



SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technological
Development District, Guangzhou, China 510663

Telephone: +86 (0) 20 82155555
Fax: +86 (0) 20 82075059
Email: ee.guangzhou@sgs.com

Report No.: GZEM180500270202
Page: 1 of 106
FCC ID: 2AEHM-EM01

TEST REPORT

Application No.: GZEM1805002702CR
Applicant: E&M ACTIVE LIMITED
Address of Applicant: THE INNOVATION CENTRE, HERE EAST, QUEEN ELIZABETH OLYMPIC PARK, LONDON E20 3BS, UNITED KINGDOM
Manufacturer: Shenzhen Pentasmart Technology Co.,Ltd
Address of Manufacturer: 4th Floor, No.2 Building, Youya Industrial Zone, Pinghu Street, Longgang District, Shenzhen.
Factory: Shenzhen Pentasmart Technology Co.,Ltd
Address of Factory: 4th Floor, No.2 Building, Youya Industrial Zone, Pinghu Street, Longgang District, Shenzhen.
Equipment Under Test (EUT):
FCC ID: 2AEHM-EM01
EUT Name: OPTIC MASSAGER
Model No.: EM01
Trade Mark: E&M ACTIVE / MAGICTOUCH
Standard(s) : 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2018-05-25
Date of Test: 2018-06-04 to 2018-06-10
Date of Issue: 2018-06-29

Test Result:	Pass
---------------------	-------------

* In the configuration tested, the EUT complied with the standards specified above.



Kobe Jian

EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 2 of 106

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2018-06-29		Original

Authorized for issue by:			
Tested By	 Lily_Kuang /Project Engineer	2018-06-04 to 2018-06-10 Date	
Checked By	 Ricky_Liu /Reviewer	2018-06-29 Date	



2 Test Summary

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

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



3 Contents

	Page
1 Cover Page.....	1
2 Test Summary.....	3
3 Contents.....	4
4 General Information	6
4.1 Details of E.U.T.....	6
4.2 Environment Parameter.....	6
4.3 Description of Support Units	8
4.4 Measurement Uncertainty.....	8
4.5 Test Location	8
4.6 Test Facility.....	9
4.7 Deviation from Standards	10
4.8 Abnormalities from Standard Conditions	10
5 Equipment List.....	11
6 Radio Spectrum Technical Requirement	14
6.1 Antenna Requirement.....	14
6.1.1 Test Requirement:	14
6.1.2 Conclusion.....	14
6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	15
6.2.1 Test Requirement:	15
6.2.2 Conclusion.....	15
7 Radio Spectrum Matter Test Results.....	16
7.1 Conducted Emissions at AC Power Line (150kHz-30MHz).....	16
7.1.1 E.U.T. Operation.....	17
7.1.2 Test Setup Diagram.....	17
7.1.3 Measurement Procedure and Data	17
7.2 Conducted Peak Output Power	20
7.2.1 E.U.T. Operation.....	20
7.2.2 Test Setup Diagram.....	20
7.2.3 Measurement Procedure and Data	20
7.3 20dB Bandwidth.....	21
7.3.1 E.U.T. Operation.....	21
7.3.2 Test Setup Diagram.....	21
7.3.3 Measurement Procedure and Data	21
7.4 Carrier Frequencies Separation.....	22
7.4.1 E.U.T. Operation.....	22
7.4.2 Test Setup Diagram.....	22
7.4.3 Measurement Procedure and Data	22
7.5 Hopping Channel Number	23
7.5.1 E.U.T. Operation.....	23
7.5.2 Test Setup Diagram.....	23
7.5.3 Measurement Procedure and Data	23
7.6 Dwell Time	24
7.6.1 E.U.T. Operation.....	24



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202

Page: 5 of 106

7.6.2	Test Setup Diagram.....	24
7.6.3	Measurement Procedure and Data	24
7.7	Conducted Band Edges Measurement.....	25
7.7.1	E.U.T. Operation.....	25
7.7.2	Test Setup Diagram.....	25
7.7.3	Measurement Procedure and Data	25
7.8	Conducted Spurious Emissions.....	26
7.8.1	E.U.T. Operation.....	26
7.8.2	Test Setup Diagram.....	26
7.8.3	Measurement Procedure and Data	26
7.9	Radiated Emissions which fall in the restricted bands.....	27
7.9.1	E.U.T. Operation.....	28
7.9.2	Test Setup Diagram.....	28
7.9.3	Measurement Procedure and Data	29
7.10	Radiated Spurious Emissions.....	32
7.10.1	E.U.T. Operation	33
7.10.2	Test Setup Diagram	33
7.10.3	Measurement Procedure and Data.....	34
8	Appendix	40
8.1	Appendix 15.247	40



4 General Information

4.1 Details of E.U.T.

Power Supply:	DC 5V 0.8A
Cable:	2 wires x about 1m unscreened DC output cable
Adaptive Type	N/A
Antenna Gain	0dBi
Antenna Type	Integral
Channel Spacing	1MHz
Modulation Type	GFSK, π /4DQPSK, 8DPSK
Number of Channels	79
Operation Frequency	2402MHz to 2480MHz
Power Class	N/A
Spectrum Spread Technology	Frequency Hopping Spread Spectrum(FHSS)

4.2 Environment Parameter

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Value	Temperature(°C)	Voltage(V)
TNVN	25	5
TLVN	-20	5
THVN	55	5

Note:

VN: Normal Voltage

TN: Normal Temperature

TL: Low Extreme

Test Temperature TH: High Extreme Test Temperature



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 7 of 106

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

Using test software was control EUT work in continuous transmitter and receiver mode.and select test channel as below:

Channel	Frequency
The lowest channel (CH0)	2402MHz
The middle channel (CH39)	2441MHz
The highest channel (CH78)	2480MHz



4.3 Description of Support Units

The EUT has been tested as an independent unit.

4.4 Measurement Uncertainty

RF

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.25 x 10 ⁻⁸
2	Timeout	2s
3	Duty cycle	0.37%
4	Occupied Bandwidth	3%
5	RF Conducted power	0.75dB
6	RF Power Density	2.84dB
7	Conducted Spurious Emissions	0.75dB
8	RF Radiated Power	4.5dB (below 1GHz)
		4.8dB (above 1GHz)
9	Radiated Spurious Emission Test	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-18GHz)
10	Temperature	0.4°C
11	Humidity	1.3%
12	Supply Voltages	1.5%
13	Time	3%

4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,
198 Kezhu Road, Sciencetech Park, Guangzhou Economic & Technology Development District,
Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.



4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

● **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

● **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

● **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2006 accreditation criteria for testing laboratories (identical to

ISO/IEC 17025:2005 General Requirements) for the Competence of Testing Laboratories.

● **FCC Recognized 2.948 Listed Test Firm(Registration No.: 282399)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

● **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818, Jul 13, 2017.

● **Industry Canada (Registration No.: 4620B-1)**

The 3m/10m Alternate Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Certification and Engineering of Industry Canada for radio equipment testing with Registration No. 4620B-1.

● **VCCI (Registration No.: R-2460, C-2584, G-449 and T-1179)**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2460, C-2584, G-449 and T-1179 respectively.

● **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.



4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None



5 Equipment List

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

Carrier Frequencies Separation					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

Hopping Channel Number					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

Dwell Time					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
MXA Signal Analyzer	AgilentTechnologies	N9020A	SEM004-10	2018-03-10	2019-03-09
ESG Vector Signal Generator	Keysight	E4438C	SEM006-03	2018-04-10	2019-04-10
EXG Analog Signal Generator	AgilentTechnologies	N5171B	SEM006-04	2017-07-26	2020-07-25
Power Meter	AgilentTechnologies	U2021XA_C h2	SEM009-02	2017-09-19	2018-09-18
Power Meter	AgilentTechnologies	U2021XA_C h3	SEM009-03	2017-09-19	2018-09-18
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202

Page: 12 of 106

Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EXA Signal Analyzer	AgilentTechnologies	N9010A	EMC2138	2017-11-15	2018-11-14

Radiated Emissions which fall in the restricted bands					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2018-01-19	2019-01-18
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2018-01-19	2019-01-18
chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9160	EMC2025	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6112B	EMC0524	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6143	EMC0519	2017-05-04	2020-05-03
Horn Antenna 1GHz-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2016-09-09	2019-09-08
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2018-01-08	2019-01-07
Amplifier	HP	8447F	EMC2065	2017-06-19	2018-06-18
Pre-Amplifier MH648A	ANRITSU CORP	MH648A	EMC2086	2017-11-20	2018-11-19
Active Loop Antenna	EMCO	6502	EMC0523	2018-02-24	2019-02-23
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2018-01-19	2019-01-18
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2018-01-08	2019-01-07
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2017-06-18	2019-06-18
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2017-11-29	2018-11-28
MXE EMI Receiver	Keysight	N9038A	EMC2139	2017-11-15	2018-11-14
EXA Signal Analyzer	Keysight	N9010A	EMC2138	2017-11-15	2018-11-14



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202

Page: 13 of 106

Radiated Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2018-01-19	2019-01-18
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2018-01-19	2019-01-18
chamber cable	HangTianXing	N/A	EMC0542	2017-06-30	2019-06-30
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKME SS-ELEKTRONIK	VULB 9160	EMC2025	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6112B	EMC0524	2016-09-08	2019-09-07
Bi-log Type Antenna	Schaffner -Chase	CBL6143	EMC0519	2017-05-04	2020-05-03
Horn Antenna 1GHz-18GHz	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120D	EMC2026	2016-09-09	2019-09-08
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2018-01-08	2019-01-07
Amplifier	HP	8447F	EMC2065	2017-06-19	2018-06-18
Pre-Amplifier MH648A	ANRITSU CORP	MH648A	EMC2086	2017-11-20	2018-11-19
Active Loop Antenna	EMCO	6502	EMC0523	2018-02-24	2019-02-23
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2018-01-19	2019-01-18
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2018-01-08	2019-01-07
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2017-06-18	2019-06-18
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2017-11-29	2018-11-28
MXE EMI Receiver	Keysight	N9038A	EMC2139	2017-11-15	2018-11-14
EXA Signal Analyzer	Keysight	N9010A	EMC2138	2017-11-15	2018-11-14

General used equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DMM	Fluke	73	EMC0006	2017-07-26	2018-07-25
DMM	Fluke	73	EMC0007	2017-07-26	2018-07-25



6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

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

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.



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)

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

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 s



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(dB μ V)	
	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.

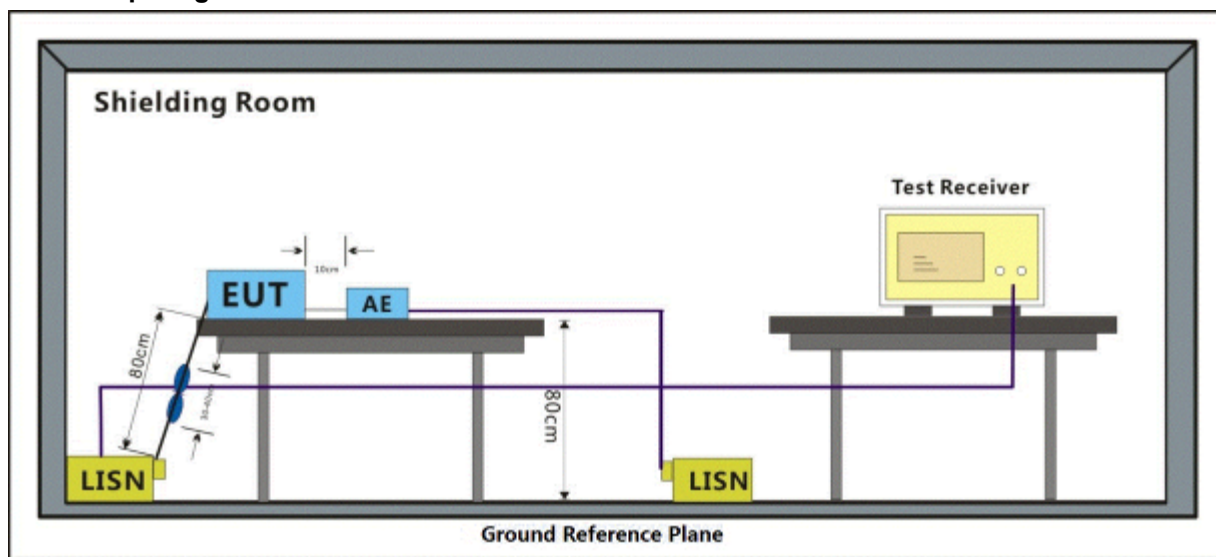
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 25 °C Humidity: 57.9 % RH Atmospheric Pressure: 1020 mbar

Test mode b:Charge + TX_non-Hop mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.1.2 Test Setup Diagram

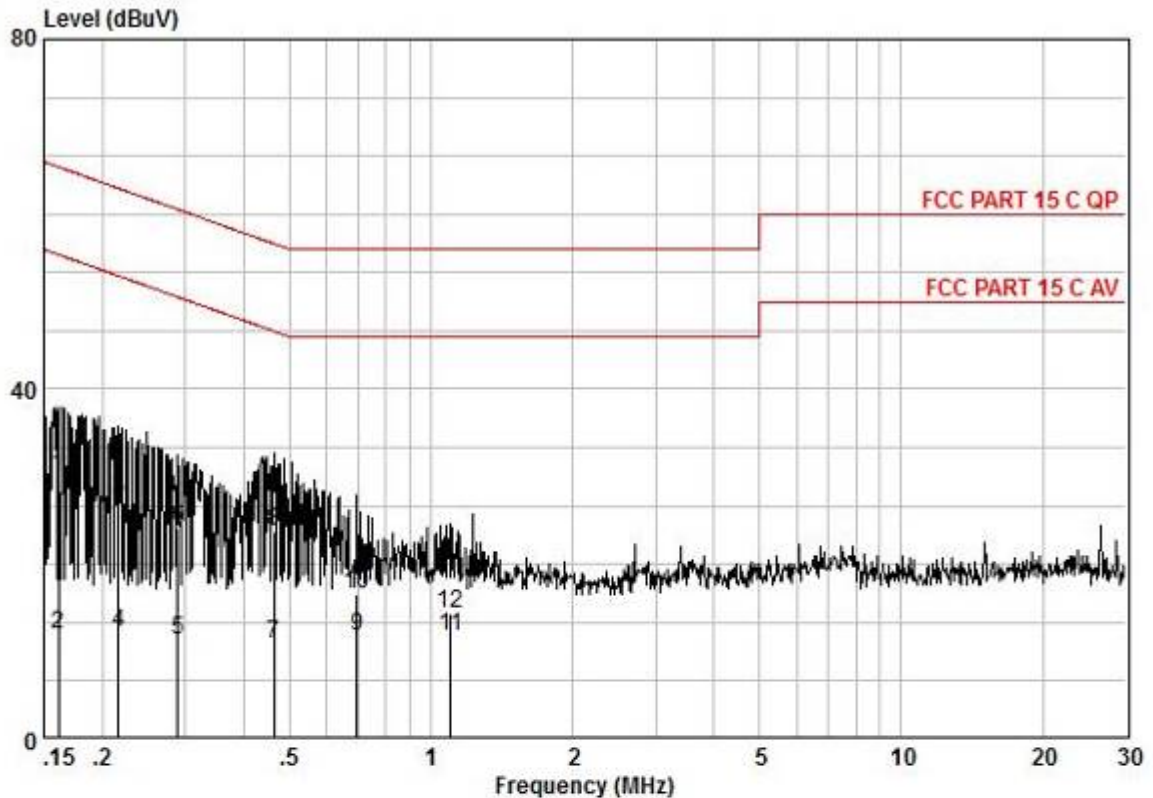


7.1.3 Measurement Procedure and Data

- 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/50 μ H + 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.

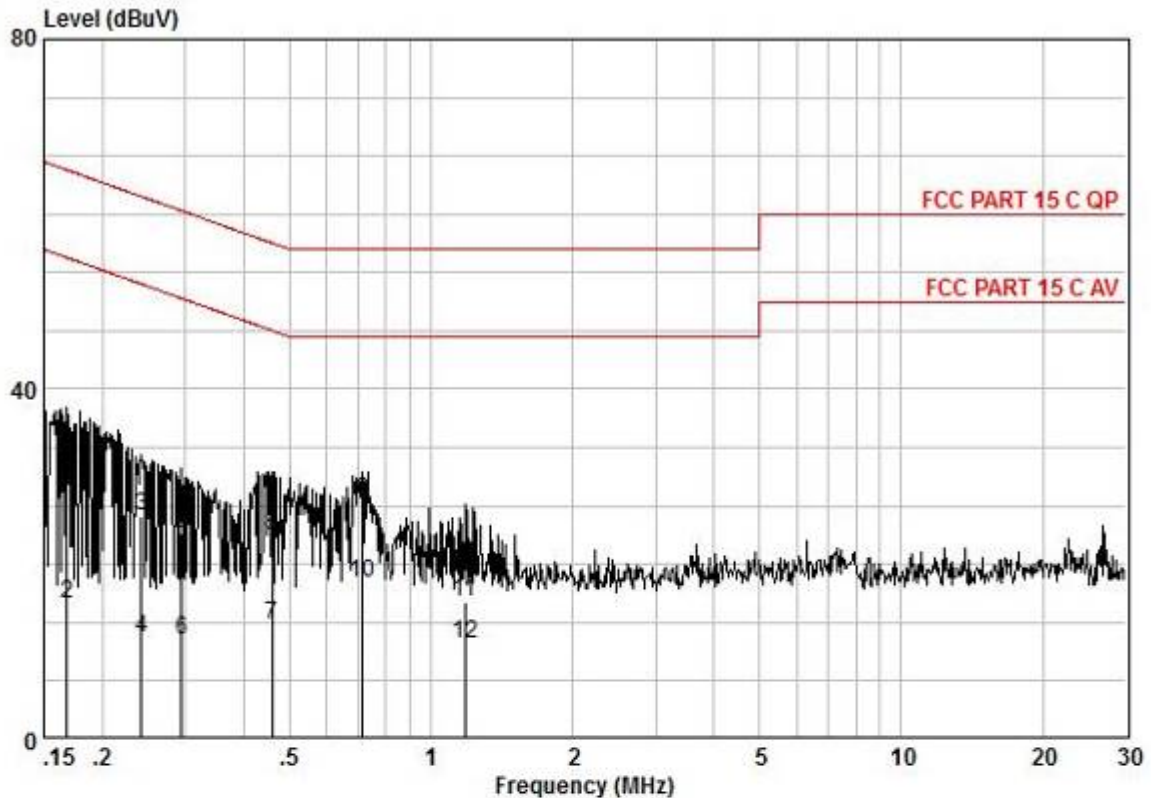
Remark: LISN=Read Level+ Cable Loss+ LISN Factor

Mode:b; Line:Live Line



Pol	:LIVE							
No	:							
Model	:							
Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark	
0,16	20,50	0,10	9,50	30,10	65,38	-35,28	QP	
0,16	2,41	0,10	9,50	12,01	58,20	-46,19	AVERAGE	
0,22	17,65	0,11	9,62	27,38	62,96	-35,58	QP	
0,22	2,49	0,11	9,62	12,22	55,05	-42,83	AVERAGE	
0,29	1,51	0,14	9,63	11,28	51,91	-40,62	AVERAGE	
0,29	14,52	0,14	9,63	24,29	60,54	-36,25	QP	
0,46	1,04	0,19	9,65	10,88	46,81	-35,93	AVERAGE	
0,46	13,83	0,19	9,65	23,67	56,63	-32,96	QP	
0,70	1,88	0,25	9,61	11,74	46,00	-34,26	AVERAGE	
0,70	6,79	0,25	9,61	16,65	56,00	-39,35	QP	
1,10	1,74	0,30	9,63	11,67	46,00	-34,33	AVERAGE	
1,10	4,49	0,30	9,63	14,42	56,00	-41,58	QP	

Mode:b; Line:Neutral Line



Pol : NEUTRAL
No :
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuV	Limit Line dBuV	Over limit dB	Remark
0,17	20,65	0,10	9,46	30,21	65,03	-34,82	QP
0,17	5,94	0,10	9,46	15,50	57,74	-42,24	AVERAGE
0,24	15,84	0,12	9,58	25,54	62,04	-36,50	QP
0,24	1,77	0,12	9,58	11,47	53,85	-42,38	AVERAGE
0,29	13,77	0,14	9,57	23,49	60,41	-36,93	QP
0,29	1,55	0,14	9,57	11,27	51,73	-40,47	AVERAGE
0,46	3,24	0,19	9,55	12,98	46,93	-33,94	AVERAGE
0,46	13,64	0,19	9,55	23,38	56,71	-33,33	QP
0,72	17,35	0,25	9,59	27,19	56,00	-28,81	QP
0,72	8,13	0,25	9,59	17,97	46,00	-28,03	AVERAGE
1,18	5,79	0,30	9,57	15,66	56,00	-40,34	QP
1,18	1,08	0,30	9,57	10,95	46,00	-35,05	AVERAGE

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:

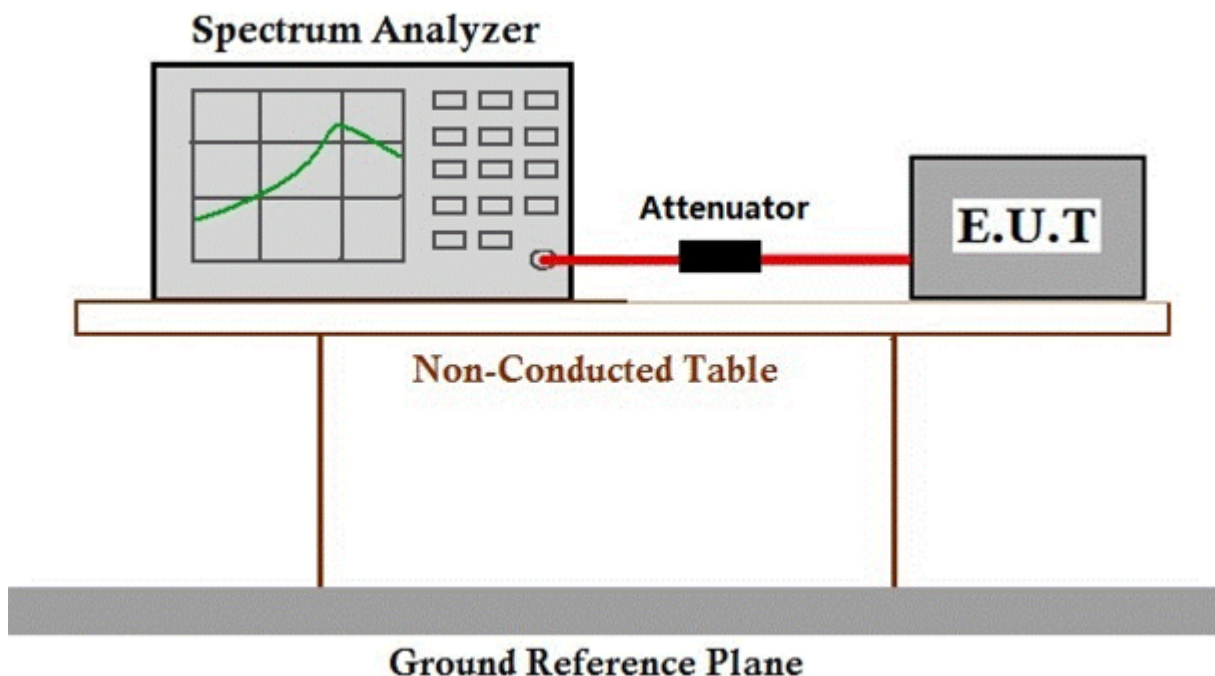
Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation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

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.2 % RH Atmospheric Pressure: 1020 mbar

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

7.3 20dB Bandwidth

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

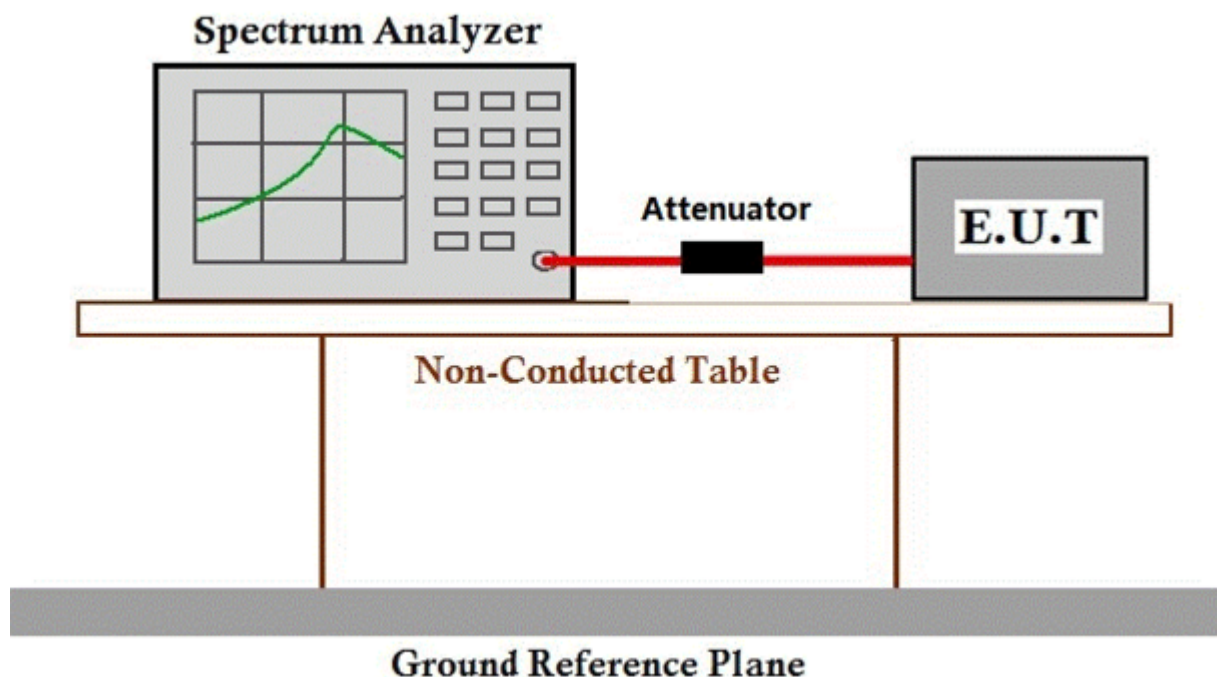
Test Method: ANSI C63.10 (2013) Section 7.8.7

7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.1 % RH Atmospheric Pressure: 1020 mbar

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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

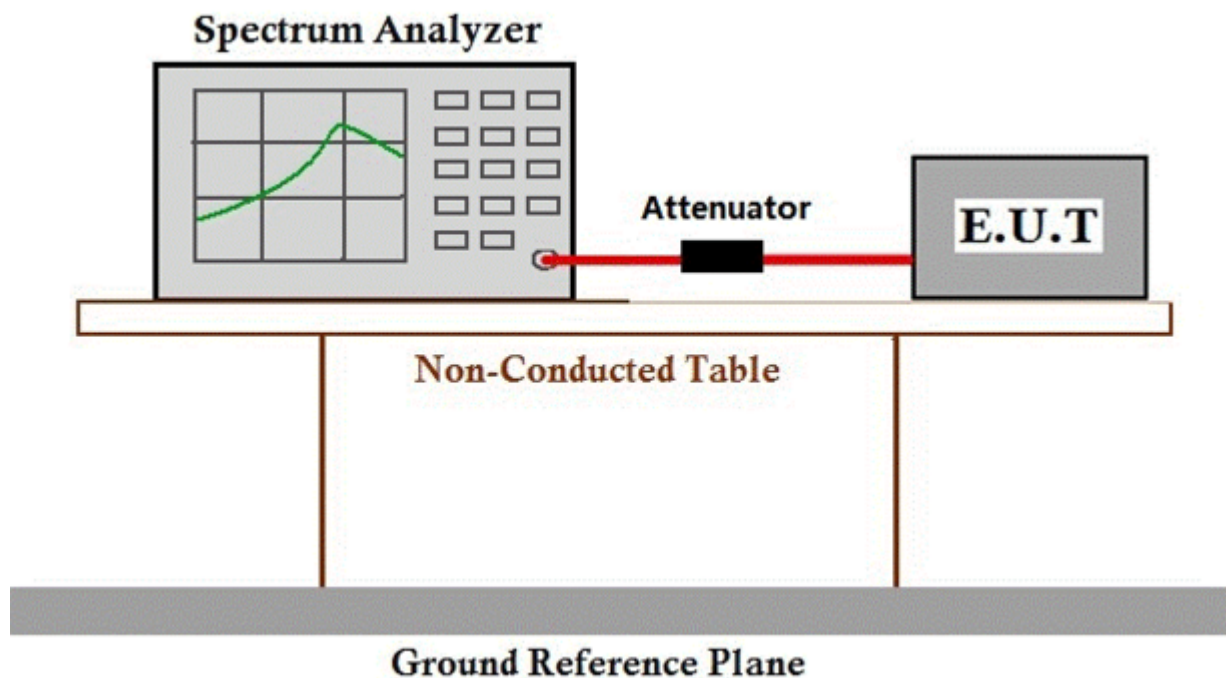
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.2 % RH Atmospheric Pressure: 1020 mbar

Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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:

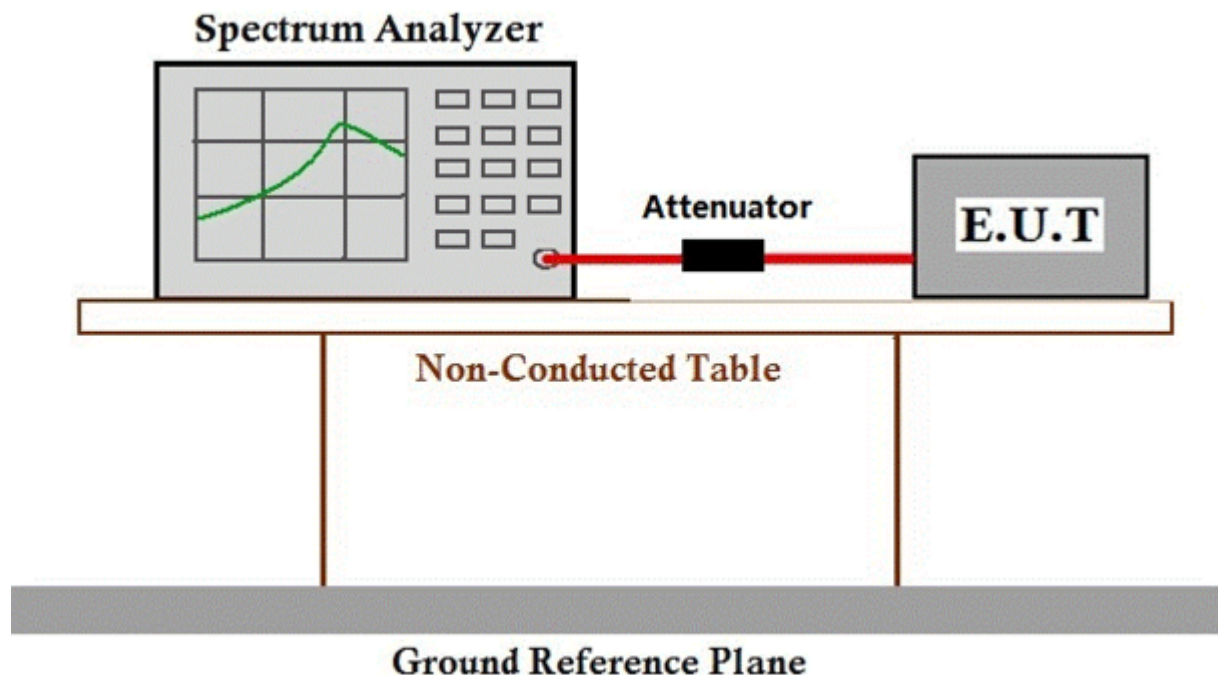
Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.2 % RH Atmospheric Pressure: 1020 mbar
Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

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

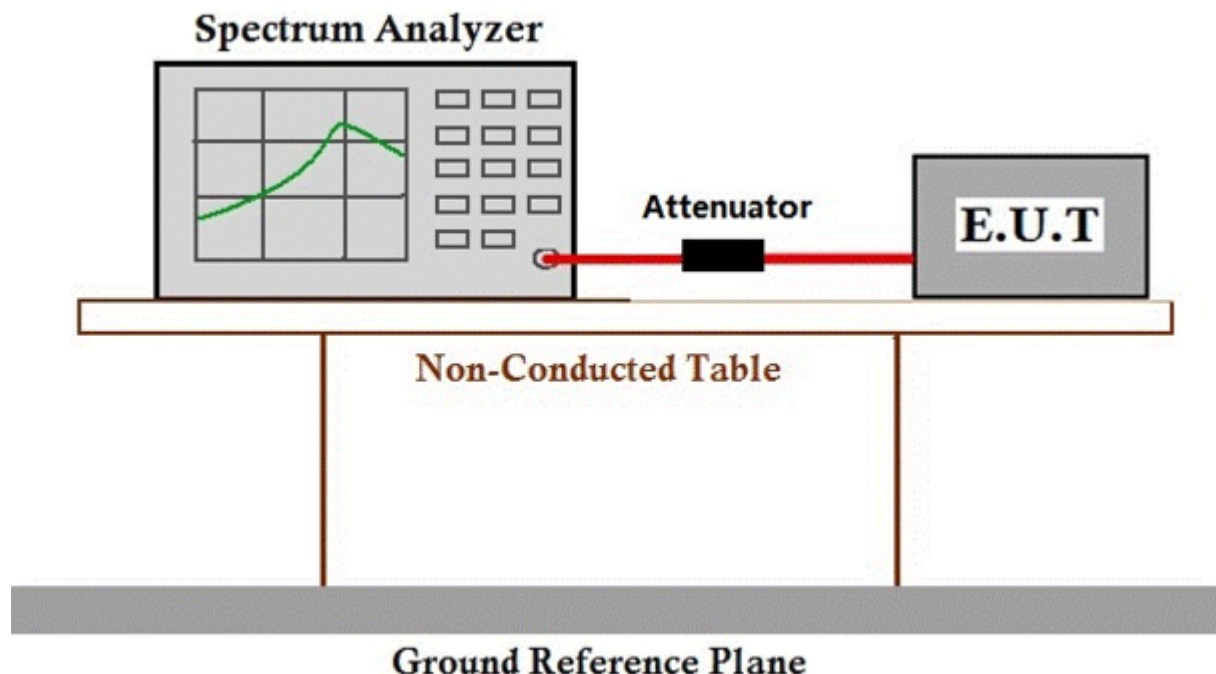
7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.3 % RH Atmospheric Pressure: 1020 mbar

Test mode: a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.6.2 Test Setup Diagram



7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

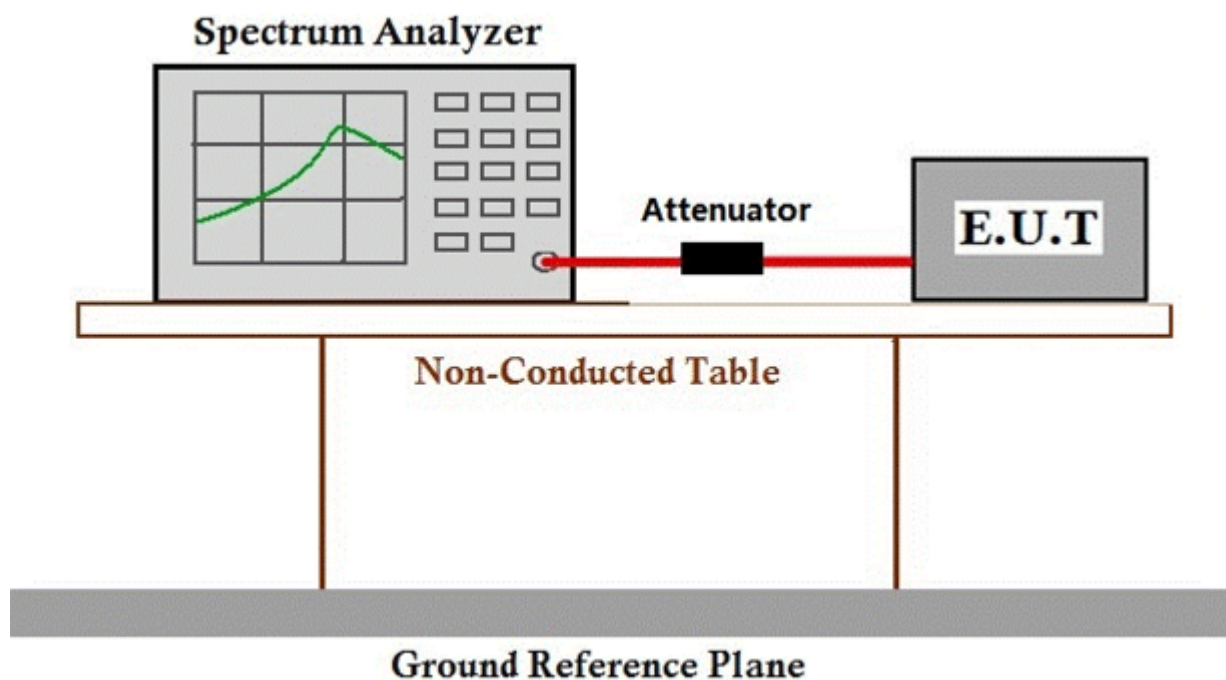
7.7 Conducted Band Edges Measurement

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 E.U.T. Operation

Operating Environment:					
Temperature:	23.8 °C	Humidity:	60.3 % RH	Atmospheric Pressure:	1020 mbar
Test mode	a:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.				

7.7.2 Test Setup Diagram



7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247

7.8 Conducted Spurious Emissions

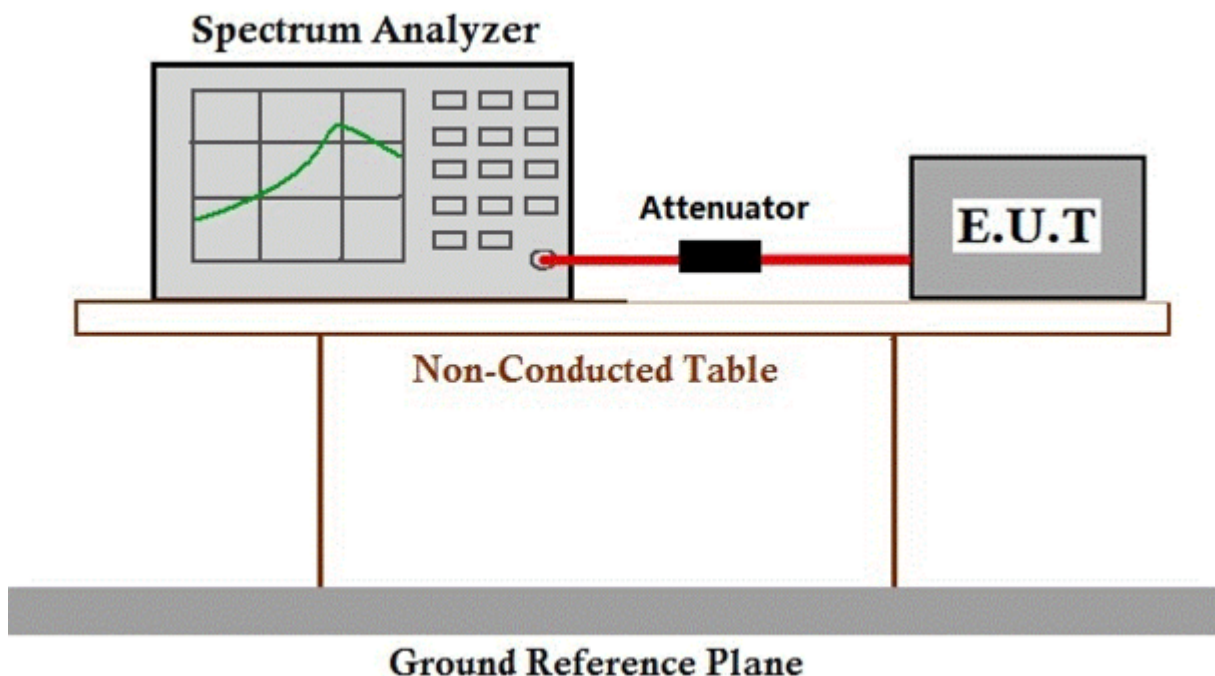
Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.8
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional 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 E.U.T. Operation

Operating Environment:

Temperature: 23.8 °C Humidity: 60.3 % RH Atmospheric Pressure: 1020 mbar

7.8.2 Test Setup Diagram



7.8.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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
Measurement Distance: 3m
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.

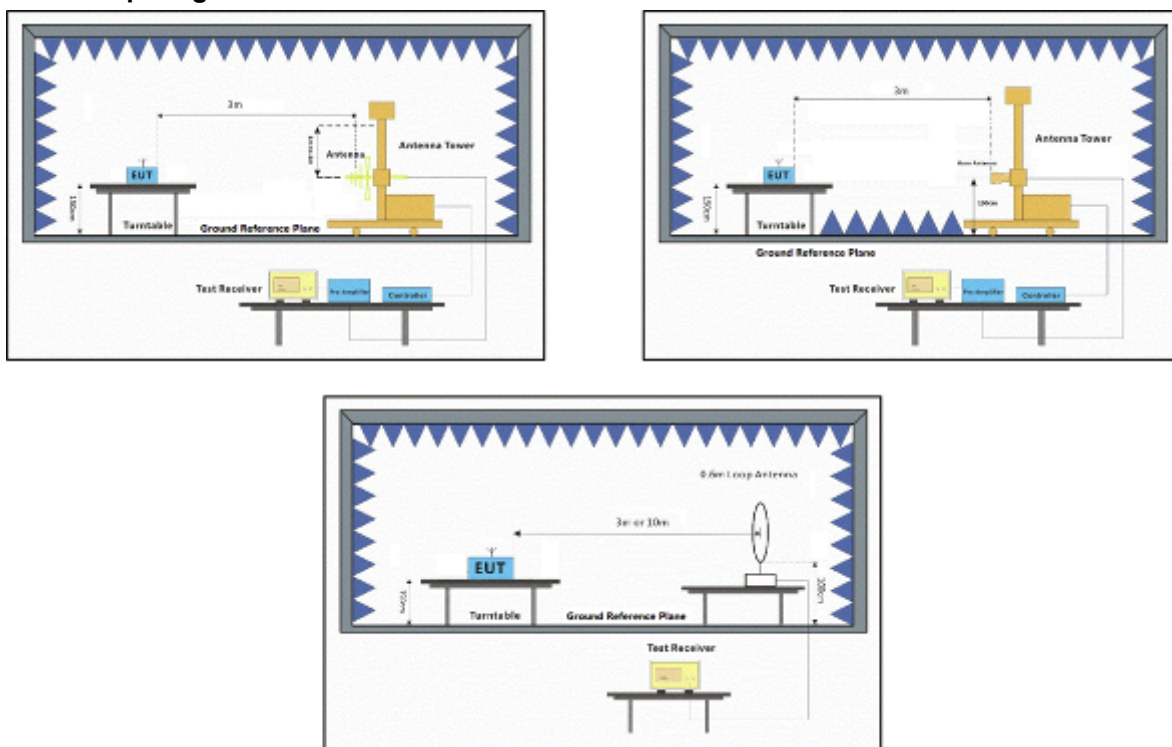
7.9.1 E.U.T. Operation

Operating Environment:

Temperature: 23 °C Humidity: 55 % RH Atmospheric Pressure: 1020 mbar

Test mode b:Charge + TX_non-Hop mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.9.2 Test Setup Diagram



7.9.3 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 middle 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: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamplifier Factor}$

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.

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark	
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	2310.000	33.59	26.25	5.03	37.44	27.43	54.00	-26.57	HORIZONTAL Average
2	2310.000	46.45	26.25	5.03	37.44	40.29	74.00	-33.71	HORIZONTAL Peak
3	2390.000	35.02	26.43	4.88	37.42	28.91	54.00	-25.09	HORIZONTAL Average
4	2390.000	46.15	26.43	4.88	37.42	40.04	74.00	-33.96	HORIZONTAL Peak
5	2483.500	34.51	26.58	5.23	37.40	28.92	54.00	-25.08	HORIZONTAL Average
6	2483.500	47.18	26.58	5.23	37.40	41.59	74.00	-32.41	HORIZONTAL Peak
7	2500.000	34.83	26.60	4.95	37.39	28.99	54.00	-25.01	HORIZONTAL Average
8	2500.000	47.56	26.60	4.95	37.39	41.72	74.00	-32.28	HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark		
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	2310.000	34.88	26.25	5.03	37.44	28.72	54.00	-25.28	VERTICAL	Average
2	2310.000	47.57	26.25	5.03	37.44	41.41	74.00	-32.59	VERTICAL	Peak
3	2390.000	33.82	26.43	4.88	37.42	27.71	54.00	-26.29	VERTICAL	Average
4	2390.000	46.45	26.43	4.88	37.42	40.34	74.00	-33.66	VERTICAL	Peak
5	2483.500	34.26	26.58	5.23	37.40	28.67	54.00	-25.33	VERTICAL	Average
6	2483.500	49.93	26.58	5.23	37.40	44.34	74.00	-29.66	VERTICAL	Peak
7	2500.000	34.27	26.60	4.95	37.39	28.43	54.00	-25.57	VERTICAL	Average
8	2500.000	47.55	26.60	4.95	37.39	41.71	74.00	-32.29	VERTICAL	Peak

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	34.65	26.25	5.03	37.44	28.49	54.00	-25.51 HORIZONTAL Average
2	2310.000	46.52	26.25	5.03	37.44	40.36	74.00	-33.64 HORIZONTAL Peak
3	2390.000	34.47	26.43	4.88	37.42	28.36	54.00	-25.64 HORIZONTAL Average
4	2390.000	47.34	26.43	4.88	37.42	41.23	74.00	-32.77 HORIZONTAL Peak
5	2483.500	43.71	26.58	5.23	37.40	38.12	54.00	-15.88 HORIZONTAL Average
6	2483.500	60.45	26.58	5.23	37.40	54.86	74.00	-19.14 HORIZONTAL Peak
7	2500.000	35.34	26.60	4.95	37.39	29.50	54.00	-24.50 HORIZONTAL Average
8	2500.000	46.90	26.60	4.95	37.39	41.06	74.00	-32.94 HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB
1	2310.000	33.04	26.25	5.03	37.44	26.88	54.00	-27.12 VERTICAL Average
2	2310.000	47.00	26.25	5.03	37.44	40.84	74.00	-33.16 VERTICAL Peak
3	2390.000	33.24	26.43	4.88	37.42	27.13	54.00	-26.87 VERTICAL Average
4	2390.000	46.86	26.43	4.88	37.42	40.75	74.00	-33.25 VERTICAL Peak
5	2483.500	33.61	26.58	5.23	37.40	28.02	54.00	-25.98 VERTICAL Average
6	2483.500	47.44	26.58	5.23	37.40	41.85	74.00	-32.15 VERTICAL Peak
7	2500.000	34.38	26.60	4.95	37.39	28.54	54.00	-25.46 VERTICAL Average
8	2500.000	47.54	26.60	4.95	37.39	41.70	74.00	-32.30 VERTICAL Peak



7.10 Radiated Spurious Emissions

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
Measurement Distance: 3m
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.

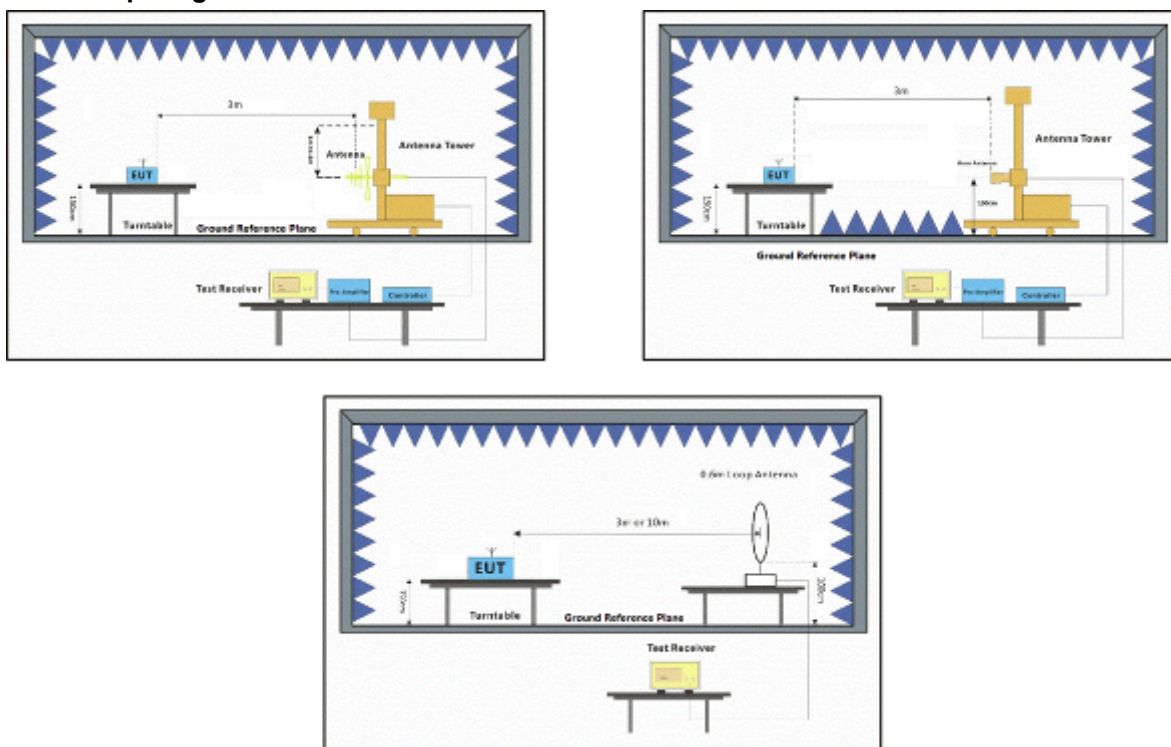
7.10.1 E.U.T. Operation

Operating Environment:

Temperature: 23 °C Humidity: 55 % RH Atmospheric Pressure: 1020 mbar

Test mode b:Charge + TX_non-Hop mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation, $\pi/4$ DQPSK modulation, 8DPSK modulation. All modes have been tested and only the data of worst case is recorded in the report.

7.10.2 Test Setup Diagram



7.10.3 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 middle 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) For emission below 1GHz, 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 = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and 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.
- 4) 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

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	31.620	20.77	12.24	0.10	21.79	11.32	40.00	-28.68	HORIZONTAL QP
2	50.409	24.01	12.98	0.60	24.88	12.71	40.00	-27.29	HORIZONTAL QP
3	137.903	27.26	13.01	1.02	28.16	13.13	43.50	-30.37	HORIZONTAL QP
4	191.745	27.72	11.74	1.26	28.22	12.50	43.50	-31.00	HORIZONTAL QP
5	515.437	28.08	18.47	2.28	29.88	18.95	46.00	-27.05	HORIZONTAL QP
6	807.429	28.61	22.78	2.76	28.63	25.52	46.00	-20.48	HORIZONTAL QP

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	4804.110	42.41	30.79	5.87	36.94	42.13	54.00	-11.87	HORIZONTAL Average
2	4804.110	53.33	30.79	5.87	36.94	53.05	74.00	-20.95	HORIZONTAL Peak
3	5864.443	32.23	32.22	7.44	37.00	34.89	54.00	-19.11	HORIZONTAL Average
4	5864.443	45.51	32.22	7.44	37.00	48.17	74.00	-25.83	HORIZONTAL Peak
5	7206.070	33.81	35.45	7.34	36.93	39.67	54.00	-14.33	HORIZONTAL Average
6	7206.070	44.56	35.45	7.34	36.93	50.42	74.00	-23.58	HORIZONTAL Peak
7	8588.607	32.53	36.16	7.98	36.95	39.72	54.00	-14.28	HORIZONTAL Average
8	8588.607	44.18	36.16	7.98	36.95	51.37	74.00	-22.63	HORIZONTAL Peak
9	9608.577	32.80	37.51	8.15	37.08	41.38	54.00	-12.62	HORIZONTAL Average
10	9608.577	44.44	37.51	8.15	37.08	53.02	74.00	-20.98	HORIZONTAL Peak
11	12010.160	31.31	39.50	10.67	37.20	44.28	54.00	-9.72	HORIZONTAL Average
12	12010.160	42.65	39.50	10.67	37.20	55.62	74.00	-18.38	HORIZONTAL Peak



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 36 of 106

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	30.000	23.60	12.20	0.05	21.45	14.40	40.00	-25.60 VERTICAL QP
2	37.812	22.37	12.55	0.46	23.31	12.07	40.00	-27.93 VERTICAL QP
3	57.999	23.74	12.30	0.58	25.18	11.44	40.00	-28.56 VERTICAL QP
4	138.874	26.38	13.06	1.03	28.16	12.31	43.50	-31.19 VERTICAL QP
5	188.413	26.81	12.10	1.29	28.17	12.03	43.50	-31.47 VERTICAL QP
6	824.597	28.81	22.97	2.82	28.57	26.03	46.00	-19.97 VERTICAL QP

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:Low

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dBuV/m	dBuV/m	dB	
1	3598.203	35.27	28.14	6.39	36.94	32.86	54.00	-21.14 VERTICAL Average
2	3598.203	46.00	28.14	6.39	36.94	43.59	74.00	-30.41 VERTICAL Peak
3	4804.058	37.31	30.79	5.87	36.94	37.03	54.00	-16.97 VERTICAL Average
4	4804.058	48.92	30.79	5.87	36.94	48.64	74.00	-25.36 VERTICAL Peak
5	7206.461	34.42	35.45	7.34	36.93	40.28	54.00	-13.72 VERTICAL Average
6	7206.461	45.02	35.45	7.34	36.93	50.88	74.00	-23.12 VERTICAL Peak
7	9608.710	31.97	37.51	8.15	37.08	40.55	54.00	-13.45 VERTICAL Average
8	9608.710	44.85	37.51	8.15	37.08	53.43	74.00	-20.57 VERTICAL Peak
9	12010.350	31.08	39.50	10.67	37.20	44.05	54.00	-9.95 VERTICAL Average
10	12010.350	44.60	39.50	10.67	37.20	57.57	74.00	-16.43 VERTICAL Peak
11	13797.090	21.11	40.87	12.22	35.30	38.90	54.00	-15.10 VERTICAL Average
12	13797.090	33.66	40.87	12.22	35.30	51.45	74.00	-22.55 VERTICAL Peak

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:middle

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark	
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	3725.195	34.16	28.64	7.42	36.92	33.30	54.00	-20.70	HORIZONTAL Average
2	3725.195	45.32	28.64	7.42	36.92	44.46	74.00	-29.54	HORIZONTAL Peak
3	4882.043	43.49	30.95	6.86	36.95	44.35	54.00	-9.65	HORIZONTAL Average
4	4882.043	53.82	30.95	6.86	36.95	54.68	74.00	-19.32	HORIZONTAL Peak
5	6507.536	35.92	34.30	7.07	36.98	40.31	54.00	-13.69	HORIZONTAL Average
6	6507.536	47.60	34.30	7.07	36.98	51.99	74.00	-22.01	HORIZONTAL Peak
7	7323.254	35.87	35.74	7.39	36.92	42.08	54.00	-11.92	HORIZONTAL Average
8	7323.254	46.12	35.74	7.39	36.92	52.33	74.00	-21.67	HORIZONTAL Peak
9	9764.916	33.37	37.70	8.33	37.09	42.31	54.00	-11.69	HORIZONTAL Average
10	9764.916	45.28	37.70	8.33	37.09	54.22	74.00	-19.78	HORIZONTAL Peak
11	12205.540	30.44	39.21	10.98	37.06	43.57	54.00	-10.43	HORIZONTAL Average
12	12205.540	43.69	39.21	10.98	37.06	56.82	74.00	-17.18	HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:middle

	Freq	ReadAntenna Level Factor	Cable Preamp Loss Factor	Level	Limit	Over	Pol/Phase	Remark		
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	3924.135	35.06	29.35	7.47	36.91	34.97	54.00	-19.03	VERTICAL	Average
2	3924.135	45.73	29.35	7.47	36.91	45.64	74.00	-28.36	VERTICAL	Peak
3	4882.307	39.14	30.95	6.86	36.95	40.00	54.00	-14.00	VERTICAL	Average
4	4882.307	52.87	30.95	6.86	36.95	53.73	74.00	-20.27	VERTICAL	Peak
5	6377.195	32.84	33.91	6.99	36.99	36.75	54.00	-17.25	VERTICAL	Average
6	6377.195	43.82	33.91	6.99	36.99	47.73	74.00	-26.27	VERTICAL	Peak
7	7323.070	33.85	35.74	7.39	36.92	40.06	54.00	-13.94	VERTICAL	Average
8	7323.070	45.25	35.74	7.39	36.92	51.46	74.00	-22.54	VERTICAL	Peak
9	9764.371	32.99	37.70	8.33	37.09	41.93	54.00	-12.07	VERTICAL	Average
10	9764.371	44.69	37.70	8.33	37.09	53.63	74.00	-20.37	VERTICAL	Peak
11	12205.210	30.74	39.21	10.98	37.06	43.87	54.00	-10.13	VERTICAL	Average
12	12205.210	41.46	39.21	10.98	37.06	54.59	74.00	-19.41	VERTICAL	Peak

Mode:b; Polarization:Horizontal; Modulation:GFSK; ; Channel:High

	Freq	ReadAntenna	Cable	Preamp		Limit	Over		
	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	3790.361	34.33	28.97	7.83	36.92	34.21	54.00	-19.79	HORIZONTAL Average
2	3790.361	44.65	28.97	7.83	36.92	44.53	74.00	-29.47	HORIZONTAL Peak
3	4960.307	44.63	31.05	7.84	36.96	46.56	54.00	-7.44	HORIZONTAL Average
4	4960.307	54.66	31.05	7.84	36.96	56.59	74.00	-17.41	HORIZONTAL Peak
5	7440.052	31.16	35.92	7.43	36.92	37.59	54.00	-16.41	HORIZONTAL Average
6	7440.052	43.90	35.92	7.43	36.92	50.33	74.00	-23.67	HORIZONTAL Peak
7	9920.272	32.15	37.92	8.63	37.10	41.60	54.00	-12.40	HORIZONTAL Average
8	9920.272	44.00	37.92	8.63	37.10	53.45	74.00	-20.55	HORIZONTAL Peak
9	12400.920	31.28	38.93	11.17	36.90	44.48	54.00	-9.52	HORIZONTAL Average
10	12400.920	43.75	38.93	11.17	36.90	56.95	74.00	-17.05	HORIZONTAL Peak
11	13984.540	24.37	41.20	11.95	35.20	42.32	54.00	-11.68	HORIZONTAL Average
12	13984.540	36.10	41.20	11.95	35.20	54.05	74.00	-19.95	HORIZONTAL Peak

Mode:b; Polarization:Vertical; Modulation:GFSK; ; Channel:High

	Freq	ReadAntenna	Cable	Preamp		Limit	Over		
	Level	Factor	Loss	Factor	Level	Line	Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	3347.371	36.46	27.90	5.57	36.98	32.95	54.00	-21.05	VERTICAL Average
2	3347.371	46.18	27.90	5.57	36.98	42.67	74.00	-31.33	VERTICAL Peak
3	4960.110	44.01	31.05	7.84	36.96	45.94	54.00	-8.06	VERTICAL Average
4	4960.110	53.40	31.05	7.84	36.96	55.33	74.00	-18.67	VERTICAL Peak
5	6414.167	36.56	34.03	7.01	36.99	40.61	54.00	-13.39	VERTICAL Average
6	6414.167	48.74	34.03	7.01	36.99	52.79	74.00	-21.21	VERTICAL Peak
7	7440.309	38.15	35.92	7.43	36.92	44.58	54.00	-9.42	VERTICAL Average
8	7440.309	49.29	35.92	7.43	36.92	55.72	74.00	-18.28	VERTICAL Peak
9	9920.795	34.20	37.92	8.63	37.10	43.65	54.00	-10.35	VERTICAL Average
10	9920.795	45.26	37.92	8.63	37.10	54.71	74.00	-19.29	VERTICAL Peak
11	12400.020	28.73	38.93	11.17	36.90	41.93	54.00	-12.07	VERTICAL Average
12	12400.020	41.96	38.93	11.17	36.90	55.16	74.00	-18.84	VERTICAL Peak



SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 39 of 106



8 Appendix

8.1 Appendix 15.247

1.20 dB Bandwidth

Test Mode	Test Channel	OBW[MHz]	EBW[MHz]	Limit[MHz]	Verdict
DH5	2402	0.95584	1.110	---	PASS
DH5	2441	0.95653	1.110	---	PASS
DH5	2480	0.95369	1.111	---	PASS
2DH5	2402	1.2675	1.409	---	PASS
2DH5	2441	1.2636	1.404	---	PASS
2DH5	2480	1.2678	1.403	---	PASS
3DH5	2402	1.2378	1.377	---	PASS
3DH5	2441	1.2388	1.375	---	PASS
3DH5	2480	1.2387	1.379	---	PASS

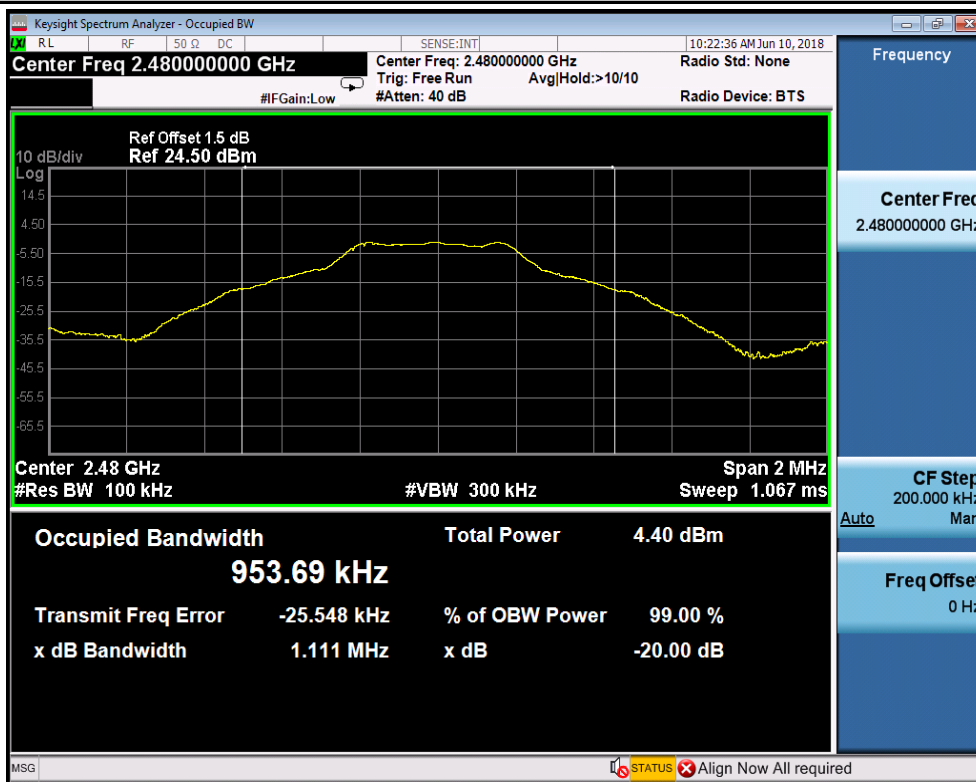




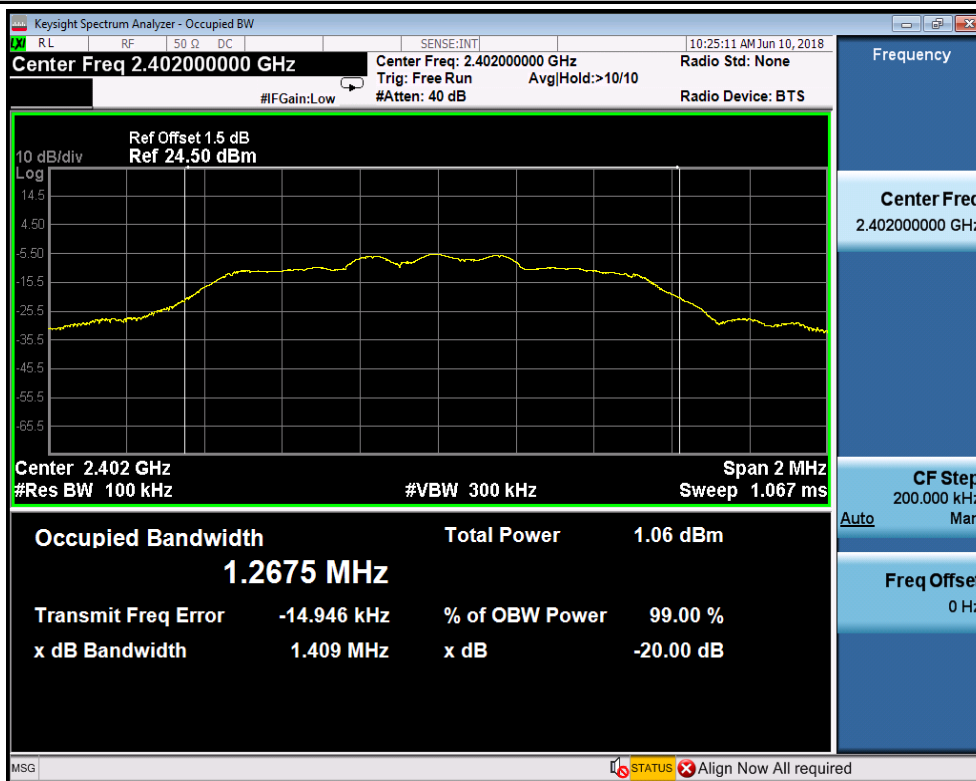
SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 42 of 106

20 dB Bandwidth_DH5_2480



20 dB Bandwidth_2DH5_2402

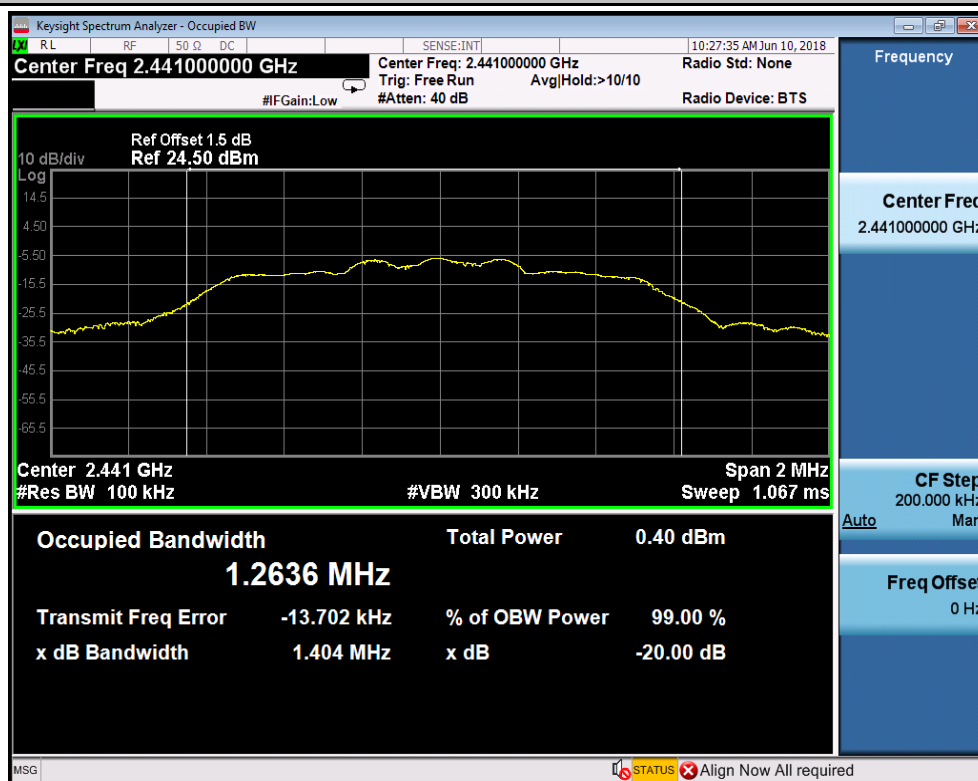




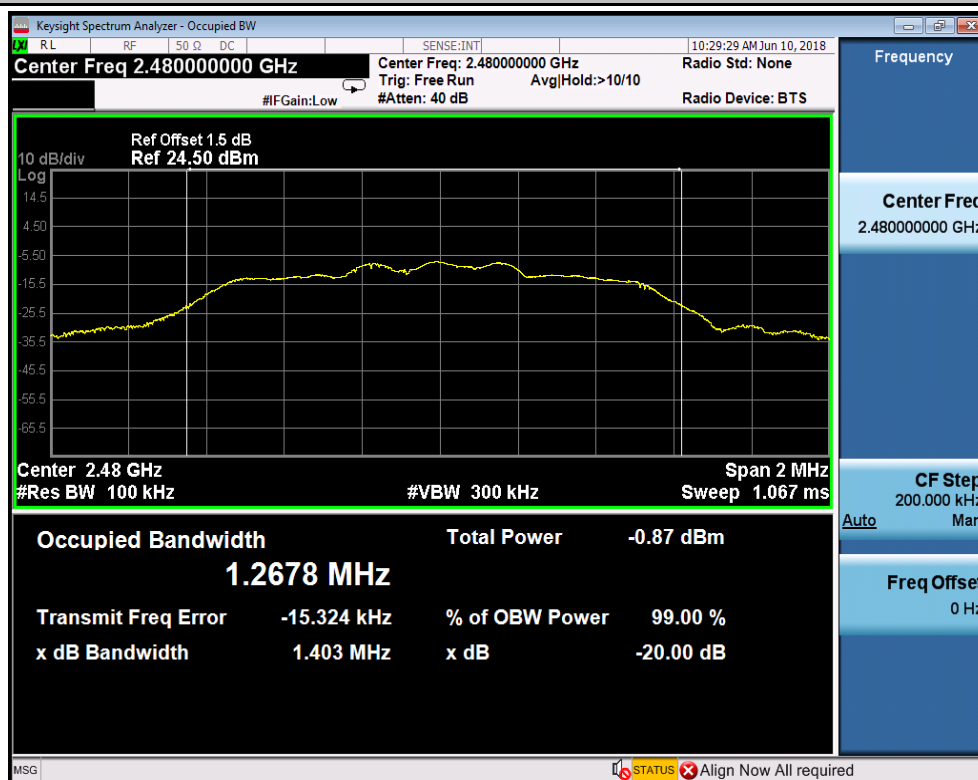
SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 43 of 106

20 dB Bandwidth_2DH5_2441



20 dB Bandwidth_2DH5_2480

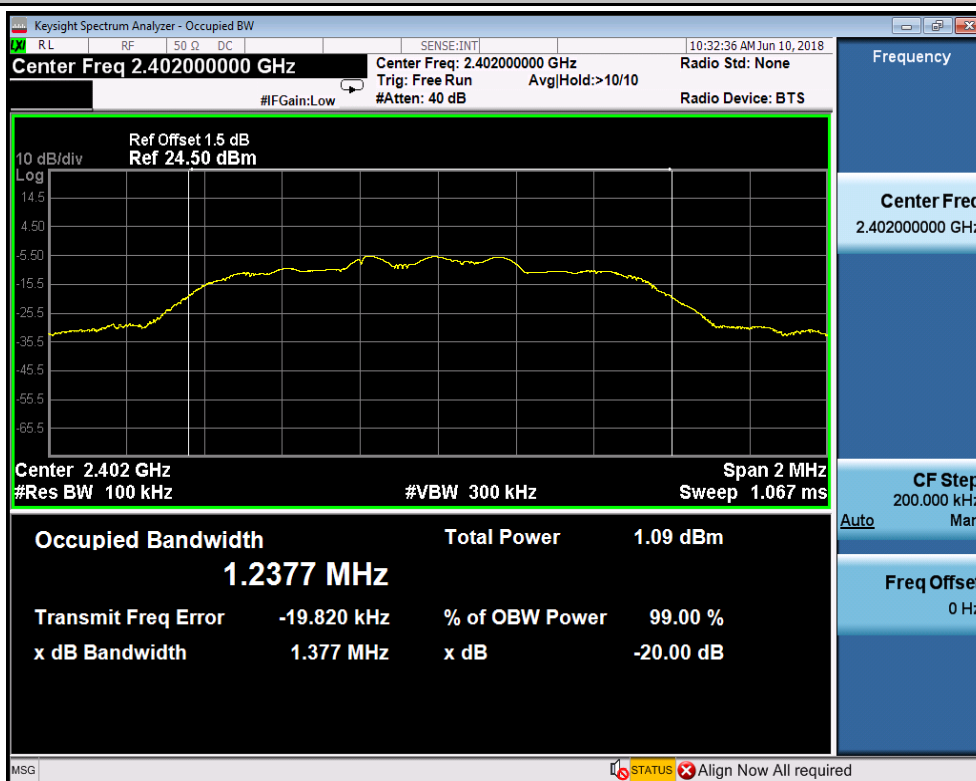




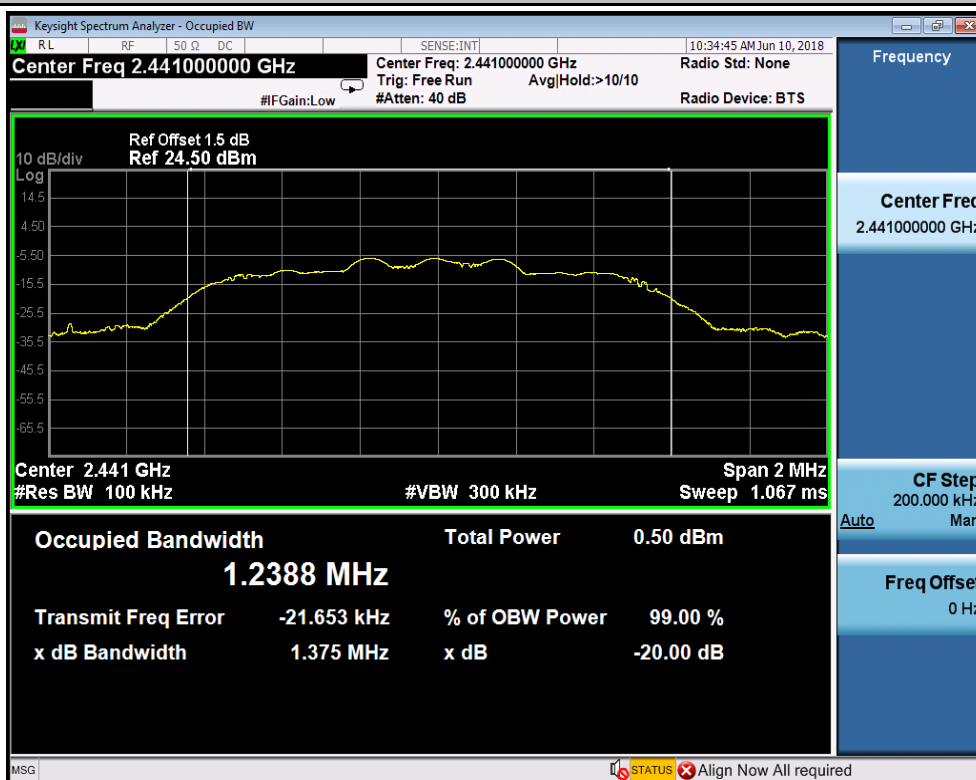
SGS-CSTC Standards Technical Services Co., Ltd.
Guangzhou Branch

Report No.: GZEM180500270202
Page: 44 of 106

20 dB Bandwidth_3DH5_2402



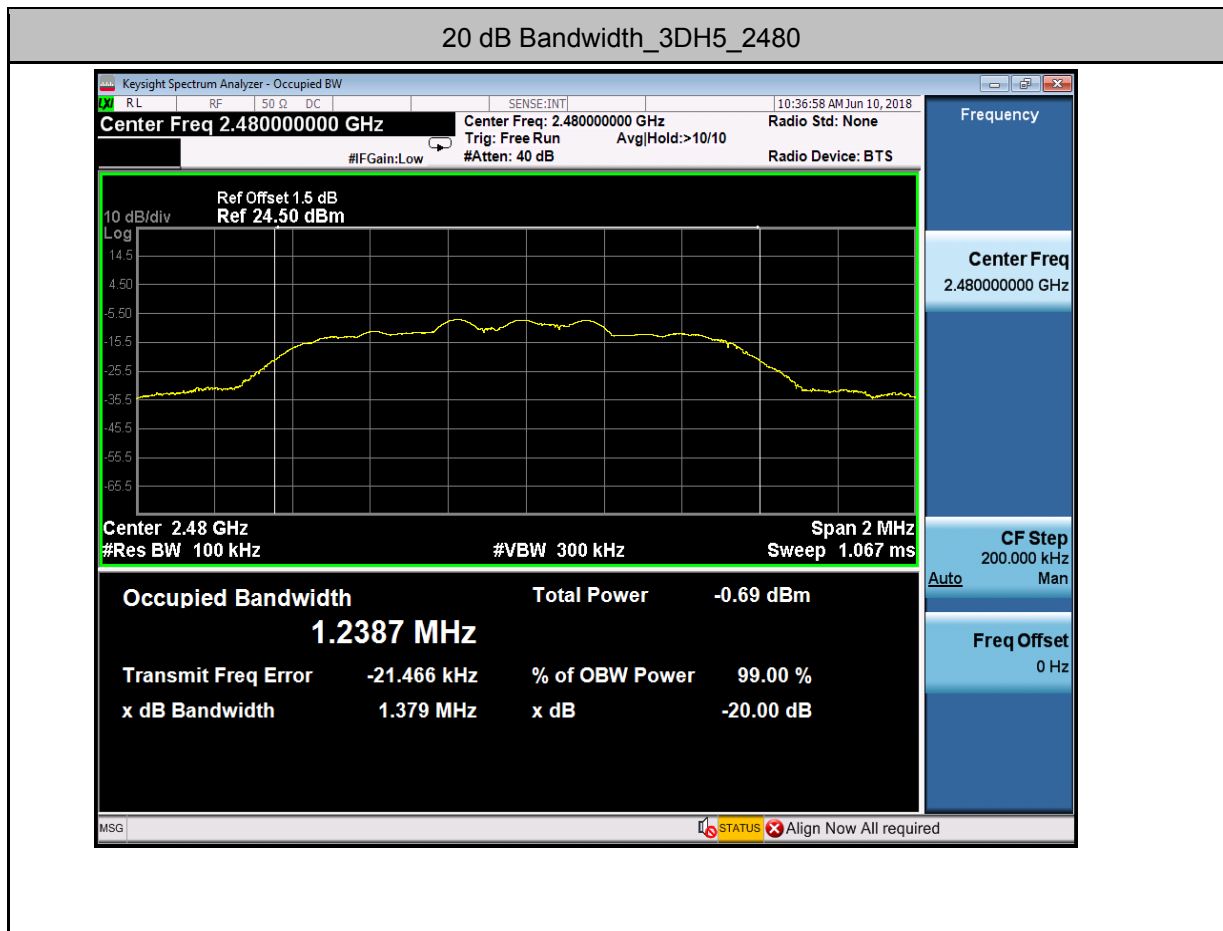
20 dB Bandwidth_3DH5_2441





SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Report No.: GZEM180500270202
Page: 45 of 106



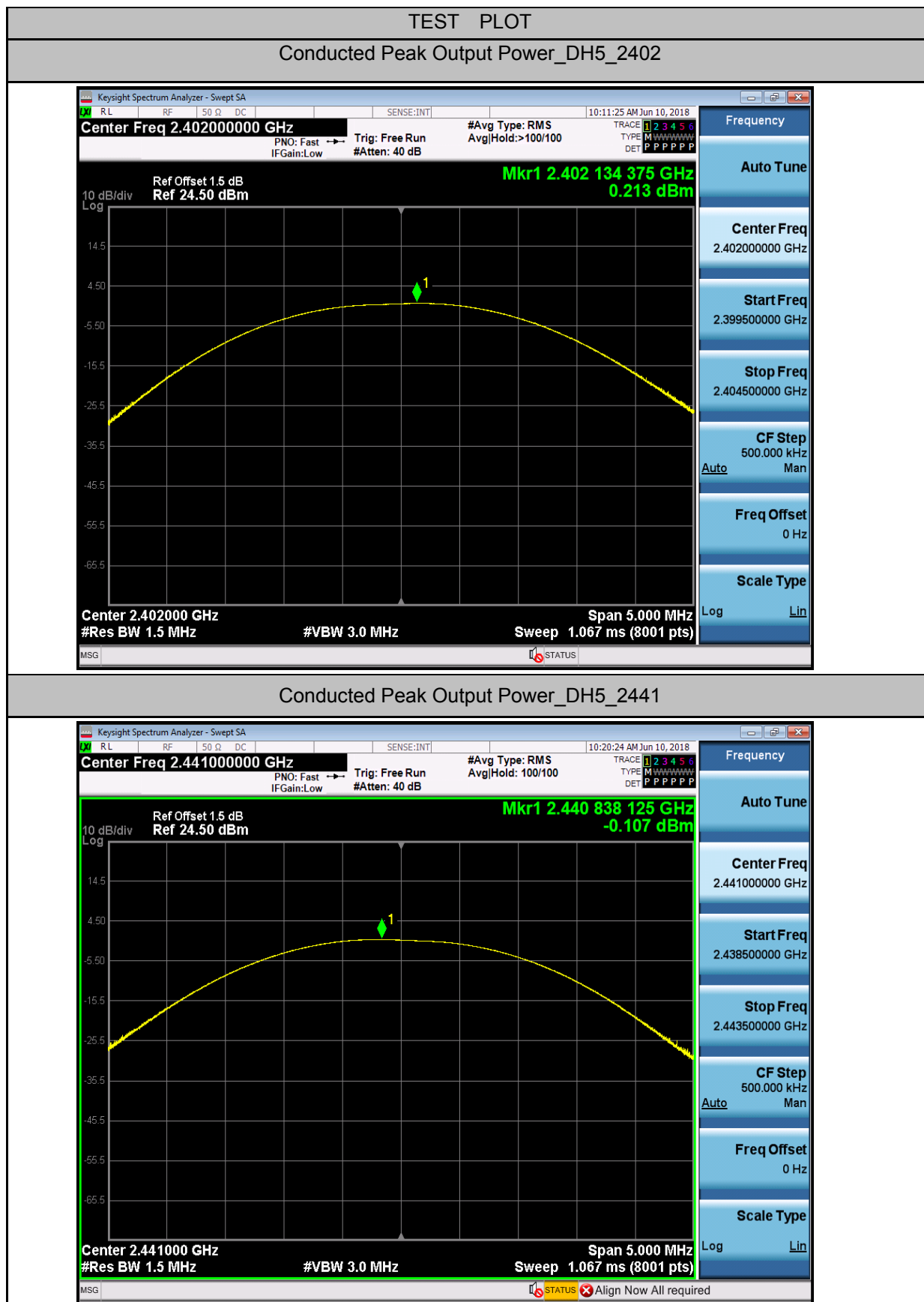
2. Conducted Peak Output Power

Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	0.213	30	PASS
DH5	2441	-0.107	30	PASS
DH5	2480	-1.09	30	PASS
2DH5	2402	-3.154	30	PASS
2DH5	2441	-3.829	30	PASS
2DH5	2480	-4.956	30	PASS
3DH5	2402	-2.705	30	PASS
3DH5	2441	-3.183	30	PASS
3DH5	2480	-4.21	30	PASS



SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Report No.: GZEM180500270202
Page: 46 of 106

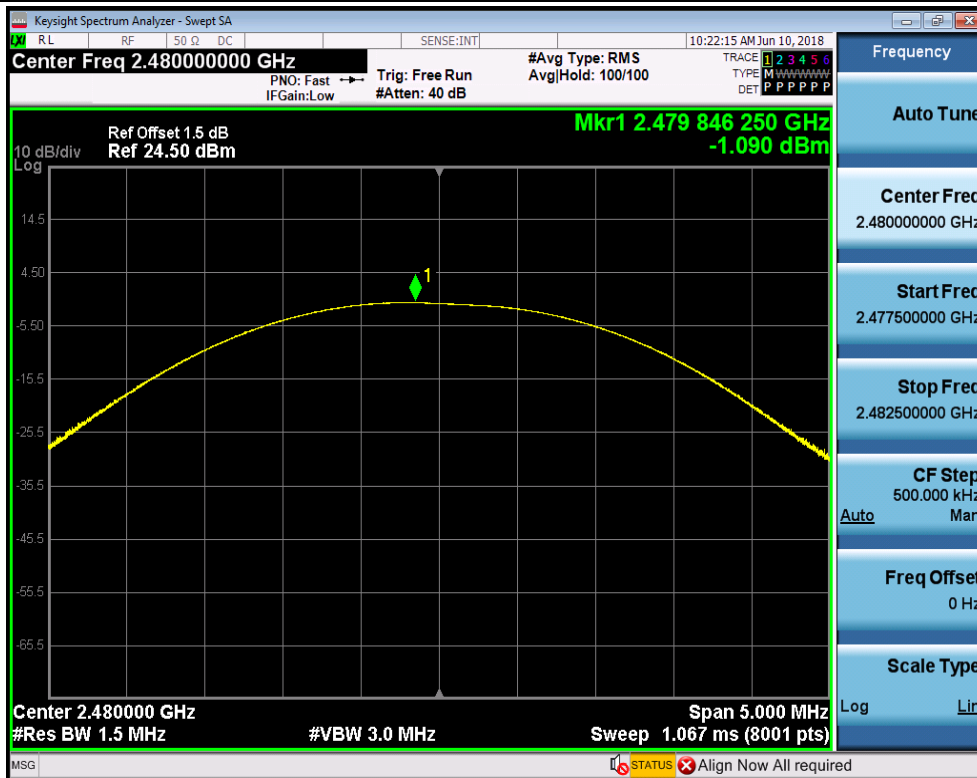




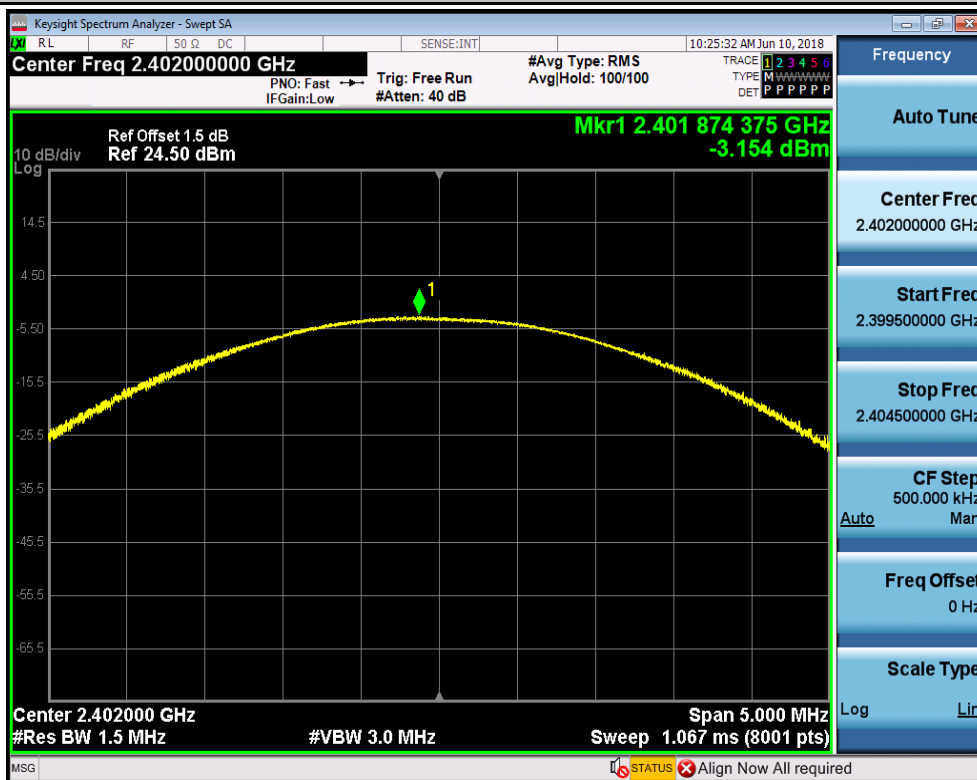
SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Report No.: GZEM180500270202
Page: 47 of 106

Conducted Peak Output Power_DH5_2480



Conducted Peak Output Power_2DH5_2402

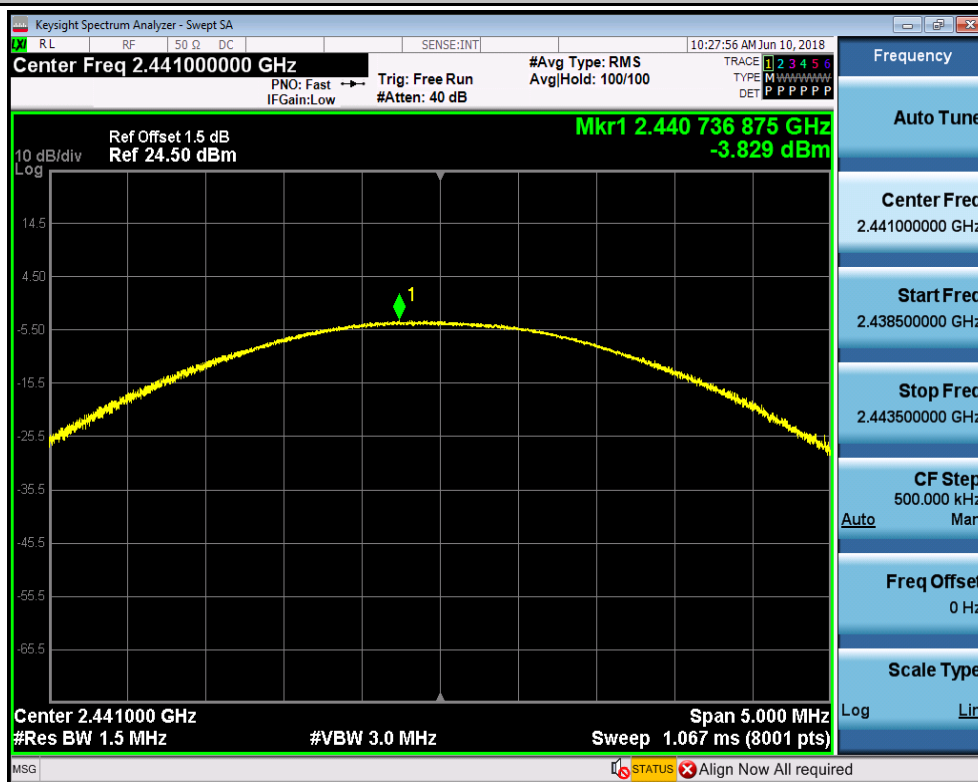




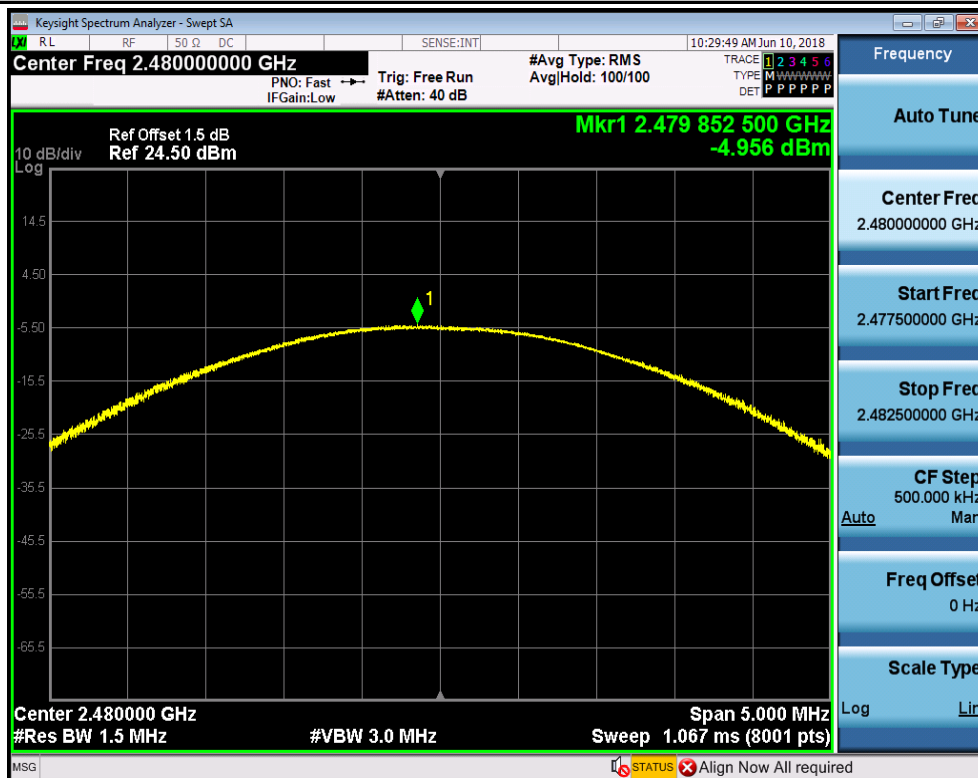
SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Report No.: GZEM180500270202
Page: 48 of 106

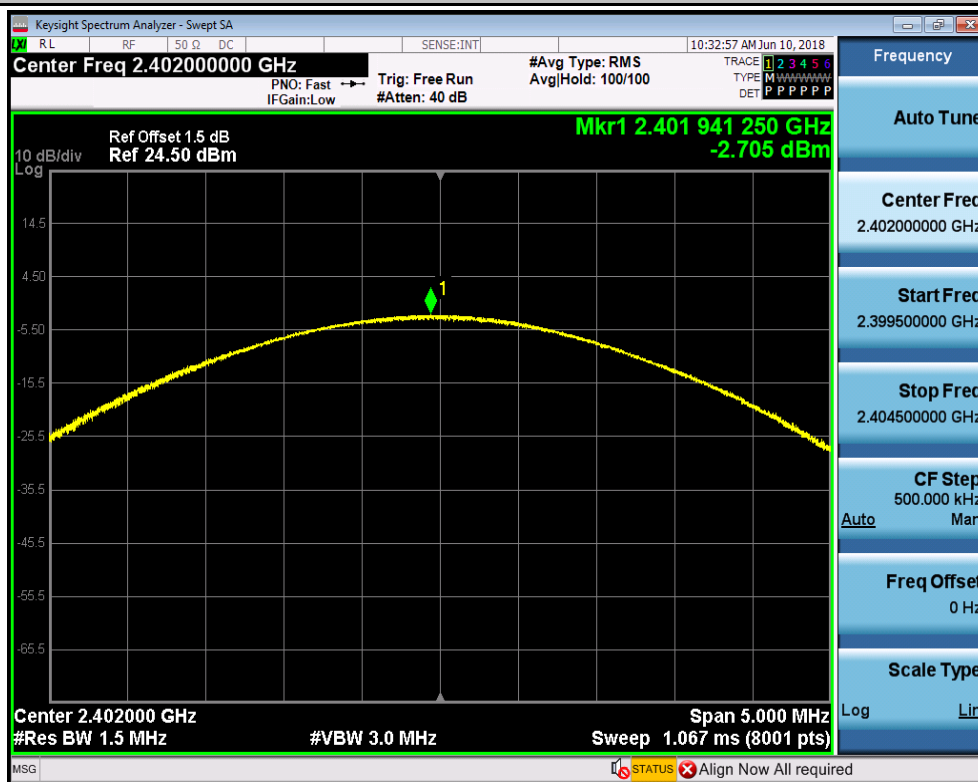
Conducted Peak Output Power_2DH5_2441



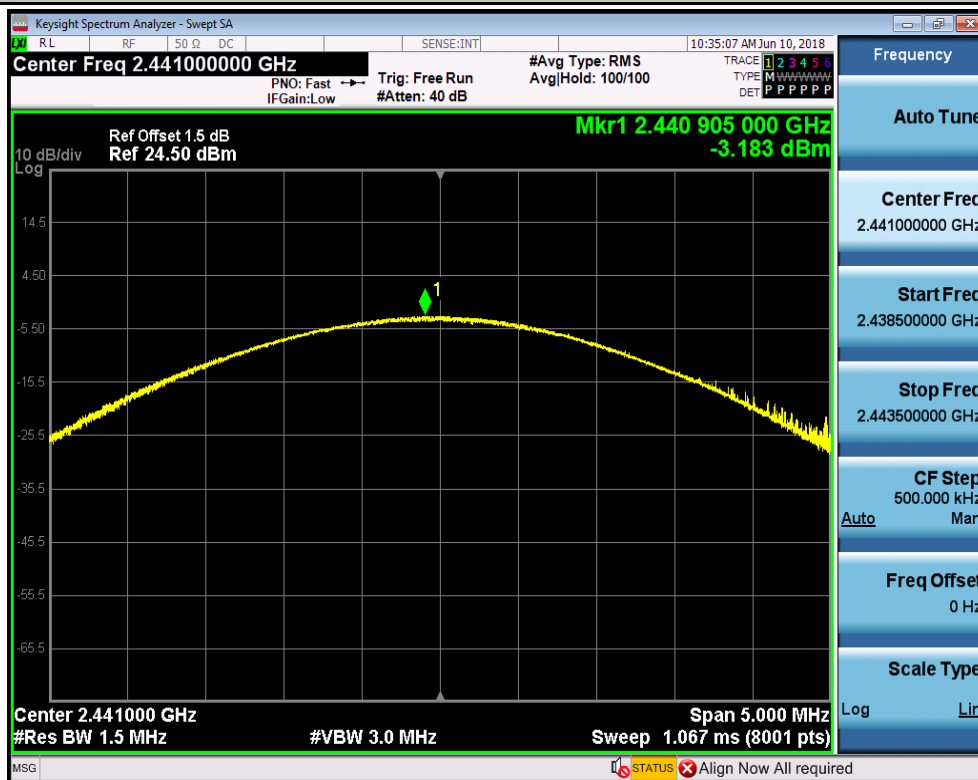
Conducted Peak Output Power_2DH5_2480



Conducted Peak Output Power_3DH5_2402



Conducted Peak Output Power_3DH5_2441

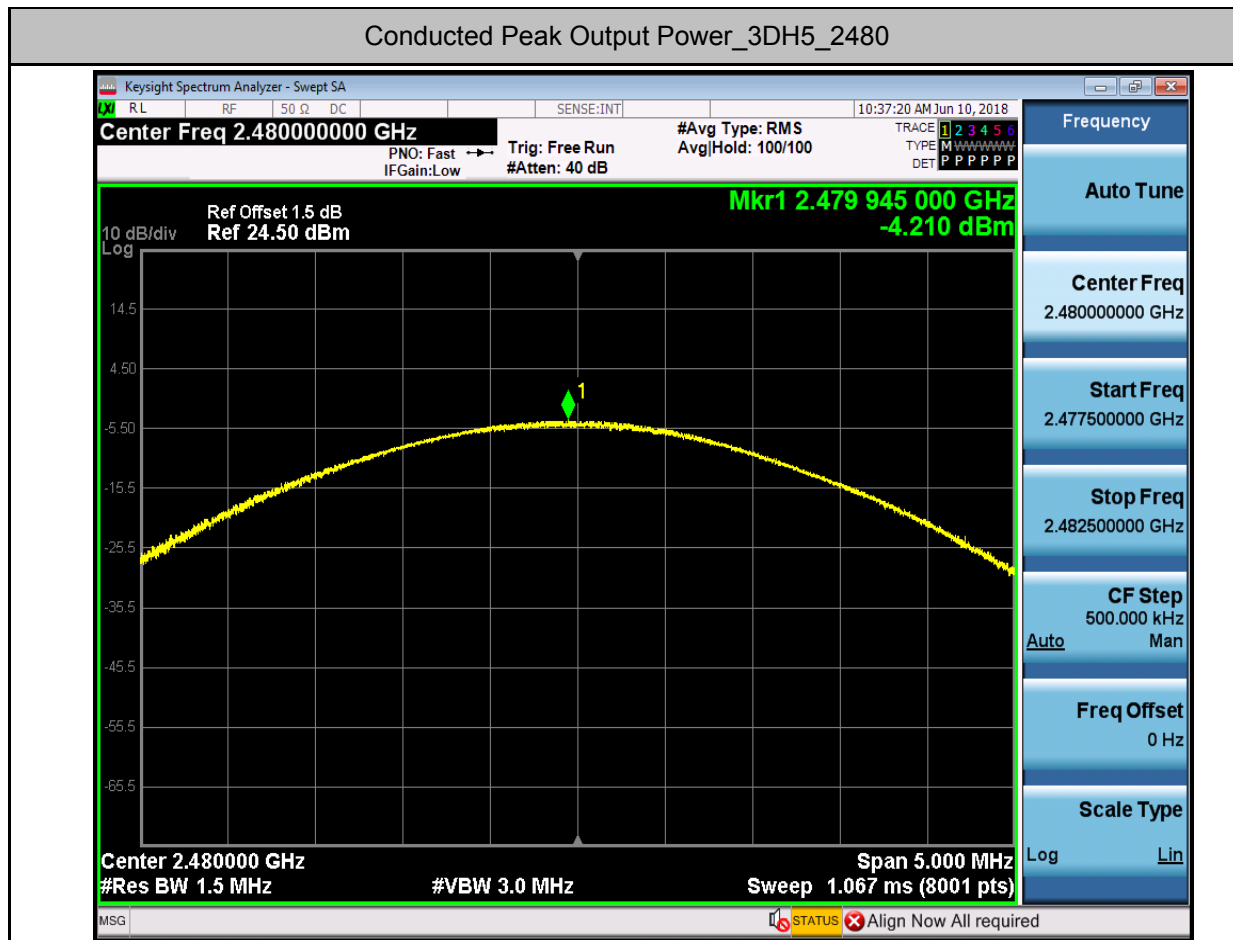




SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

Report No.: GZEM180500270202
Page: 50 of 106

Conducted Peak Output Power_3DH5_2480



3.Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2402	1.01	≥0.740	PASS
DH5	2441	0.993	≥0.740	PASS
DH5	2480	0.981	≥0.741	PASS
2DH5	2402	0.999	≥0.939	PASS
2DH5	2441	0.711	≥0.936	PASS
2DH5	2480	1.173	≥0.935	PASS
3DH5	2402	1.001	≥0.918	PASS
3DH5	2441	0.967	≥0.917	PASS
3DH5	2480	1.074	≥0.919	PASS