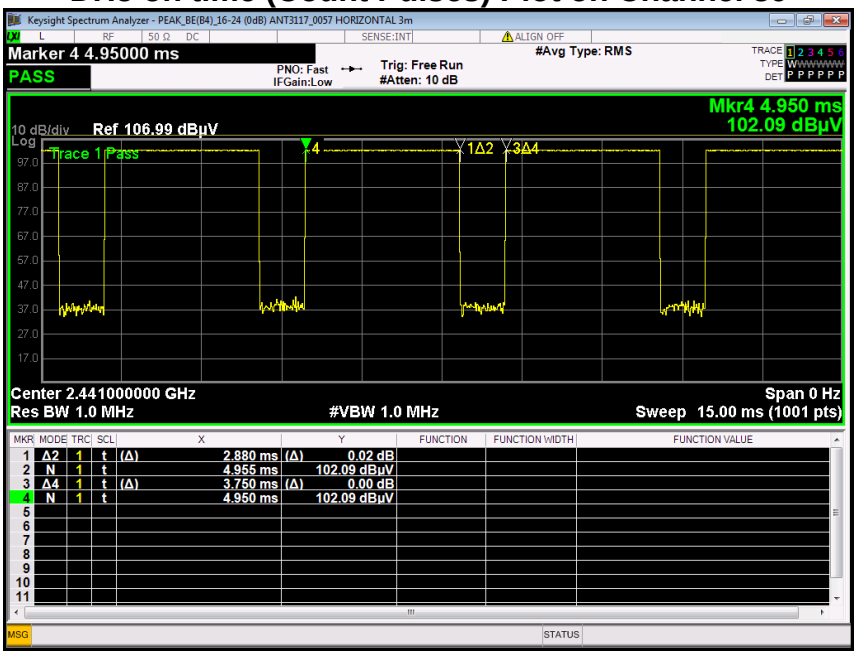
Appendix C. Duty Cycle Plots

For Ant. 1:

DH5 on time (One Pulse) Plot on Channel 39



DH5 on time (Count Pulses) Plot on Channel 39

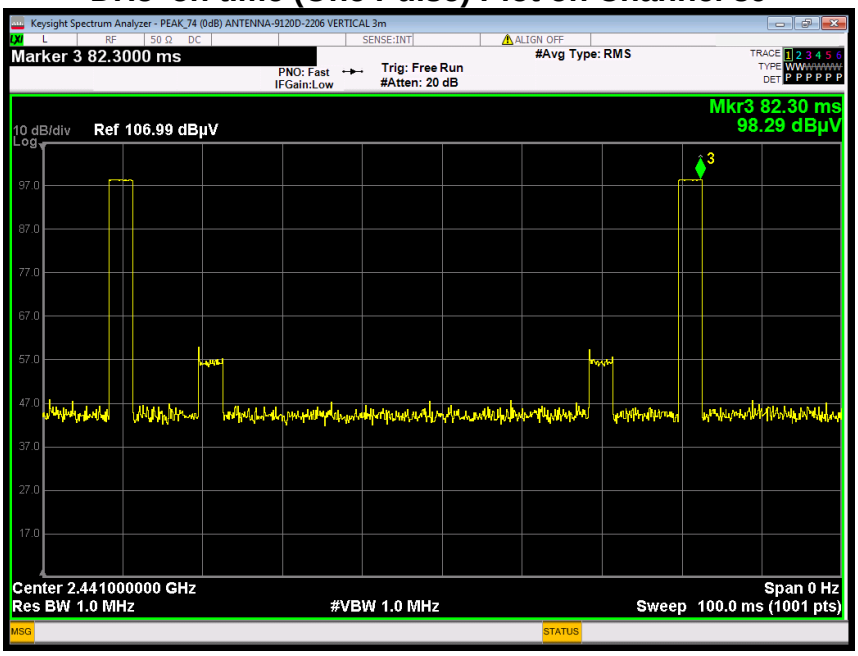


Note:

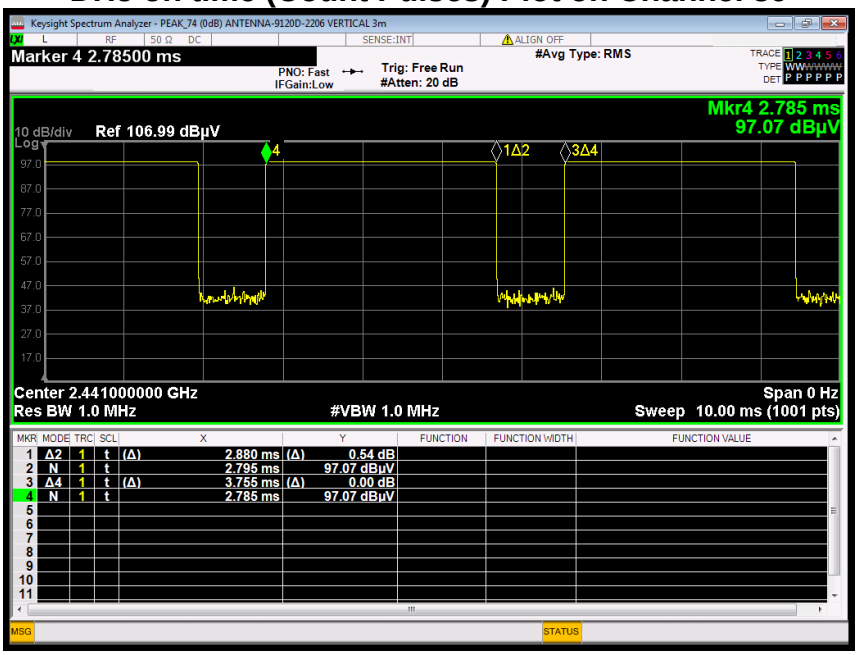
1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.88 / 100 = 5.76 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.79 dB
3. DH5 has the highest duty cycle worst case and is reported.

For Ant. 2:

DH5 on time (One Pulse) Plot on Channel 39



DH5 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. DH5 has the highest duty cycle worst case and is reported.