Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**GTS20190226001-1-5**
FCC ID..... :	**2ATMQ001A**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Aaron Yan
Approved by (position+printed name+signature)..:	Manager Jason Hu
Date of issue.....:	Jun. 4, 2019
Representative Laboratory Name .:	**Shenzhen Global Test Service Co.,Ltd.**
Address.....:	No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong
Applicant's name.....:	**LIANSHIRUI TECHNOLOGY CO., LTD.**
Address .....:	2F,BUILDING 5, 9#,ZHUZAIWAN,LICHANG COMMUITY,PINGHU TOWN,LONGGANG DISTRICT, SHENZHEN, CHINA
Test specification .....**:**	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

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Test item description .....:	Baby monitor(Camera part)
Trade Mark .....:	**/**
Manufacturer .....:	LIANSHIRUI TECHNOLOGY CO., LTD.
Model/Type reference.....:	BM-208
Listed Models .....:	**/**
Modulation Type .....:	GFSK
Operation Frequency.....:	From 2410MHz to 2473MHz
Hardware Version .....:	N/A
Software Version .....:	N/A
Rating .....:	DC 5V from adapter
Result.....:	**PASS**

TEST REPORT

Test Report No. :	GTS20190226001-1-5	Jun. 4, 2019 Date of issue

Equipment under Test	:	Baby monitor(Camera part)
Model /Type	:	BM-208
Listed Models	:	N/A
Applicant	:	LIANSHIRUI TECHNOLOGY CO., LTD.
Address	:	2F,BUILDING 5, 9#,ZHUZAIWAN,LICHANG COMMUITY,PINGHU TOWN,LONGGANG DISTRICT.
Manufacturer	:	LIANSHIRUI TECHNOLOGY CO., LTD.
Address	:	2F,BUILDING 5, 9#,ZHUZAIWAN,LICHANG COMMUITY,PINGHU TOWN,LONGGANG DISTRICT.

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices
KDB558074 D01 v05r02: Guidance for Compliance Measurements on Digital Transmission Systems (DTS) ,Frequency Hopping Spread Spectrum System(HFSS), and Hybrid System Devices Operating Under §15.247 of The FCC rules.

2 . SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	May. 12, 2019
Testing commenced on	:	May. 28, 2019
Testing concluded on	:	Jun. 4, 2019

2.2. Product Description

Product Name:	Baby monitor(Camera part)
Trade Mark:	/
Model/Type reference:	BM-208
Antenna Type	Internal
Power supply:	DC 5V from adapter
Adapter information	Model:EP19-050100WXLZ Input:100~240V 50/60Hz 0.2A Max Output:5V/1A
HFSS	
Modulation Type	GFSK
Operation frequency	2410-2473MHz
Antenna gain	1dBi Max

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 5V from adapter

2.4. Short description of the Equipment under Test (EUT)

This is a Bluetooth speaker

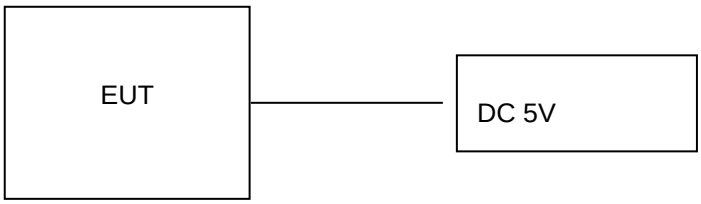
For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 19 channels provided to the EUT. Channel 00/09/18 was selected to test.

Channel	Frequency(MHz)
00	**2410**
01	2413.5
02	2417
03	2420.5
04	2424
05	2427.5
.506	2431
07	2434.5
08	2438
09	**2441.5**
10	2445
11	2448.5
12	2452
13	2455.5
14	2459
15	2462.5
16	2466
17	2469.5
18	**2473**

2.6. Block Diagram of Test Setup



2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2ATMQ001A** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
/	/	/	/	/

2.9. Modifications

No modifications were implemented to meet testing criteria.

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

3.2. Test Facility

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

CNAS (No. CNAS L8169)
Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)
Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	-/-	-/-	-/-	-/-	☐	☐	☒	☐	Not applicable for FHSS
§15.247(a)(1)	Carrier Frequency separation	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Number of Hopping channels	GFSK	☒ Full	GFSK	☒ Full	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies
§15.247(d)	Band edge compliance conducted	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	-/-	-/-	-/-	-/-	☐	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☐	☐	☒	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	-/-	-/-	-/-	-/-	☐	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report

3.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6. Equipments Used during the Test

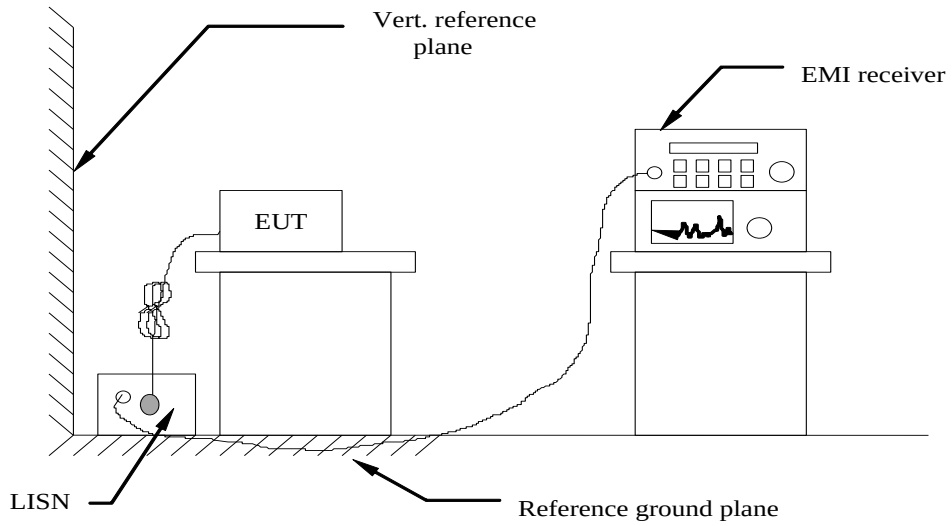
Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2018/09/28	2019/09/27
LISN	R&S	ESH2-Z5	893606/008	2018/09/27	2019/09/26
By-log Antenna	SCHWARZBECK	VULB9163	000976	2018/09/29	2019/09/28
EMI Test Receiver	R&S	ESCI	101102	2018/09/26	2019/09/25
Spectrum Analyzer	Agilent	N9020A	MY48010425	2018/09/17	2019/09/16
Spectrum Analyzer	R&S	FSV40-N	101800	2018/09/17	2019/09/16
Controller	EM Electronics	Controller EM 1000	N/A	2018/09/21	2019/09/20
Double Ridged Horn Antenna (1~18GHz)	SCHWARZBECK	BBHA 9120D	01622	2018/09/19	2019/09/18
Double Ridged Horn Antenna	Rohde&Schwarz	HF907	100265	2018/09/19	2019/09/18
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2018/09/19	2019/09/18
Horn Antenna (18GHz~40GHz)	ETS	3116	00086467	2018/12/29	2019/12/28
Amplifier (26.5GHz~40GHz)	EMCI	EMC2654045	980028	2018/09/18	2019/09/17
Amplifier (0.1GHz~26.5GHz)	EMCI	EMC012645SE	980355	2018/09/19	2019/09/18
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/09/20	2019/09/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2018/09/20	2019/09/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2018/09/20	2019/09/19
Data acquisition card	Agilent	U2531A	TW53323507	2018/09/20	2019/09/19
Power Sensor	Agilent	U2021XA	MY5365004	2018/09/20	2019/09/19
RF Cable	HUBER+SUHNER	RG214	N/A	2018/09/20	2019/09/19
Conducted Emission Test Software	ES-K1	V1.71	N/A	N/A	N/A
Radiated Emission Test Software	JS32-RE	V2.5.0.9	N/A	N/A	N/A

Note: The Cal.Interval was one year.

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013.
4 The EUT received DC 5V power, the adapter received AC120V/60Hz or AC 240V/50Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

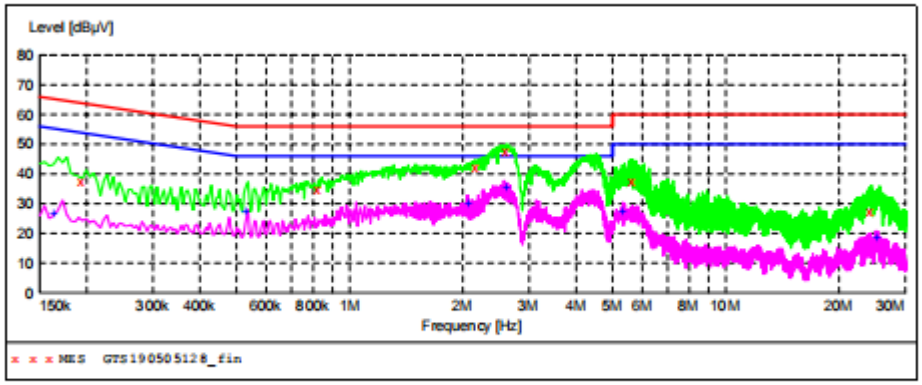
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

TEST RESULTS

Remark: We measured Conducted Emission at GFSKin AC 120V/60Hz and AC 240V/50Hz, the worst case was recorded .

Power supply:	AC 120V/60Hz	Polarization	L

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "GTS190505128_fin"

5/5/2019 4:37PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.195000	37.20	10.0	64	26.6	QP	L1	GND
0.825000	34.80	9.6	56	21.2	QP	L1	GND
2.161500	42.40	9.5	56	13.6	QP	L1	GND
2.611500	47.60	9.5	56	8.4	QP	L1	GND
5.626500	37.50	9.2	60	22.5	QP	L1	GND
24.387000	27.20	7.0	60	32.8	QP	L1	GND

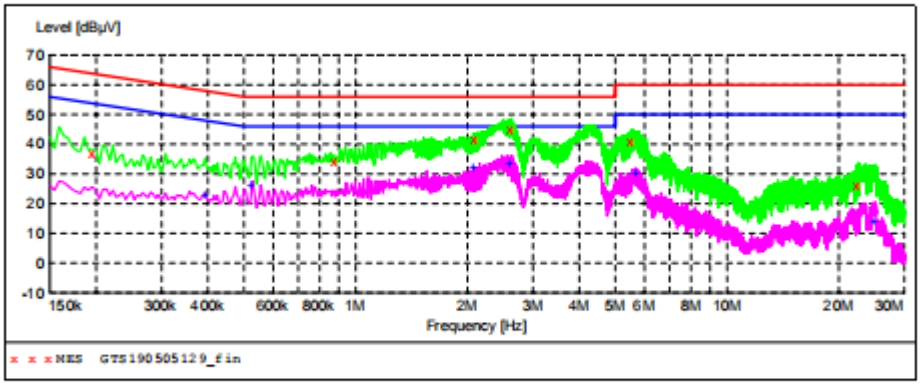
MEASUREMENT RESULT: "GTS190505128_fin2"

5/5/2019 4:37PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.163500	26.60	10.0	55	28.7	AV	L1	GND
0.532500	27.10	9.8	46	18.9	AV	L1	GND
2.080500	30.30	9.5	46	15.7	AV	L1	GND
2.611500	35.70	9.5	46	10.3	AV	L1	GND
5.307000	27.60	9.3	50	22.4	AV	L1	GND
25.134000	18.50	7.0	50	31.5	AV	L1	GND

Power supply:	AC 120V/60Hz	Polarization	N

SCAN TABLE: "Voltage (9K-30M) FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "GTS190505129_fin"

5/5/2019 4:40PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.195000	36.70	10.0	64	27.1	QP	N	GND
0.883500	33.90	9.6	56	22.1	QP	N	GND
2.103000	41.60	9.5	56	14.4	QP	N	GND
2.620500	45.30	9.5	56	10.7	QP	N	GND
5.523000	41.20	9.2	60	18.8	QP	N	GND
22.528500	26.30	7.0	60	33.7	QP	N	GND

MEASUREMENT RESULT: "GTS190505129_fin2"

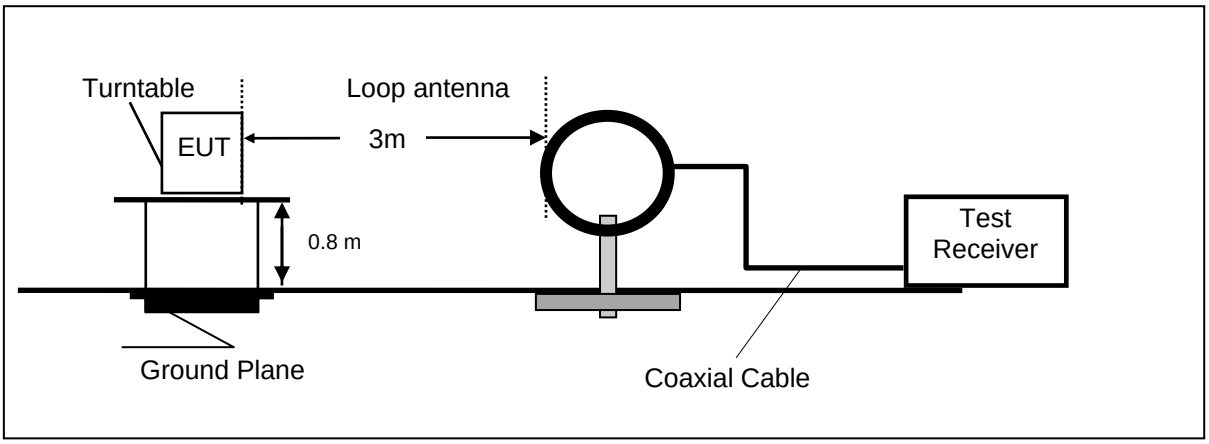
5/5/2019 4:40PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.393000	22.50	9.8	48	25.5	AV	N	GND
0.523500	26.20	9.8	46	19.8	AV	N	GND
2.071500	32.00	9.5	46	14.0	AV	N	GND
2.593500	33.40	9.5	46	12.6	AV	N	GND
5.694000	29.90	9.2	50	20.1	AV	N	GND
25.030500	14.00	7.0	50	36.0	AV	N	GND

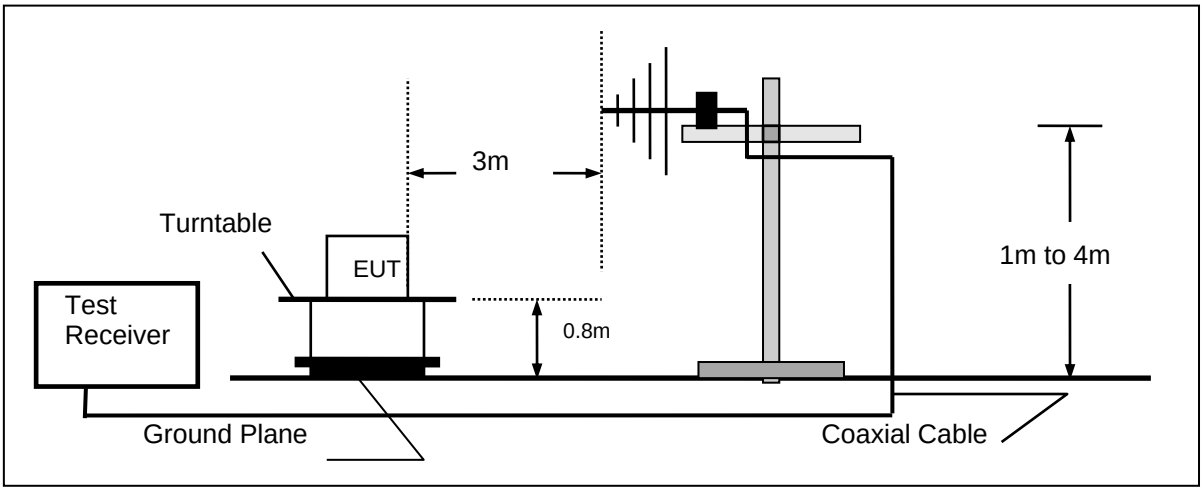
4.2. Radiated Emission

TEST CONFIGURATION

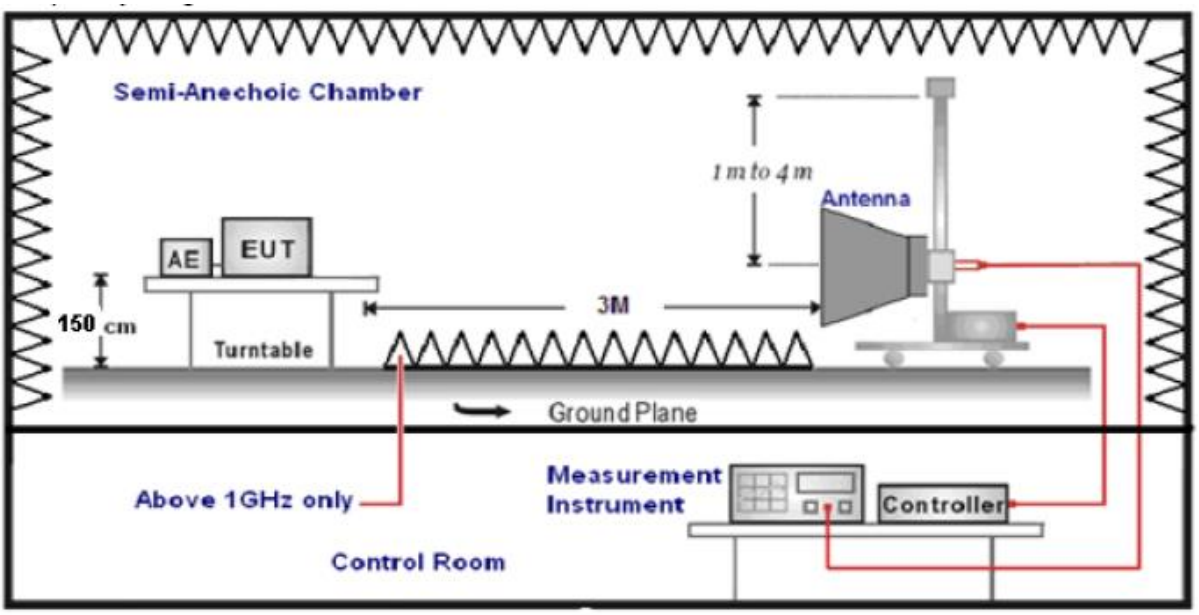
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.
The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

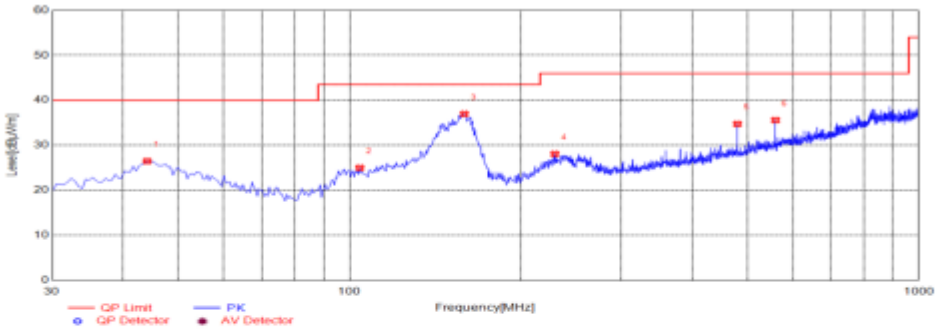
TEST RESULTS

Remark: We measured Radiated Emission at GFSKmode from 30MHz to 25GHz and recorded worst case

For 30MHz-1GHz

Horizontal

Test Graph

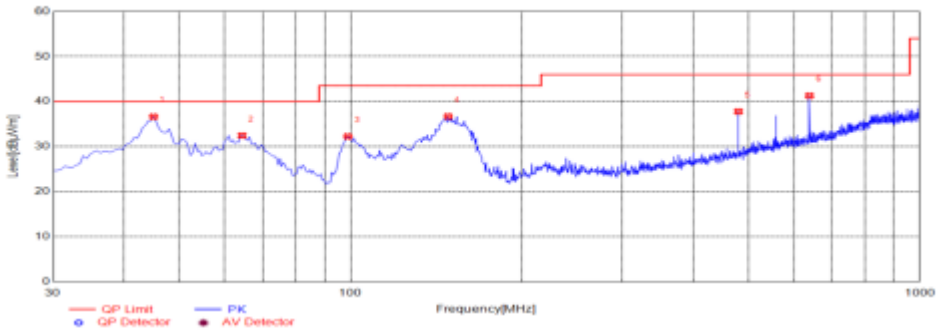


Suspected List

NO.	Freq. [MHz]	Polarity	Height [cm]	Angle [°]	Limit [dBμV/m]	Level [dBμV/m]	Factor [dB]	Readin d[dBμV /m]	Margin [dB]
1	44.0650	Horizontal	100	174	40.00	26.50	-14.99	41.49	13.50
2	104.205	Horizontal	100	266	43.50	25.02	-16.95	41.97	18.48
3	159.010	Horizontal	100	90	43.50	36.99	-19.40	56.39	6.51
4	229.335	Horizontal	100	247	46.00	28.11	-15.66	43.77	17.89
5	480.080	Horizontal	100	256	46.00	34.77	-10.43	45.20	11.23
6	560.105	Horizontal	100	310	46.00	35.61	-8.65	44.26	10.39

Vertical

Test Graph



Suspected List

NO.	Freq. [MHz]	Polarity	Height [cm]	Angle [°]	Limit [dBμV/m]	Level [dBμV/m]	Factor [dB]	Readin d[dBμV /m]	Margin [dB]
1	45.0350	Vertical	100	131	40.00	36.64	-14.76	51.40	3.36
2	64.4350	Vertical	100	142	40.00	32.45	-18.15	50.60	7.55
3	98.8700	Vertical	100	193	43.50	32.26	-17.08	49.34	11.24
4	148.340	Vertical	100	276	43.50	36.70	-19.78	56.48	6.80
5	480.080	Vertical	100	174	46.00	37.79	-10.43	48.22	8.21
6	640.130	Vertical	100	262	46.00	41.29	-7.22	48.51	4.71

For 1GHz to 25GHz

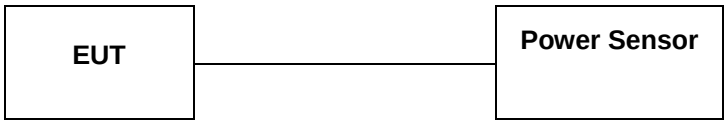
Frequency(MHz):			**2410**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
4824	50.04	PK	74	23.96	1	126	47.94	31.6	7	36.5	2.1
4824	41.48	AV	54	12.52	1	126	39.38	31.6	7	36.5	2.1
Frequency(MHz):			**2441.5**			**Polarity:**			**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
4883	50.06	PK	74	23.94	1	143	47.94	31.02	7.6	36.5	2.12
4883	41.23	AV	54	12.77	1	143	39.11	31.02	7.6	36.5	2.12
Frequency(MHz):			**2473**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
4946	50.86	PK	74	23.14	1	183	47.66	31.58	7.82	36.2	3.2
4946	41.59	AV	54	12.41	1	183	38.39	31.58	7.82	36.2	3.2

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.
The maximum Average conducted output power may be measured using a wideband RF power meter with a thermocouple derector or equivalent. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

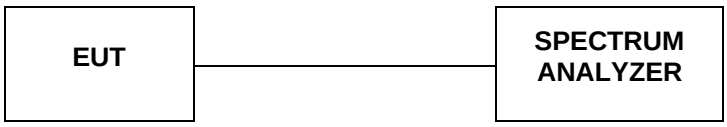
TEST RESULTS

Type	Channel	Peak Output power (dBm)	Limit (dBm)	Result
GFSK	00	8.61	21	Pass
	09	8.58		
	18	8.49		

Note: The test results including the cable lose.

4.4. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30KHz and VBW=100KHz.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

LIMIT

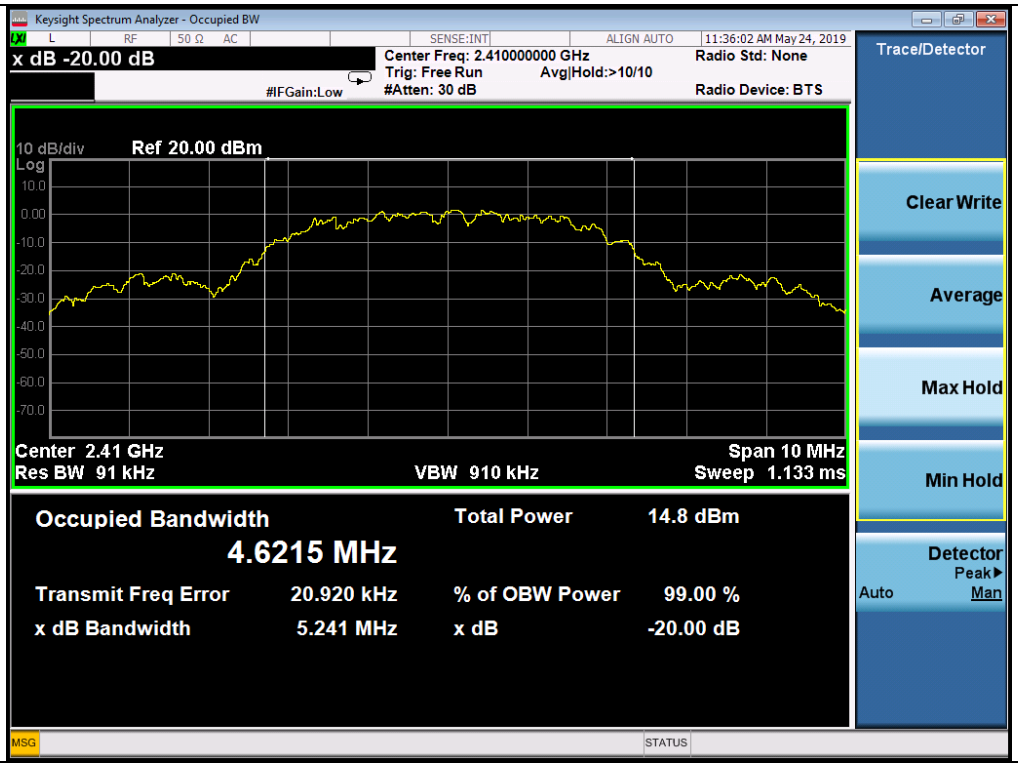
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

TEST RESULTS

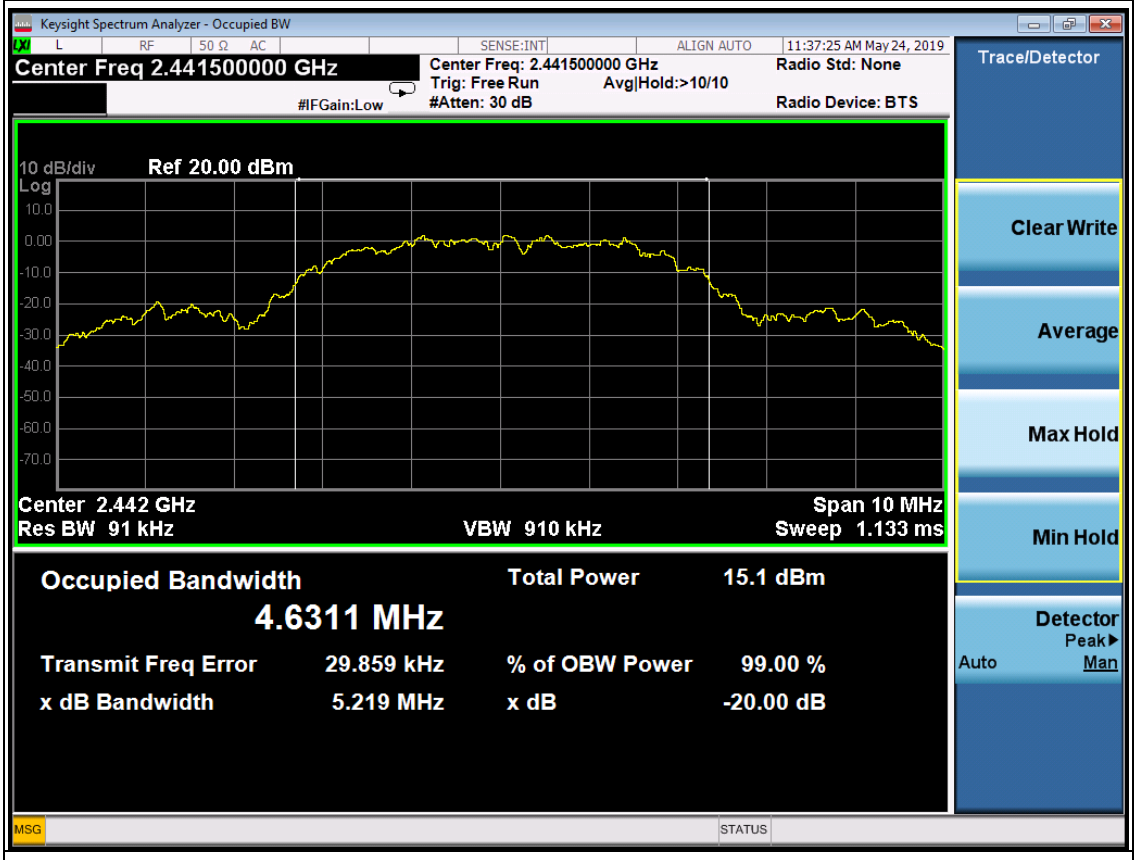
	Frequency	20dB Bandwidth (MHz)	Result
GFSK	2410 MHz	5.241	PASS
	2441.5 MHz	5.219	PASS
	2473 MHz	5.237	PASS

Test plot as follows:

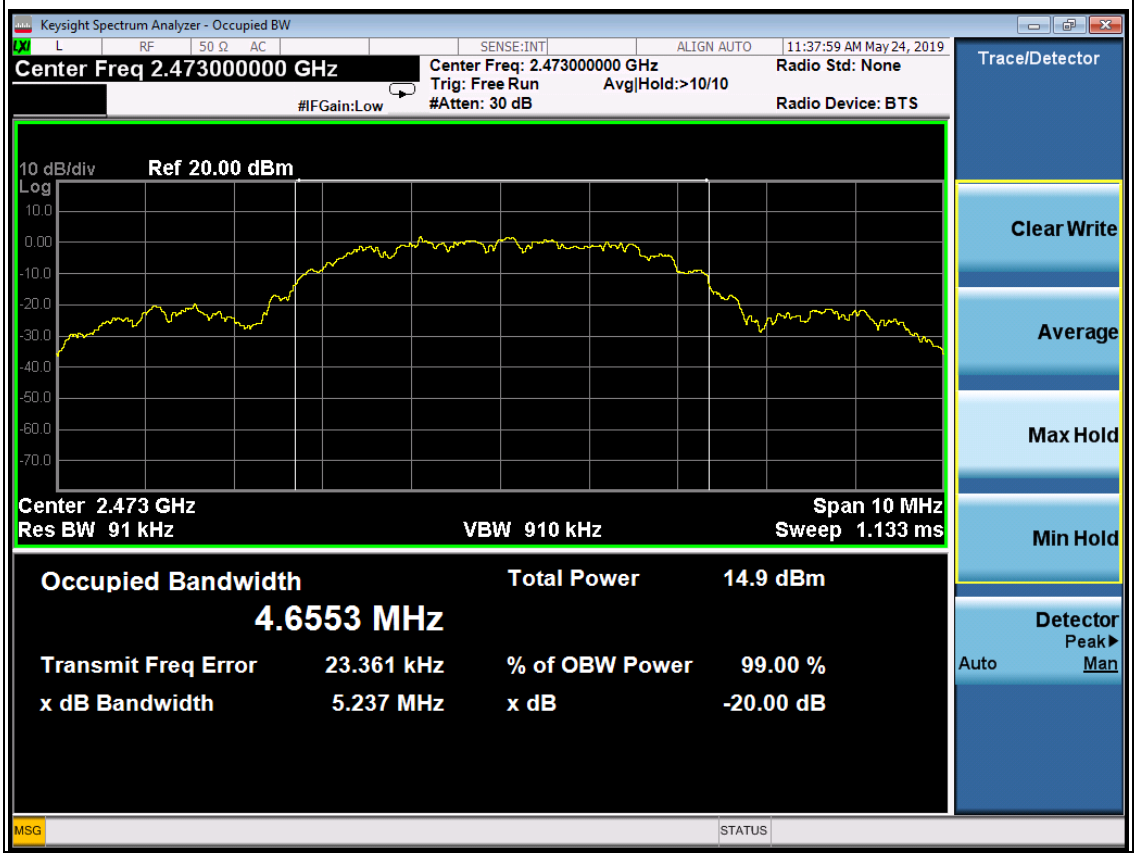
CH00



CH09

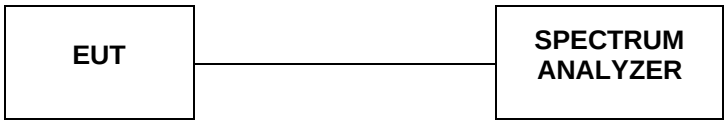

Keysight Spectrum Analyzer - Occupied BW
L RF 50 Ω AC SENSE:INT ALIGN AUTO 11:37:25 AM May 24, 2019
Center Freq 2.441500000 GHz
Center Freq: 2.441500000 GHz
Trig: Free Run Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
Trace/Detector
10 dB/div Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.442 GHz
Res BW 91 kHz
VBW 910 kHz
Span 10 MHz
Sweep 1.133 ms
Clear Write
Average
Max Hold
Min Hold
Occupied Bandwidth
4.6311 MHz
Total Power 15.1 dBm
Transmit Freq Error 29.859 kHz
% of OBW Power 99.00 %
x dB Bandwidth 5.219 MHz
x dB -20.00 dB
Detector
Peak
Auto Man
MSG
STATUS

CH18


Keysight Spectrum Analyzer - Occupied BW
L RF 50 Ω AC SENSE:INT ALIGN AUTO 11:37:59 AM May 24, 2019
Center Freq 2.473000000 GHz
Center Freq: 2.473000000 GHz
Trig: Free Run Avg|Hold:>10/10
#Atten: 30 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
Trace/Detector
10 dB/div Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.473 GHz
Res BW 91 kHz
VBW 910 kHz
Span 10 MHz
Sweep 1.133 ms
Clear Write
Average
Max Hold
Min Hold
Occupied Bandwidth
4.6553 MHz
Total Power 14.9 dBm
Transmit Freq Error 23.361 kHz
% of OBW Power 99.00 %
x dB Bandwidth 5.237 MHz
x dB -20.00 dB
Detector
Peak
Auto Man
MSG
STATUS

4.5. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30KHz and VBW=100KHz.

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST RESULTS

	Frequency	Ch. Separation (MHz)	Limit (MHz) [2/3*20dB Bandwidth]	Result
GFSK	2402 MHz	3.50	3.494	**Complies**
	2441 MHz	3.52	3.479	**Complies**
	2480 MHz	3.52	3.491	**Complies**

Ch. Separation Limits: > 2/3 of 20dB bandwidth

CH00

CH09

Keysight Spectrum Analyzer - Swept SA
L RF 50 Ω AC SENSE:INT ALIGN AUTO 11:14:53 AM May 24, 2019
Marker 1 Δ 3.520000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
TRACE 1 2 3 4 5 6
TYPE M WWWWWW
DET P N N N N N
ΔMkr1 3.52 MHz
-0.332 dB
10 dB/div Ref 19.00 dBm
Log
9.00
-1.00
-11.0
-21.0
-31.0
-41.0
-51.0
-61.0
-71.0
1Δ2
Center 2.439750 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 10.00 MHz
Sweep 10.60 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

CH18

Keysight Spectrum Analyzer - Swept SA
L RF 50 Ω AC SENSE:INT ALIGN AUTO 11:17:12 AM May 24, 2019
Marker 1 Δ 3.520000000 MHz
PNO: Wide
IFGain:Low
Trig: Free Run
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
TRACE 1 2 3 4 5 6
TYPE M WWWWWW
DET P N N N N N
ΔMkr1 3.52 MHz
-0.024 dB
10 dB/div Ref 19.00 dBm
Log
9.00
-1.00
-11.0
-21.0
-31.0
-41.0
-51.0
-61.0
-71.0
1Δ2
Center 2.471250 GHz
#Res BW 30 kHz
#VBW 100 kHz
Span 10.00 MHz
Sweep 10.60 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

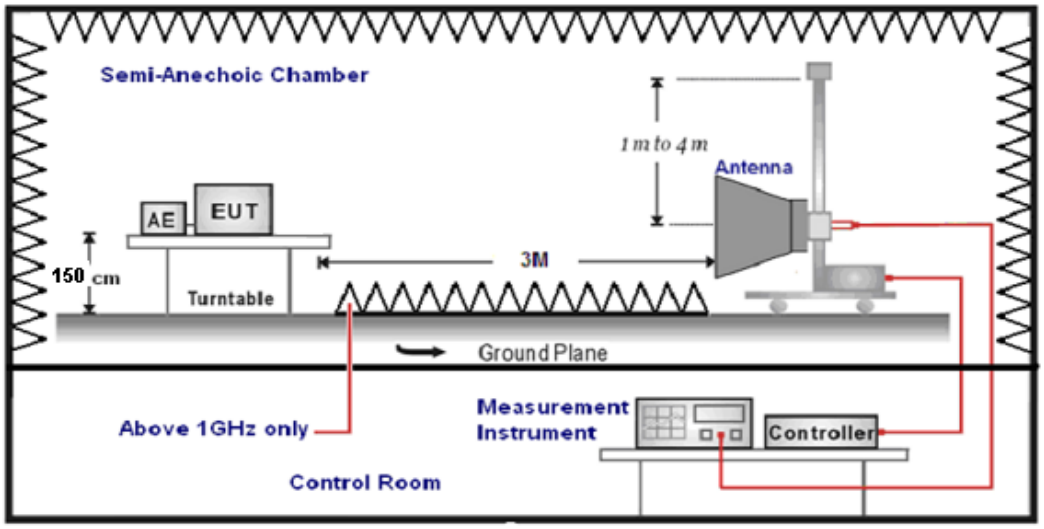
4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

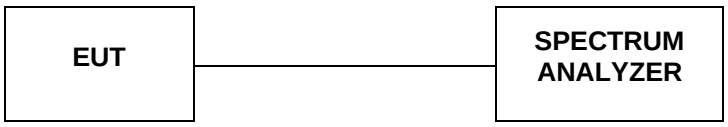
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

TEST CONFIGURATION

For Radiated



For Conducted



TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.
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)

TEST RESULTS

4.6.1 For Radiated Bandedge Measurement

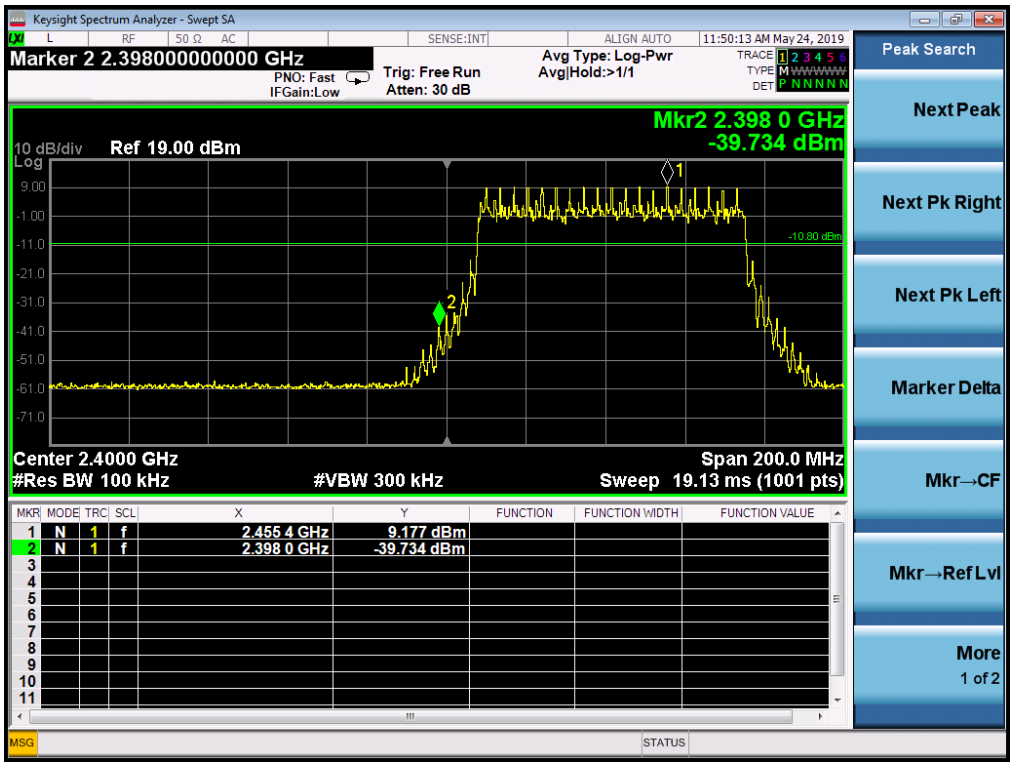
Remark: we tested radiated bandedge at both hopping and no-hopping modes,recorded worst case at no-hopping mode

GFSK

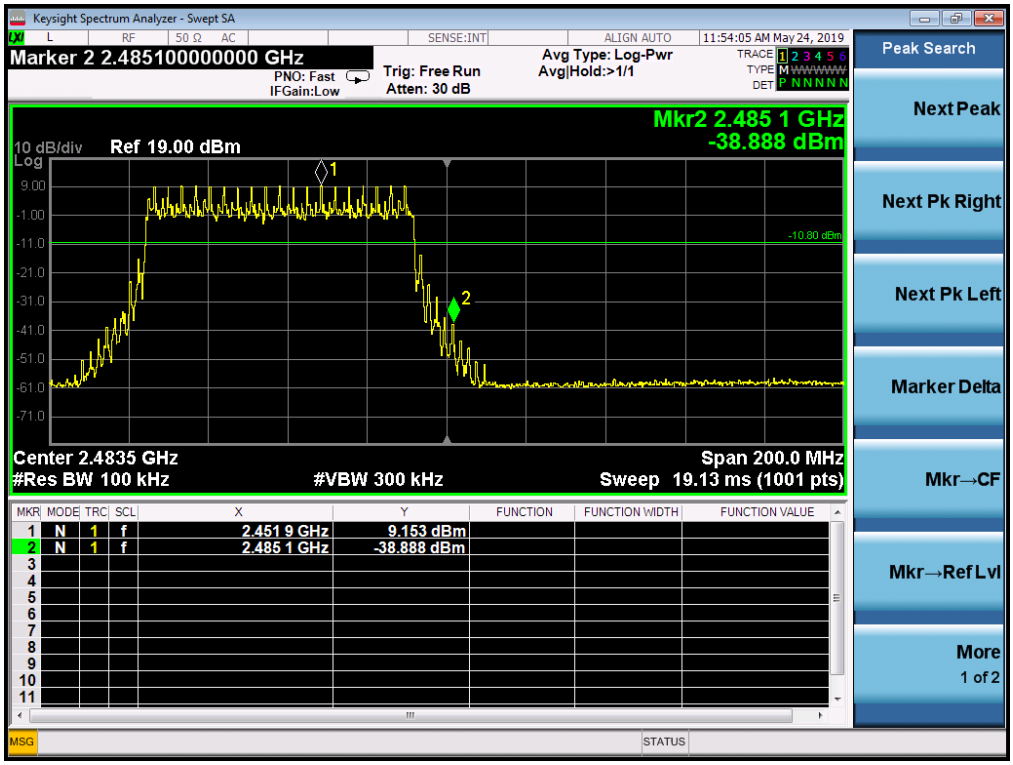
Frequency(MHz):			**2410**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	48.62	PK	74	25.38	1	159	53.93	27.49	3.32	36.12	-5.31
2390.00	38.53	AV	54	15.47	1	159	43.84	27.49	3.32	36.12	-5.31
Frequency(MHz):			**2410**			**Polarity:**			**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2390.00	48.16	PK	74	25.84	1	176	53.47	27.49	3.32	36.12	-5.31
2390.00	38.52	AV	54	15.48	1	176	43.83	27.49	3.32	36.12	-5.31
Frequency(MHz):			**2473**			**Polarity:**			**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	47.76	PK	74	24.67	1	103	53.48	27.45	3.38	36.55	-5.72
2483.50	38.49	AV	54	12.37	1	103	44.21	27.45	3.38	36.55	-5.72
Frequency(MHz):			**2473**			**Polarity:**			**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier	Correction Factor (dB/m)
2483.50	48.64	PK	74	24.67	1	119	54.36	27.45	3.38	36.55	-5.72
2483.50	37.75	AV	54	12.37	1	119	43.47	27.45	3.38	36.55	-5.72

4.6.2 For Conducted Bandedge Measurement

BDR mode (GFSK): Band Edge-Left Side



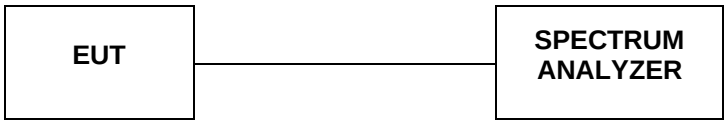
EDR mode (GFSK): Band Edge-Right Side



NOTE: Hopping enabled and disabled have evaluated, and the worst data was reported.

4.7. Number of hopping frequency

TEST CONFIGURATION



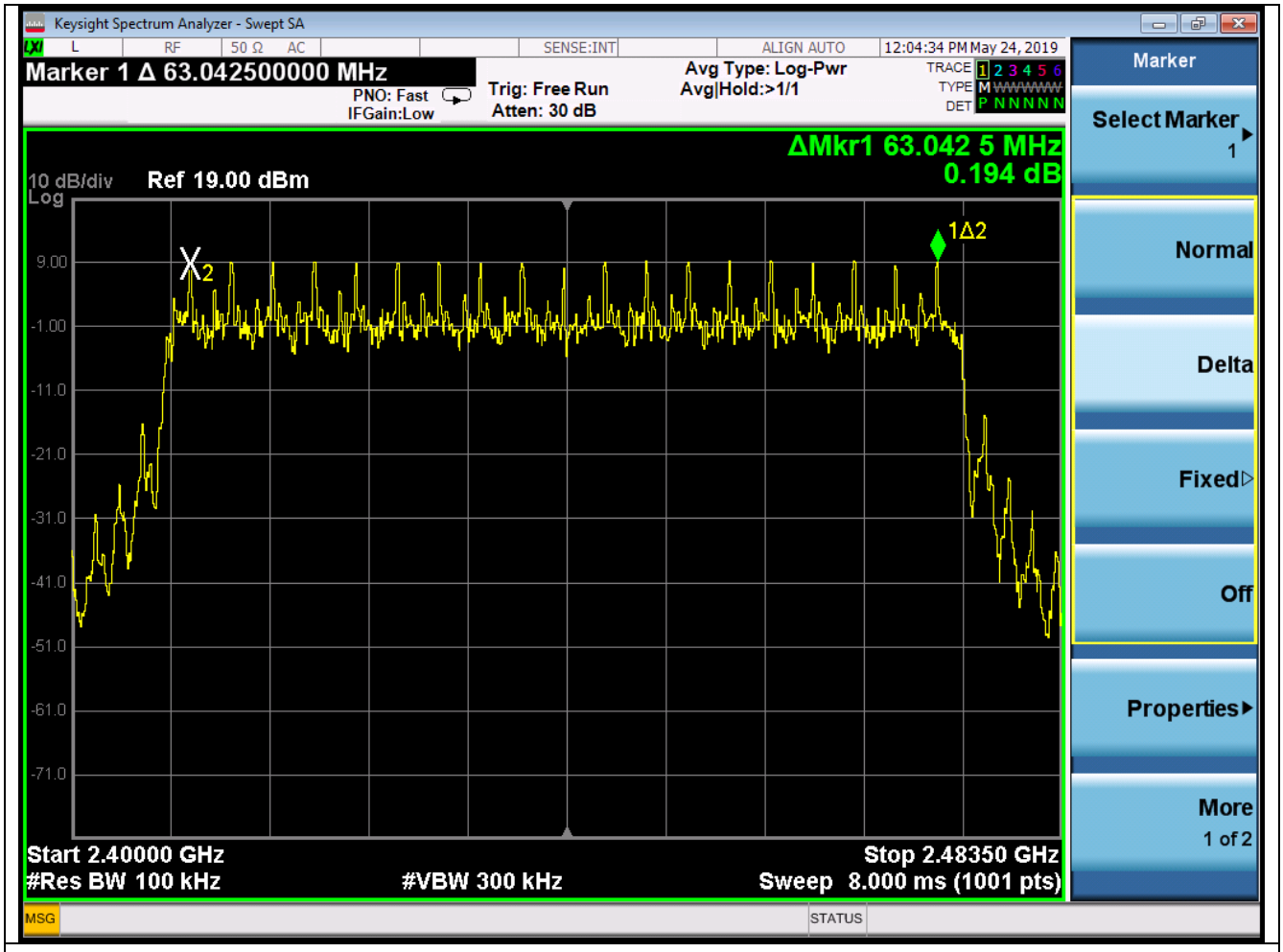
TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=1MHz and VBW=3MHz.

LIMIT

Frequency hopping systems in the 2400–2483.5MHz band shall use at least 15 channels.

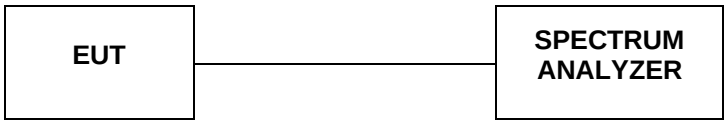
Modulation	Number of Hopping Channel	Limit	Result
GFSK	19	≥15	Pass



GFSK Modulation

4.8. Time Of Occupancy(Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

LIMIT

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

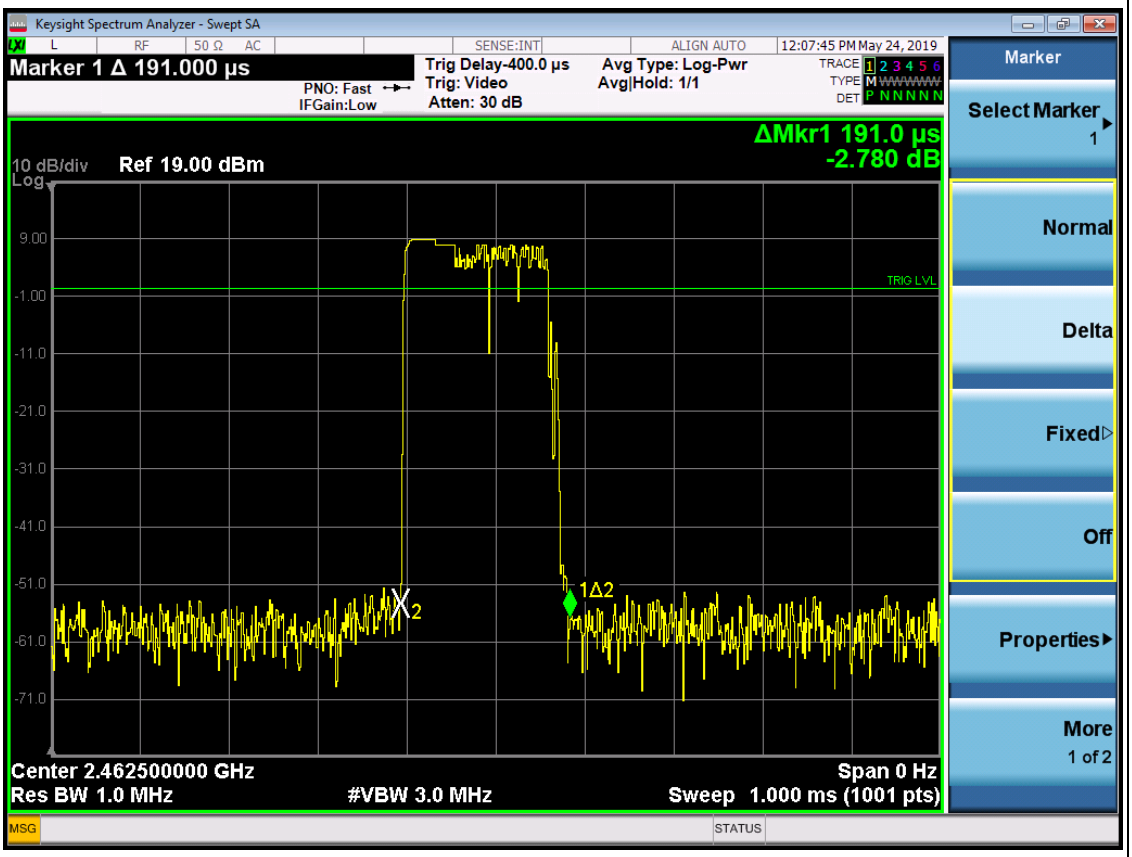
TEST RESULTS

	Frequency	Pulse Duration	Duration number	Dwell Time	Limits
		(ms)	/	(s)	(s)
GFSK	2462.5 MHz	0.191	15	0.054	0.4

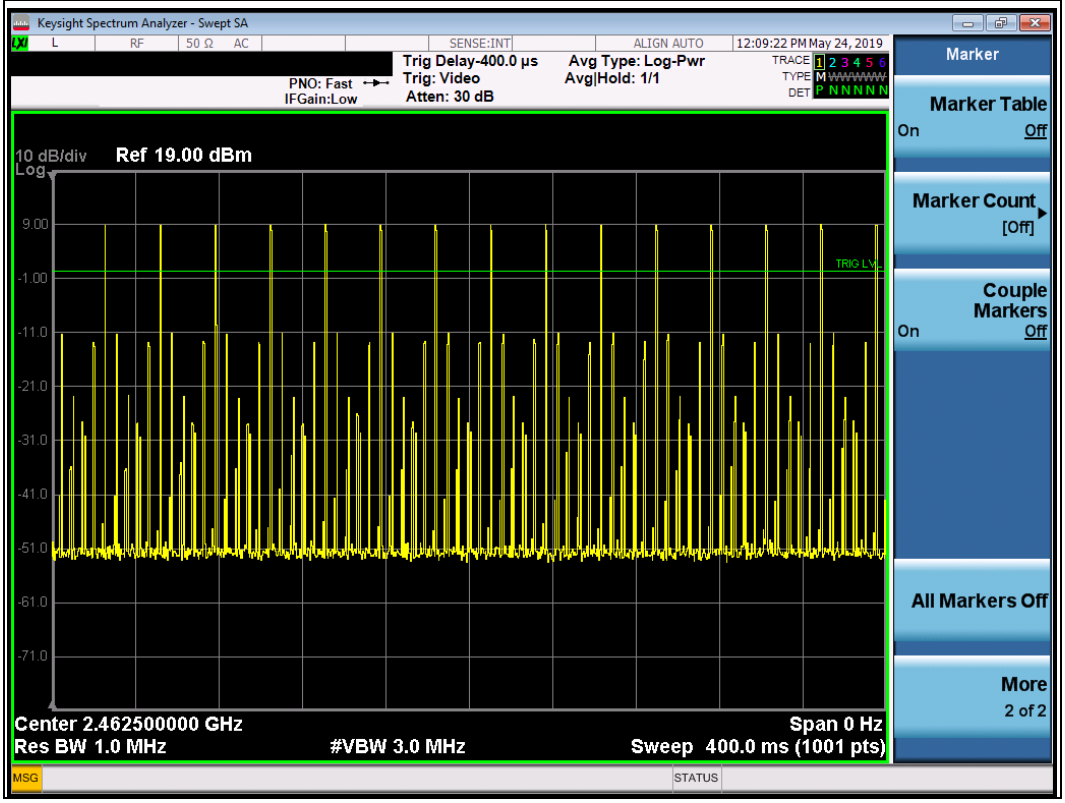
Note:Dwell time=Pulse Duration*Duration number*hopping channel

Test plot as follows:

CH09



CH09


Keysight Spectrum Analyzer - Swept SA
L
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
12:09:22 PM May 24, 2019
PNO: Fast
IFGain:Low
Trig Delay-400.0 µs
Trig: Video
Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold: 1/1
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
10 dB/div
Log
Ref 19.00 dBm
9.00
-1.00
-11.0
-21.0
-31.0
-41.0
-51.0
-61.0
-71.0
TRIG LVL
Center 2.462500000 GHz
Res BW 1.0 MHz
#VBW 3.0 MHz
Span 0 Hz
Sweep 400.0 ms (1001 pts)
Marker
Marker Table
On Off
Marker Count
[Off]
Couple Markers
On Off
All Markers Off
More
2 of 2
MSG
STATUS

4.9. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

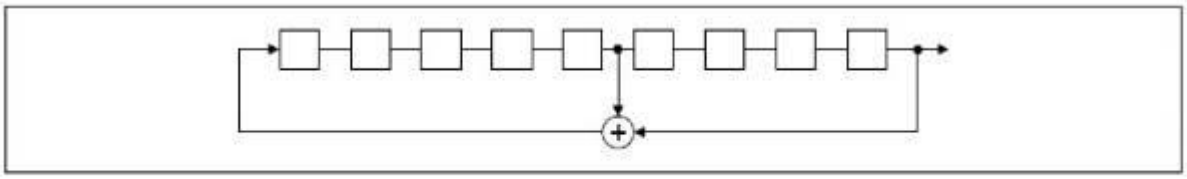
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

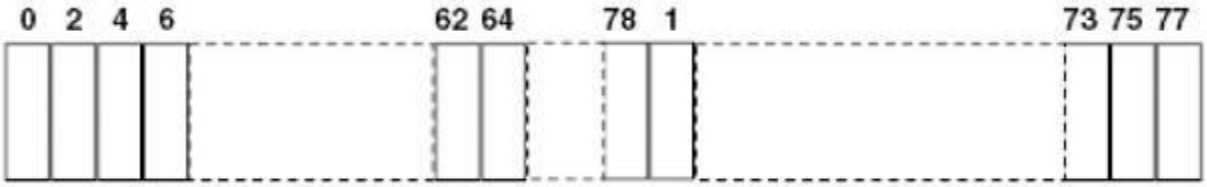
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the frist stage.The sequence begins with the frist one of 9 consecutive ones,for example:the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.10. Antenna Requirement

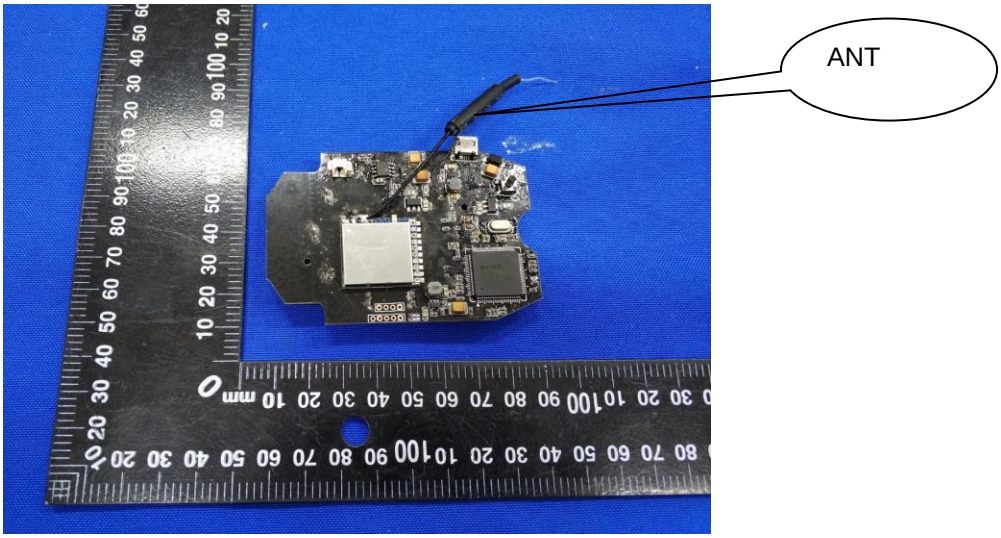
Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, 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.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

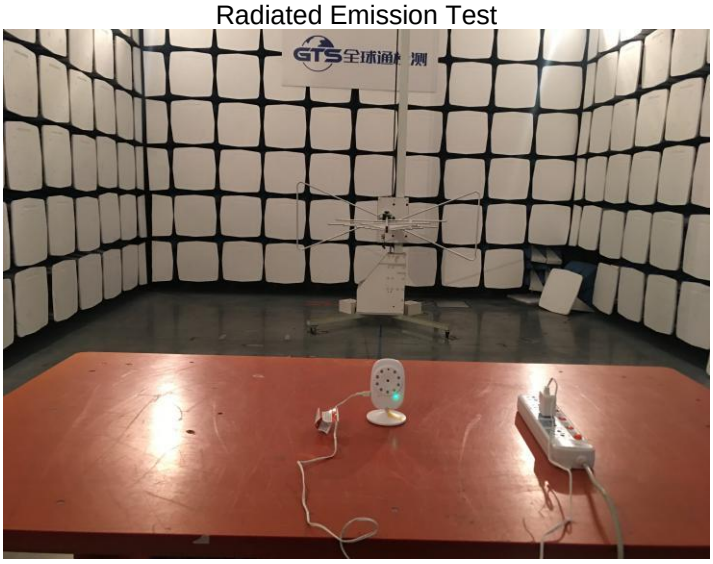
Test Result

The antenna used for this product is Internal Antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.0dBi.

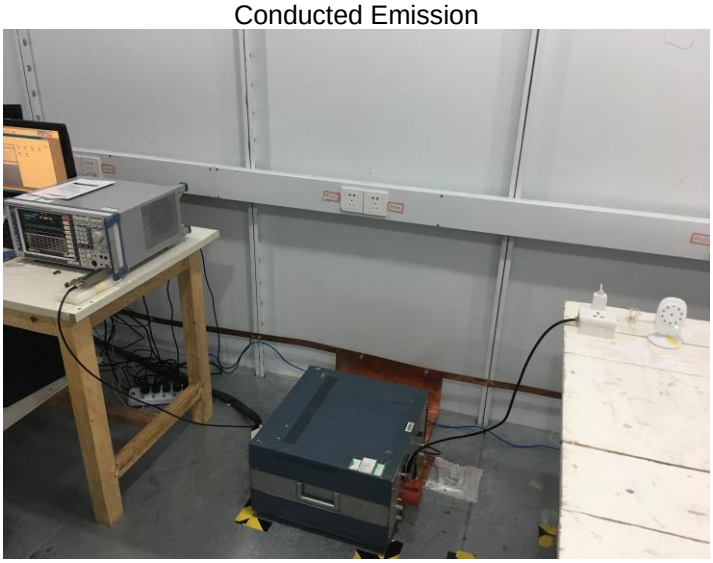


5. Test Setup Photos of the EUT

Radiated Emission Test

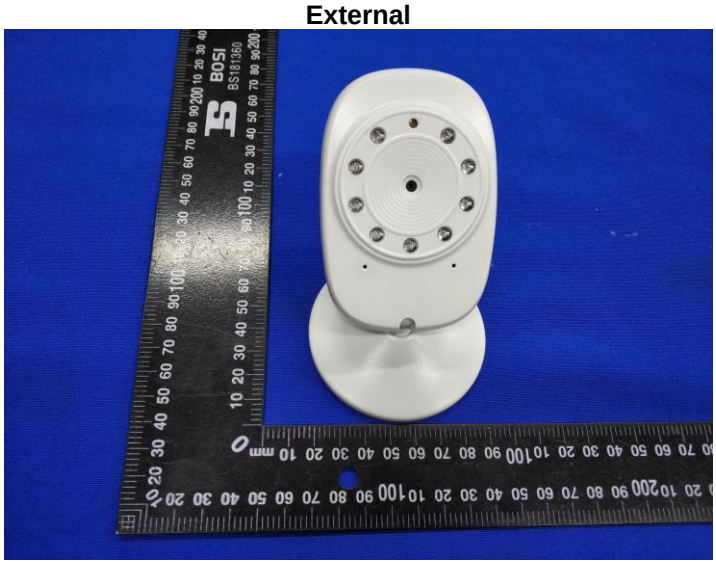


Conducted Emission



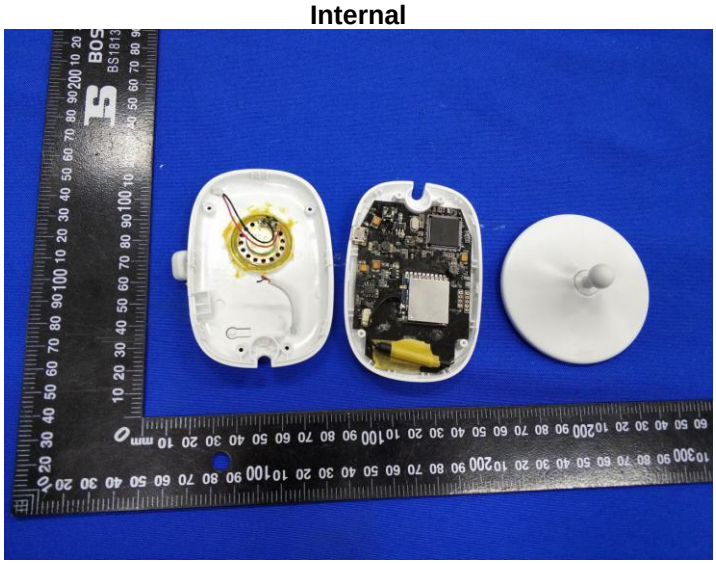
6. External and Internal Photos of the EUT

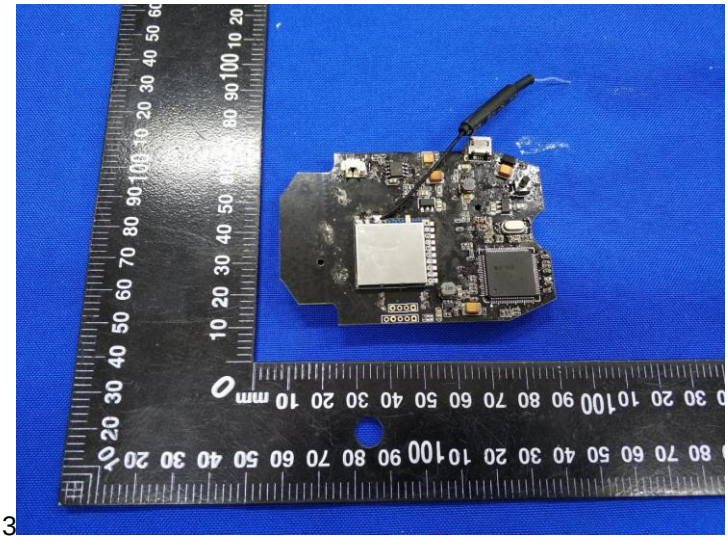
External

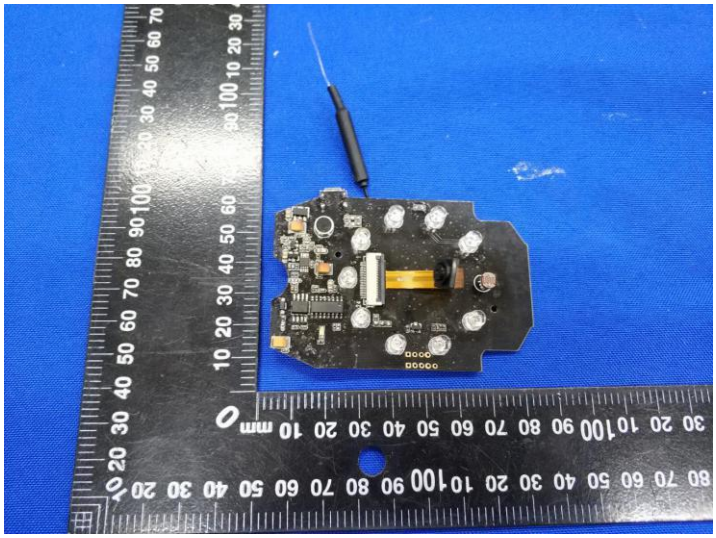


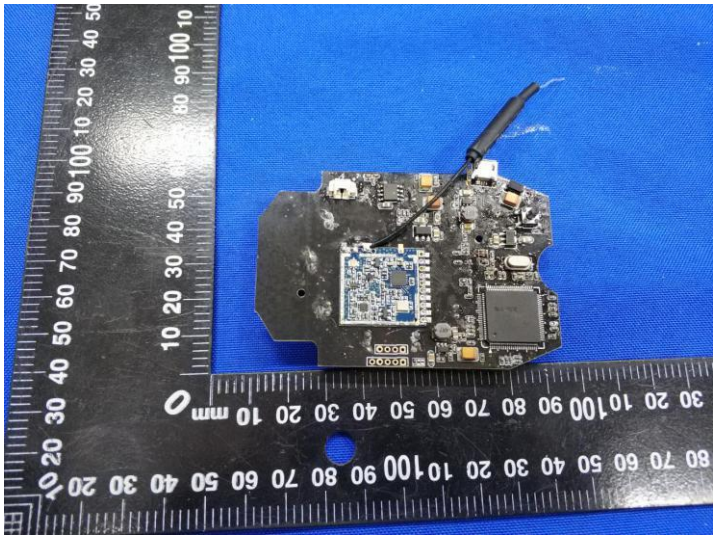
ADAPTOR
MODEL: EP19-050100WXLZ
INPUT:100~240V ~ 50/60Hz 0. 2A Max.
OUTPUT: 5 V ⎓ 1A
I. T. E. POWER SUPPLY
C UL US
ShenZhen Everest Electronics Co.,Ltd. Made in China

Internal



3 





.....End of Report.....