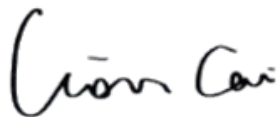


TEST REPORT

Application No.: BTEK240428001AE
Applicant: Twine Company Limited
Address of Applicant: FLAT/RM 1506 15/F WORKINGPORT COMMERCIAL BUILDING 3 HAU
FOOK STREET TSIM SHA TSUI KLN HONG KONG
Manufacturer: Betrue Technology Company Ltd
Address of Manufacturer: D07, 5/F, King Yip Factory Building, 59 King Yip Street, Kwun Tong,
Kowloon, Hong Kong
Equipment Under Test (EUT):
EUT Name: Sound Spot II
Test Model.: SFQ-18
Adding Model(s): /
Trade Mark: SOUNDFREQ
FCC ID: 2A3UZ-SFQ18
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2024-05-08
Date of Test: 2024-05-08 to 2024-06-03
Date of Issue: 2024-06-04

Test Result:	Pass*
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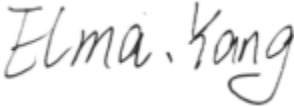
* In the configuration tested, the EUT complied with the standards specified above.



Lion Cai/ Approved & Authorized
EMC Laboratory Manager



Revision Record				
Version	Chapter	Date	Modifier	Remark
V0		2024-06-04		Original

Authorized for issue by			
			
		David Zhuang/Project Engineer	
			
		Elma Yang/Reviewer	

Remarks:

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



2 Test Summary

Radio Spectrum Technical Requirement				
Standard	Item	Method	Requirement	Result
47 CFR Part 15, Subpart C 15.247	Antenna Requirement	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)	Pass
	Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	N/A	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
47 CFR Part 15, Subpart C 15.247	Conducted Emissions at AC Power Line (150kHz-30MHz)	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
	Conducted Peak Output Power	ANSI C63.10 (2013) Section 7.8.5	47 CFR Part 15, Subpart C 15.247(b)(1)	Pass
	20dB Bandwidth	ANSI C63.10 (2013) Section 7.8.7	47 CFR Part 15, Subpart C 15.247(a)(1)	Pass
	Carrier Frequencies Separation	ANSI C63.10 (2013) Section 7.8.2	47 CFR Part 15, Subpart C 15.247a(1)	Pass
	Hopping Channel Number	ANSI C63.10 (2013) Section 7.8.3	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
	Dwell Time	ANSI C63.10 (2013) Section 7.8.4	47 CFR Part 15, Subpart C 15.247a(1)(iii)	Pass
	Conducted Band Edges Measurement	ANSI C63.10 (2013) Section 7.8.6	47 CFR Part 15, Subpart C 15.247(d)	Pass
	Conducted Spurious Emissions	ANSI C63.10 (2013) Section 7.8.8	47 CFR Part 15, Subpart C 15.247(d)	Pass
	Radiated Emissions which fall in the restricted bands	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
	Radiated Spurious Emissions	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass

Declaration of EUT Family Grouping:

Model No.: Sound Spot II, SFQ-18 have the same the electrical circuit design, layout, components used,only model number is difference.



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4 General Information

4.1 Details of E.U.T.

Power supply:	Battery/Cell model: UTL18650 3.7V 4000mAh Adapter:GS-W20A0938C Input:100-240V-50/60Hz,0.6A Output:5V \pm 3A;9V \pm 2.2A or 12V \pm 1.67A
Frequency Range:	2402MHz to 2480MHz
Bluetooth Version:	V5.3
This test report is for classic mode.	
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK, π /4DQPSK
Number of Channels:	79
Channel Spacing:	1MHz
Antenna Type:	PCB Antenna
Antenna Gain:	-0.58 dBi
Sample No.:	BTEK240428001AE-01
Remark: The information in this section is provided by the applicant or manufacturer, BANTEK is not liable to the accuracy, suitability, reliability or/and integrity of the information.	

4.2 EUT Test Mode and Test Condition

Test Mode	Description	Remark
1	Low/mid/High Channel	DH5/2DH5
2	Hopping	DH5/2DH5
Remark:1.only show the worst case in the test report.		

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	45~55 %
ATM Pressure:	1010 mbar

4.3 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Adapter	Shenzhen good-she technology Co.,Ltd.	GS-W20A0938C	/



4.4 Measurement Uncertainty

Test Item	Measurement Uncertainty
Conducted Emissions at AC Power Line (150kHz-30MHz)	$\pm 3.12\text{dB}$
Conducted Peak Output Power	$\pm 0.76\text{dB}$
20dB Bandwidth	$\pm 3\%$
Carrier Frequencies Separation	$\pm 7.3 \times 10^{-8}$
Hopping Channel Number	$\pm 7.3 \times 10^{-8}$
Dwell Time	$\pm 0.4\%$
Conducted Band Edges Measurement	$\pm 0.8\text{dB}$
Conducted Spurious Emissions	$\pm 0.8\text{dB}$
Radiated Emissions which fall in the restricted bands	$\pm 5.1\text{dB}$ (1GHz-6GHz); $\pm 5.2\text{dB}$ (above 6GHz)
Radiated Spurious Emissions (Below 1GHz)	$\pm 5.1\text{dB}$
Radiated Spurious Emissions (Above 1GHz)	$\pm 5.1\text{dB}$ (1GHz-6GHz); $\pm 5.2\text{dB}$ (above 6GHz)

4.5 Test Location

All tests were performed at:

Shenzhen BANTEK Testing Co., Ltd.,

A5&A6, Building B1&B2, No.45 Gangtuo Road, Bogang Community, Shajing Street, Bao'an District, Shenzhen, Guangdong, China 518104

Tel:0755-2334 4200

Fax: 0755-2334 4200

FCC Registration Number: 264293

Designation Number: CN1356

No tests were sub-contracted.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



5 Equipment List

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Shielding Room	YIHENG ENELECTRONIC	9*5*3.3	YH-BT-220304-04	2022-03-03	2025-03-02
EMI Test Receiver	Rohde&Schwarz	ESCI	101021	2023-06-12	2024-06-11
Measurement Software	Fara	EZ EMC Ver. FA-03A2	N/A	N/A	N/A
LISN	Rohde&Schwarz	ENV216	101472	2023-06-12	2024-06-11
LISN	Schwarzbeck	NSLK 8128	05127	2023-06-12	2024-06-11

RF Conducted					
Equipment	Manufacturer	Model No	Serial No	Cal Date	Cal Due Date
Shielding Room	YIHENG ENELECTRONIC	5.5*3.1*3	YH-BT-220304-03	2022-03-03	2025-03-02
EXA Signal Analyzer	KEYSIGHT	N9020A	MY54230486	2023-06-12	2024-06-11
DC Power Supply	E3632A	E3642A	KR75304416	2023-06-12	2024-06-11
Attenuator	RswTech	SMA-JK-6dB	N/A	2023-06-12	2024-06-11
Attenuator	RswTech	SMA-JK-3dB	N/A	2023-06-12	2024-06-11
RF Control Unit	Techy	TR1029-1	N/A	2023-06-12	2024-06-11
RF Sensor Unit	Techy	TR1029-2	N/A	2023-06-12	2024-06-11
WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW 500	141258	2023-06-12	2024-06-11
MXG Vector Signal Generator	Agilent	N5182A	US46240522	2023-06-12	2024-06-11
Programmable Temperature&Humidity Chamber	GRT	GR-HWX1000	GR22051001	2023-06-12	2024-06-11
Measurement Software	TACHOY	RF TestSoft V2.0.0.0	N/A	N/A	N/A

RSE					
Equipment	Manufacturer	Model No	Serial No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	YIHENG ENELECTRONIC	966	YH-BT-220304-01	2022-03-03	2025-03-02
EMI Test Receiver	Rohde&Schwarz	ESCI	100694	2023-06-12	2024-06-11
TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	01324	2022-06-15	2025-06-14
Pre-Amplifier	Schwarzbeck	BBV 9745	#180	2023-06-12	2024-06-11
Measurement Software	Fara	EZ EMC Ver. FA-03A2	N/A	2023-06-12	2024-06-11
EXA Signal Analyzer	Keysight	N9020A	MY54440290	2023-06-12	2024-06-11
Horn Antenna	Schwarzbeck	BBHA 9120D	02695	2022-06-15	2025-06-14
Pre-Amplifier	Tonscend	TAP0118045	AP20K806109	2023-06-12	2024-06-11



Horn Antenna	SCHWARZBECK	BBHA9170	1157	2022-06-15	2025-06-14
Low Noise Pre-amplifier	SKET	LNPA-1840G-50	SK2022032902	2023-06-12	2024-06-11
Signal analyzer	ROHDE&SCHWARZ	FSQ40	100010	2023-06-12	2024-06-11
Loop Antenna	ETS	6502	00201177	2022-06-15	2025-06-14

General used equipment					
Equipment	Manufacturer	Model No	Serial No	Cal Date	Cal Due Date
Humidity/Temperature/B arometric Pressure Indicator	KUMAR	F132	N/A	2023-06-12	2024-06-11
Humidity/Temperature/B arometric Pressure Indicator	KUMAR	F132	N/A	2023-06-12	2024-06-11



6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

6.1.2 Conclusion

This product has a PCB antenna, fulfill the requirement of this section.



6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

Limit:

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

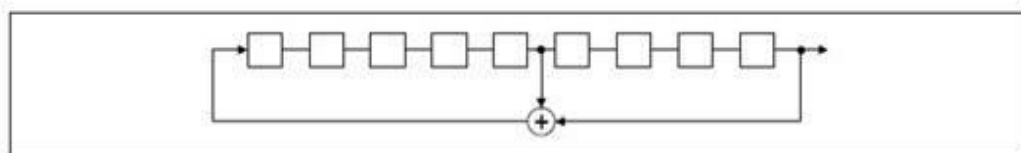
> Number of shift register stages: 9

> Length of pseudo-random sequence: $2^9 - 1 = 511$ bits

> Longest sequence of zeros: 8 (non-inverted signal)

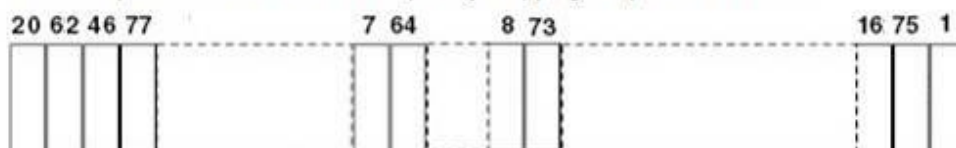
Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.



Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

6.2.2 Conclusion

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.

> Number of shift register stages: 9

> Length of pseudo-random sequence: $2^9 - 1 = 511$ bits

> Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to



avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207

Test Method: ANSI C63.10 (2013) Section 6.2

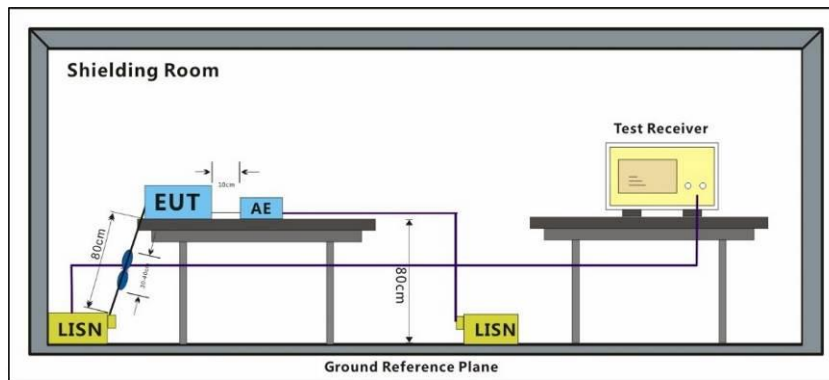
Limit:

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.

Detector: Peak for pre-scan (9kHz resolution bandwidth) 0.15M to 30MHz

7.1.1 Test Setup Diagram



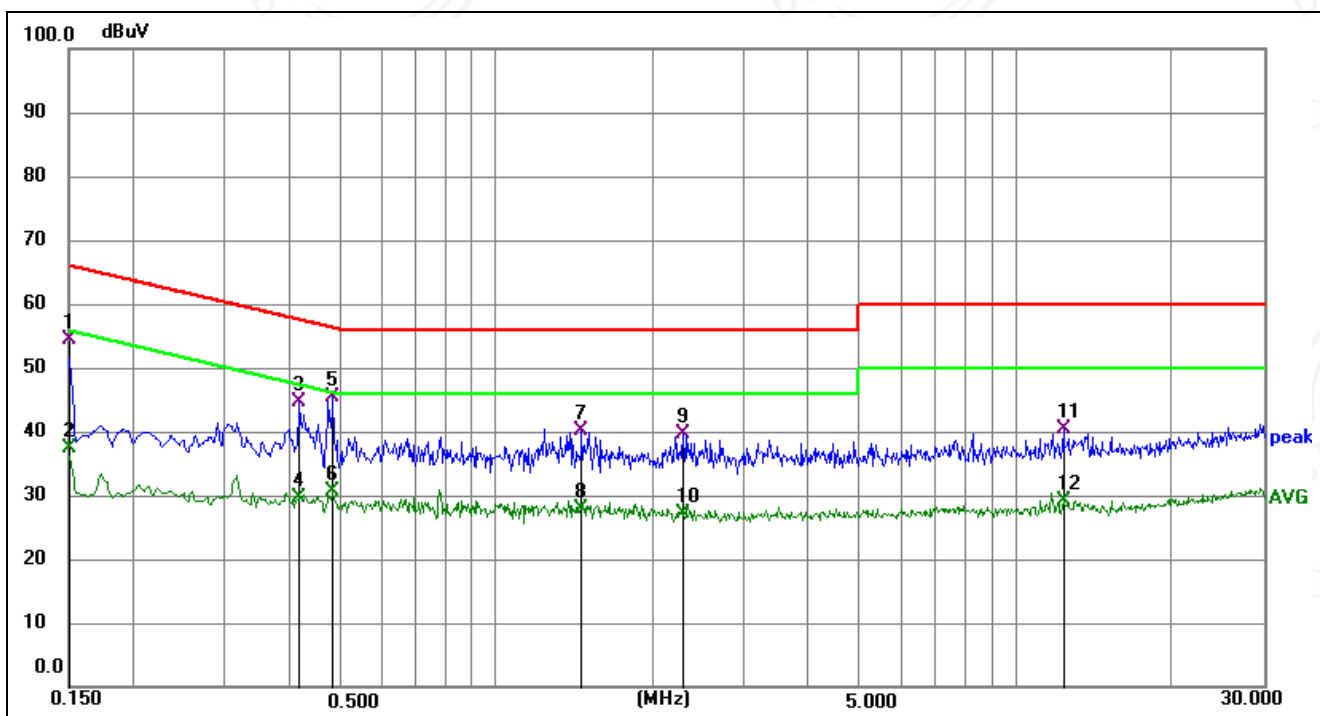
7.1.2 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor



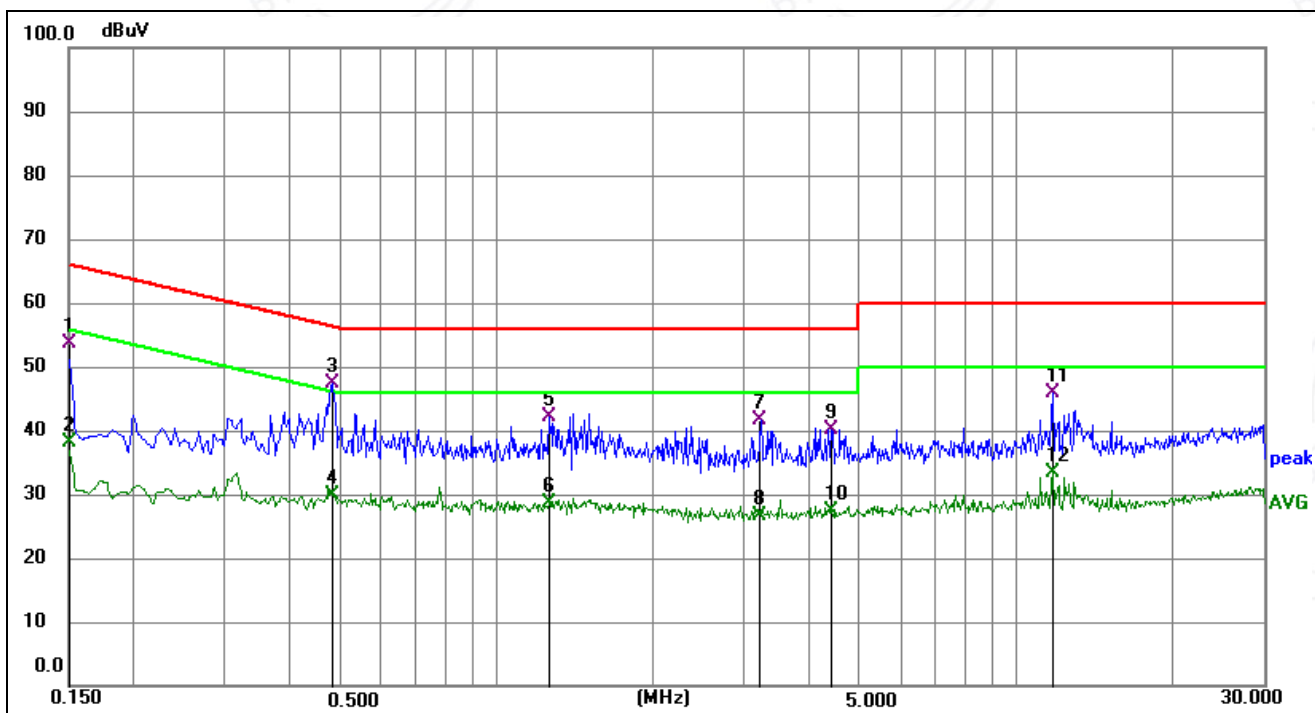
Test Mode	Communication	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1500	34.58	19.76	54.34	66.00	-11.66	QP	P	
2	0.1500	17.63	19.76	37.39	56.00	-18.61	AVG	P	
3	0.4155	24.77	19.83	44.60	57.54	-12.94	QP	P	
4	0.4155	9.70	19.83	29.53	47.54	-18.01	AVG	P	
5 *	0.4830	25.59	19.84	45.43	56.29	-10.86	QP	P	
6	0.4830	10.88	19.84	30.72	46.29	-15.57	AVG	P	
7	1.4595	20.04	20.05	40.09	56.00	-15.91	QP	P	
8	1.4595	7.79	20.05	27.84	46.00	-18.16	AVG	P	
9	2.2965	19.42	20.10	39.52	56.00	-16.48	QP	P	
10	2.2965	7.00	20.10	27.10	46.00	-18.90	AVG	P	
11	12.3540	19.29	20.99	40.28	60.00	-19.72	QP	P	
12	12.3540	8.16	20.99	29.15	50.00	-20.85	AVG	P	



Test Mode	Communication	Polarity:	Line
-----------	---------------	-----------	------



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1500	33.88	19.74	53.62	66.00	-12.38	QP	P	
2	0.1500	18.32	19.74	38.06	56.00	-17.94	AVG	P	
3 *	0.4837	27.44	19.84	47.28	56.28	-9.00	QP	P	
4	0.4837	10.02	19.84	29.86	46.28	-16.42	AVG	P	
5	1.2621	22.06	20.03	42.09	56.00	-13.91	QP	P	
6	1.2621	8.69	20.03	28.72	46.00	-17.28	AVG	P	
7	3.2239	21.34	20.19	41.53	56.00	-14.47	QP	P	
8	3.2239	6.53	20.19	26.72	46.00	-19.28	AVG	P	
9	4.4071	20.02	20.23	40.25	56.00	-15.75	QP	P	
10	4.4071	7.10	20.23	27.33	46.00	-18.67	AVG	P	
11	11.7446	24.89	21.02	45.91	60.00	-14.09	QP	P	
12	11.7446	12.29	21.02	33.31	50.00	-16.69	AVG	P	

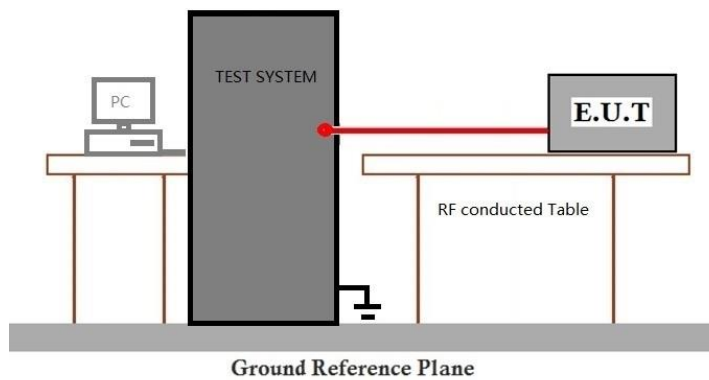


7.2 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)
Test Method: ANSI C63.10 (2013) Section 7.8.5
Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

7.2.1 Test Setup Diagram



7.2.2 Measurement Procedure and Data

cable loss=0.83dB

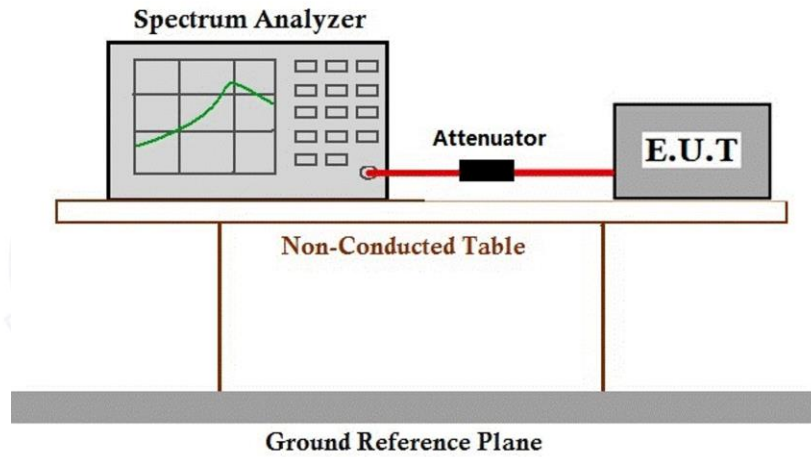
Please Refer to Appendix for Details



7.3 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)
Test Method: ANSI C63.10 (2013) Section 7.8.7

7.3.1 Test Setup Diagram



7.3.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details



7.4 Carrier Frequencies Separation

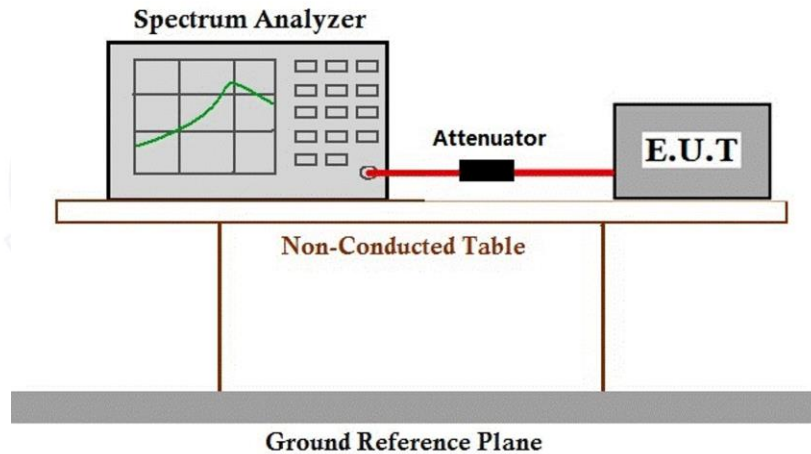
Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)

Test Method: ANSI C63.10 (2013) Section 7.8.2

Limit:

2/3 of the 20dB bandwidth base on the transmission power is less than 0.125W.

7.4.1 Test Setup Diagram



7.4.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details



7.5 Hopping Channel Number

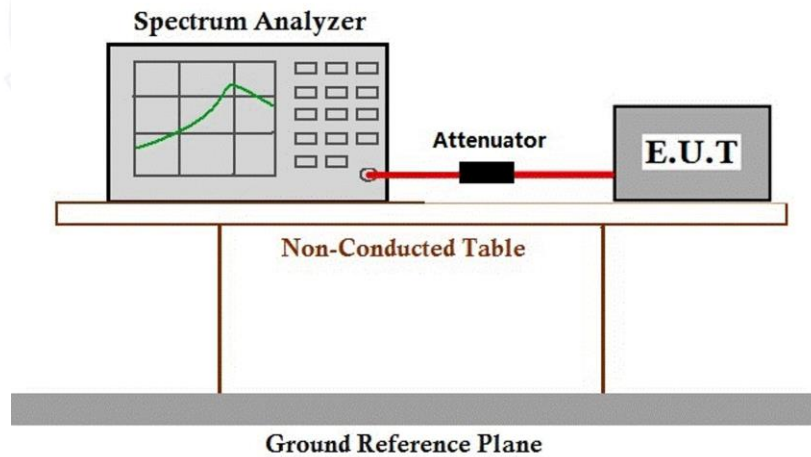
Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

7.5.1 Test Setup Diagram



7.5.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details

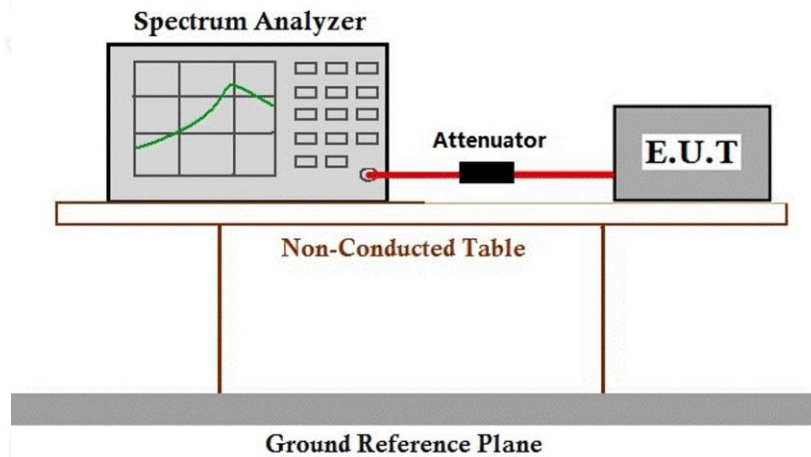


7.6 Dwell Time

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)
Test Method: ANSI C63.10 (2013) Section 7.8.4
Limit:

Frequency(MHz)	Limit
902-928	0.4s within a 20s period(20dB bandwidth<250kHz)
	0.4s within a 10s period(20dB bandwidth≥250kHz)
2400-2483.5	0.4s within a period of 0.4s multiplied by the number of hopping channels
5725-5850	0.4s within a 30s period

7.6.1 Test Setup Diagram



7.6.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details



7.7 Conducted Band Edges Measurement

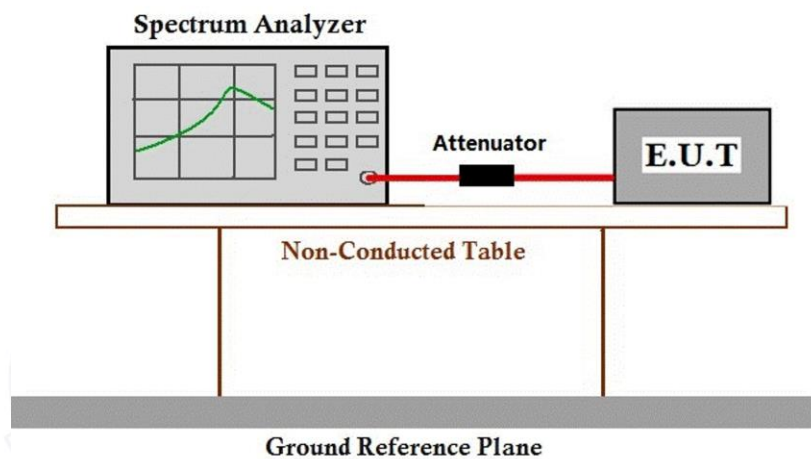
Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.6

Limit:

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

7.7.1 Test Setup Diagram



7.7.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details



7.8 Conducted Spurious Emissions

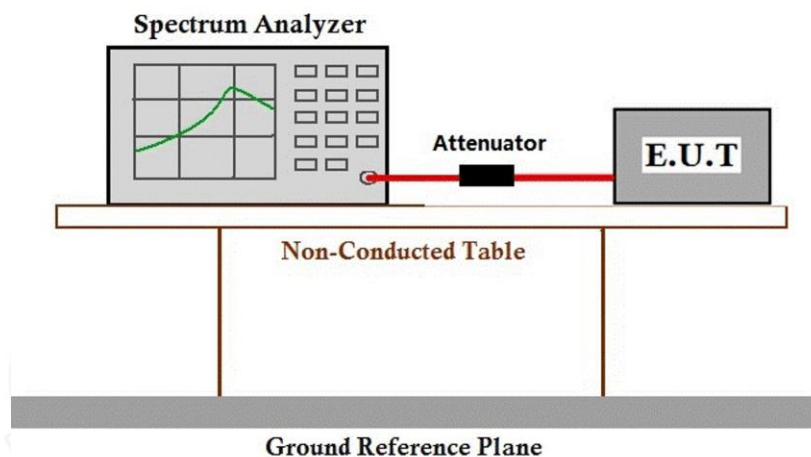
Test Requirement 47 CFR Part 15, Subpart C 15.247(d)

Test Method: ANSI C63.10 (2013) Section 7.8.8

Limit:

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

7.8.1 Test Setup Diagram



7.8.2 Measurement Procedure and Data

cable loss=0.83dB

Please Refer to Appendix for Details



7.9 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

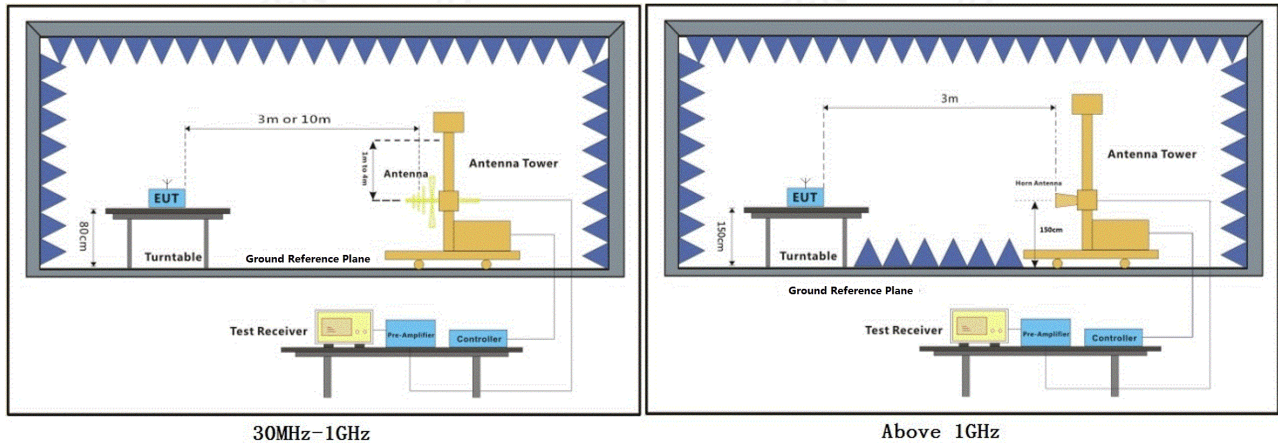
Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



7.9.1 Test Setup Diagram



7.9.2 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Reading Level + Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Note:1) Level = Reading level + Factor

2) Through pre-scan found the worst case is 2DH5 mode. Only the worst case is recorded in the report.



Test Mode: 01; Polarity: Horizontal; Modulation: 2DH5; Channel: Low

No.	Frequency (MHz)	Reading (dBuv)	Factor (dB/m)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	P/F
1	2310.000	65.25	-30.59	34.66	74.00	-39.34	peak	P
2	2390.000	67.77	-30.49	37.28	74.00	-36.72	peak	P
3	2400.000	71.69	-30.48	41.21	74.00	-32.79	peak	P

Test Mode: 01; Polarity: Vertical; Modulation: 2DH5; Channel: Low

No.	Frequency (MHz)	Reading (dBuv)	Factor (dB/m)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	P/F
1	2310.000	66.55	-30.59	35.96	74.00	-38.04	peak	P
2	2390.000	69.57	-30.49	39.08	74.00	-34.92	peak	P
3	2400.000	73.06	-30.48	42.58	74.00	-31.42	peak	P

Test Mode: 01; Polarity: Horizontal; Modulation: 2DH5; Channel: High

No.	Frequency (MHz)	Reading (dBuv)	Factor (dB/m)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	P/F
1	2483.500	79.27	-30.39	48.88	74.00	-25.12	peak	P
2	2500.000	74.98	-30.37	44.61	74.00	-29.39	peak	P

Test Mode: 01; Polarity: Vertical; Modulation: 2DH5; Channel: High

No.	Frequency (MHz)	Reading (dBuv)	Factor (dB/m)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	P/F
1	2483.500	77.71	-30.39	47.32	74.00	-26.68	peak	P
2	2500.000	74.79	-30.37	44.42	74.00	-29.58	peak	P



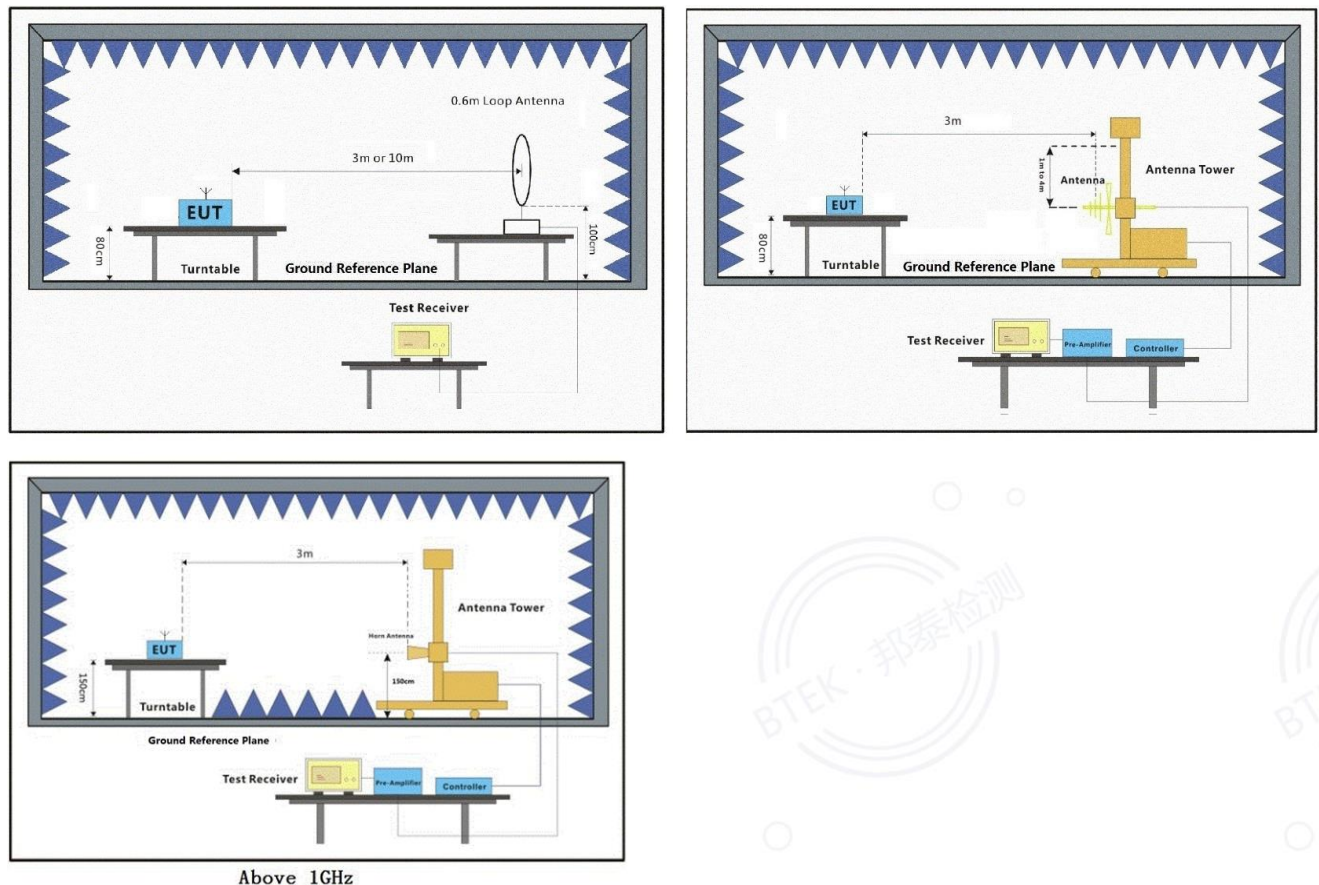
7.10 Radiated Spurious Emissions (Below 1GHz)

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6
Limit:

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

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

7.10.1 Test Setup Diagram



7.10.2 Measurement Procedure and Data

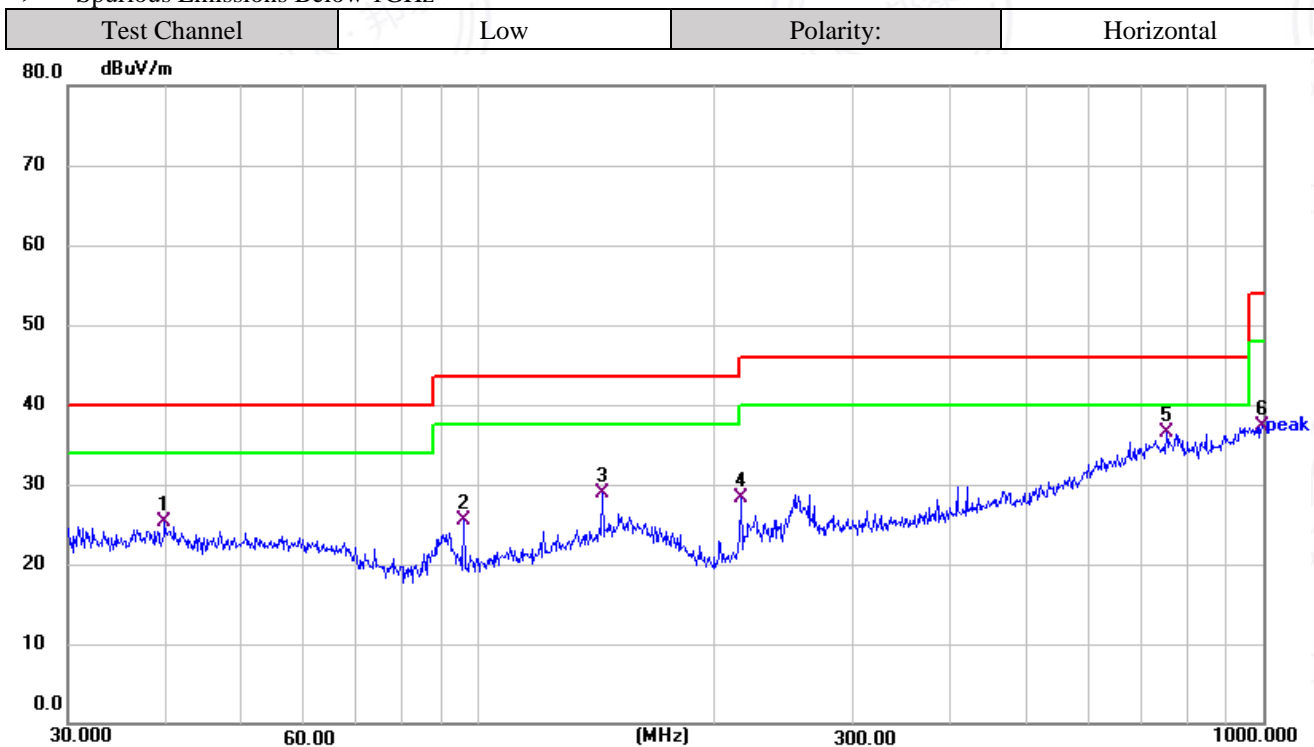
- For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.



- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
 - d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
 - e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
 - f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
 - g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
 - h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
 - i. Repeat above procedures until all frequencies measured was complete.
-
- a. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
 - b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
 - c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
 - d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
 - e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
 - f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
 - g. Test the EUT in the lowest channel, the middle channel, the Highest channel.
 - h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
 - i. Repeat above procedures until all frequencies measured was complete.



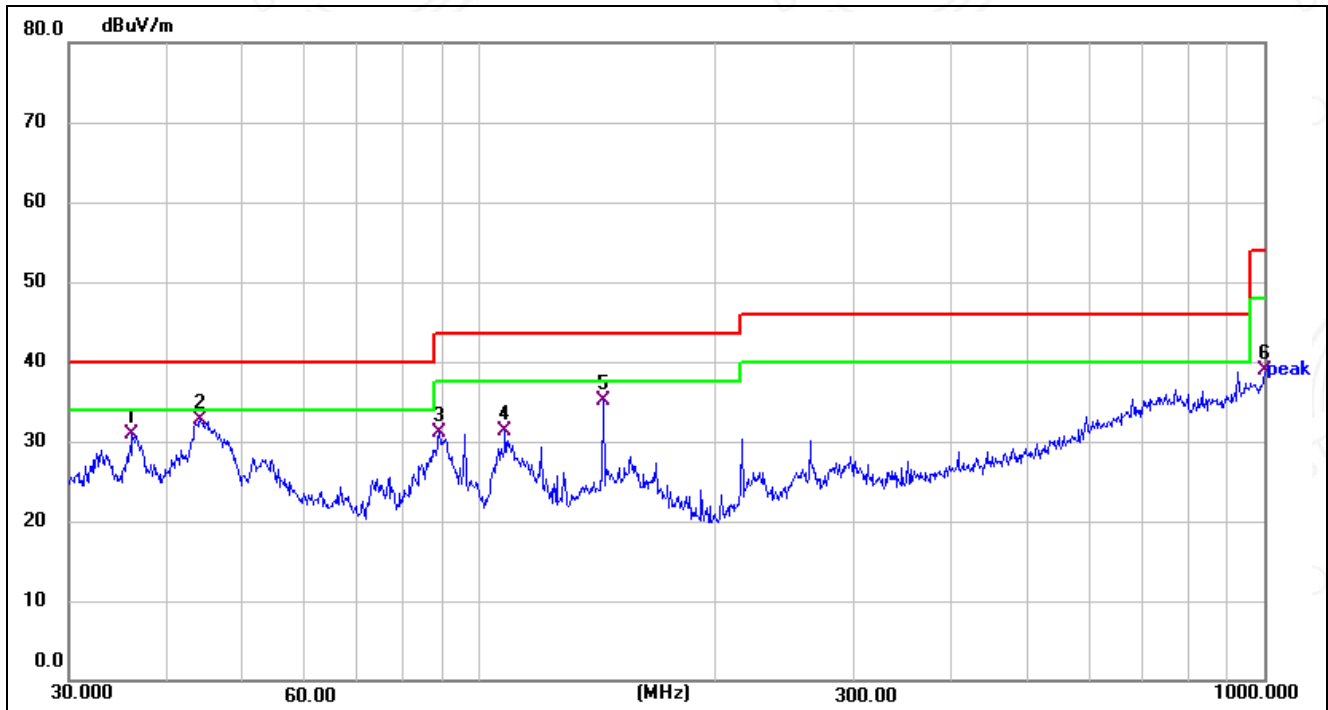
➤ Spurious Emissions Below 1GHz



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	39.8542	42.28	-16.90	25.38	40.00	-14.62	QP	200	360	P	
2	95.7622	46.77	-21.31	25.46	43.50	-18.04	QP	200	360	P	
3	143.8295	46.23	-17.26	28.97	43.50	-14.53	QP	200	360	P	
4	216.0240	48.95	-20.61	28.34	46.00	-17.66	QP	200	360	P	
5 *	752.7432	45.33	-8.80	36.53	46.00	-9.47	QP	200	360	P	
6	996.4996	44.13	-6.79	37.34	54.00	-16.66	QP	200	360	P	



Test Channel	Low	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Height (cm)	Azimuth (deg.)	P/F	Remark
1	36.1272	48.35	-17.38	30.97	40.00	-9.03	QP	100	360	P	
2 *	44.1202	50.54	-17.87	32.67	40.00	-7.33	QP	100	360	P	
3	88.9639	52.79	-21.78	31.01	43.50	-12.49	QP	100	360	P	
4	107.8877	51.35	-20.01	31.34	43.50	-12.16	QP	100	360	P	
5	143.8295	52.32	-17.26	35.06	43.50	-8.44	QP	100	360	P	
6	1000.0000	45.69	-6.71	38.98	54.00	-15.02	QP	100	360	P	

Remark:

- 1) Through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Reading Level + Factor

- 3) Scan from 9kHz to 1 GHz, the disturbance below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



2DH5 Low CH-*Vertical*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2632.000	55.80	-22.86	32.94	74.00	-41.06	peak
2	2632.000	45.65	-22.86	22.79	54.00	-31.21	AVG
3	5272.000	56.72	-14.14	42.58	74.00	-31.42	peak
4	5272.000	42.49	-14.14	28.35	54.00	-25.65	AVG
5	6580.000	52.94	-12.00	40.94	74.00	-33.06	peak
6	6580.000	40.33	-12.00	28.33	54.00	-25.67	AVG
7	8080.000	49.90	-7.93	41.97	74.00	-32.03	peak
8	8080.000	39.31	-7.93	31.38	54.00	-22.62	AVG
9	10276.000	47.17	-4.96	42.21	74.00	-31.79	peak
10	10276.000	37.81	-4.96	32.85	54.00	-21.15	AVG
11	11884.000	47.46	-3.98	43.48	74.00	-30.52	peak
12 *	11884.000	37.82	-3.98	33.84	54.00	-20.16	AVG

2DH5 Low CH-*Horizontal*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	3256.000	54.73	-20.47	34.26	74.00	-39.74	peak
2	3256.000	43.80	-20.47	23.33	54.00	-30.67	AVG
3	5596.000	53.47	-13.47	40.00	74.00	-34.00	peak
4	5596.000	40.98	-13.47	27.51	54.00	-26.49	AVG
5	8092.000	50.31	-7.90	42.41	74.00	-31.59	peak
6	8092.000	39.12	-7.90	31.22	54.00	-22.78	AVG
7	10384.000	48.26	-4.93	43.33	74.00	-30.67	peak
8	10384.000	37.54	-4.93	32.61	54.00	-21.39	AVG
9	11116.000	50.10	-4.58	45.52	74.00	-28.48	peak
10	11116.000	38.08	-4.58	33.50	54.00	-20.50	AVG
11	12892.000	47.77	-3.20	44.57	74.00	-29.43	peak
12 *	12892.000	36.80	-3.20	33.60	54.00	-20.40	AVG

2DH5 Mid CH-*Vertical*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5272.000	56.17	-14.14	42.03	74.00	-31.97	peak
2	5272.000	42.32	-14.14	28.18	54.00	-25.82	AVG
3	8800.000	49.36	-6.73	42.63	74.00	-31.37	peak
4	8800.000	37.63	-6.73	30.90	54.00	-23.10	AVG
5	9592.000	49.02	-5.62	43.40	74.00	-30.60	peak
6	9592.000	37.55	-5.62	31.93	54.00	-22.07	AVG
7	11116.000	48.27	-4.58	43.69	74.00	-30.31	peak
8 *	11116.000	38.18	-4.58	33.60	54.00	-20.40	AVG
9	11680.000	47.69	-4.13	43.56	74.00	-30.44	peak
10	11680.000	37.49	-4.13	33.36	54.00	-20.64	AVG
11	12772.000	47.55	-3.29	44.26	74.00	-29.74	peak
12	12772.000	36.88	-3.29	33.59	54.00	-20.41	AVG



2DH5 Mid CH-*Horizontal*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	5764.000	51.43	-13.25	38.18	74.00	-35.82	peak
2	5764.000	41.07	-13.25	27.82	54.00	-26.18	AVG
3	7084.000	50.60	-11.39	39.21	74.00	-34.79	peak
4	7084.000	39.91	-11.39	28.52	54.00	-25.48	AVG
5	8728.000	50.01	-6.86	43.15	74.00	-30.85	peak
6	8728.000	38.50	-6.86	31.64	54.00	-22.36	AVG
7	10300.000	48.21	-4.96	43.25	74.00	-30.75	peak
8	10300.000	38.17	-4.96	33.21	54.00	-20.79	AVG
9	11812.000	48.16	-4.03	44.13	74.00	-29.87	peak
10	11812.000	37.53	-4.03	33.50	54.00	-20.50	AVG
11	12904.000	46.97	-3.20	43.77	74.00	-30.23	peak
12 *	12904.000	36.87	-3.20	33.67	54.00	-20.33	AVG

2DH5 High CH-*Vertical*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	2632.000	58.19	-22.86	35.33	74.00	-38.67	peak
2	2632.000	46.34	-22.86	23.48	54.00	-30.52	AVG
3	4660.000	54.65	-16.19	38.46	74.00	-35.54	peak
4	4660.000	42.64	-16.19	26.45	54.00	-27.55	AVG
5	7240.000	50.67	-10.86	39.81	74.00	-34.19	peak
6	7240.000	40.17	-10.86	29.31	54.00	-24.69	AVG
7	9616.000	48.40	-5.59	42.81	74.00	-31.19	peak
8	9616.000	37.26	-5.59	31.67	54.00	-22.33	AVG
9	11860.000	48.22	-4.00	44.22	74.00	-29.78	peak
10	11860.000	37.49	-4.00	33.49	54.00	-20.51	AVG
11	12784.000	48.02	-3.29	44.73	74.00	-29.27	peak
12 *	12784.000	37.22	-3.29	33.93	54.00	-20.07	AVG

2DH5 High CH-*Horizontal*

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
1	3040.000	54.32	-20.72	33.60	74.00	-40.40	peak
2	3040.000	43.98	-20.72	23.26	54.00	-30.74	AVG
3	4000.000	53.22	-18.55	34.67	74.00	-39.33	peak
4	4000.000	42.79	-18.55	24.24	54.00	-29.76	AVG
5	5320.000	52.34	-14.02	38.32	74.00	-35.68	peak
6	5320.000	41.44	-14.02	27.42	54.00	-26.58	AVG
7	7552.000	51.34	-9.77	41.57	74.00	-32.43	peak
8	7552.000	39.68	-9.77	29.91	54.00	-24.09	AVG
9	9976.000	48.34	-5.12	43.22	74.00	-30.78	peak
10	9976.000	37.34	-5.12	32.22	54.00	-21.78	AVG
11	11128.000	50.20	-4.57	45.63	74.00	-28.37	peak
12 *	11128.000	38.39	-4.57	33.82	54.00	-20.18	AVG



Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

2) Through pre-scan found the worst case is 2DH5 mode. Only the worst case is recorded in the report.

3) Scan from 1GHz to 25GHz, the disturbance above 18GHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) The field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



8 Test Setup Photo

Refer to Appendix – Test Setup Photos.

9 EUT Constructional Details (EUT Photos)

Refer to Appendix - External and Internal Appendix EUT Photos

- End of the Report -

