



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

No. 1 Workshop, M-10, Middle section, Science & Technology Park,
Shenzhen, Guangdong, China 518057

Telephone: +86 (0) 755 2601 2053
Fax: +86 (0) 755 2671 0594
Email: ee.shenzhen@sgs.com

Report No.: SZEM161201125801
Page: 1 of 60

TEST REPORT

Application No.: SZEM1612011258CR
Applicant: Winners'Sun Plastic & Electronic (Shenzhen) Co., Ltd
Address of Applicant: Zone E, Ying Tai Industrial Park, Dalang, Longhua Town, Bao An District, Shenzhen, Guang Dong Province, China
Manufacturer: Winners'Sun Plastic & Electronic (Shenzhen) Co., Ltd
Address of Manufacturer: Zone E, Ying Tai Industrial Park, Dalang, Longhua Town, Bao An District, Shenzhen, Guang Dong Province, China
Factory: Winners'Sun Plastic & Electronic (Shenzhen) Co., Ltd
Address of Factory: Zone E, Ying Tai Industrial Park, Dalang, Longhua Town, Bao An District, Shenzhen, Guang Dong Province, China
Equipment Under Test (EUT):
EUT Name: STIKBOX
Model No.: WS-SQB627B
FCC ID: UR9WS-SQB627B
Standards: 47 CFR Part 15, Subpart C 15.247
Date of Receipt: 2017-01-09
Date of Test: 2017-02-13 to 2017-03-07
Date of Issue: 2017-03-09

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



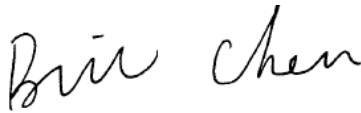
Jack Zhang
EMC Laboratory Manager

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.

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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2017-03-09		Original

Authorized for issue by:				
Tested By				2017-03-07
		(Bill Chen) /Project Engineer		Date
Checked By				2017-03-09
		(Eric Fu) /Reviewer		Date



2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013)	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	PASS

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Disturbance 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
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
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
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 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 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*
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
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



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4 General Information

4.1 Details of E.U.T.

Frequency Range:	2402MHz to 2480MHz
Bluetooth Version:	V3.0
Modulation Type:	FHSS
Number of Channels:	79
Sample Type:	Portable production
Antenna Type:	PCB
Antenna Gain:	2.3dBi
Power Supply:	Rechargeable battery: DC 3.7V 65mAh 0.24Wh (Charge by USB)
Test Voltage:	AC120V 60Hz

4.2 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.
Laptop	Lenovo	T430u
Test board	Supply to SGS	FT232

4.3 Measurement Uncertainty

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 test	1 °C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%



4.4 Test Location

All tests were performed at:

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

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

4.5 Test Facility

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

- **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

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.: G-823, R-4188, T-1153 and C-2383 respectively.

- **FCC – Registration No.: 556682**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen 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 No.: 556682.

- **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



5 Equipment List

20dB Bandwidth					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Conducted Peak Output Power					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Carrier Frequencies Separation					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Hopping Channel Number					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Dwell Time					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09



Conducted Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

Conducted Band Edges Measurement					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
DC Power Supply	ZhaoXin	RXN-305D	SEM011-02	2016-10-09	2017-10-09
Spectrum Analyzer	Rohde & Schwarz	FSP	SEM004-06	2016-10-09	2017-10-09
Signal Generator	Rohde & Schwarz	SML03	SEM006-02	2016-04-25	2017-04-25
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2016-10-09	2017-10-09

General used equipment					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-03	2016-10-12	2017-10-12
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	ZJ1-2B	SEM002-04	2016-10-12	2017-10-12
Humidity/ Temperature Indicator	Mingle	N/A	SEM002-08	2016-10-12	2017-10-12
Barometer	Changchun Meteorological Industry Factory	DYM3	SEM002-01	2016-05-18	2017-05-18

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247

6.1.2 Conclusion

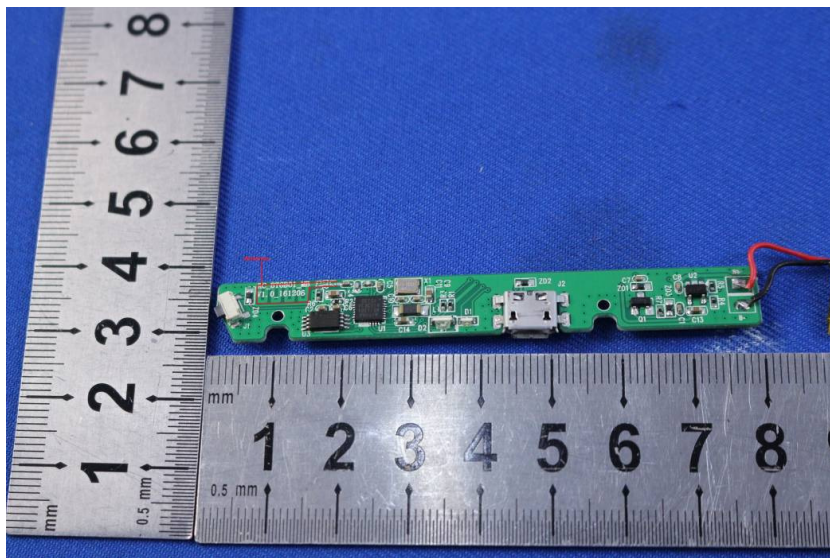
Standard Requirement:

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 2.3dBi.



6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247

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):



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Shenzhen Branch**

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According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individ



7 Radio Spectrum Matter Test Results

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

Test Requirement: 47 CFR Part 15, Subpart C 15.247

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: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Non-hopping transmitting mode with all kind of modulation and all kind of data type at the lowest, middle, high channel.

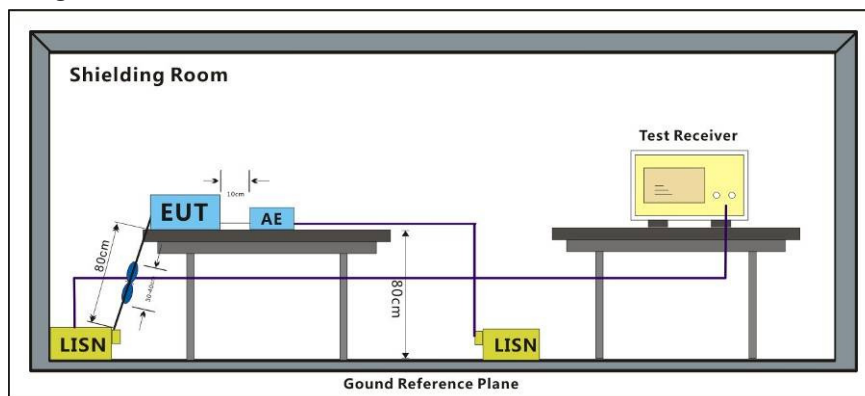
Charge + Transmitting mode.

Final Test Mode: Through Pre-scan, find the DH1 of data type and GFSK modulation at the lowest channel is the worst case.

Charge + Transmitting mode

Only the worst case is recorded in the report.

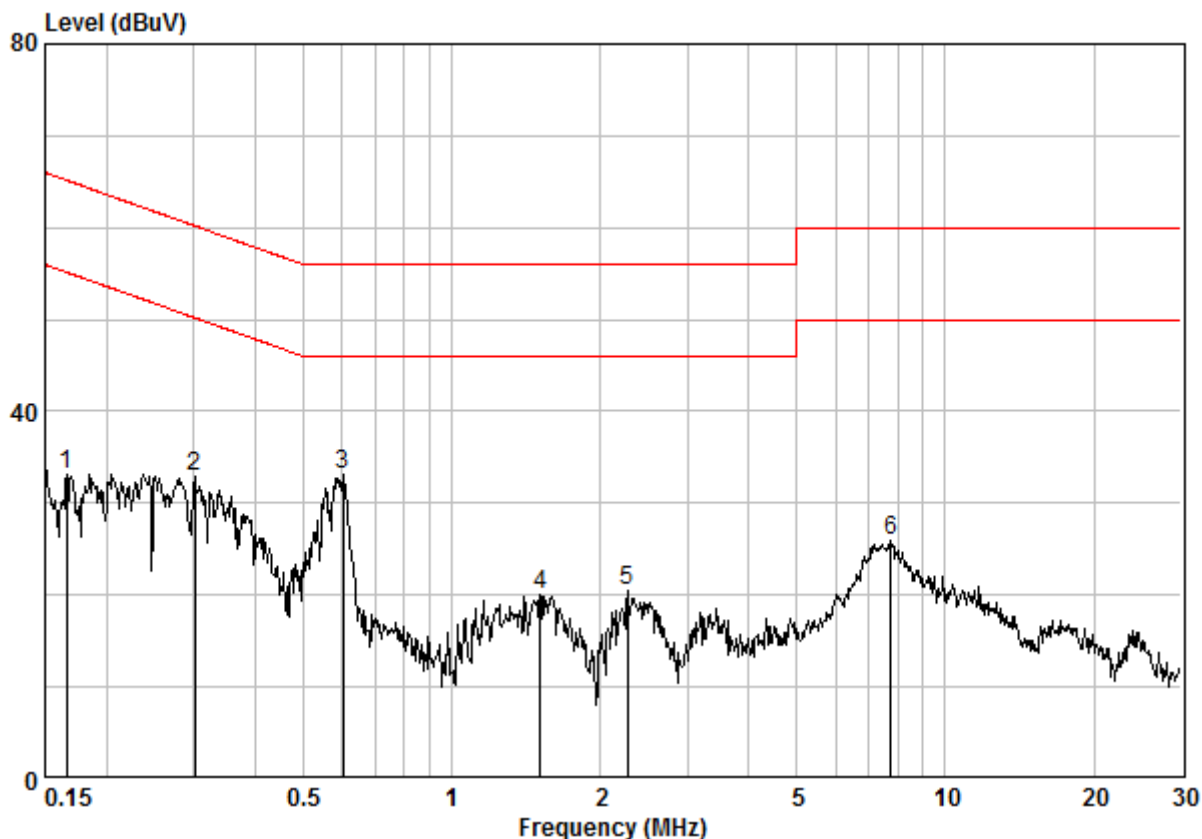
7.1.2 Test Setup Diagram



7.1.3 Measurement 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: 2013 on conducted measurement.

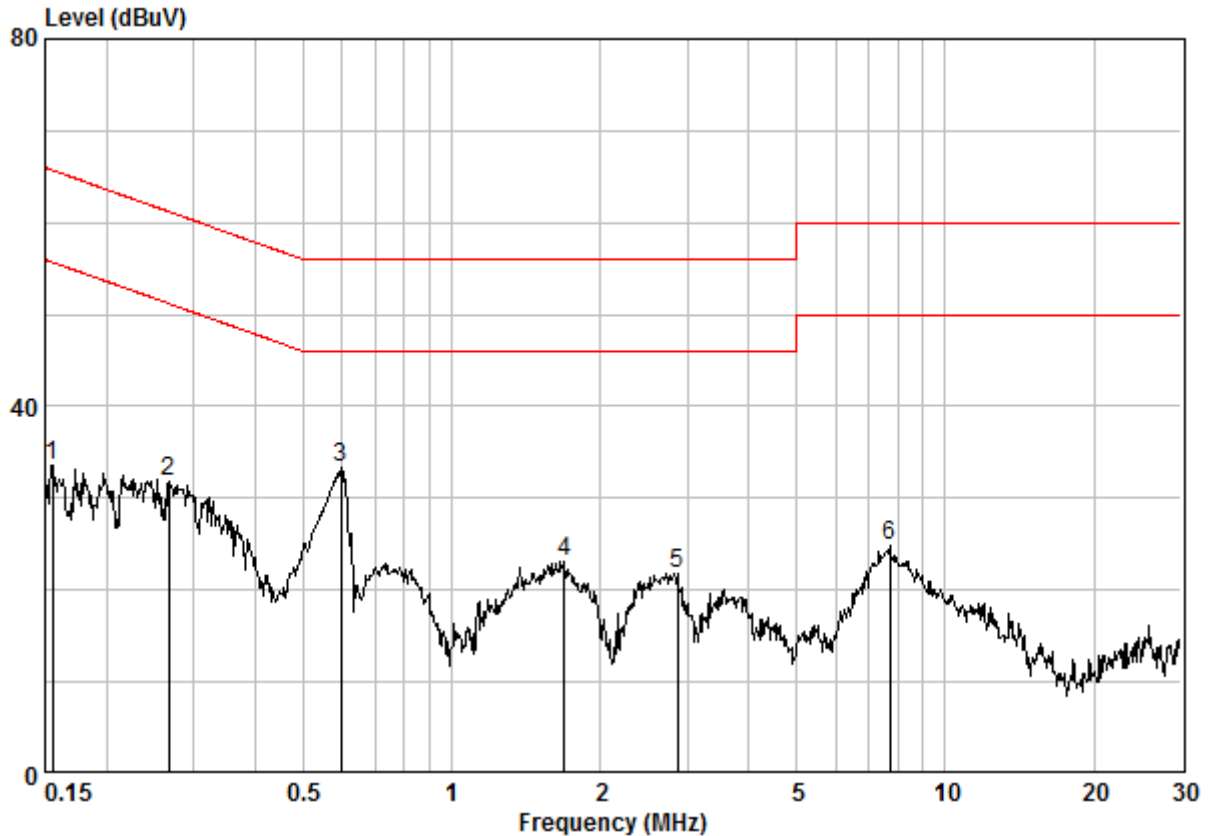
Mode:b;Line:Live Line



Site : Shielding Room
Condition : CE LINE
Job No. : 11258CR
Test mode : b

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.16589	0.02	9.64	23.45	33.11	55.16	-22.05	Peak
2	0.30188	0.02	9.64	23.15	32.81	50.19	-17.38	Peak
3	0.60112	0.02	9.65	23.45	33.12	46.00	-12.88	Peak
4	1.511	0.03	9.66	10.40	20.09	46.00	-25.91	Peak
5	2.273	0.03	9.68	10.77	20.47	46.00	-25.53	Peak
6	7.769	0.10	9.81	16.08	25.98	50.00	-24.02	Peak

Mode:b;Line:Neutral Line



Site : Shielding Room
Condition : CE NEUTRAL
Job No. : 11258CR
Test mode : b

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.15567	0.02	9.64	24.02	33.67	55.69	-22.02	Peak
2	0.26724	0.02	9.63	22.22	31.87	51.20	-19.34	Peak
3 @	0.59794	0.02	9.63	23.64	33.30	46.00	-12.70	Peak
4	1.689	0.03	9.65	13.40	23.08	46.00	-22.92	Peak
5	2.869	0.03	9.67	12.21	21.90	46.00	-24.10	Peak
6	7.728	0.10	9.79	14.93	24.82	50.00	-25.18	Peak

7.2 20dB Bandwidth

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

7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

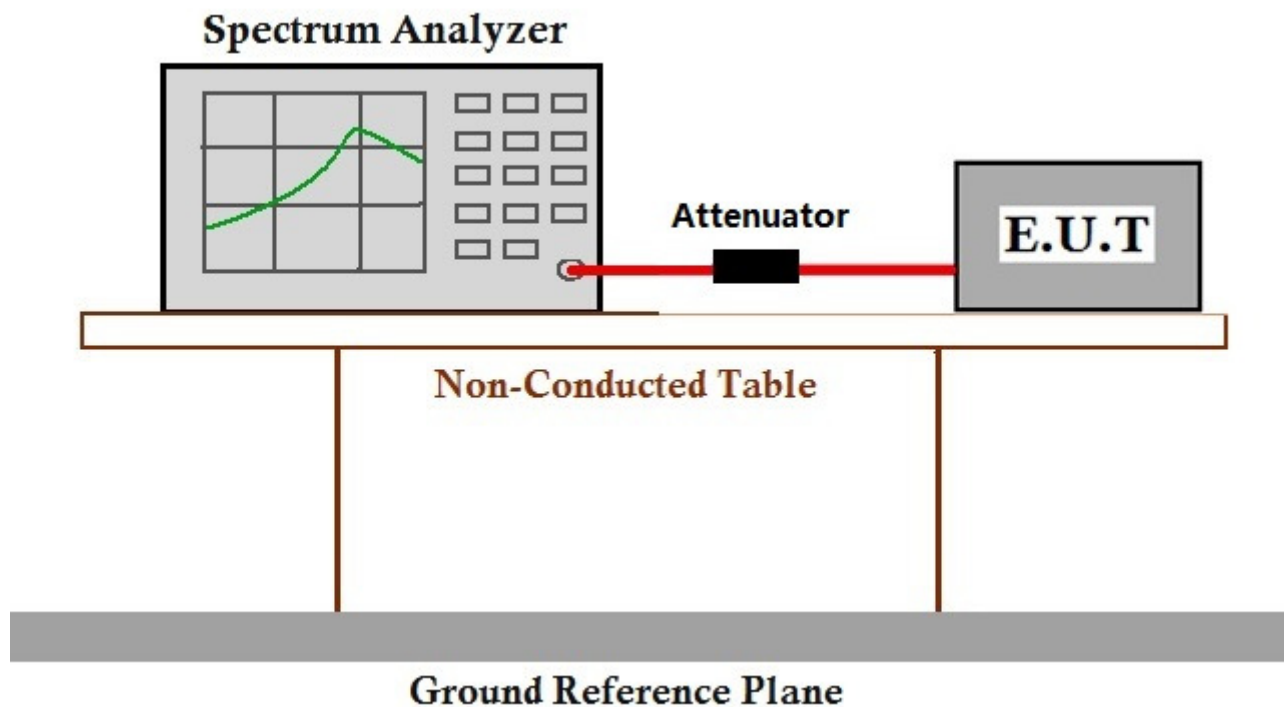
Exploratory Test Mode: Non-hopping transmitting with all kind of modulation and all kind of data type.

Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Transmitting mode is the worst case

Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.2.2 Test Setup Diagram



7.2.3 Measurement Data

The detailed test data see: Appendix 15.247

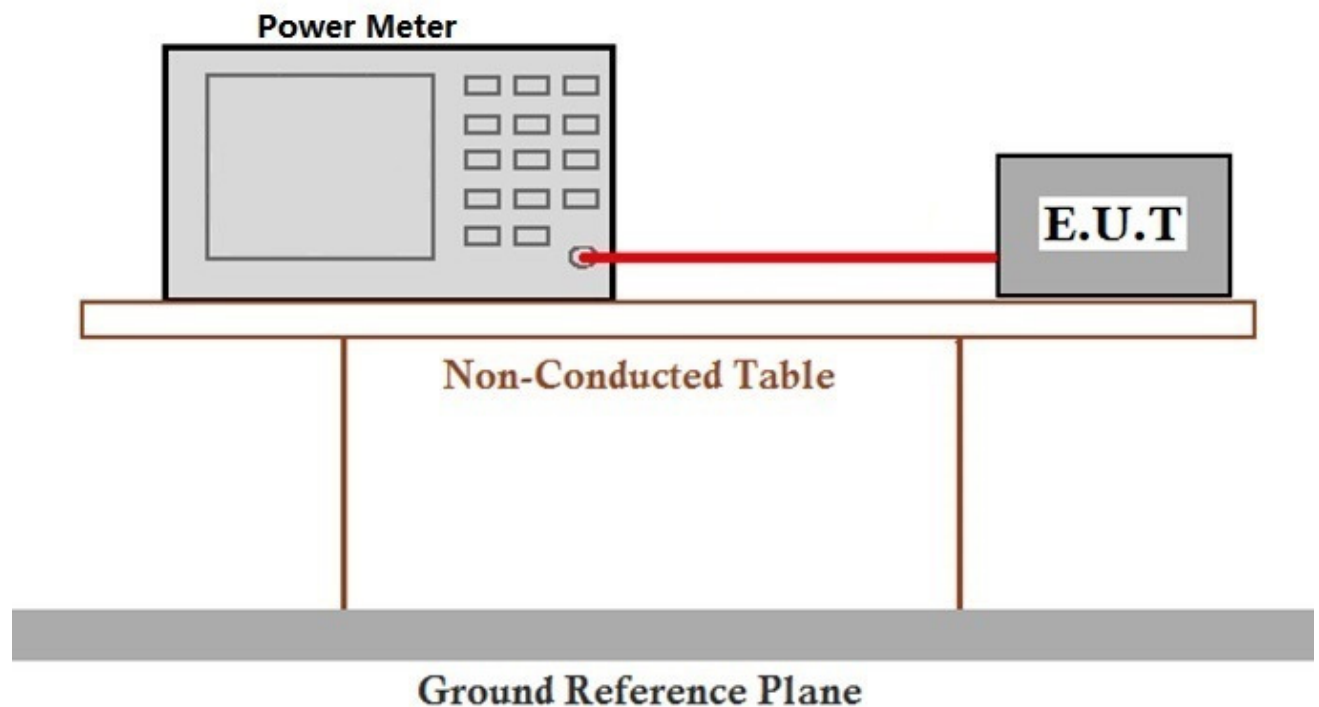
7.3 Conducted Peak Output Power

Test Requirement: 47 CFR Part 15, Subpart C 15.247
Test Method: ANSI C63.10 (2013) Section 7.8.5
Limit: 20.97dBm

7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar
Exploratory Test Mode: Non-hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.
Final Test Mode: Transmitting mode is the worst case
Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.3.2 Test Setup Diagram



7.3.3 Measurement Data

The detailed test data see: Appendix 15.247

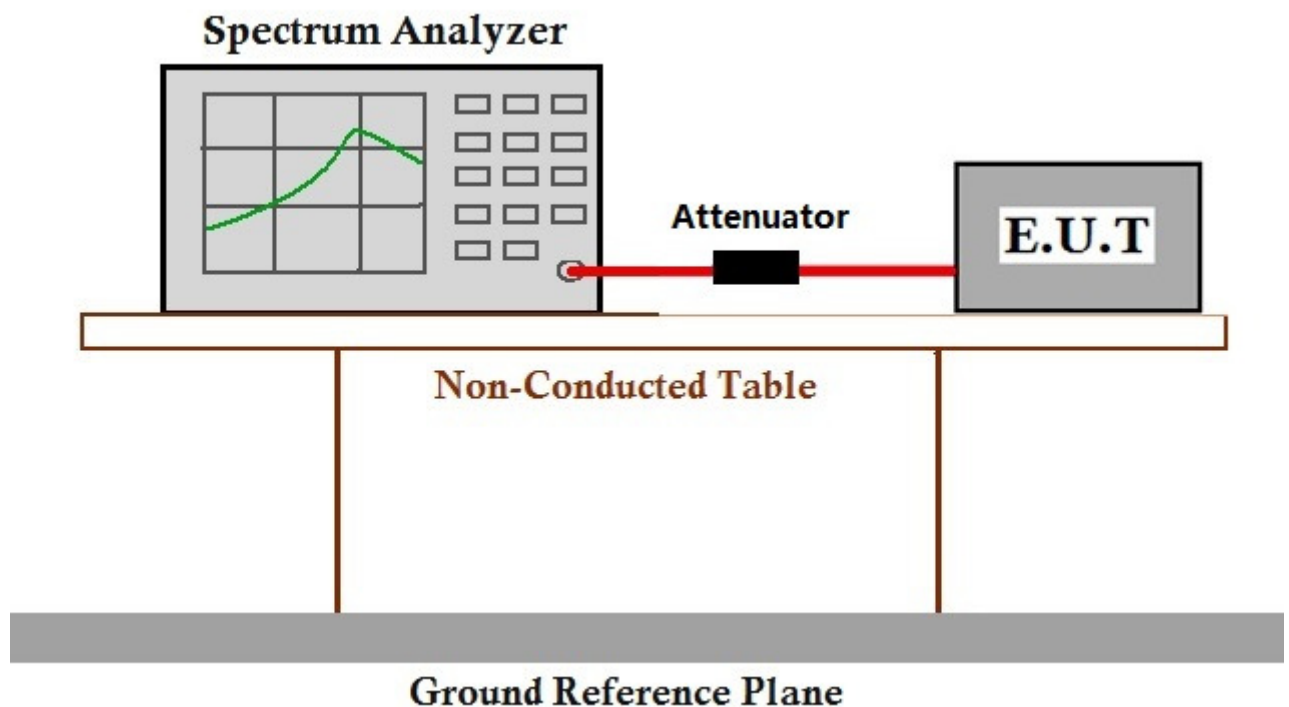
7.4 Carrier Frequencies Separation

Test Requirement: 47 CFR Part 15, Subpart C 15.247
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: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar
Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.
Final Test Mode: Transmitting mode is the worst case
Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.4.2 Test Setup Diagram



7.4.3 Measurement Data

The detailed test data see: Appendix 15.247



7.5 Hopping Channel Number

Test Requirement: 47 CFR Part 15, Subpart C 15.247

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

Limit:

Frequency range(MHz)	Channel Number(minimum)
2400-2483.5	15

7.5.1 E.U.T. Operation

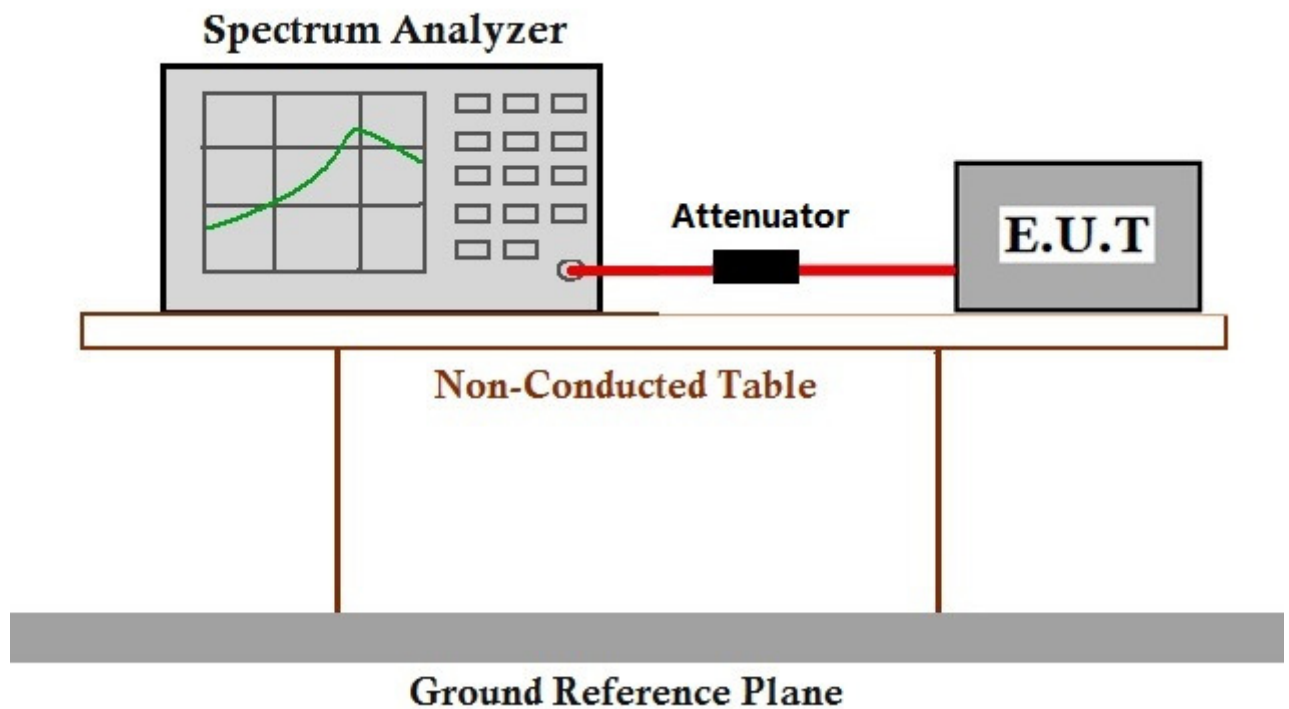
Operating Environment:

Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Transmitting mode is the worst case
Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.5.2 Test Setup Diagram



7.5.3 Measurement Data

The detailed test data see: Appendix 15.247



7.6 Dwell Time

Test Requirement:	47 CFR Part 15, Subpart C 15.247
Test Method:	ANSI C63.10 (2013) Section 7.8.4
Limit:	0.4 Second

7.6.1 E.U.T. Operation

Operating Environment:

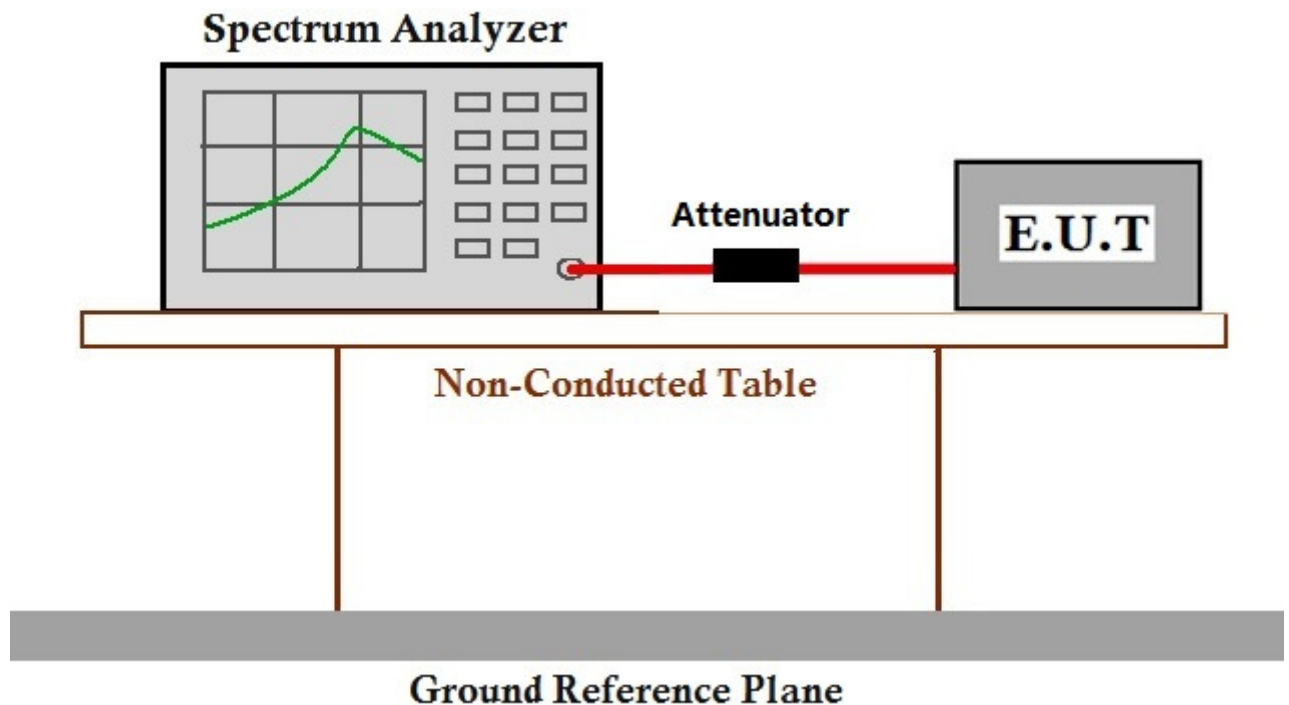
Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Transmitting mode is the worst case

Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.6.2 Test Setup Diagram



7.6.3 Measurement Data

The detailed test data see: Appendix 15.247

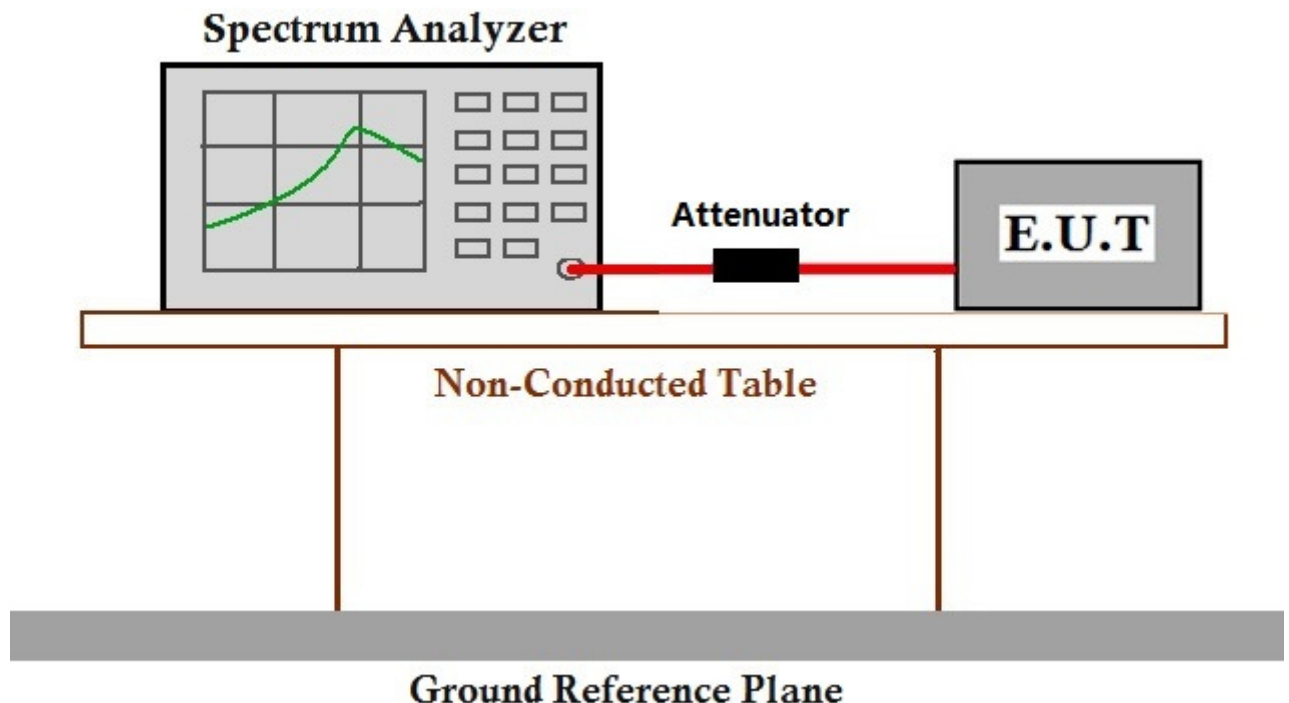
7.7 Conducted Spurious Emissions

Test Requirement: 47 CFR Part 15, Subpart C 15.247
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 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.

7.7.1 E.U.T. Operation

Operating Environment:
Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar
Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.
Final Test Mode: Transmitting mode is the worst case
Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.7.2 Test Setup Diagram



7.7.3 Measurement Data

The detailed test data see: Appendix 15.247



7.8 Radiated Spurious Emissions

Test Requirement: 47 CFR Part 15, Subpart C 15.247
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.

7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

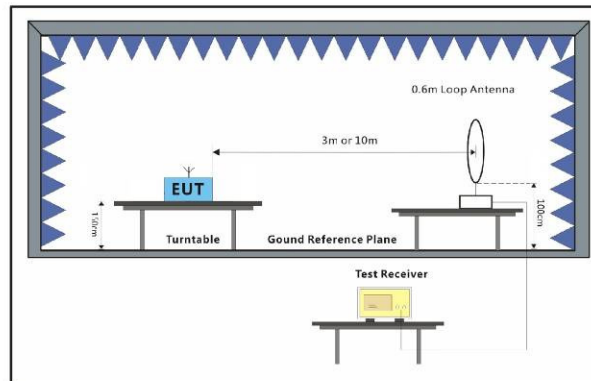
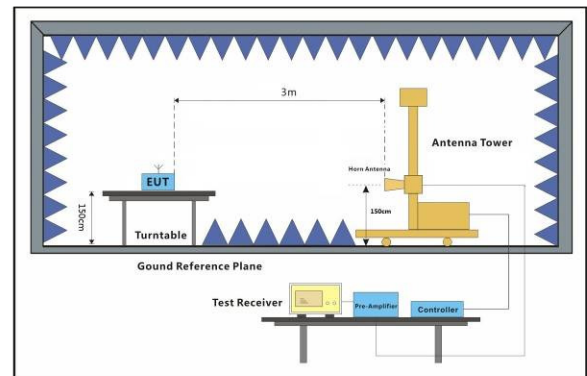
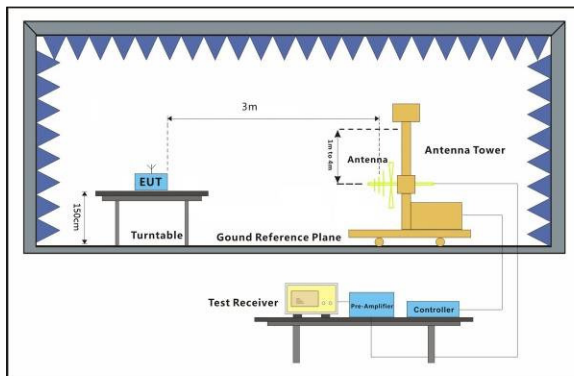
Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.

Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Charge + Transmitting mode is the worst case

Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.8.2 Test Setup Diagram



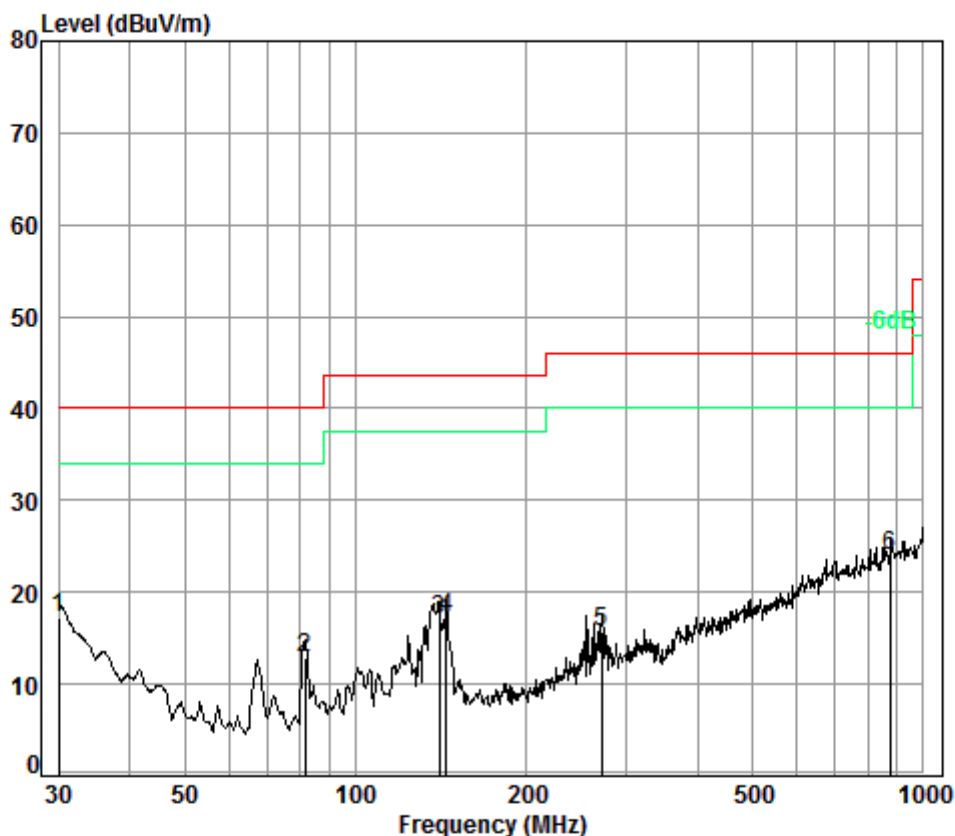


7.8.3 Measurement Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 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 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 (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz)
- 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.



Radiated Emission below 1GHz
Mode:b;Polarization:Horizontal

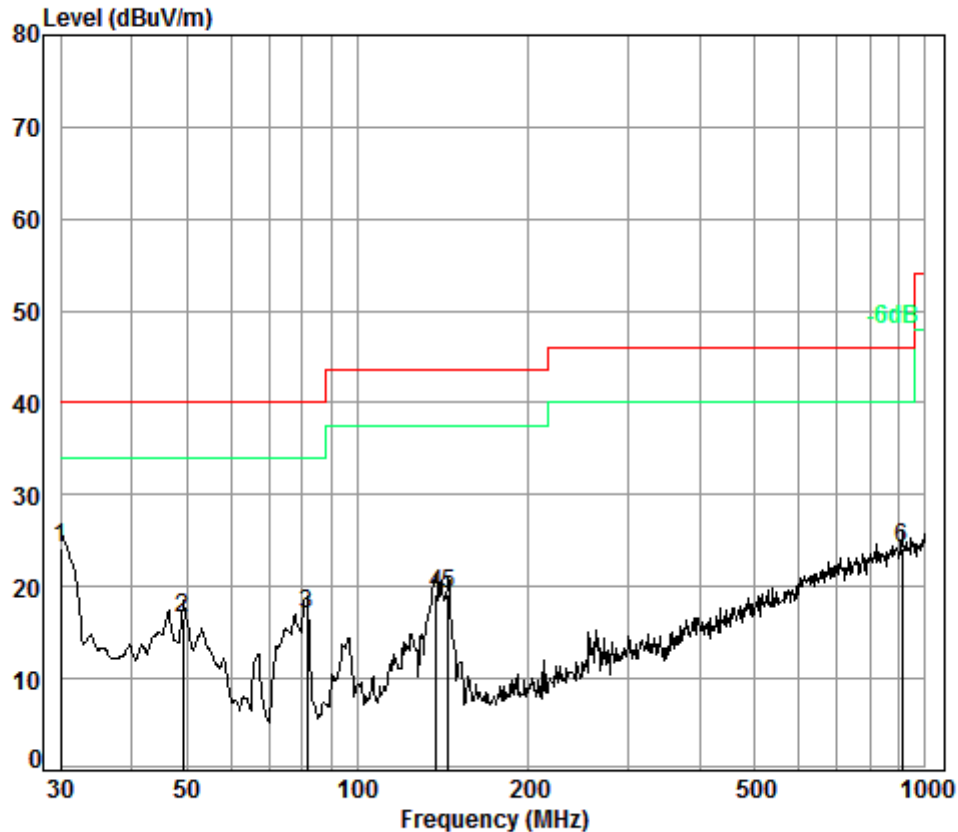


Condition: 3m HORIZONTAL
Job No. : 11258CR
Test mode: b

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	30.00	0.60	18.70	27.36	25.23	17.17	40.00	-22.83
2	81.50	1.10	7.85	27.23	31.15	12.87	40.00	-27.13
3	140.34	1.30	8.13	26.95	34.58	17.06	43.50	-26.44
4	144.33	1.31	8.49	26.94	34.33	17.19	43.50	-26.31
5	271.32	1.77	12.73	26.47	27.59	15.62	46.00	-30.38
6 pp	875.25	3.51	23.00	26.89	24.32	23.94	46.00	-22.06



Mode:b;Polarization:Vertical



Condition: 3m VERTICAL

Job No. : 11258CR

Test mode: b

		Cable	Ant	Preamp	Read		Limit	Over
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1 pp	30.00	0.60	18.70	27.36	32.23	24.17	40.00	-15.83
2	49.36	0.79	8.98	27.29	34.11	16.59	40.00	-23.41
3	81.50	1.10	7.85	27.23	35.24	16.96	40.00	-23.04
4	137.42	1.29	8.00	26.97	36.79	19.11	43.50	-24.39
5	144.33	1.31	8.49	26.94	36.31	19.17	43.50	-24.33
6	909.67	3.61	23.24	26.71	23.98	24.12	46.00	-21.88



Transmitter Emission above 1GHz

Test mode:		GFSK(DH1)		Test channel:		Lowest		Remark:		Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization		
3786.970	33.03	7.74	37.98	44.75	47.54	74.00	-26.46	Vertical		
4804.000	34.16	8.87	38.40	49.04	53.67	74.00	-20.33	Vertical		
5930.516	34.66	10.37	38.31	44.90	51.62	74.00	-22.38	Vertical		
7206.000	36.42	10.68	37.11	42.08	52.07	74.00	-21.93	Vertical		
9601.651	37.52	12.50	35.10	37.92	52.84	74.00	-21.16	Vertical		
12226.070	38.74	14.37	36.14	36.31	53.28	74.00	-20.72	Vertical		
3842.163	33.18	7.76	37.98	45.18	48.14	74.00	-25.86	Horizontal		
4804.000	34.16	8.87	38.40	48.82	53.45	74.00	-20.55	Horizontal		
5904.828	34.64	10.30	38.32	44.92	51.54	74.00	-22.46	Horizontal		
7206.000	36.42	10.68	37.11	42.76	52.75	74.00	-21.25	Horizontal		
9608.000	37.52	12.50	35.10	37.61	52.53	74.00	-21.47	Horizontal		
12190.740	38.72	14.40	36.06	36.43	53.49	74.00	-20.51	Horizontal		

Test mode:		GFSK(DH1)		Test channel:	Middle		Remark:		Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization	
3831.060	33.15	7.75	37.98	44.79	47.71	74.00	-26.29	Vertical	
4882.000	34.30	8.98	38.44	49.89	54.73	74.00	-19.27	Vertical	
6043.124	34.74	10.50	38.26	44.94	51.92	74.00	-22.08	Vertical	
7323.000	36.37	10.72	37.01	42.78	52.86	74.00	-21.14	Vertical	
9764.000	37.55	12.58	35.02	37.83	52.94	74.00	-21.06	Vertical	
12067.890	38.64	14.50	35.76	36.15	53.53	74.00	-20.47	Vertical	
3727.173	32.86	7.71	37.97	44.56	47.16	74.00	-26.84	Horizontal	
4882.000	34.30	8.98	38.44	50.17	55.01	74.00	-18.99	Horizontal	
5939.103	34.66	10.39	38.31	45.20	51.94	74.00	-22.06	Horizontal	
7323.000	36.37	10.72	37.01	42.26	52.34	74.00	-21.66	Horizontal	
9764.000	37.55	12.58	35.02	37.25	52.36	74.00	-21.64	Horizontal	
12033.020	38.62	14.53	35.68	36.19	53.66	74.00	-20.34	Horizontal	



Test mode:		GFSK(DH1)		Test channel:		Middle		Remark:		Average	
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization			
4882.000	34.30	8.98	38.44	46.08	50.92	54.00	-3.08	Vertical			
4882.000	34.30	8.98	38.44	46.96	51.80	54.00	-2.20	Horizontal			

Test mode:		GFSK(DH1)		Test channel:		Highest		Remark:		Peak
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization		
3842.163	33.18	7.76	37.98	44.79	47.75	74.00	-26.25	Vertical		
4960.000	34.43	9.09	38.48	47.74	52.78	74.00	-21.22	Vertical		
6078.201	34.76	10.46	38.22	44.06	51.06	74.00	-22.94	Vertical		
7440.000	36.32	10.77	36.90	40.94	51.13	74.00	-22.87	Vertical		
9920.000	37.58	12.67	34.94	37.43	52.74	74.00	-21.26	Vertical		
12226.070	38.74	14.37	36.14	36.10	53.07	74.00	-20.93	Vertical		
3743.387	32.90	7.72	37.97	44.47	47.12	74.00	-26.88	Horizontal		
4960.000	34.43	9.09	38.48	49.38	54.42	74.00	-19.58	Horizontal		
6069.413	34.76	10.47	38.23	43.99	50.99	74.00	-23.01	Horizontal		
7440.000	36.32	10.77	36.90	41.63	51.82	74.00	-22.18	Horizontal		
9920.000	37.58	12.67	34.94	38.40	53.71	74.00	-20.29	Horizontal		
12120.390	38.67	14.46	35.89	36.72	53.96	74.00	-20.04	Horizontal		

Test mode:		GFSK(DH1)		Test channel:		Highest		Remark:		Average	
Frequency (MHz)	Antenna factors (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Over limit (dB)	Polarization			
4960.000	34.43	9.09	38.48	44.47	49.51	54.00	-4.49	Vertical			
4960.000	34.43	9.09	38.48	48.18	53.22	54.00	-0.78	Horizontal			

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) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.



7.9 Radiated Emissions which fall in the restricted bands

Test Requirement: 47 CFR Part 15, Subpart C 15.247

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 E.U.T. Operation

Operating Environment:

Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

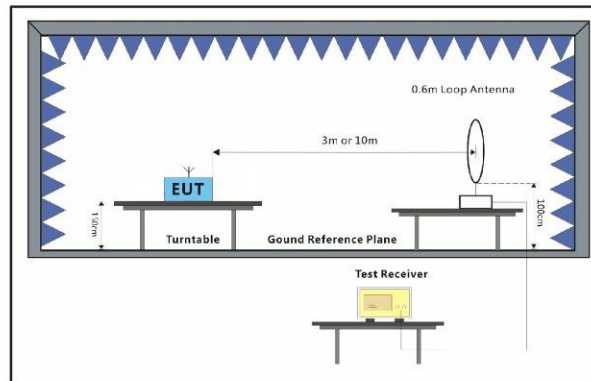
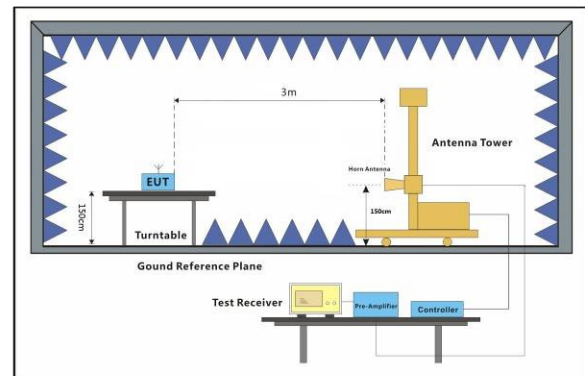
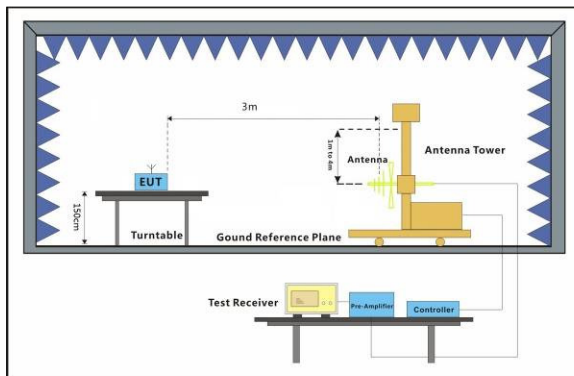
Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.

Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Charge + Transmitting mode is the worst case

Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.9.2 Test Setup Diagram





7.9.3 Measurement 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 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 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 (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz)
- 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.

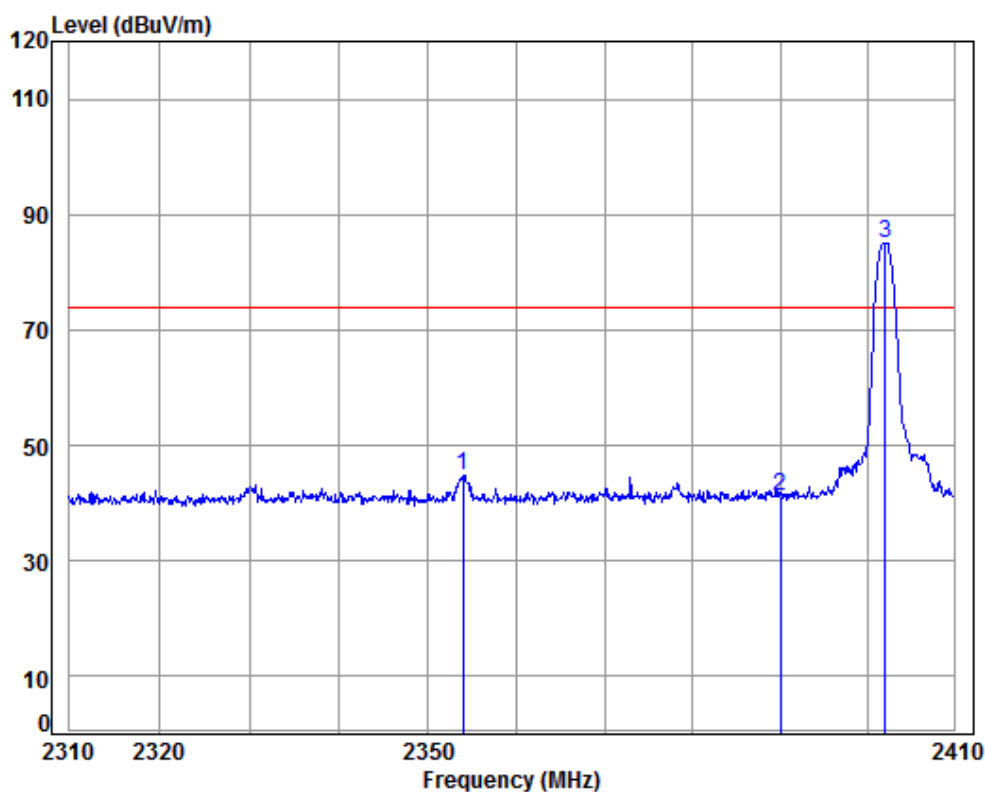


SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

Report No.: SZEM161201125801

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Worse case mode:	GFSK (DH5)	Test channel:	Lowest	Remark:	Peak	Vertical
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Condition: 3m VERTICAL

Job No: : 11258CR

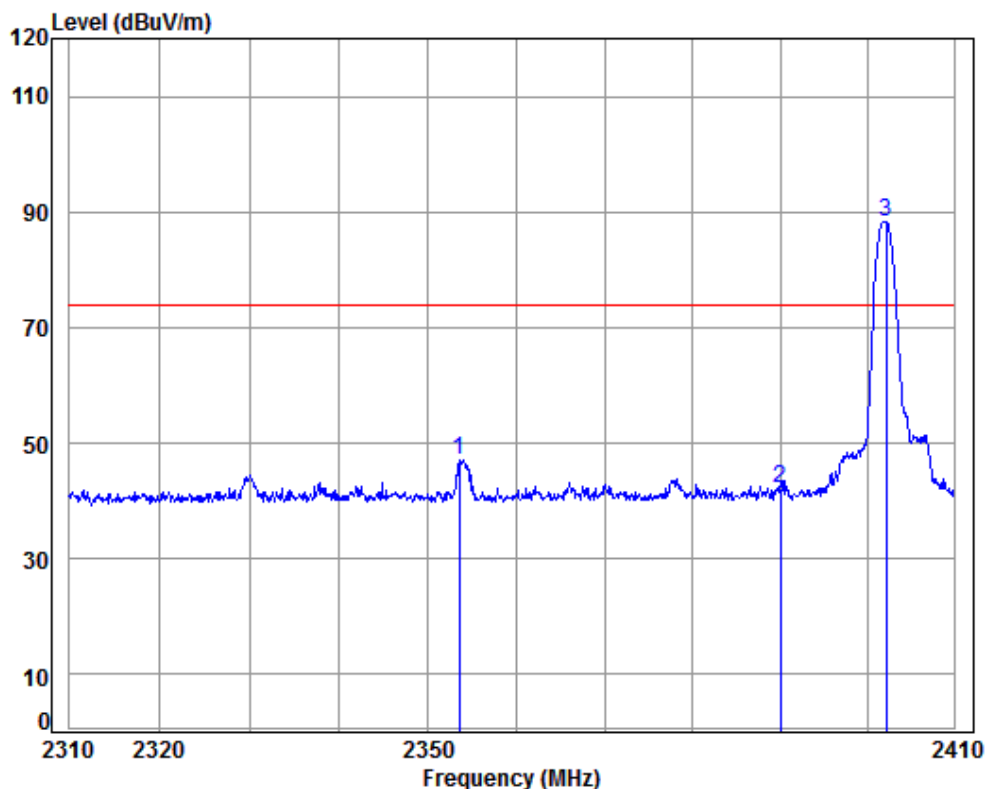
Mode: : 2402 Bandedge

: BT

		Cable	Ant	Preamp	Read	Limit	Over	
	Freq	Loss	Factor	Factor	Level	Level	Line	Limit Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2353.977	5.31	28.97	37.96	48.56	44.88	74.00	-29.12
2	2390.000	5.34	29.08	37.96	44.81	41.27	74.00	-32.73
3 pp	2402.047	5.35	29.11	37.96	88.51	85.01	74.00	11.01



Worse case mode:	GFSK (DH5)	Test channel:	Lowest	Remark:	Peak	Horizontal
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Condition: 3m HORIZONTAL

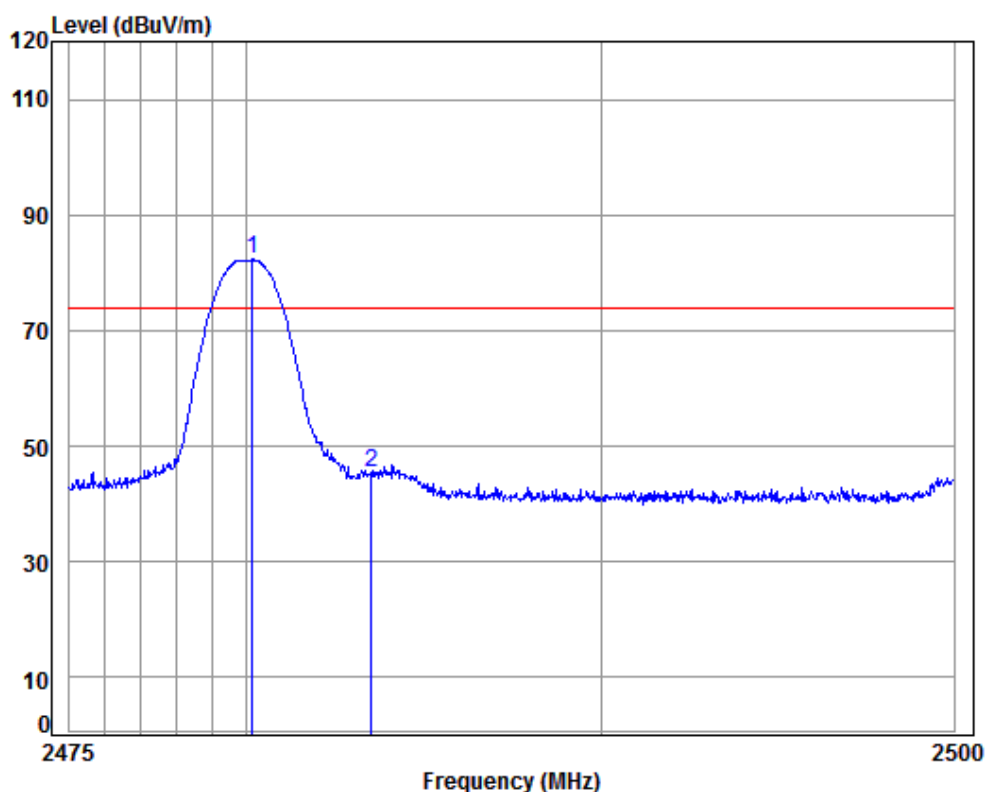
Job No: : 11258CR

Mode: : 2402 Bandedge
: BT

	Freq	Cable	Ant	Preamp	Read	Limit	Over	
	MHz	Loss	Factor	Factor	Level	Level	Line	Limit
	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	Remark
1	2353.578	5.31	28.97	37.96	50.77	47.09	74.00	-26.91
2	2390.000	5.34	29.08	37.96	45.87	42.33	74.00	-31.67
3 pp	2402.148	5.35	29.11	37.96	91.67	88.17	74.00	14.17



Worse case mode:	GFSK (DH5)	Test channel:	Highest	Remark:	Peak	Vertical
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Condition: 3m VERTICAL

Job No: : 11258CR

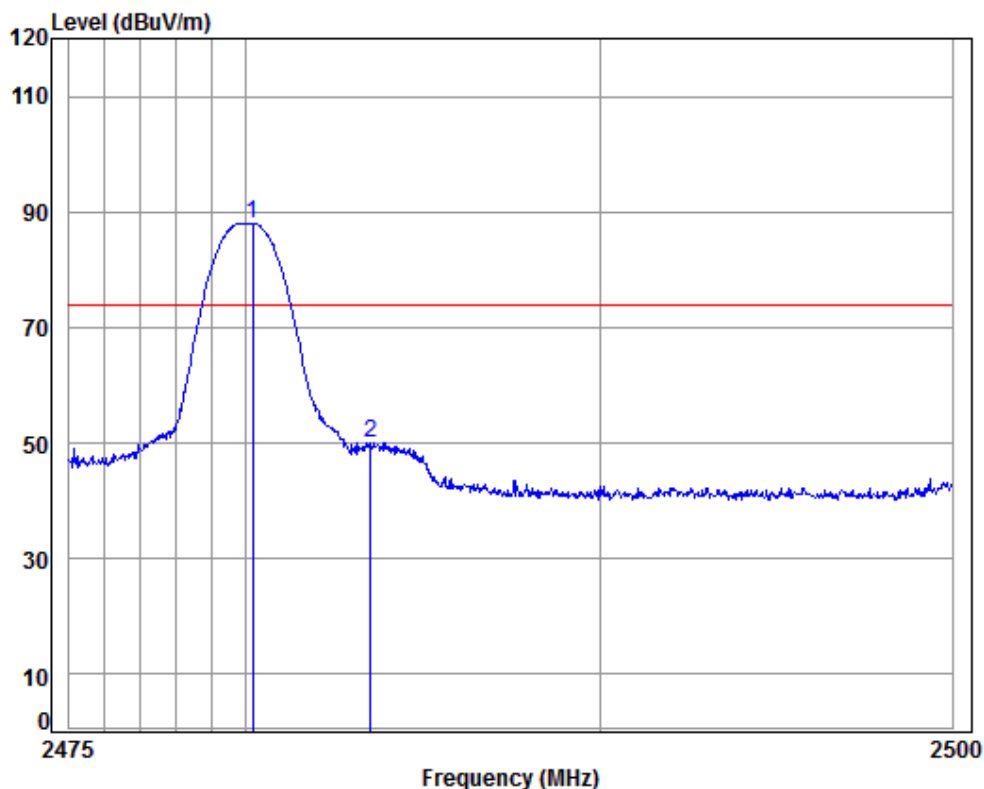
Mode: : 2480 Bandedge

: BT

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Limit Level	Limit Line	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2480.154	5.41	29.34	37.95	85.45	82.25	74.00	8.25	
2	2483.500	5.41	29.35	37.95	48.59	45.40	74.00	-28.60	



Worse case mode:	GFSK(DH5)	Test channel:	Highest	Remark:	Peak	Horizontal
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Condition: 3m HORIZONTAL
Job No: : 11258CR
Mode: : 2480 Bandedge
: BT

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit	Over Limit	Remark
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB	
1 pp	2480.179	5.41	29.34	37.95	91.20	88.00	74.00	14.00	
2	2483.500	5.41	29.35	37.95	53.28	50.09	74.00	-23.91	

Note:

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

7.10 Conducted Band Edges Measurement

Test Requirement: 47 CFR Part 15, Subpart C 15.247
Test Method: ANSI C63.10 (2013) Section 7.8.6

7.10.1 E.U.T. Operation

Operating Environment:

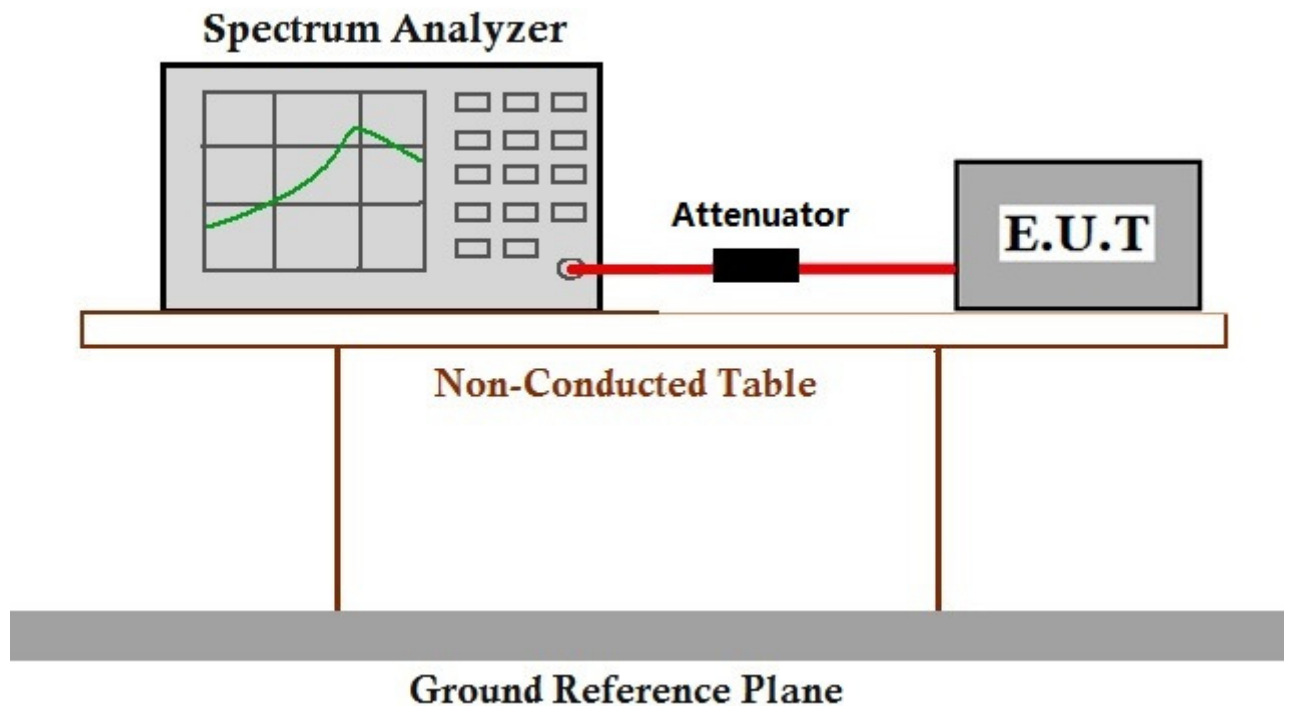
Temperature: 25.0 °C Humidity: 56 % RH Atmospheric Pressure: 1020 mbar

Exploratory Test Mode: Hopping transmitting with all kind of modulation and all kind of data type.
Charge + Transmitting mode and Transmitting mode.

Final Test Mode: Transmitting mode is the worst case

Through Pre-scan, find the DH1 of data type is the worst case of GFSK modulation type.

7.10.2 Test Setup Diagram



7.10.3 Measurement Data

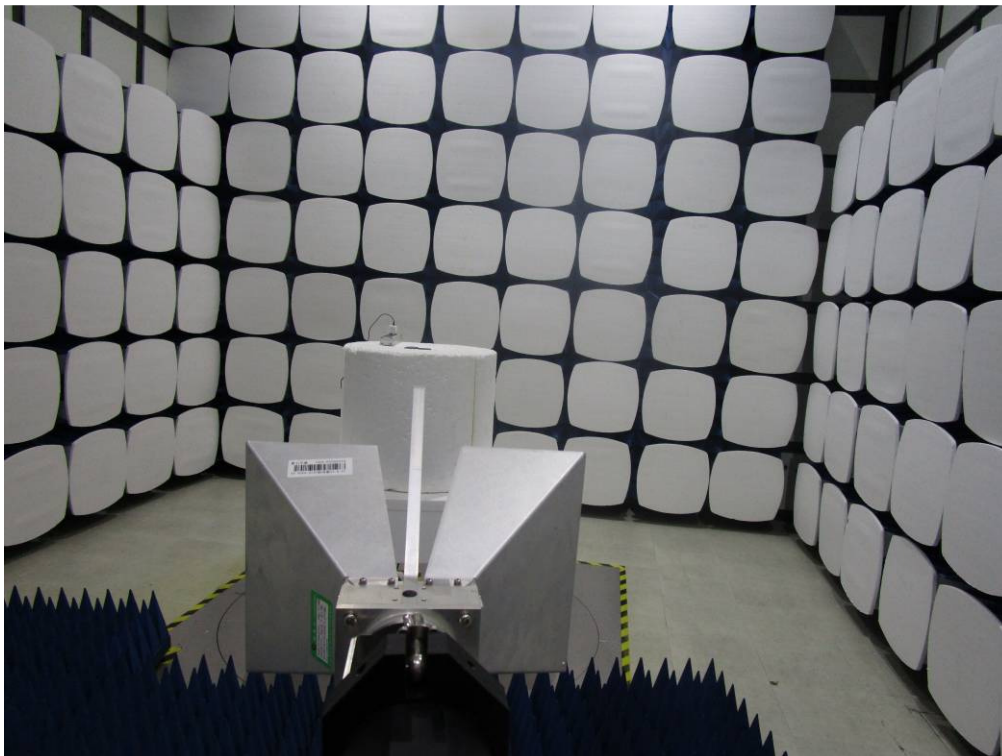
The detailed test data see: Appendix 15.247

8 Photographs

8.1 Conducted Disturbance at AC Power Line(150kHz-30MHz) Test Setup



8.2 Radiated Spurious Emissions Test Setup





8.3 EUT Constructional Details

Appendix A - Photographs of EUT Constructional Details for SZEM1612011258CR.

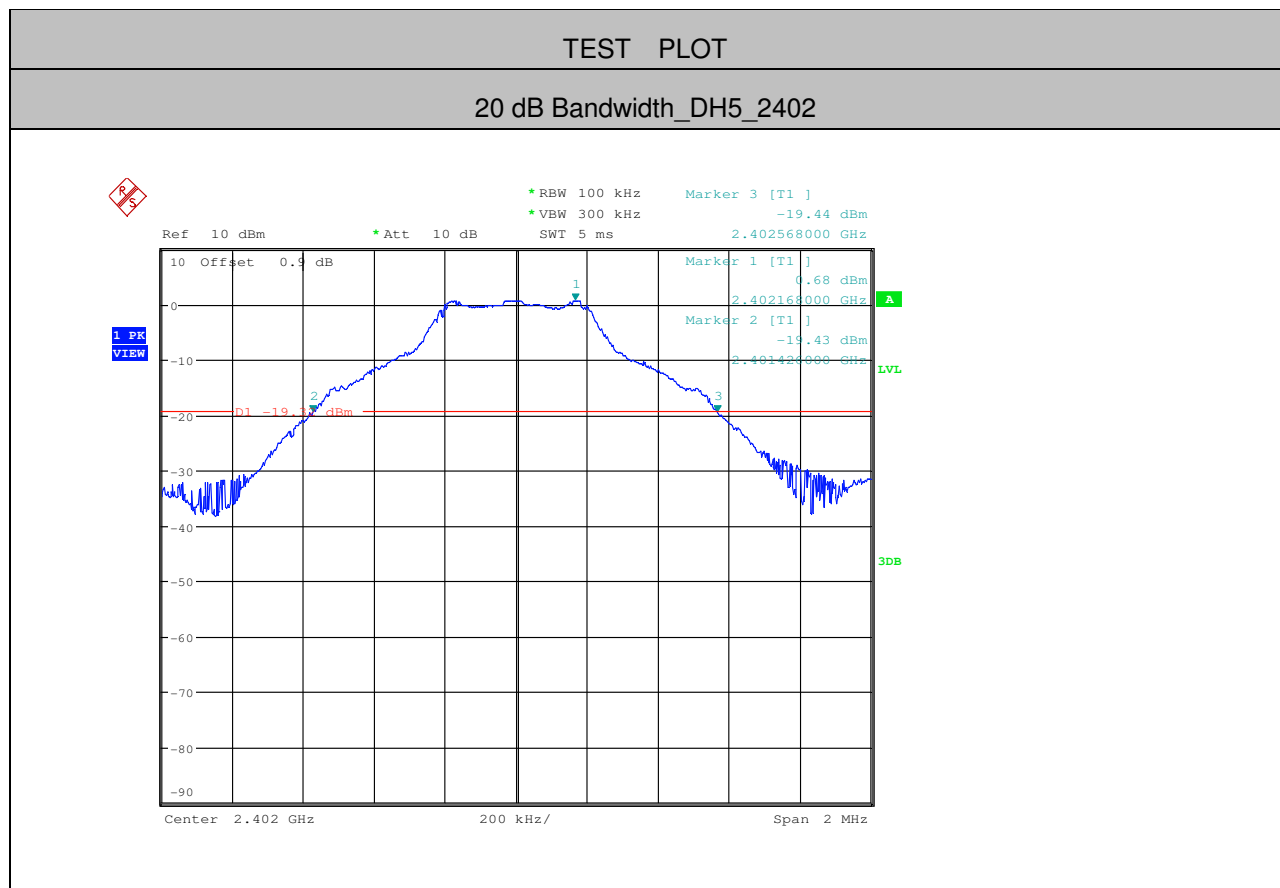


9 Appendix

9.1 Appendix 15.247

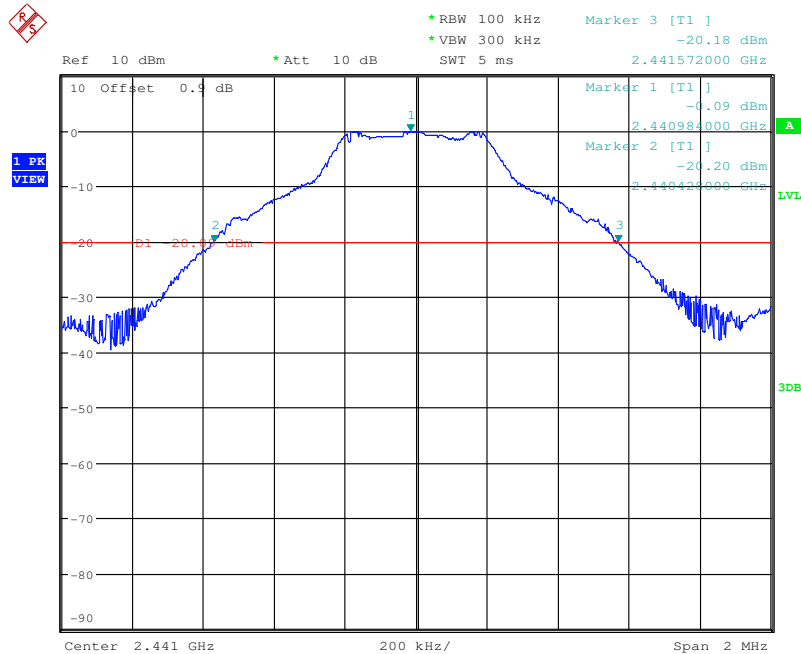
1.20 dB Bandwidth

Test Mode	Test Channel	EBW[MHz]	Limit[MHz]	Verdict
DH5	2402	1.142	---	PASS
DH5	2441	1.144	---	PASS
DH5	2480	1.136	---	PASS

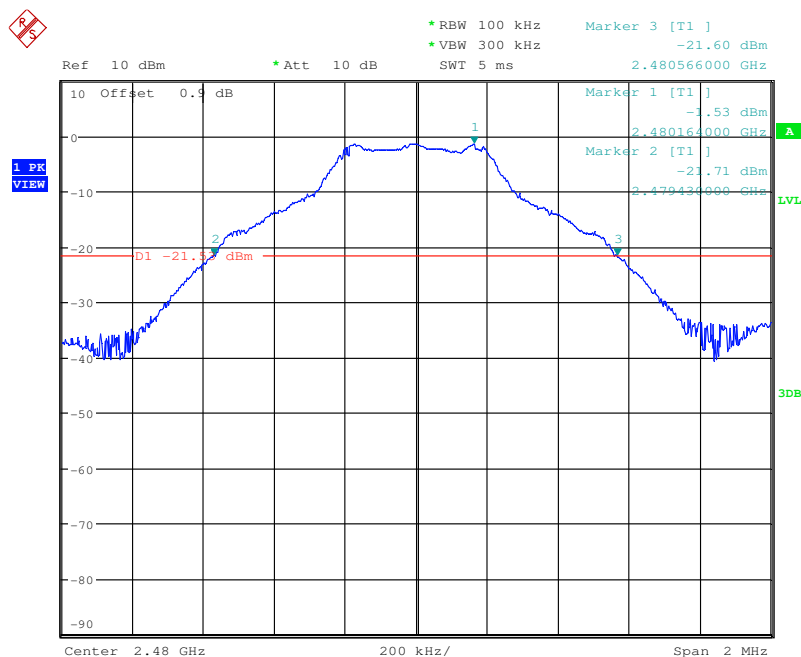




20 dB Bandwidth_DH5_2441



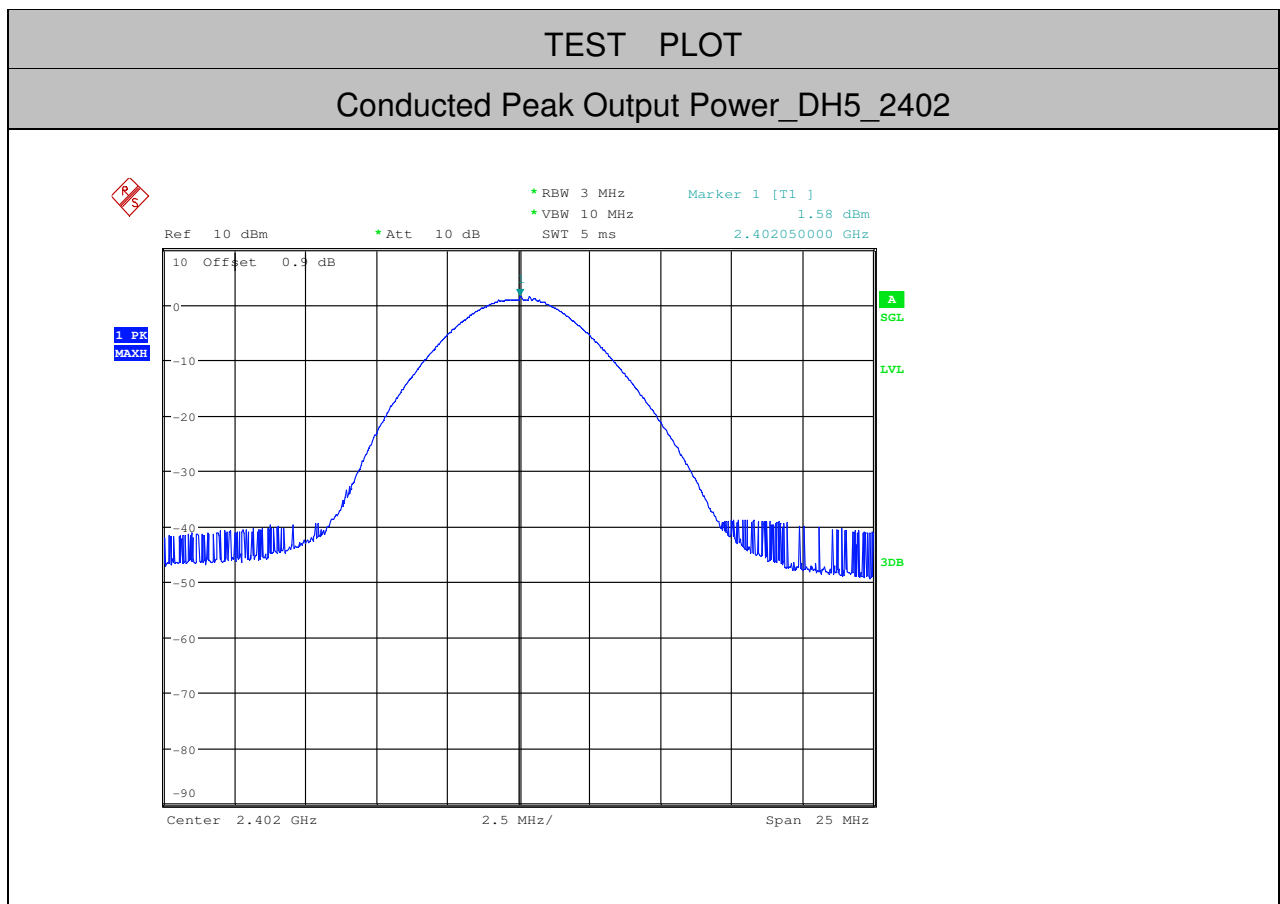
20 dB Bandwidth_DH5_2480



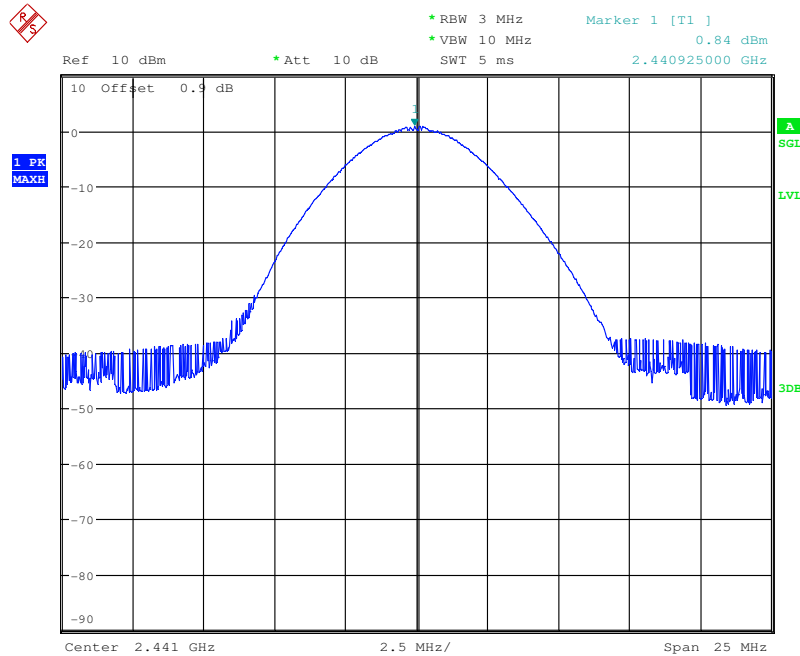


2. Conducted Peak Output Power

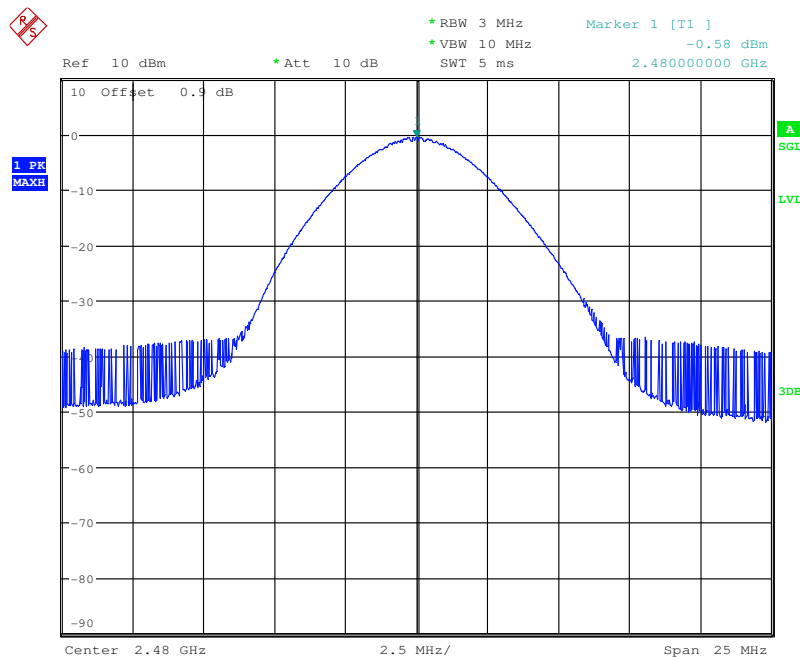
Test Mode	Test Channel	Power[dBm]	Limit[dBm]	Verdict
DH5	2402	1.58	<20.97	PASS
DH5	2441	0.84	<20.97	PASS
DH5	2480	-0.58	<20.97	PASS



Conducted Peak Output Power_DH5_2441



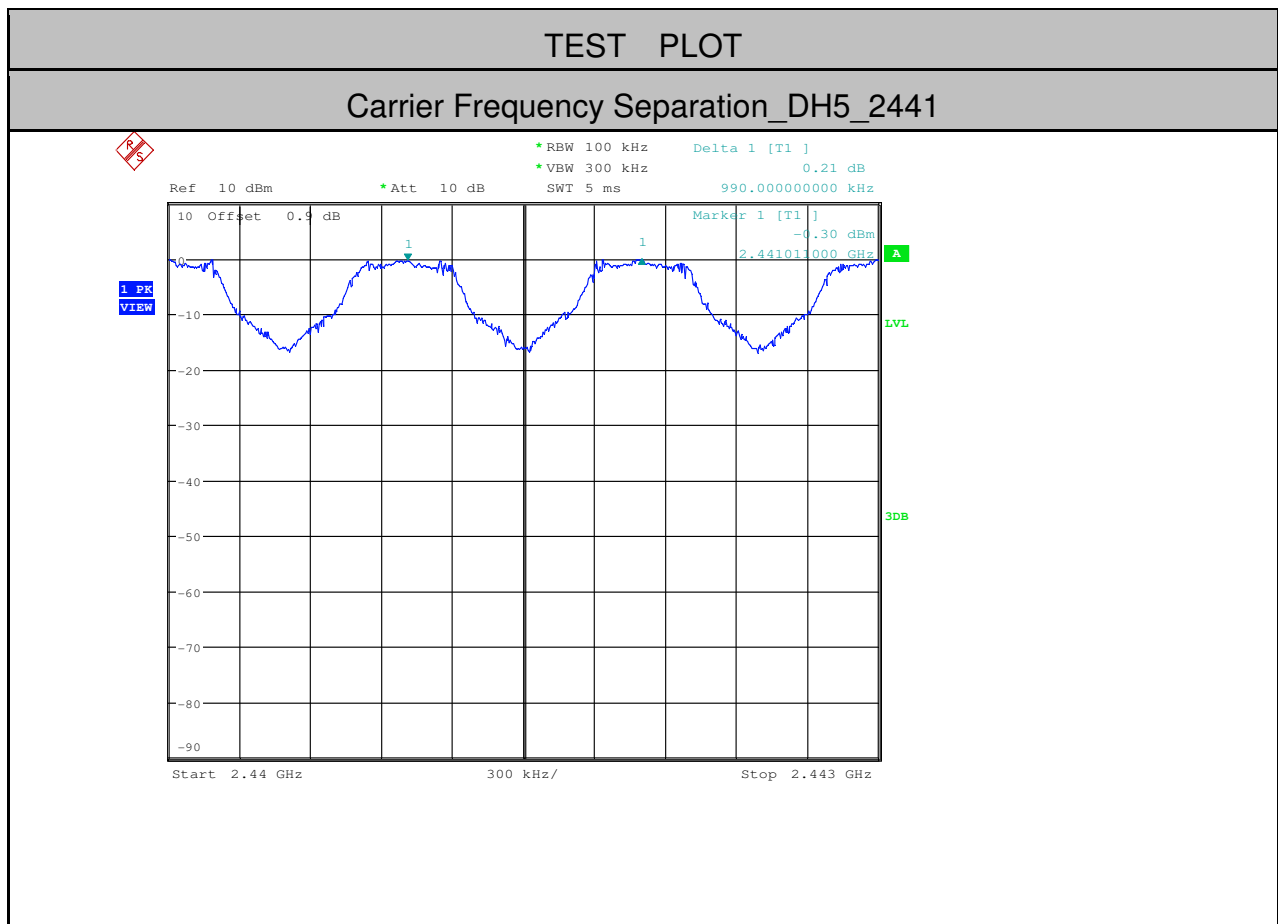
Conducted Peak Output Power_DH5_2480





3.Carrier Frequency Separation

Test Mode	Test Channel	Result[MHz]	Limit[MHz]	Verdict
DH5	2441	0.99	>=0.767	PASS





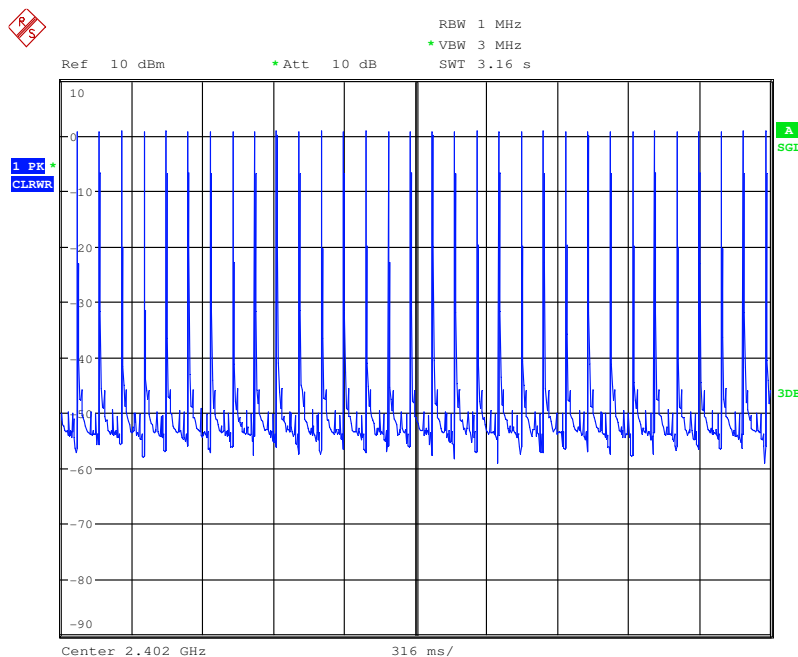
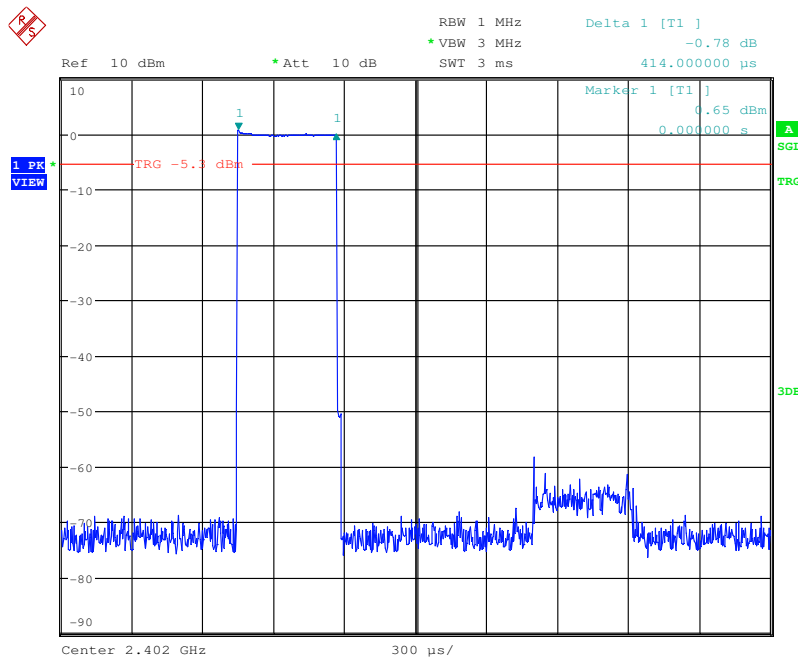
4.Dwell Time

Test Mode	Test Channel	Burst Width[ms/hop/ch]	Total Hops[hop*ch]	Dwell Time[s]	Limit[s]	Verdict
DH1	2402	0.41	320	0.131	<0.4	PASS
DH3	2402	1.68	160	0.269	<0.4	PASS
DH5	2402	2.92	110	0.321	<0.4	PASS



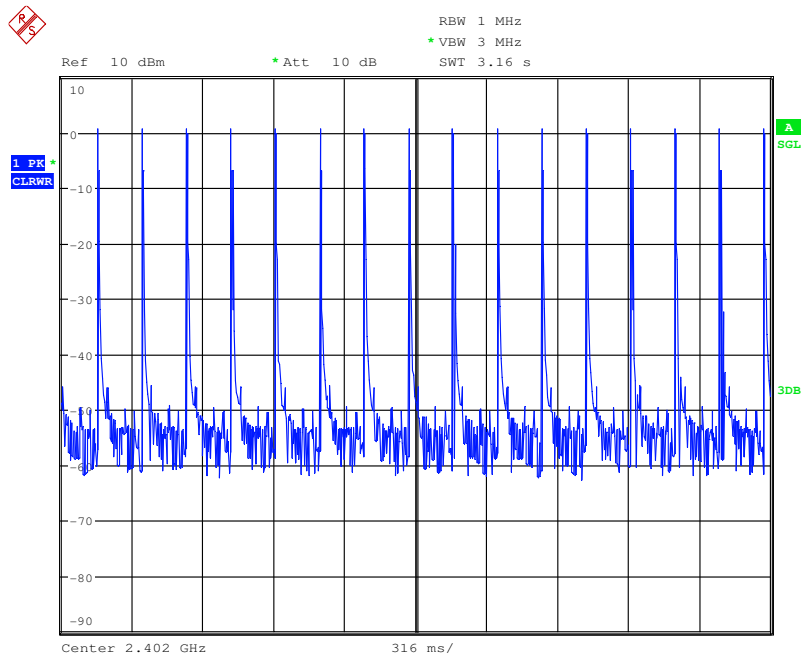
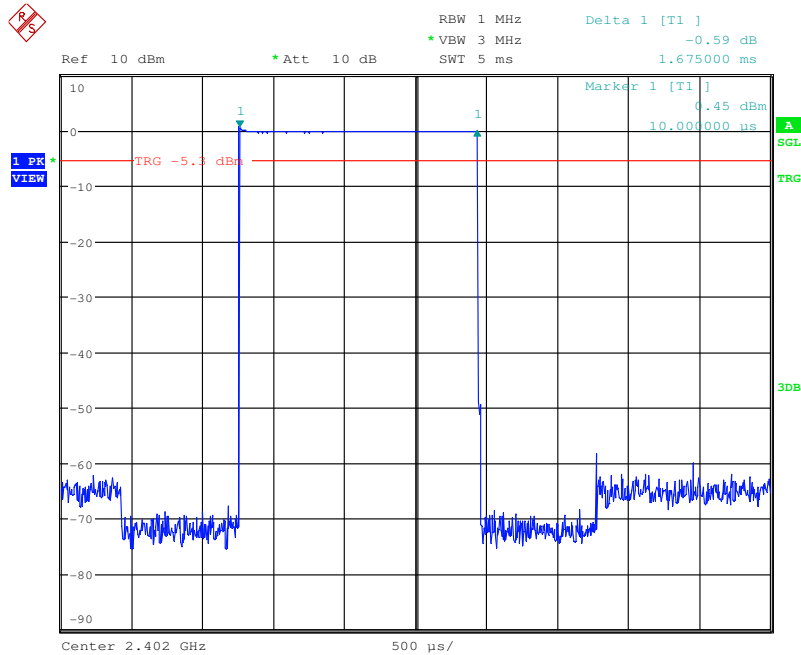
TEST PLOT

Dwell Time_DH1_2402



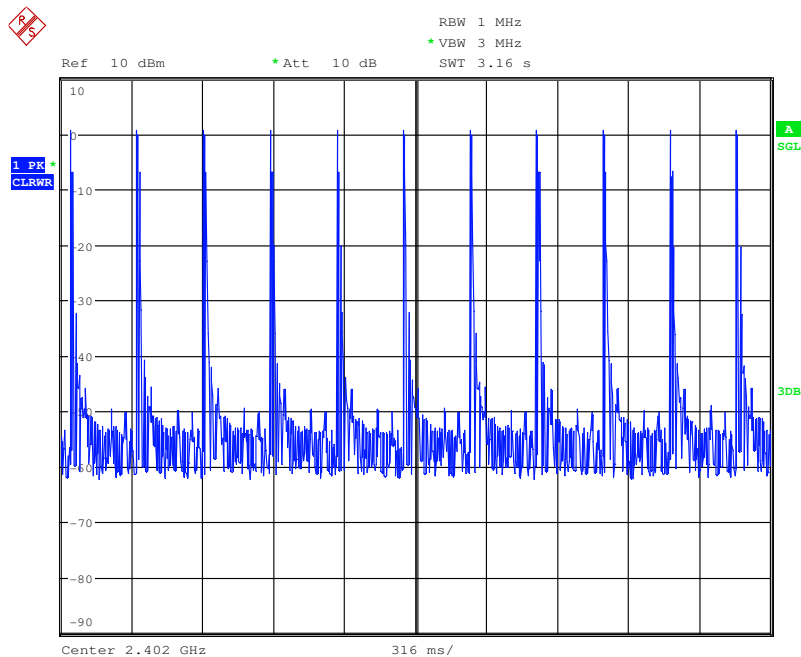
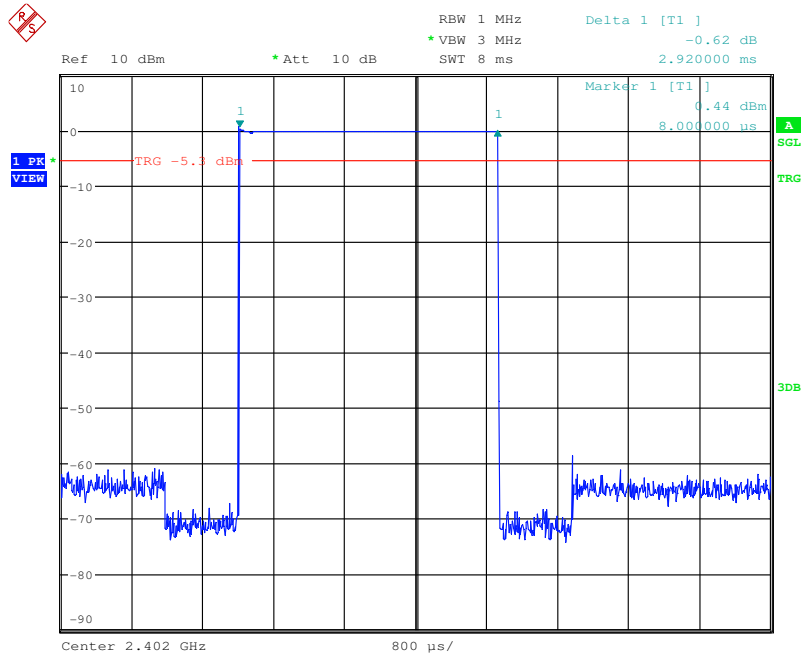


Dwell Time_DH3_2402





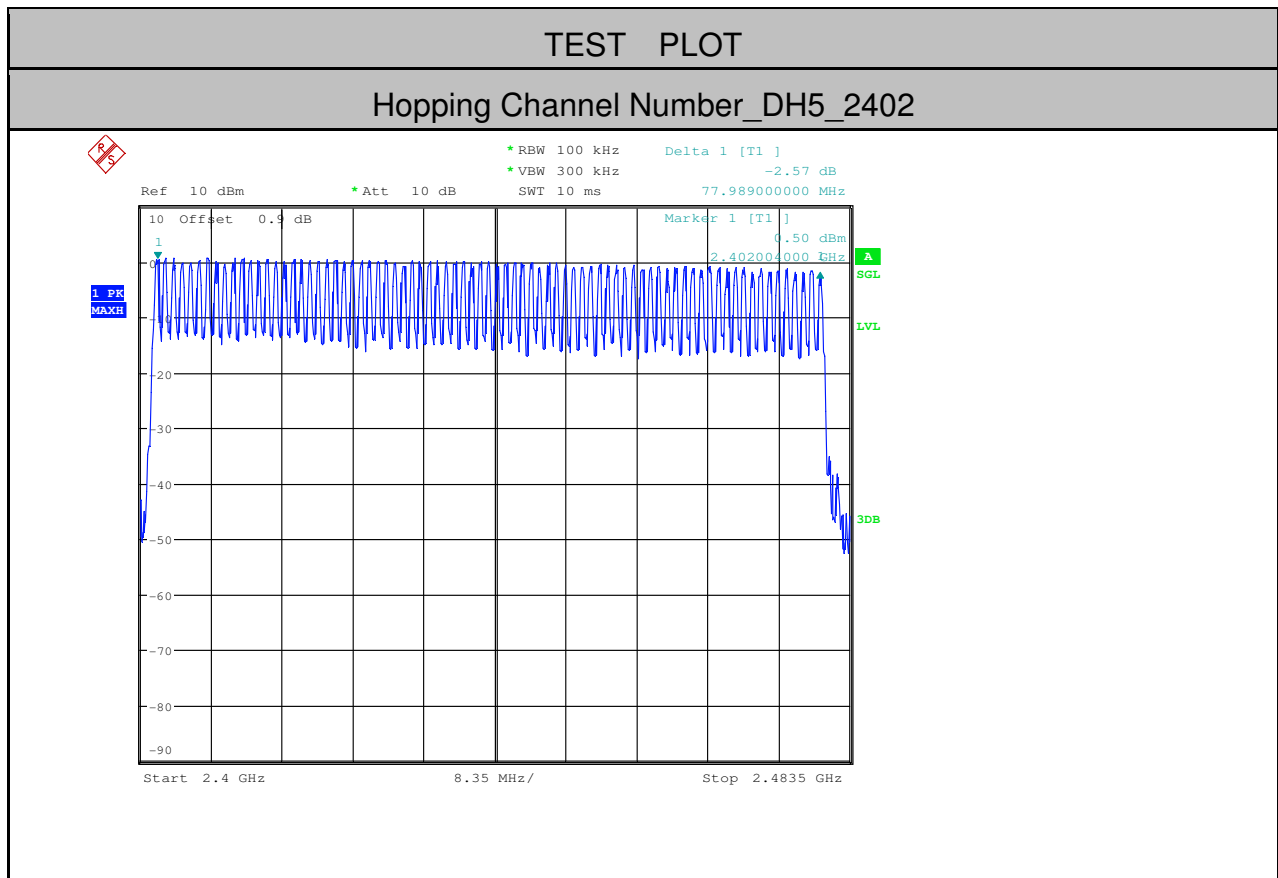
Dwell Time_DH5_2402





5.Hopping Channel Number

Test Mode	Test Channel	Number of Hopping Channel[N]	Limit[N]	Verdic
DH5	2402	79	>=15	PASS



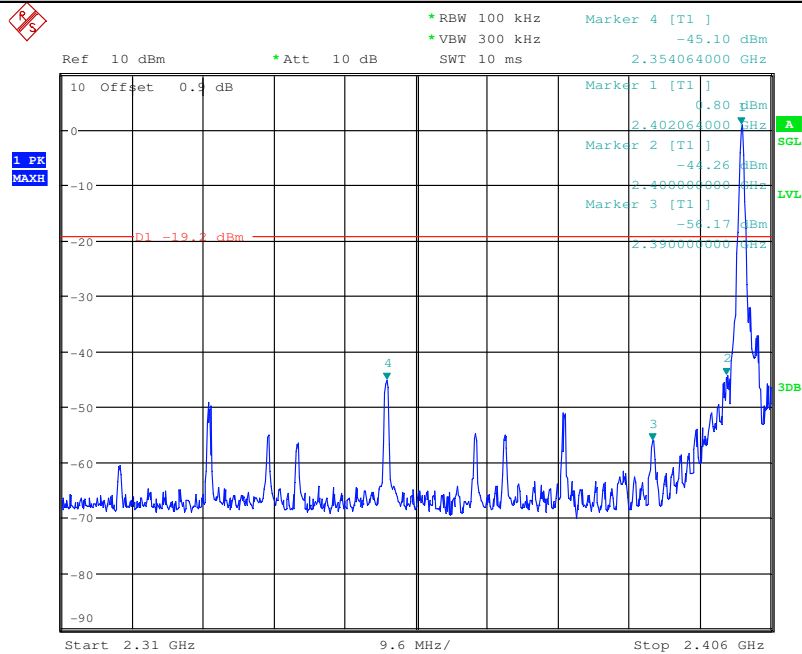


6.Band-edge for RF Conducted Emissions

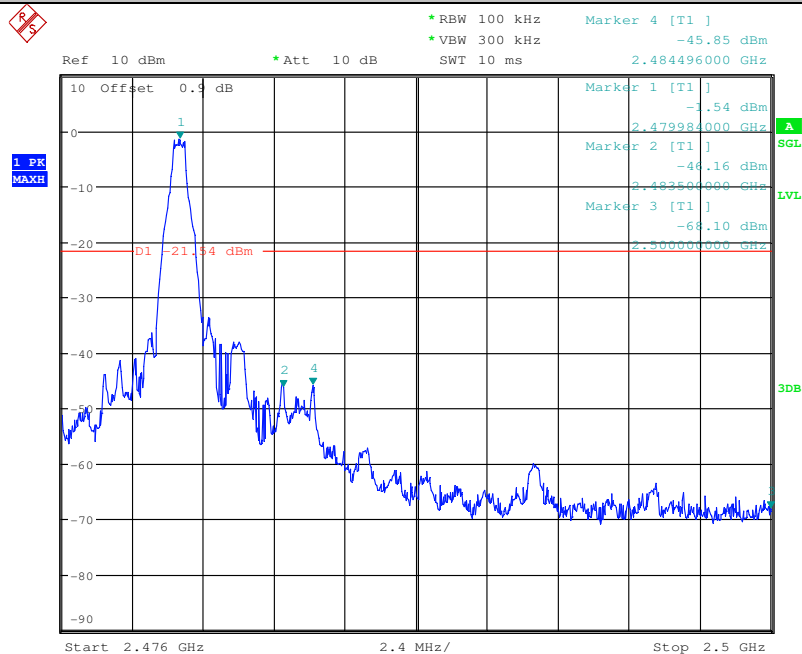
Test Mode	Test Channel	Hopping	Carrier Power[dBm]	Max. Spurious Level [dBm]	Limit[dBm]	Verdict
DH5	2402	Off	0.800	-45.100	<-19.2	PASS
DH5	2480	Off	-1.540	-45.853	<-21.54	PASS
DH5	2402	On	0.790	-45.190	<-19.21	PASS
DH5	2480	On	-1.690	-47.307	<-21.69	PASS

TEST PLOT

Band-edge for RF Conducted Emissions_DH5_2402_Hopping Off

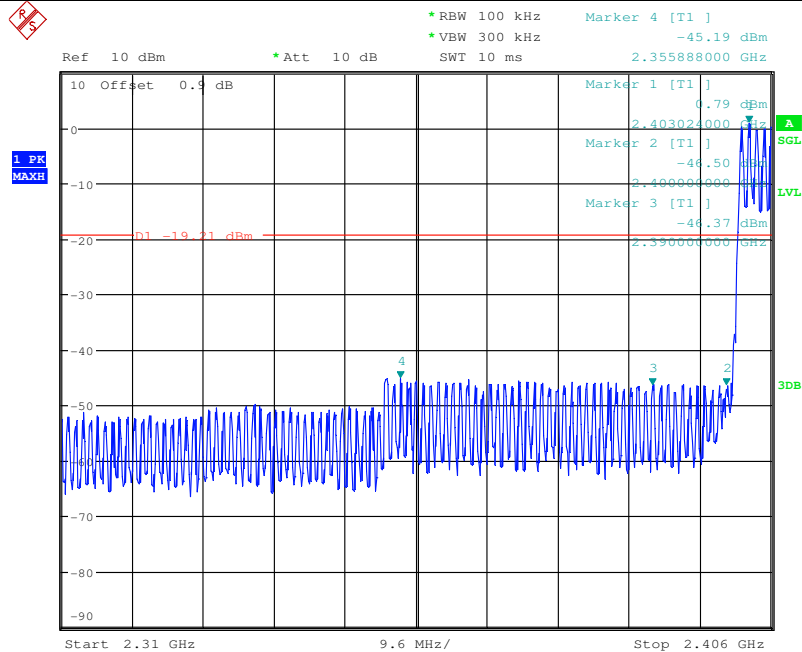


Band-edge for RF Conducted Emissions_DH5_2480_Hopping Off

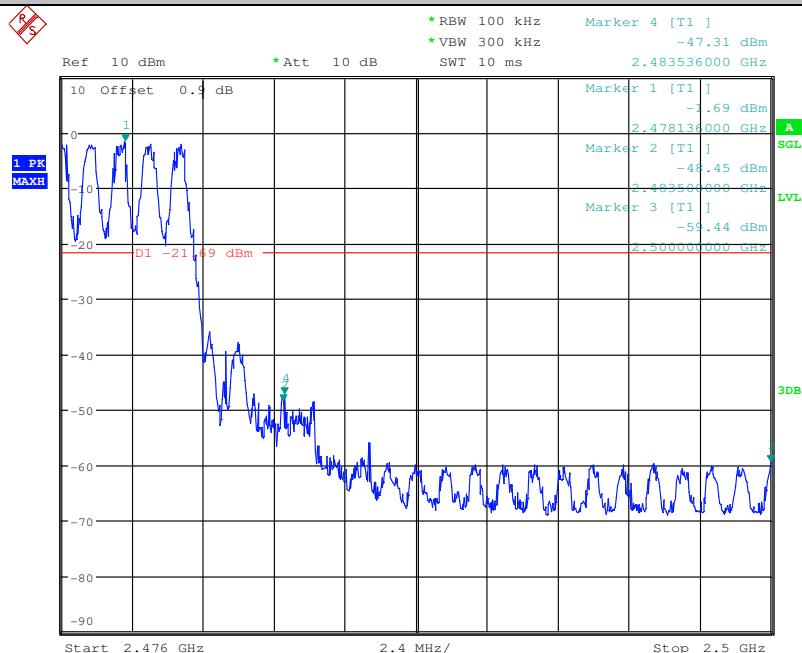




Band-edge for RF Conducted Emissions_DH5_2402_Hopping On



Band-edge for RF Conducted Emissions_DH5_2480_Hopping On





7.RF Conducted Spurious Emissions

Test Mode	Test Channel	StartFre [MHz]	StopFre [MHz]	RBW [kHz]	VBW [kHz]	Pref[dBm]	Max. Level [dBm]	Limit [dBm]	Verdict
DH5	2402	30	10000	1000	3000	0.77	-41.120	<-19.23	PASS
DH5	2402	10000	25000	1000	3000	0.77	-53.490	<-19.23	PASS
DH5	2441	30	10000	1000	3000	0.09	-42.370	<-19.91	PASS
DH5	2441	10000	25000	1000	3000	0.09	-51.180	<-19.91	PASS
DH5	2480	30	10000	1000	3000	-1.52	-43.230	<-21.52	PASS
DH5	2480	10000	25000	1000	3000	-1.52	-49.610	<-21.52	PASS

