FCC TEST REPORT

Test report

On Behalf of

Cellacom Technologies Company Limited

For

MOBILE PHONE

Model No.: W20, W20a, W20b

FCC ID: 2AQ6D-W20

Prepared for :	**Cellacom Technologies Company Limited** **RM. 05-15, 13A/F, SOUT TOWER, WORLD FINANCE CENTER** **Harbour City, 17 Canton Road, Tsim Sha Tsui, Kowloon, Hongkong**
Prepared By :	**Shenzhen HUAK Testing Technology Co., Ltd.** **1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China**
Date of Test:	**Sep. 04, 2018~Sep. 28, 2018**
Date of Report:	**Sep. 28, 2018**
Report Number:	**HK1809111018E**

TEST RESULT CERTIFICATION

Applicant's name ..... :	Cellacom Technologies Company Limited
Address ..... :	RM. 05-15, 13A/F, SOUT TOWER, WORLD FINANCE CENTER Harbour City, 17 Canton Road, Tsim Sha Tsui, Kowloon, Hongkong
Manufacture's Name ..... :	Cellacom Technologies Company Limited
Address ..... :	RM. 05-15, 13A/F, SOUT TOWER, WORLD FINANCE CENTER Harbour City, 17 Canton Road, Tsim Sha Tsui, Kowloon, Hongkong
Product description	MOBILE PHONE
Brand Name	Cellacom
Mode Name	W20,W20a,W20b
Difference Description	All the same except for model name.
Standards ..... :	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013

Date of Test ..... :	
Date (s) of performance of tests ..... :	**Sep. 04, 2018~Sep. 28, 2018**
Date of Issue ..... :	**Sep. 28, 2018**
Test Result ..... :	**Pass**

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

Revision	Issue Date	Revisions	Revised By
V1.0	Sep. 28, 2018	Initial Issue	Jason Zhou

TABLE OF CONTENTS

1. VERIFICATION OF CONFORMITY

1.1. PRODUCT DESCRIPTION

Equipment	MOBILE PHONE
Model Name	W20
Hardware Version	FS330-MB-V0.2C
Software Version	Cellacom_W20_V1.0_20180829
FCC ID	**2AQ6D-W20**
Antenna Type	PIFA Antenna
Antenna Gain	1.0dBi
BT Operation frequency	2.402 GHz to 2.480GHz
Number of Channels	79(For BR/EDR)
Modulation Type	GFSK, π /4-DQPSK, 8DPSK
Power Supply	DC3.7V by Battery

1.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
2400~2483.5MHZ	0	2402MHZ
	1	2403MHZ
	:	:
	38	2440 MHZ
	39	2441 MHZ
	40	2442 MHZ
	:	:
	77	2479 MHZ
	78	2480 MHZ

1.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHZ,In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection(e.g. single of multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

1.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a 79 hopping sequence in data mode:
40,21,44,23,42,53,46,55,48,33,52,35,50,65,54,67
56,37,60,39,58,69,62,71,64,25,68,27,66,57,70,59
72,29,76,31,74,61,78,63,01,41,05,43,03,73,07,75
09,45,13,47,11,77,15,00,64,49,66,53,68,02,70,06
01, 51, 03, 55, 05, 04

1.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values:
1. LAP/UAP of the master of the connection.
2. Internal master clock

The LAP(lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP(upper address part) are the 24MSB's of the 48BD_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For ehavior zation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us.The clock has a cycle of about one day(23h30).In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire. LAP(24 bits),4LSB's(4bits)(Input 1) and the 27MSB's of the clock(Input 2) are used. With this input values different mathematical procedures(permutations, additions, XOR-operations)are performed to generate te Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following ehavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended.

The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer(and it Cannot be shorter) than the minimum resolution of the clock(312.5us).The hopping sequence will always Differ from the first one.

1.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2AQ6D-W20** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

1.8. SPECIAL ACCESSORIES

Refer to section 5.2.

1.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

2. MEASUREMENT UNCERTAINTY

Test	Measurement Uncertainty	Notes
Transmitter power conducted	±0.57 dB	(1)
Transmitter power Radiated	±2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	±2.20 dB	(1)
Occupied Bandwidth	±0.01ppm	(1)
Radiated Emission 30~1000MHz	±4.10dB	(1)
Radiated Emission Above 1GHz	±4.32dB	(1)
Conducted Disturbance0.15~30MHz	±3.20dB	(1)

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

3. DESCRIPTION OF TEST MODES

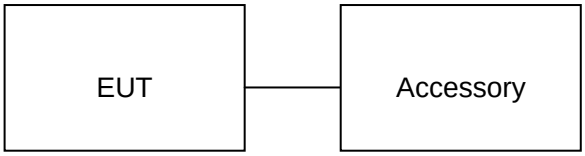
NO.	TEST MODE DESCRIPTION
1	Low channel GFSK
2	Middle channel GFSK
3	High channel GFSK
4	Low channel π /4-DQPSK
5	Middle channel π /4-DQPSK
6	High channel π /4-DQPSK
7	Low channel 8DPSK
8	Middle channel 8DPSK
9	High channel 8DPSK
10	Normal Hopping

Note:
1. All the test modes can be supply by Built-in Li-ion battery, only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

4. SYSTEM TEST CONFIGURATION

4.1. CONFIGURATION OF EUT SYSTEM

Configuration:



4.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	MOBILE PHONE	W20	2AQ6D-W20	EUT
2	Adapter	W20	DC 5.0V 500mA	Accessory
3	Battery	W20	DC3.7V/ 1000mAh	Accessory
4	USB	N/A	N/A	Accessory
5	Earphone	N/A	N/A	Accessory

4.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247	Peak Output Power	Compliant
§15.247	20 dB Bandwidth	Compliant
§15.247	Spurious Emission	Compliant
§15.209	Radiated Emission	Compliant
§15.247	Band Edges	Compliant
§15.207	Power Line Conduction Emission	Compliant
§15.247	Number of Hopping Frequency	Compliant
§15.247	Time of Occupancy	Compliant
§15.247	Frequency Separation	Compliant

5. TEST FACILITY

Site	Shenzhen HUAK Testing Technology Co., Ltd.
Location	1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China
Designation Number	CN1229
Test Firm Registration Number : 616276	

ALL TEST EQUIPMENT LIST

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Power meter	Agilent	E4417B	HKE-107	Dec. 28, 2018
Power Sensor	Agilent	E9327A	HKE-113	Dec. 28, 2018
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018
RF Cable (9KHz-26.5GHz)	Tonscend	170660	N/A	Dec. 28, 2018
Signal generator	Agilent	N5183A	HKE-071	Dec. 28, 2018
Receiver	R&S	ESCI-7	HKE-010	Dec. 28, 2018
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018
Preamplifier	EMCI	EMC051845SE	HKE-015	Dec. 28, 2018
Preamplifier	Agilent	83051A	HKE-016	Dec. 28, 2018
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 28, 2018
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Dec. 28, 2018
Horn antenna	Schwarzbeck	9120D	HKE-013	Dec. 28, 2018
Antenna Mast	Keleto	CC-A-4M	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 28, 2018
Radiated test software	Tonscend	TS+ Rev 2.5.0.0	HKE-082	N/A
RF cable (9KHz-1GHz)	Times	381806-001	N/A	N/A
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018

6. PEAK OUTPUT POWER

6.1. MEASUREMENT PROCEDURE

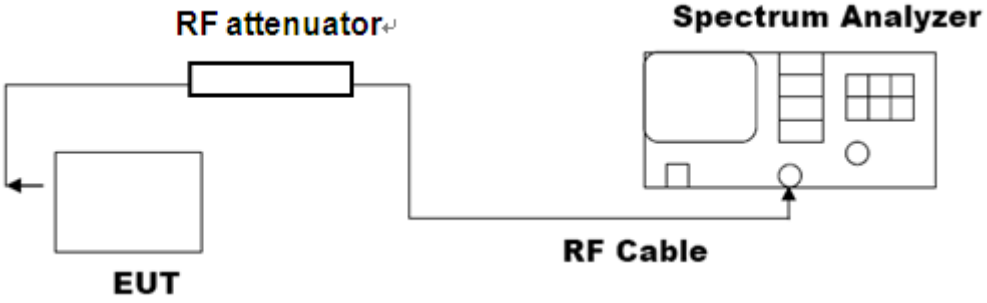
For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, middle and the bottom operation frequency individually.
3. Use the following spectrum analyzer settings:
   1) Span : Approximately five times the 20 dB bandwidth, centered on a hopping channel.
   2) RBW > 20 dB bandwidth of the emission being measured.
   3) VBW ≧ RBW.
   4) Sweep: Auto.
   5) Detector function: Peak.
   6) Trace: Max hold.
4. Record the maximum power from the Spectrum Analyzer.

Note：The EUT was tested according for compliance ANSI C63.10 (2013) requirements.

6.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

PEAK POWER TEST SETUP



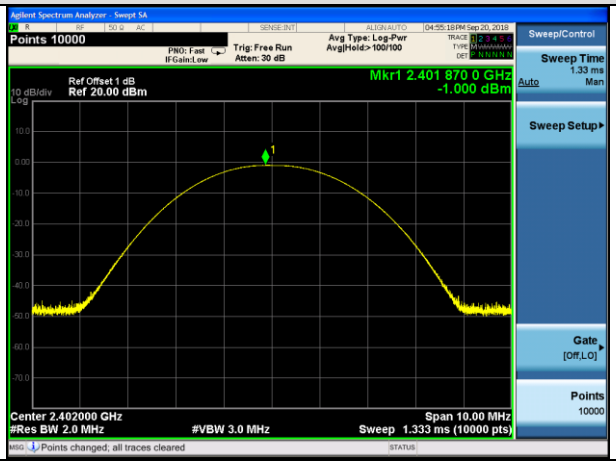
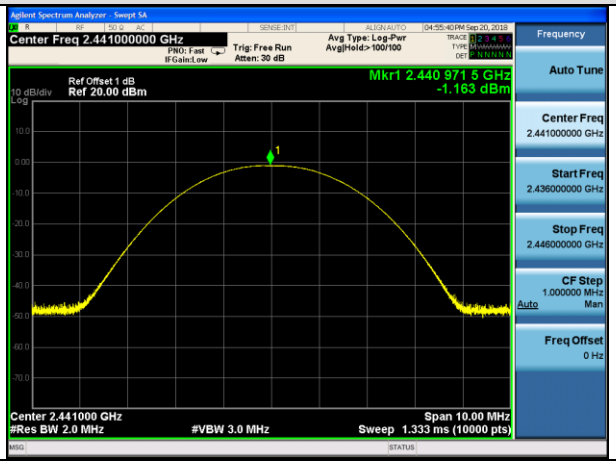
6.3. LIMITS AND MEASUREMENT RESULT

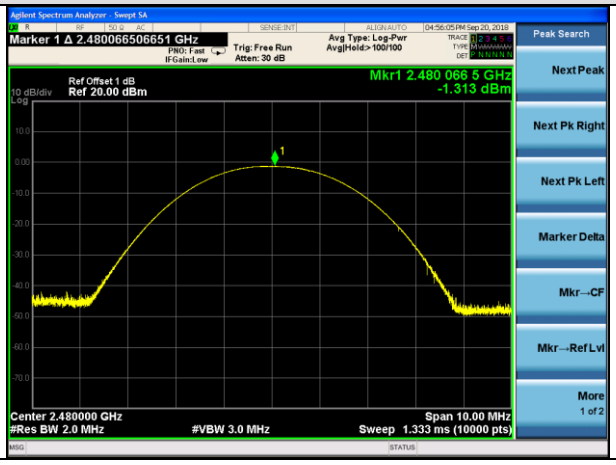
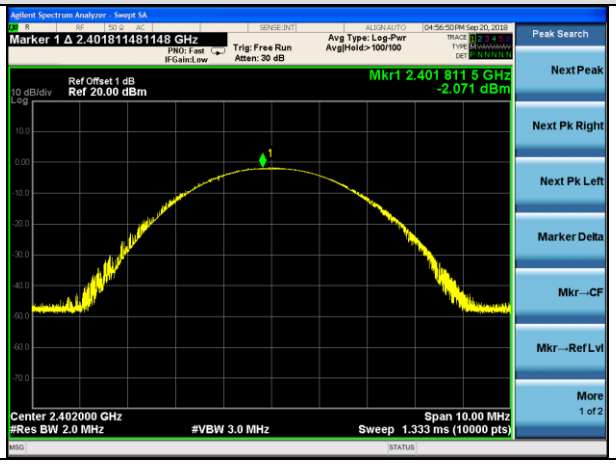
Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
GFSK	2.402	-1.000	30	Pass
	2.441	-1.163	30	Pass
	2.480	-1.313	30	Pass

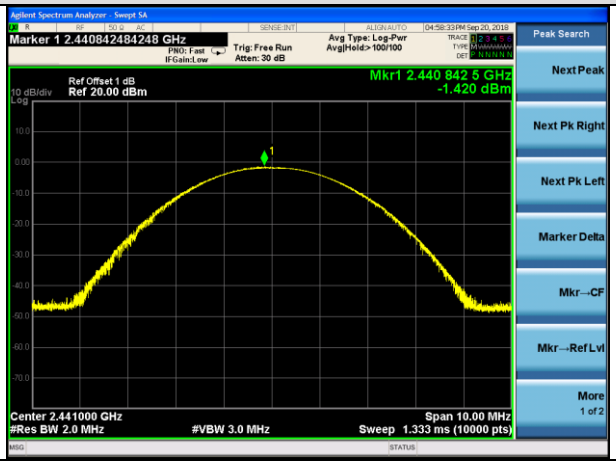
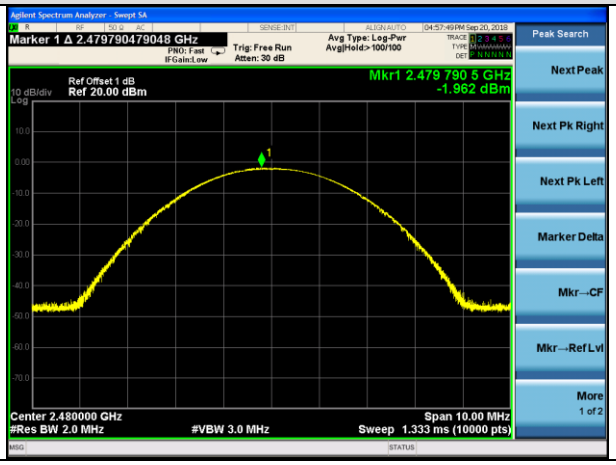
Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
π /4-DQPSK	2.402	-2.071	30	Pass
	2.441	-1.420	30	Pass
	2.480	-1.962	30	Pass

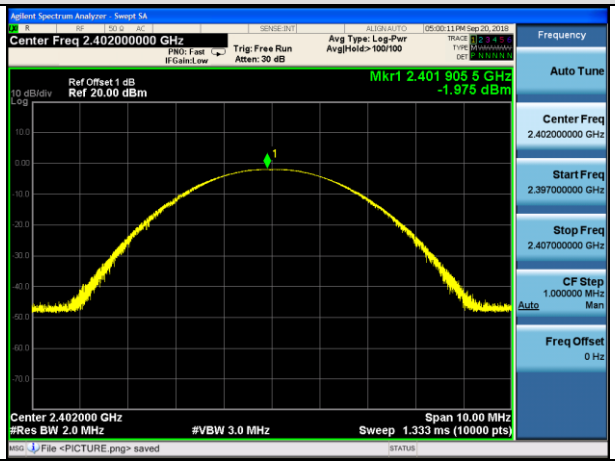
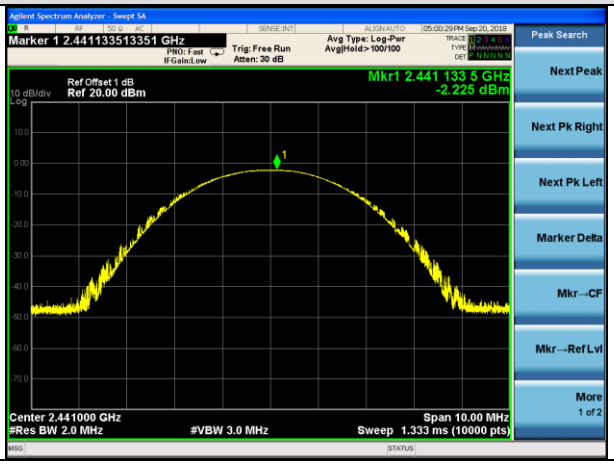
Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
8DPSK	2.402	-1.975	30	Pass
	2.441	-2.225	30	Pass
	2.480	-2.397	30	Pass

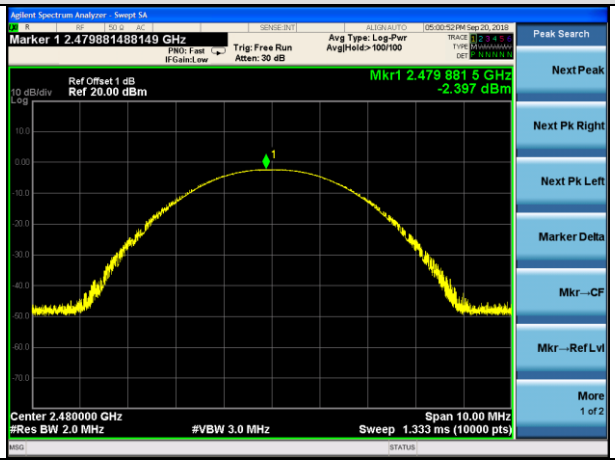
Test Graph

GFSK-LCH	GFSK-MCH
	

GFSK-HCH	π/4DQPSK-LCH
	

π/4DQPSK-MCH	π/4DQPSK-HCH
	

8DPSK-LCH	8DPSK-MCH
	

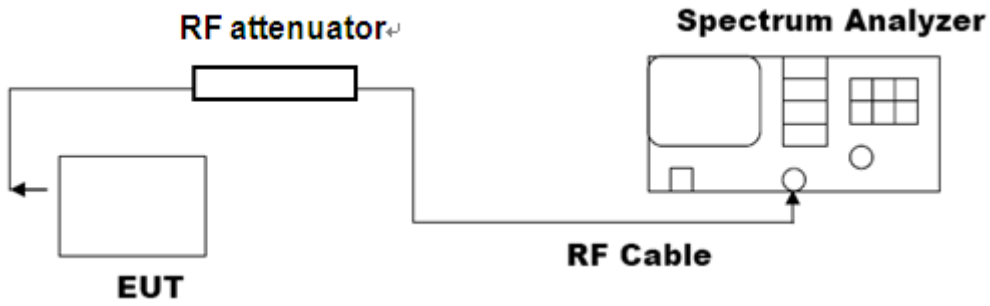
8DPSK-HCH	
	

7. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hoping channel
   RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

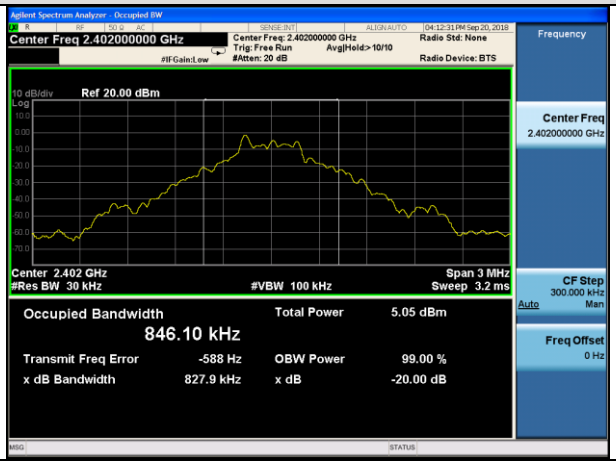
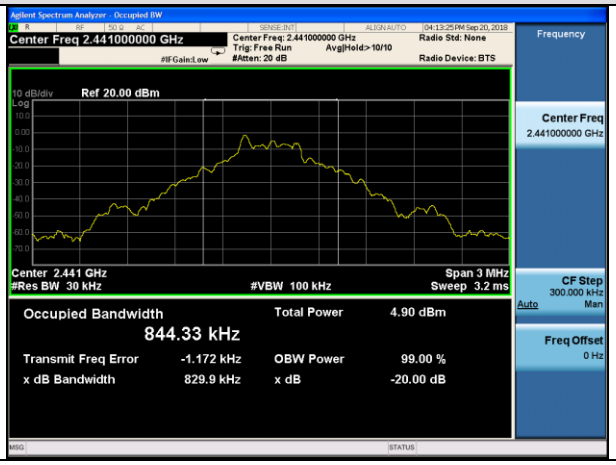
7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

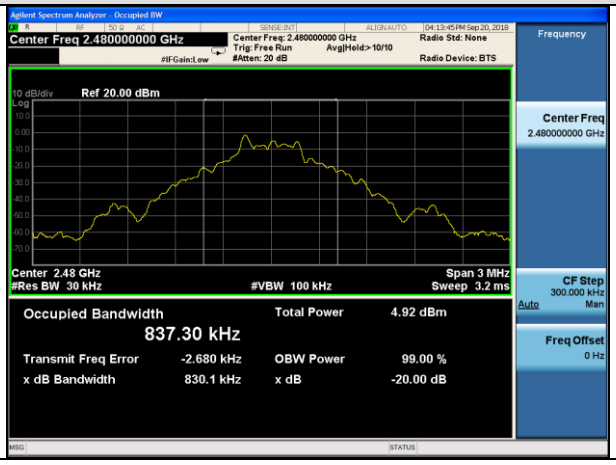
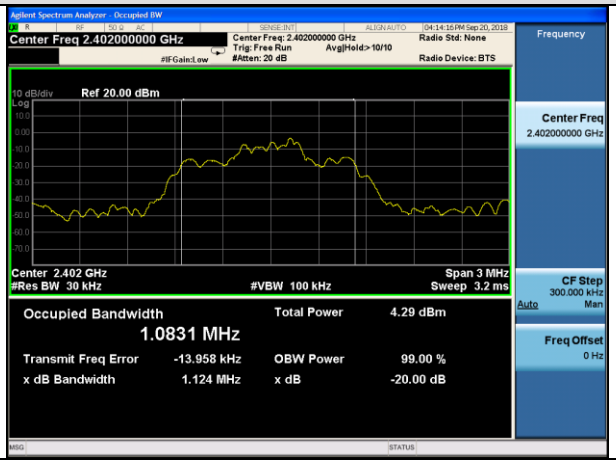


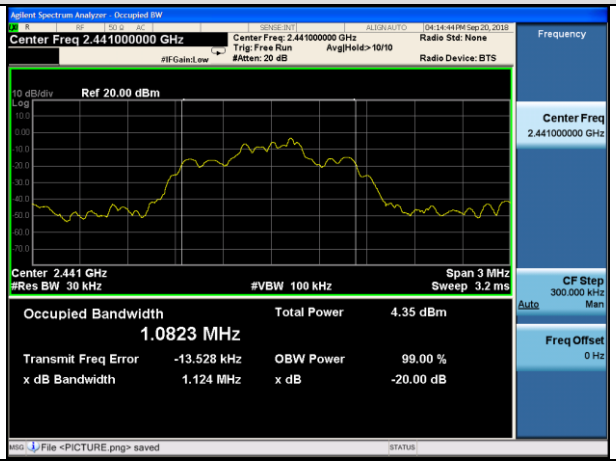
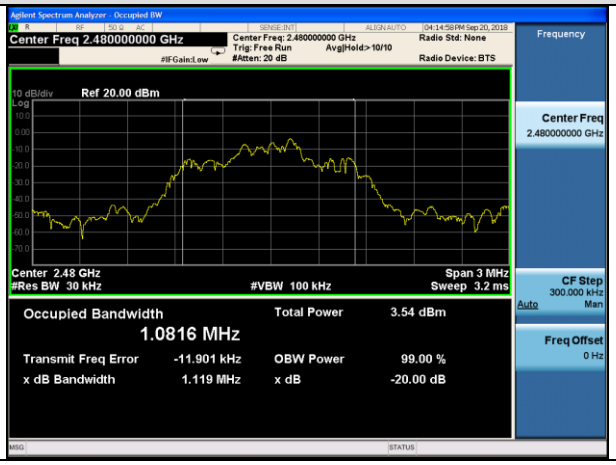
7.3. LIMITS AND MEASUREMENT RESULTS

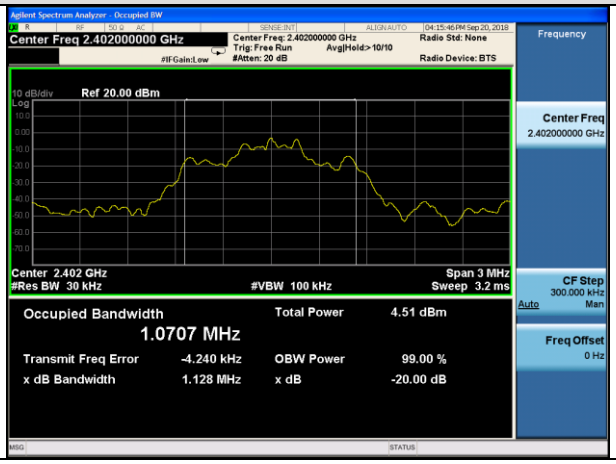
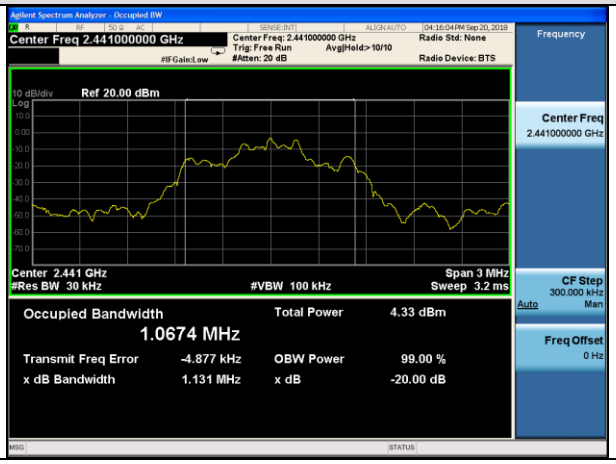
Mode	Channel.	20dB Bandwidth [KHz]	Verdict
GFSK	LCH	827.9	PASS
GFSK	MCH	829.9	PASS
GFSK	HCH	830.1	PASS
π/4DQPSK	LCH	1.124	PASS
π/4DQPSK	MCH	1.124	PASS
π/4DQPSK	HCH	1.119	PASS
8DPSK	LCH	1.128	PASS
8DPSK	MCH	1.131	PASS
8DPSK	HCH	1.142	PASS

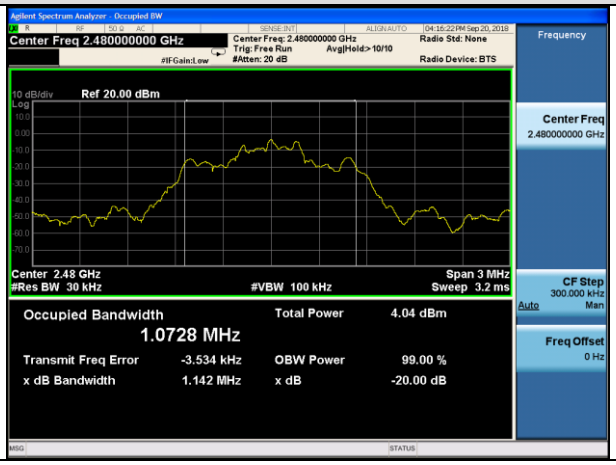
Test Graph

GFSK-LCH	GFSK-MCH
	

GFSK-HCH	π/4DQPSK-LCH
	

π/4DQPSK-MCH	π/4DQPSK-HCH
	

8DPSK-LCH	8DPSK-MCH
	

8DPSK-HCH	
	

8. CONDUCTED SPURIOUS EMISSION

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
   RBW = 100 kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according for compliance ANSI C63.10 (2013) requirements. Owing to satisfy the requirements of the number of measurement points, we set the RBW=1MHz, VBW＞RBW, scan up through 10th harmonic, and consider the tested results as the worst case, if the tested results conform to the requirement, we can deem that the real tested results(set the RBW=100KHz, VBW＞RBW) are conform to the requirement.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

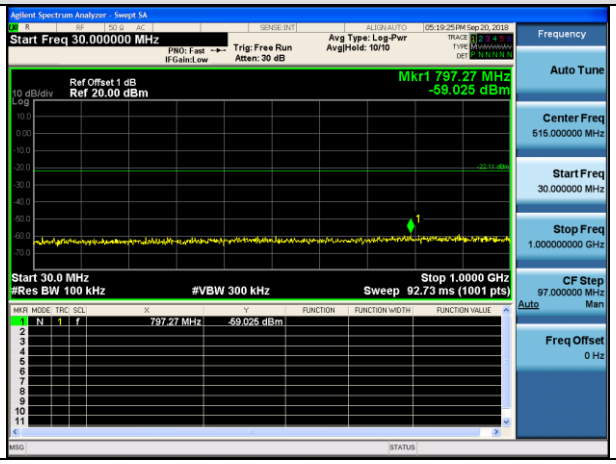
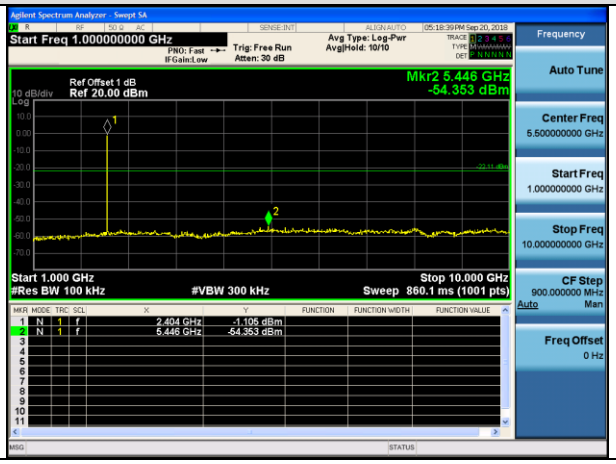
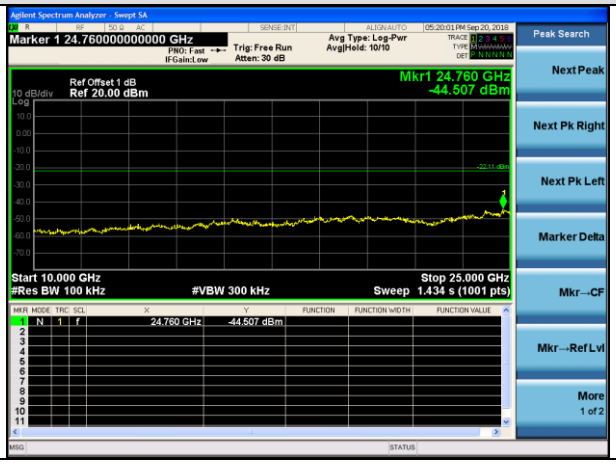
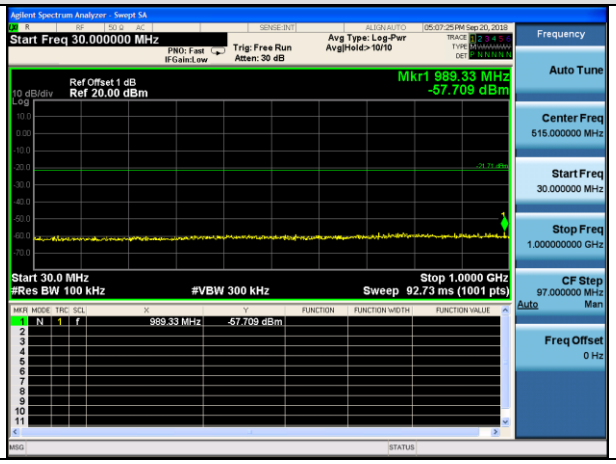
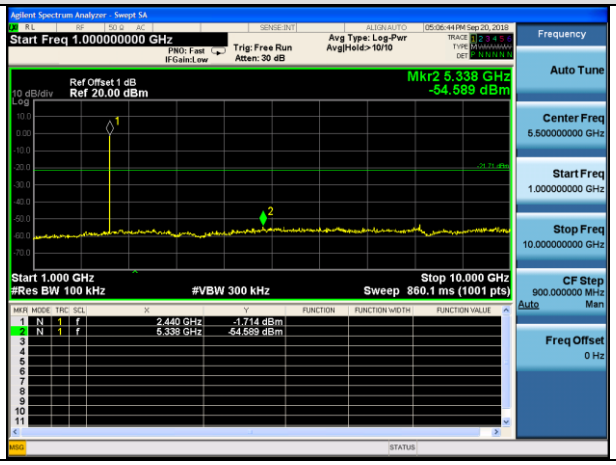
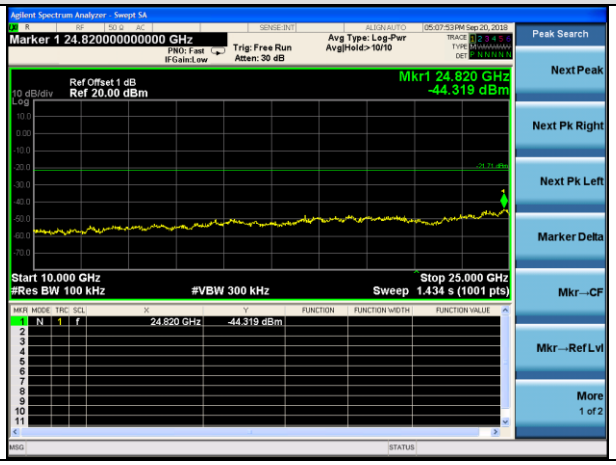
8.3. MEASUREMENT EQUIPMENT USED

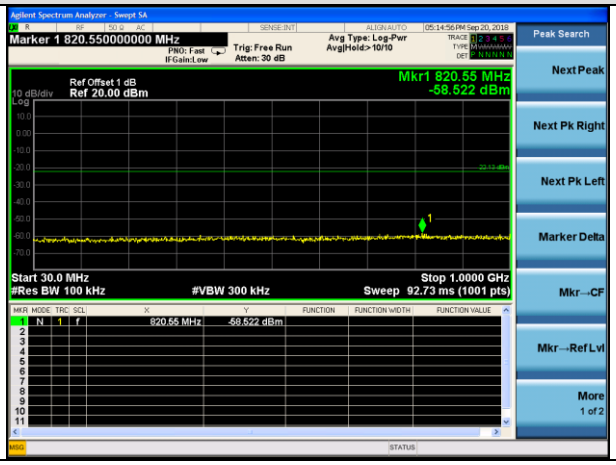
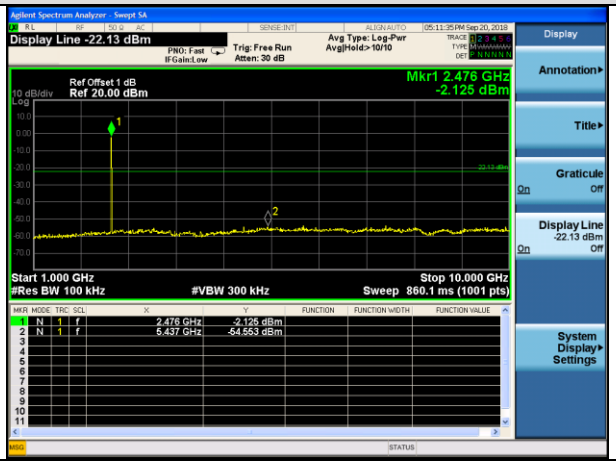
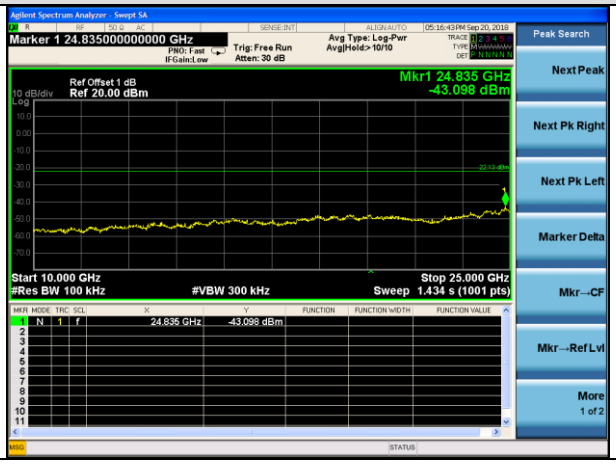
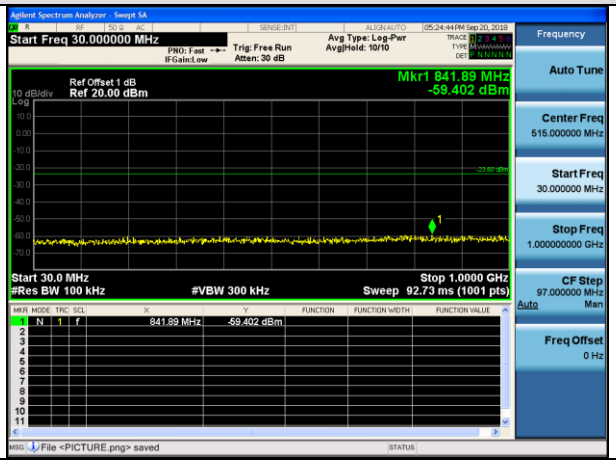
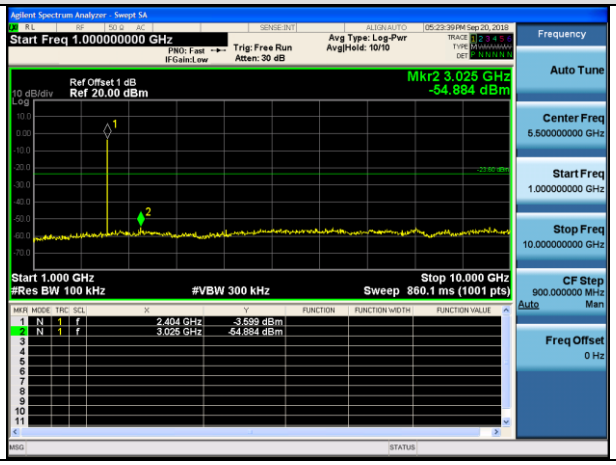
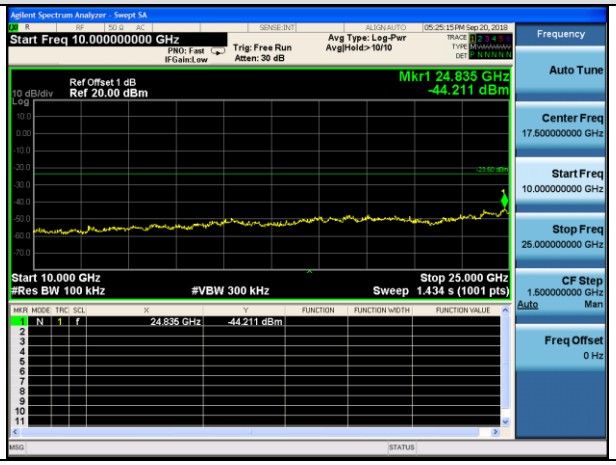
The same as described in section 6

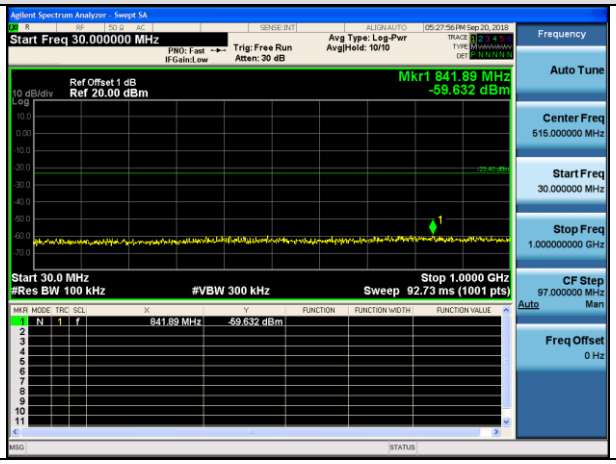
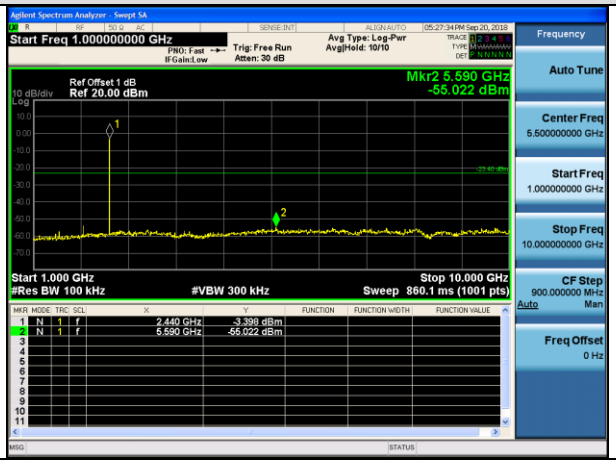
8.4. LIMITS AND MEASUREMENT RESULT

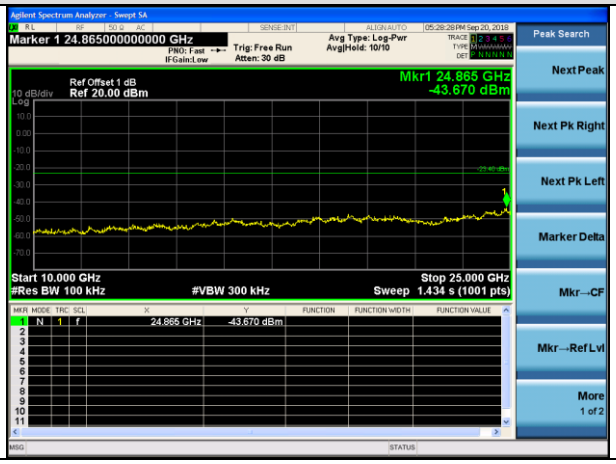
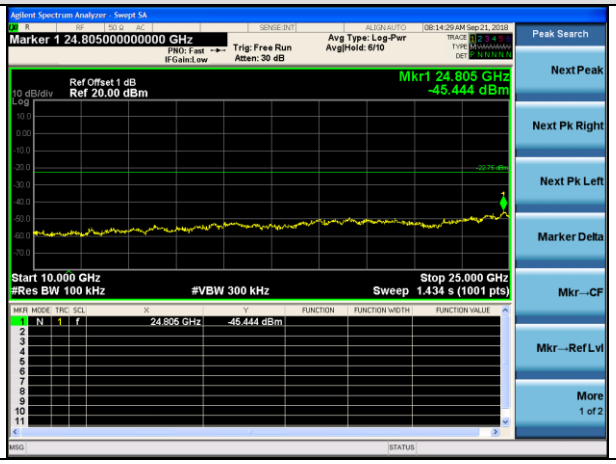
LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation 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))	Refer Test Graph	PASS

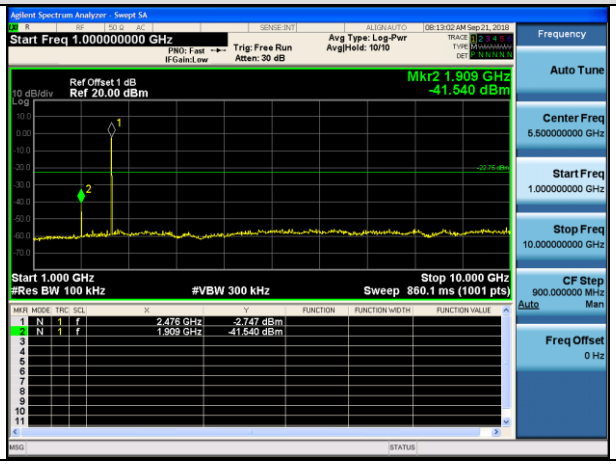
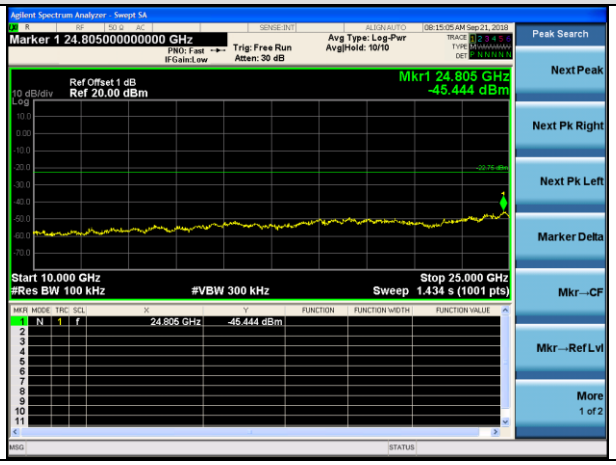
Test Graph

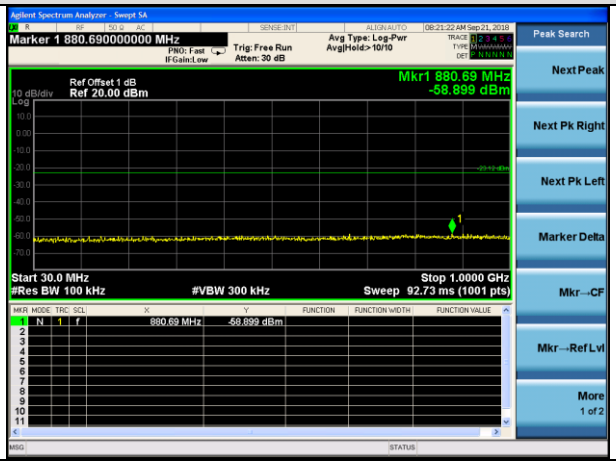
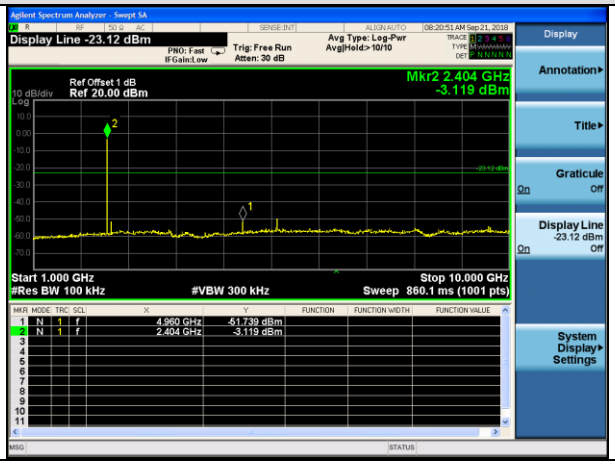
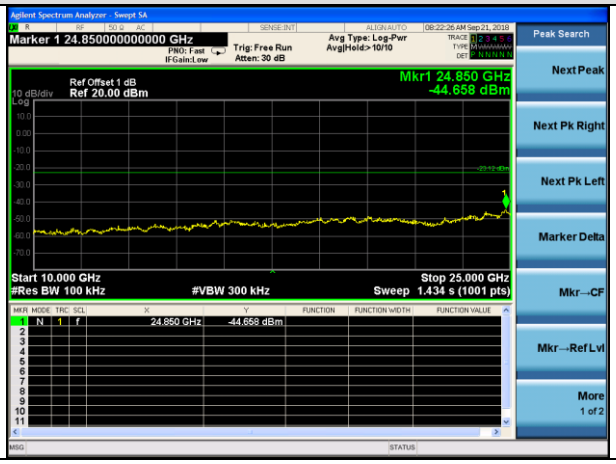
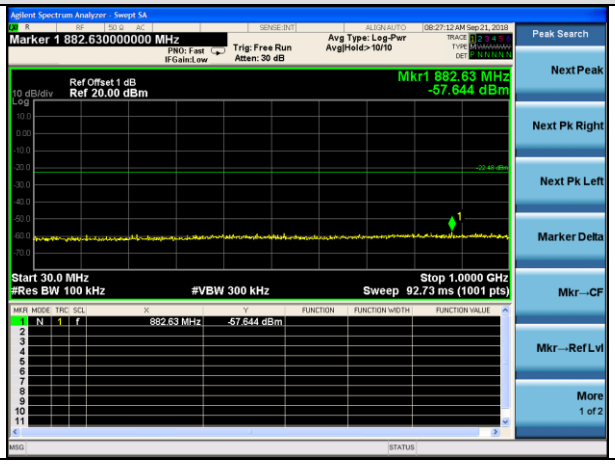
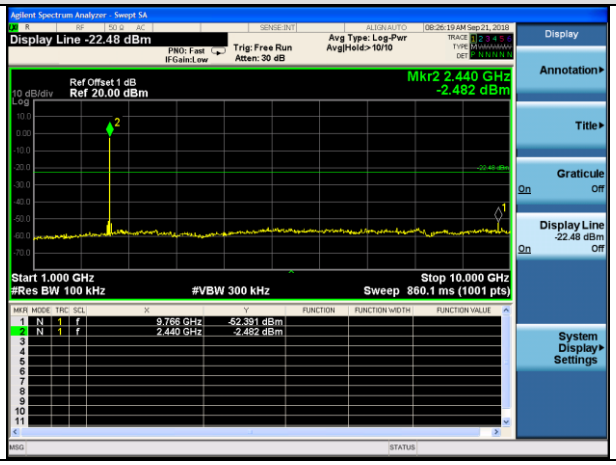
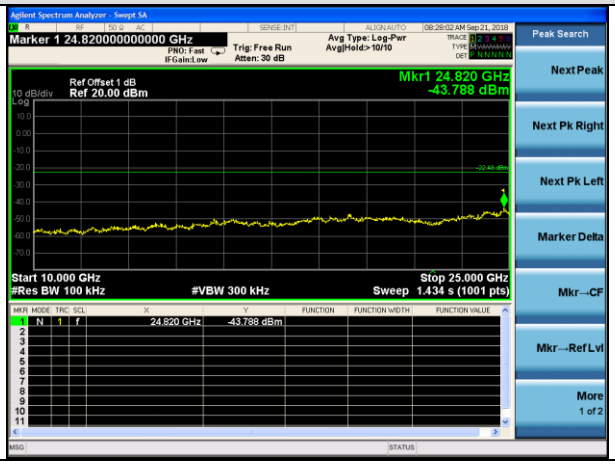
GFSK-LCH	GFSK-LCH
	
GFSK-LCH	GFSK-MCH
	
GFSK-MCH	GFSK-MCH
	

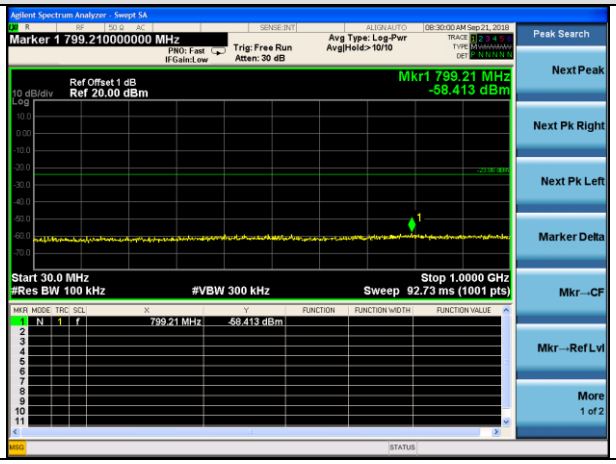
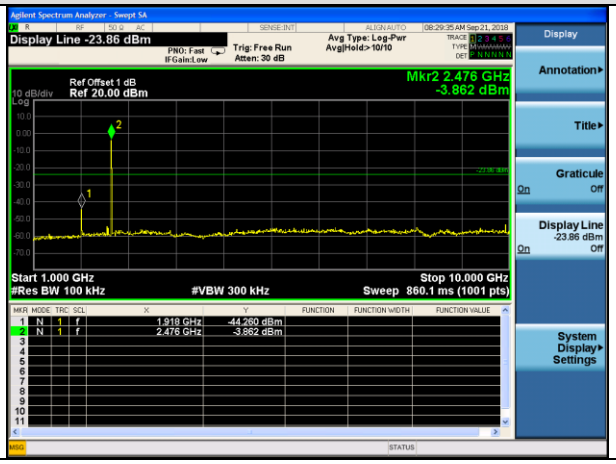
GFSK-HCH	GFSK-HCH
	
GFSK-HCH	π/4DQPSK-LCH
	
π/4DQPSK-LCH	π/4DQPSK-LCH
	

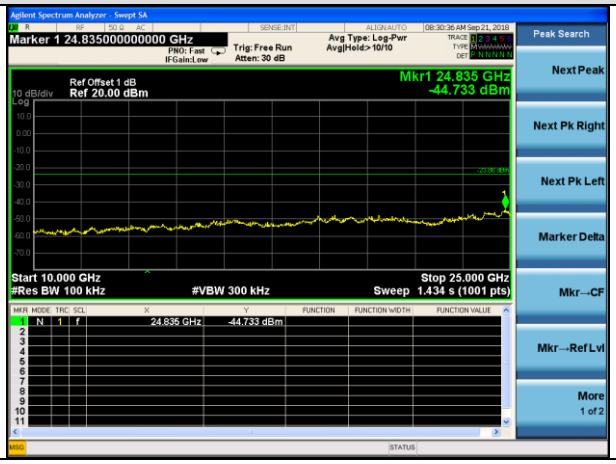
π/4DQPSK-MCH	π/4DQPSK-MCH
	

π/4DQPSK-MCH	π/4DQPSK-HCH
	

π/4DQPSK-HCH	π/4DQPSK-HCH
	

8DPSK-LCH	8DPSK-LCH
	
8DPSK-LCH	8DPSK-MCH
	
8DPSK-MCH	8DPSK-MCH
	

8DPSK-HCH	8DPSK-HCH
	

8DPSK-HCH	
	

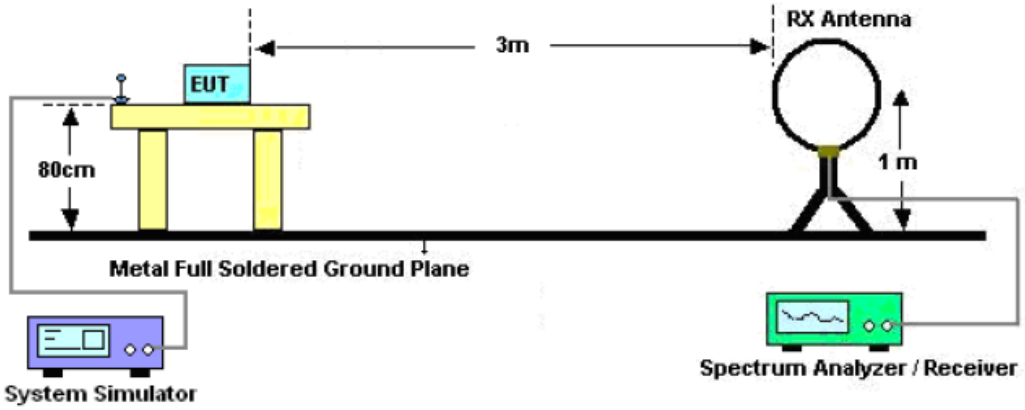
9. RADIATED EMISSION

9.1. MEASUREMENT PROCEDURE

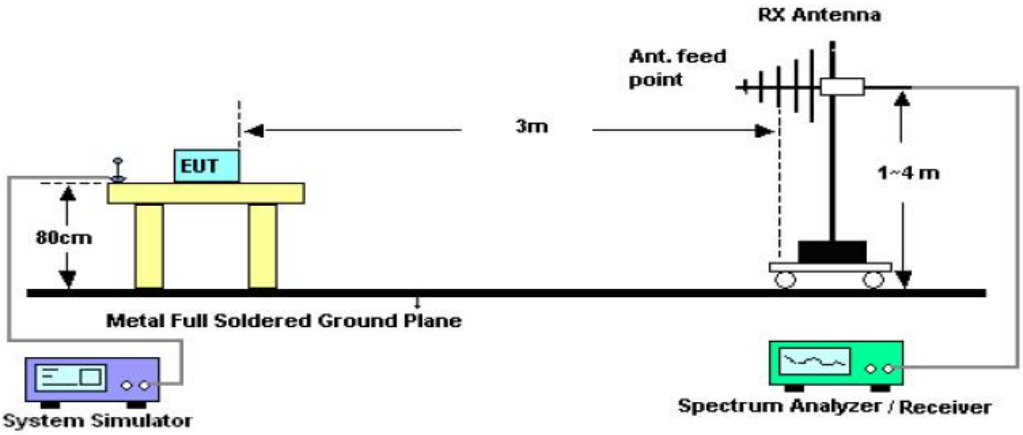
1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

9.2. TEST SETUP

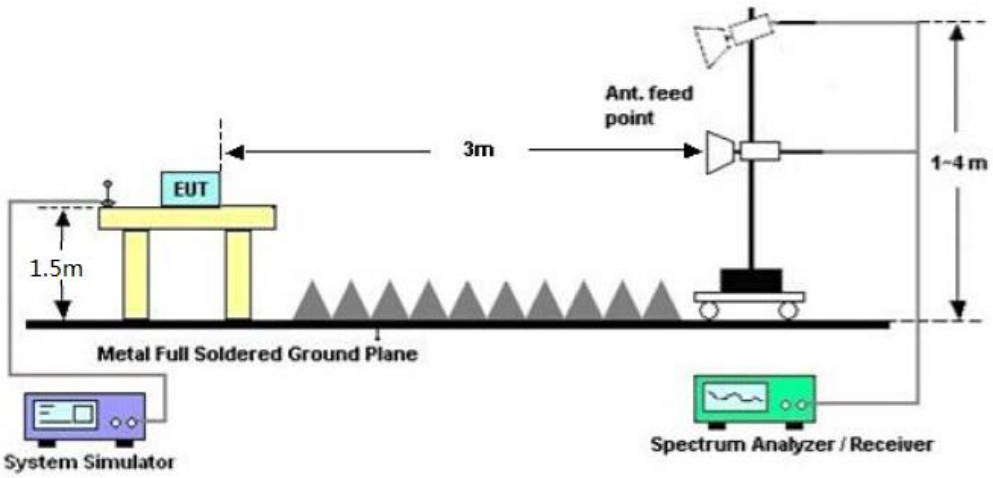
RADIATED EMISSION TEST-SETUP FREQUENCY BELOW 30MHZ



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



9.3. LIMITS AND MEASUREMENT RESULT

15.209(a) Limit in the below table has to be followed

Frequencies (MHz)	Field Strength (micorvolts/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

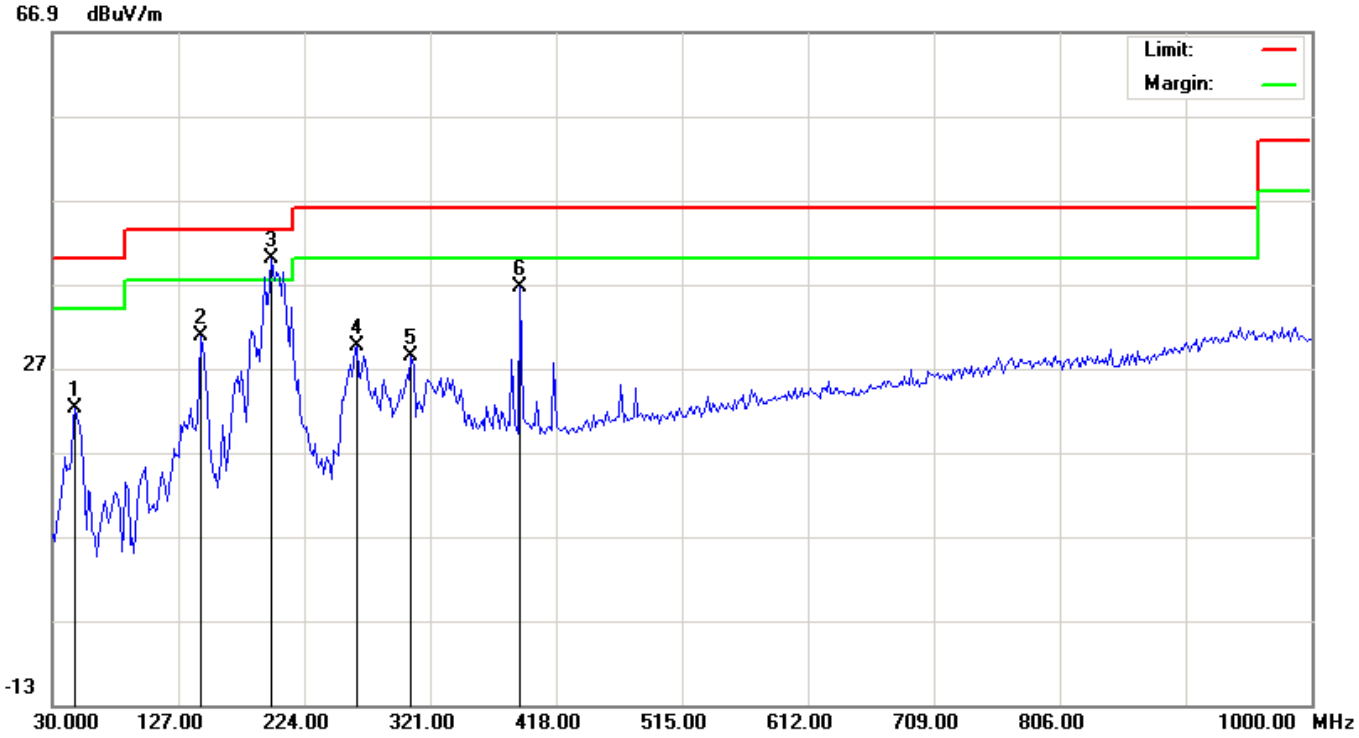
9.4. TEST RESULT

RADIATED EMISSION BELOW 30MHZ

No emission found between lowest internal used/generated frequencies to 30MHz.

RADIATED EMISSION BELOW 1GHZ

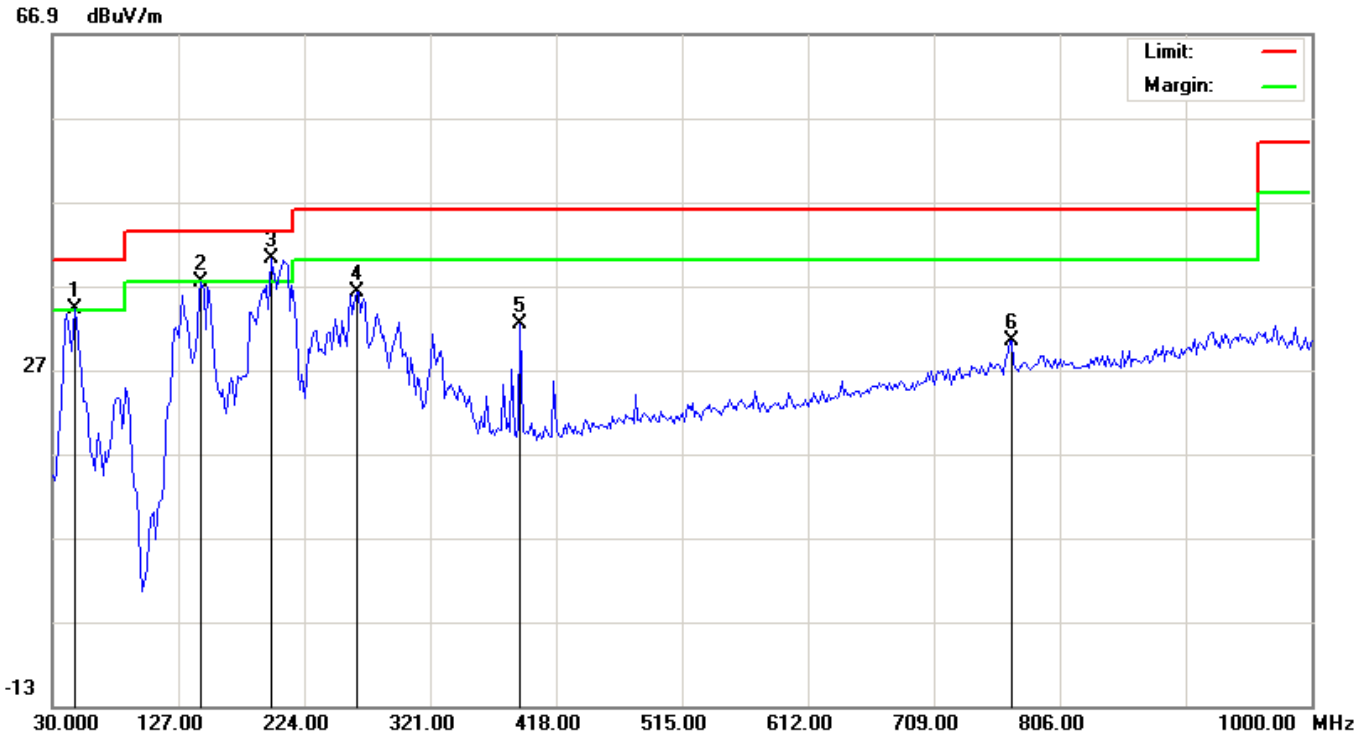
RADIATED EMISSION TEST- (30MHZ-1GHZ) -HORIZONTAL



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		47.7833	10.81	11.39	22.20	40.00	-17.80	peak			
2		144.7833	16.74	14.04	30.78	43.50	-12.72	peak			
3	*	198.1333	28.15	11.91	40.06	43.50	-3.44	peak			
4		264.4166	20.28	9.35	29.63	46.00	-16.37	peak			
5		306.4500	12.55	15.84	28.39	46.00	-17.61	peak			
6		390.5167	17.56	19.01	36.57	46.00	-9.43	peak			

RESULT: PASS

RADIATED EMISSION TEST- (30MHZ-1GHZ) -VERTICAL



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1	!	47.7833	25.85	8.39	34.24	40.00	-5.76	peak			
2		144.7833	22.15	15.23	37.38	43.50	-6.12	peak			
3	*	198.1333	30.73	9.47	40.20	43.50	-3.30	peak			
4		264.4166	21.88	14.34	36.22	46.00	-9.78	peak			
5		390.5167	13.32	19.01	32.33	46.00	-13.67	peak			
6		768.8167	3.57	26.89	30.46	46.00	-15.54	peak			

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. The “Factor” value can be calculated automatically by software of measurement system.

3. All test modes for different EUT are pre-tested. The low channel for GFSK mode is the worst case and recorded in the report.

RADIATED EMISSION TEST- (ABOVE 1GHZ)

Frequency (MHz)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Low Channel (2402 MHz)					
4804	51.42	74	-22.58	Pk	Vertical
4804	36.36	54	-17.64	AV	Vertical
4804	50.17	74	-23.83	Pk	Horizontal
4804	38.42	54	-15.58	AV	Horizontal
Mid Channel (2441 MHz)					
4882	52.45	74	-21.55	Pk	Vertical
4882	38.22	54	-15.78	AV	Vertical
4882	51.36	74	-22.64	Pk	Horizontal
4882	37.49	54	-16.51	AV	Horizontal
High Channel (2480 MHz)					
4960	50.05	74	-23.95	pk	Vertical
4960	35.16	54	-18.84	AV	Vertical
4960	50.35	74	-23.65	pk	Horizontal
4960	40.49	54	-13.51	AV	Horizontal

RESULT: PASS

Note:

1. 1GHz~25GHz:(Scan with GFSK, π/4-DQPSK,8DPSK, the worst case is GFSK Mode, No recording in the test report at least have 20dB margin)
2. Margin = Emission Level - Limit

10. BAND EDGE EMISSION

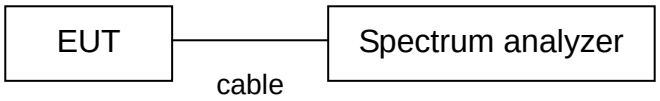
10.1. MEASUREMENT PROCEDURE

1. The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100kHz.The video bandwidth is set to 300kHz.
2. Transmitter set to the normal hopping mode at 2.4 and 2.4835 GHz.

10.2. TEST SET-UP

Radiated same as 10.2

Conducted set up



10.3. RADIATED TEST RESULT

Frequency	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	Type	
GFSK					
2399.9	37.68	74	-36.32	peak	Vertical
2399.9	37.89	54	-16.11	AVG	Vertical
2399.9	40.49	74	-33.51	peak	Horizontal
2399.9	38.48	54	-15.52	AVG	Horizontal
2483.6	37.14	74	-36.86	peak	Vertical
2483.6	38.78	54	-15.22	AVG	Vertical
2483.6	52.22	74	-21.78	peak	Horizontal
2483.6	42.95	54	-11.05	AVG	Horizontal
π/4-DQPSK					
2399.9	37.85	74	-36.15	peak	Vertical
2399.9	37.89	54	-16.11	AVG	Vertical
2399.9	40.67	74	-33.33	peak	Horizontal
2399.9	38.80	54	-15.20	AVG	Horizontal
2483.6	37.16	74	-36.84	peak	Vertical
2483.6	38.75	54	-15.25	AVG	Vertical
2483.6	52.17	74	-21.83	peak	Horizontal
2483.6	43.21	54	-10.79	AVG	Horizontal
8DPSK					
2399.9	38.00	74	-36.00	peak	Vertical
2399.9	37.66	54	-16.34	AVG	Vertical
2399.9	40.69	74	-33.31	peak	Horizontal
2399.9	38.46	54	-15.54	AVG	Horizontal
2483.6	37.30	74	-36.7	peak	Vertical
2483.6	38.92	54	-15.08	AVG	Vertical
2483.6	52.43	74	-21.57	peak	Horizontal
2483.6	42.84	54	-11.16	AVG	Horizontal

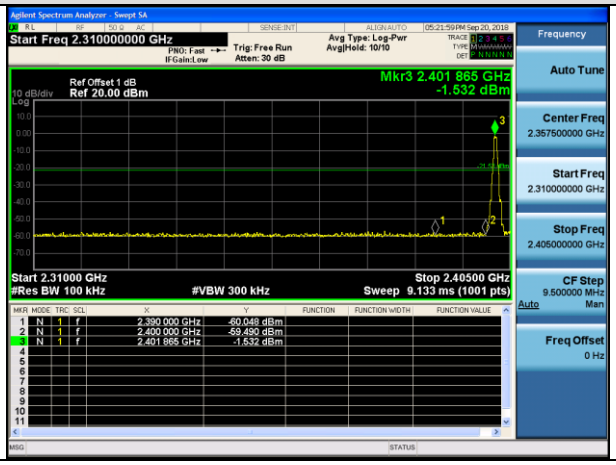
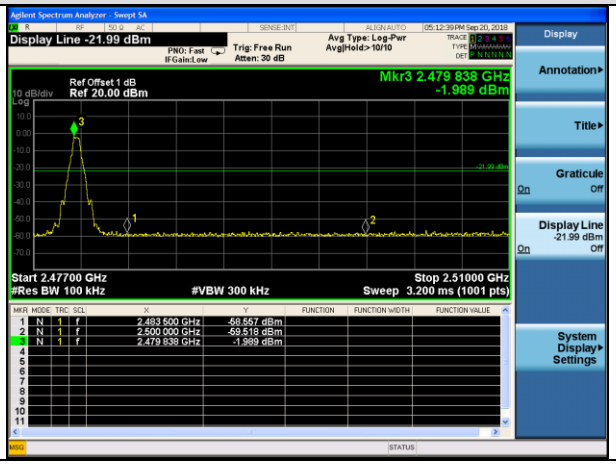
RESULT: PASS

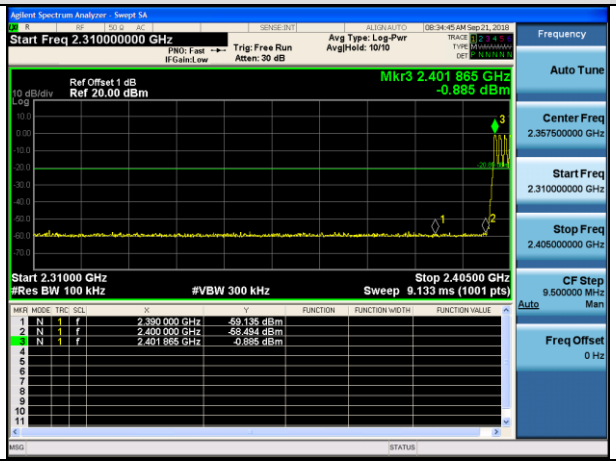
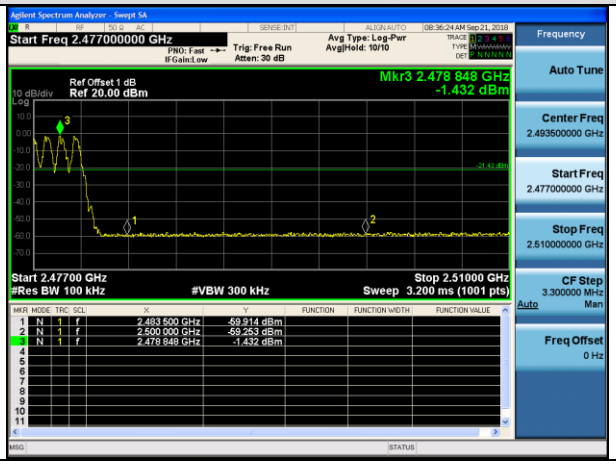
Note: The other modes radiation emission have enough 20dB margin.

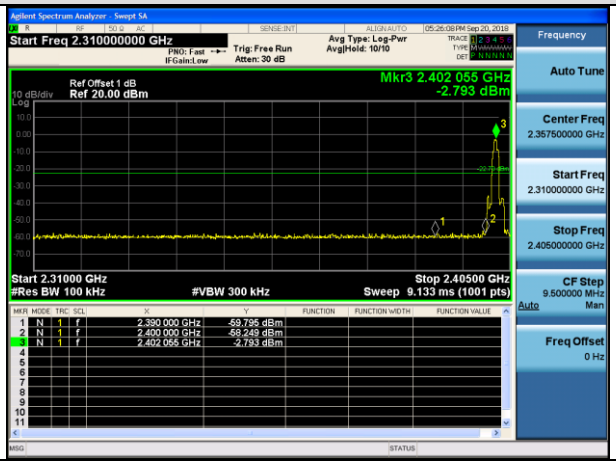
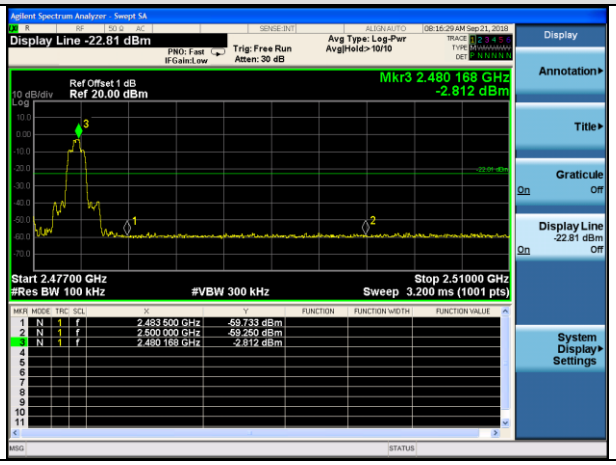
Margin = Emission Level – Limit

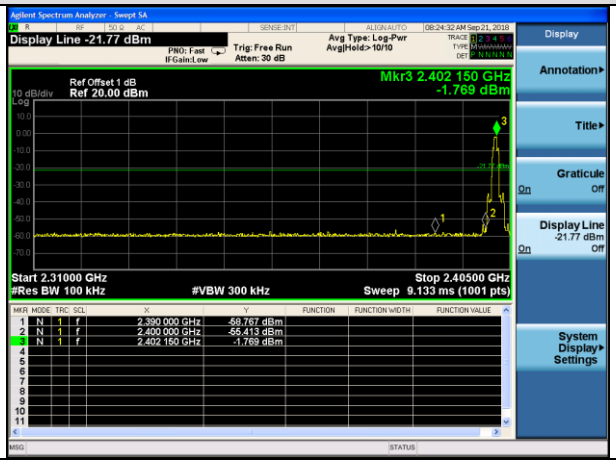
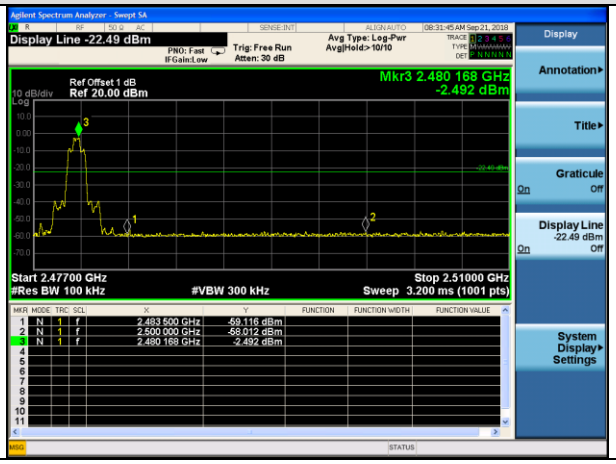
10.4 CONDUCTED TEST RESULT

Test Graph

GFSK/LCH/No Hop	GFSK/HCH/ No Hop
	

GFSK/LCH/Hop	GFSK/HCH/Hop
	

π/4DQPSK/LCH/No Hop	π/4DQPSK /HCH/No Hop
	

8DPSK/LCH/No Hop	8DPSK/HCH/No Hop
	

Note: All modes were tested, only the worst case record in the report.

11. NUMBER OF HOPPING FREQUENCY

11.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer Start = 2.4GHz Stop = 2.4835GHz
4. Set the Spectrum Analyzer as RBW>=1%span, VBW>=RBW.

11.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

11.3. MEASUREMENT EQUIPMENT USED

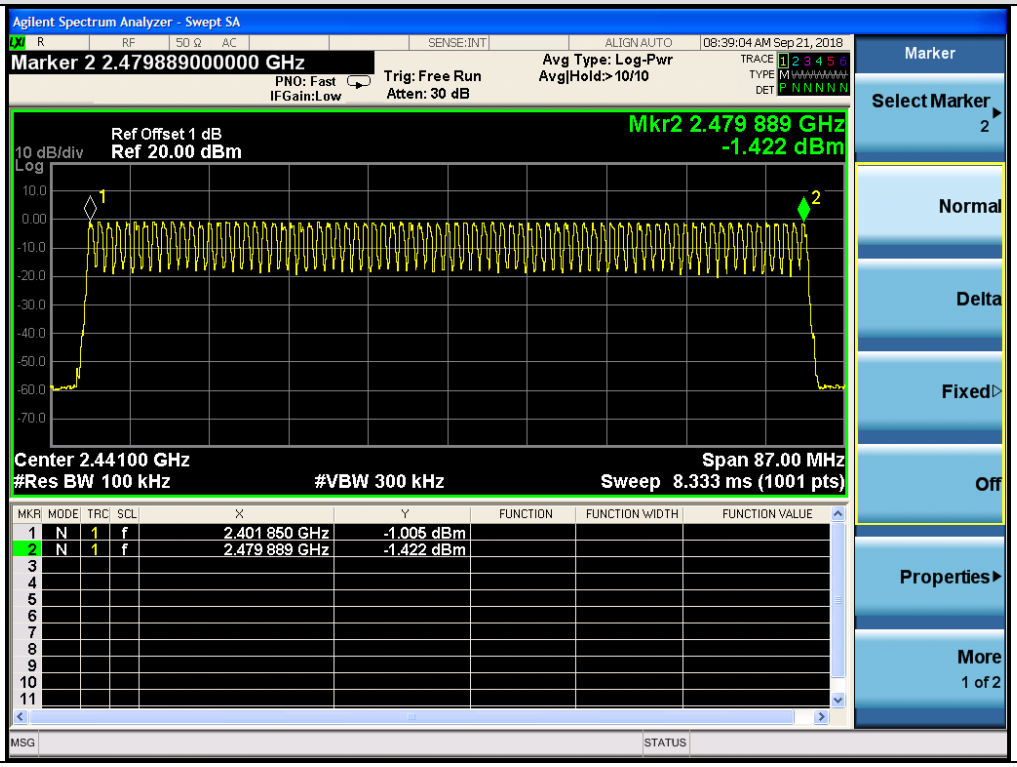
The same as described in section 6

11.4. LIMITS AND MEASUREMENT RESULT

Mode	Channel.	Number of Hopping Channel	Verdict
GFSK	Hop	79	PASS

Note: All modes were tested, only the worst case record in the report.

Test Graph

Graphs		
GFSK/Hop		

12. TIME OF OCCUPANCY (DWELL TIME)

12.1. MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
1. Span: Zero span, centered on a hopping channel.
2. RBW shall be≤channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel.
4. Detector function: Peak. Trace: Max hold.
5. Use the marker-delta function to determine the transmit time per hop.
6. Using the following equation:

The dwell time is calculated with the following formula:

Dwell time = t_{pulse} x n_{hops} / number of channels x 31.6 s

Where:

t_{pulse} is the measured pulse time (pls. refer the plots of the spectrum analyser above) [s],
n_{hops} is the number of hops per second in the actual operating mode of the transmitter [1/s].

The hopping rate of the system is 1600 hops per second and the system uses 79 channels. For this reason one time slot has a length of 625 µs.

With the used hopping mode (DH5) a packet need 5 timeslots for transmitting and the next timeslot for receiving. So the system makes in worst case 266,67 hops per second in transmit mode (n_{hops} = 266.667 1/s)

12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

12.3. MEASUREMENT EQUIPMENT USED

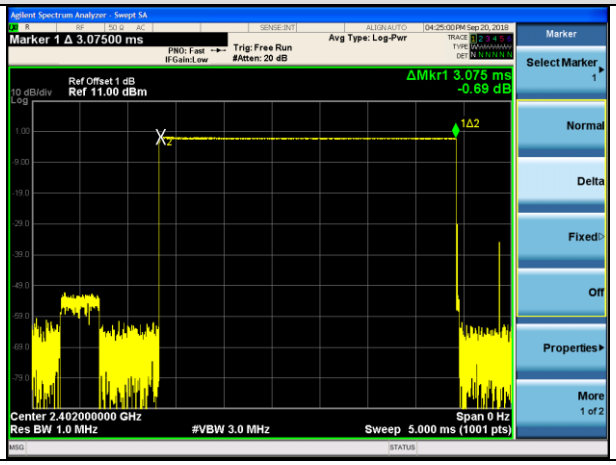
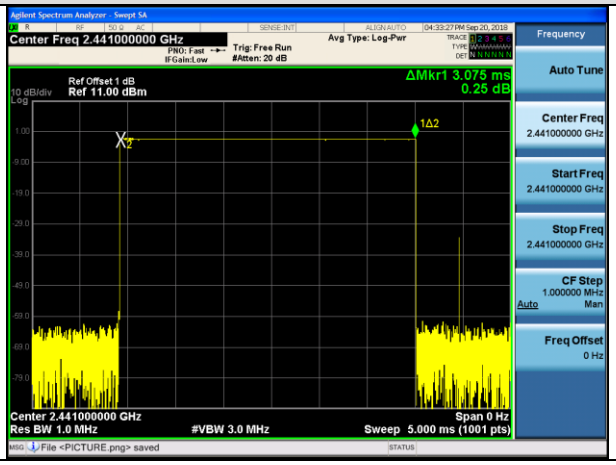
The same as described in section 6

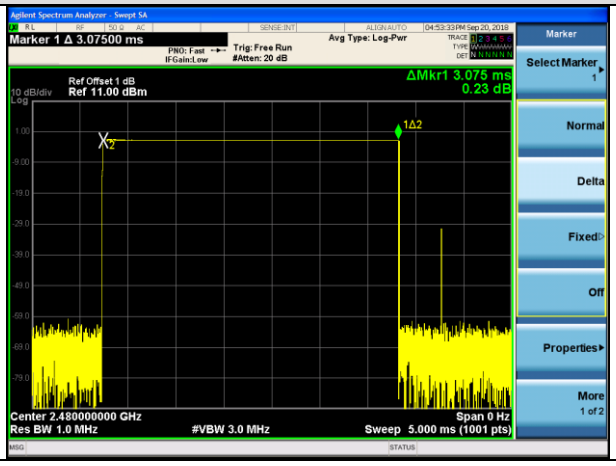
12.4. LIMITS AND MEASUREMENT RESULT

Channel.	Burst Width [ms/hop/ch]	Dwell Time[ms]	Verdict	Limit (ms)
LCH	3.075	328.0004	PASS	400
MCH	3.075	328.0004	PASS	400
HCH	3.075	328.0004	PASS	400

Note: The DH5 for GFSK modulation is the worst case and recorded in the report.

Test Graph

GFSK-LCH	GFSK-MCH
	

GFSK-HCH	
	

13. FREQUENCY SEPARATION

13.1. MEASUREMENT PROCEDURE

1. Place the EUT on the table and set it in transmitting mode
2. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum analyzer
3. Set Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold

13.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 6.2

13.3. MEASUREMENT EQUIPMENT USED

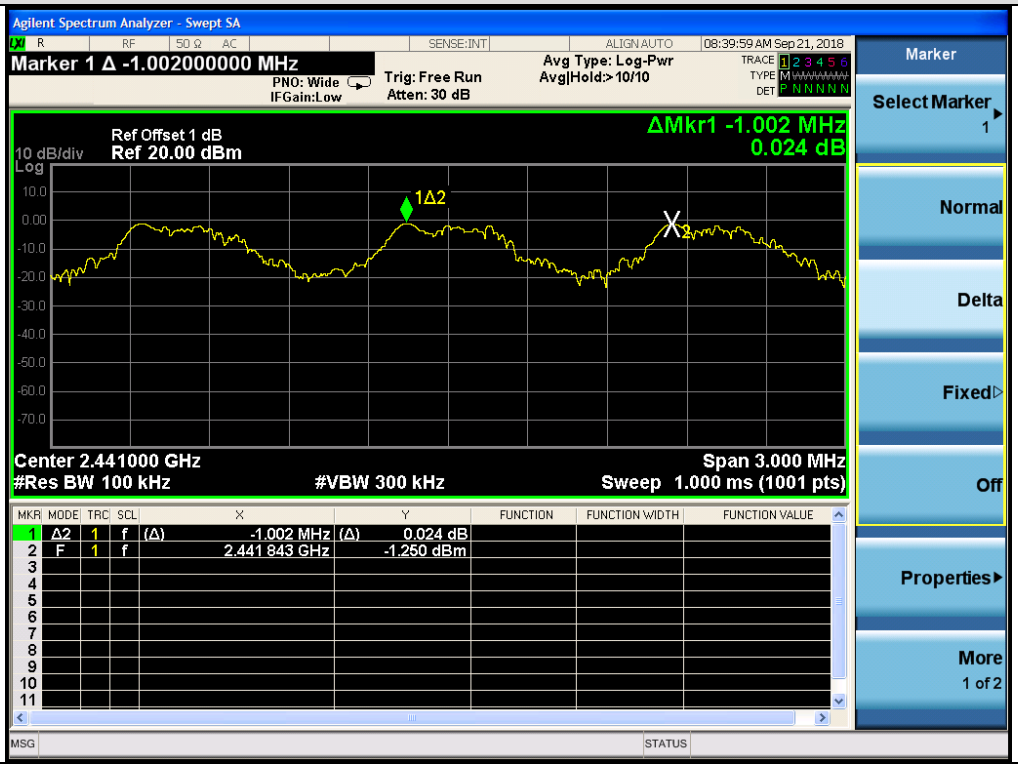
The same as described in section 6.3

13.4. LIMITS AND MEASUREMENT RESULT

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	Hop	1.002	PASS

Note: All modes were tested, only the worst case record in the report.

Test Graph

Graphs		
GFSK/Hop		

14. FCC LINE CONDUCTED EMISSION TEST

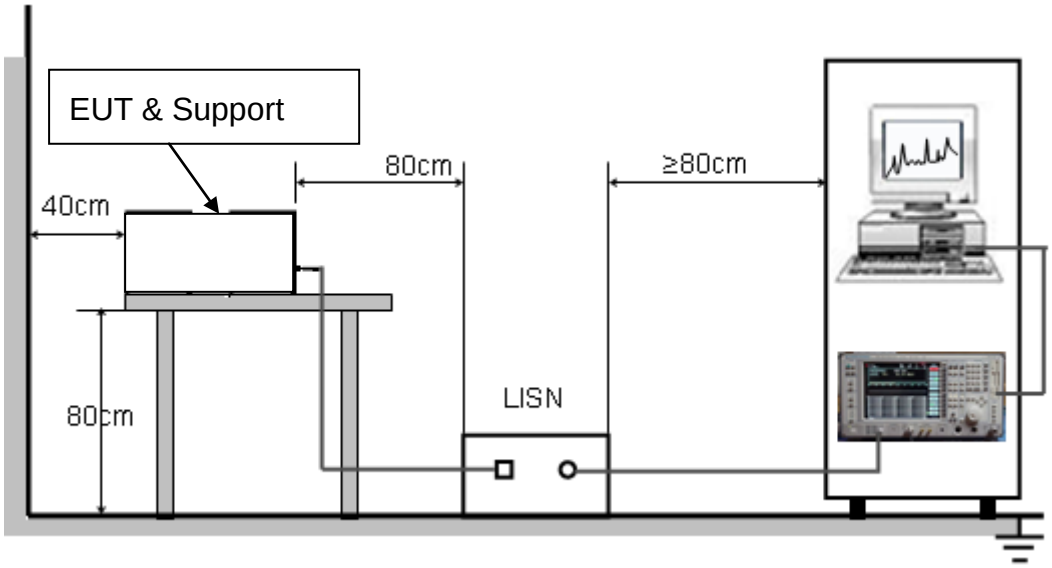
15.1. LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P.(dBuV)	Average(dBuV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

14.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



14.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When 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 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
2. Support equipment, if needed, was placed as per ANSI C63.10.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
4. All support equipments received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC charging voltage by adapter which received 120V/60Hzpower by a LISN..
6. The 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.
9. The test mode(s) were scanned during the preliminary test.

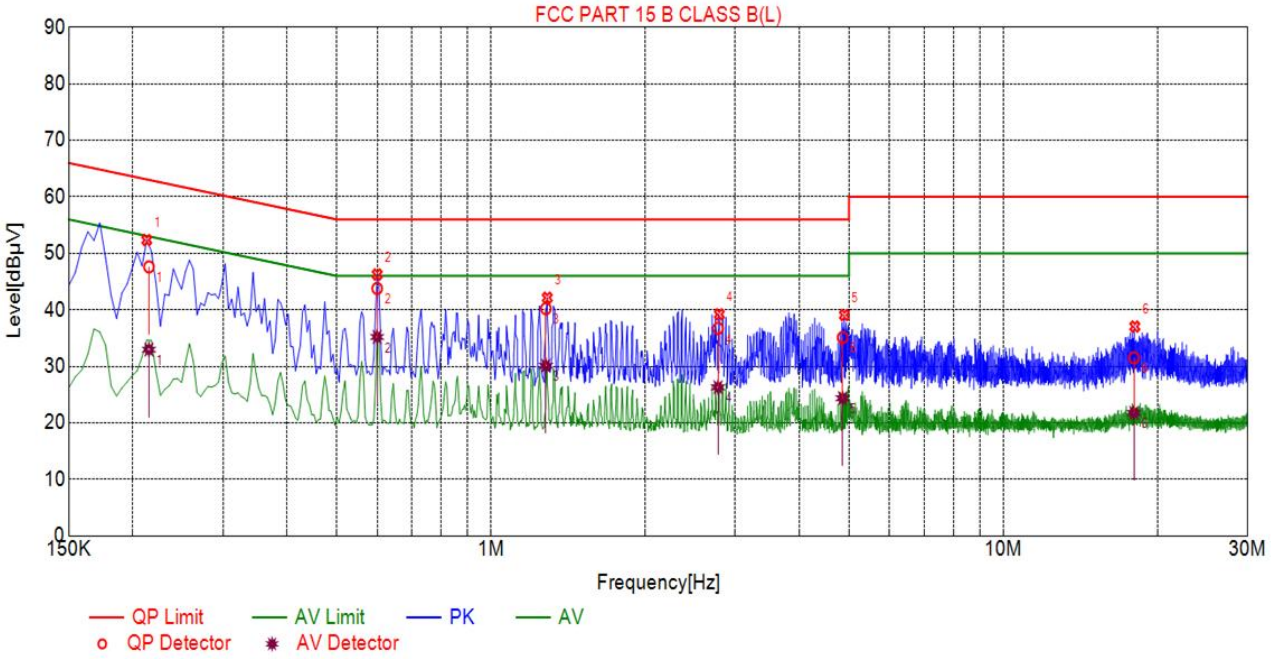
Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

14.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

14.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

LINE CONDUCTED EMISSION TEST LINE 1-L

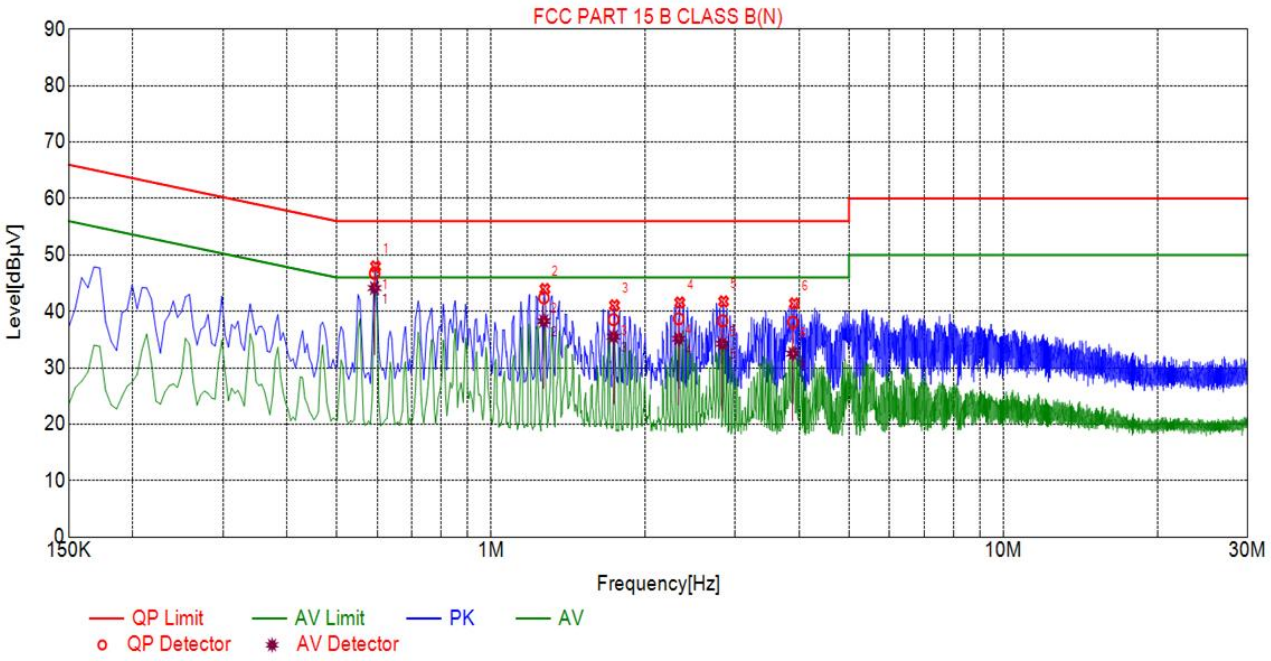


Suspected List						
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector
1	0.2130	52.35	10.05	63.09	10.74	PK
2	0.6000	46.25	10.05	56.00	9.75	PK
3	1.2885	42.14	10.09	56.00	13.86	PK
4	2.7915	39.19	10.21	56.00	16.81	PK
5	4.8975	39.07	10.26	56.00	16.93	PK
6	18.0645	37.04	10.04	60.00	22.96	PK

Final Data List								
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.2151	10.05	47.61	63.00	15.39	32.96	53.00	20.04
2	0.5998	10.05	43.79	56.00	12.21	35.20	46.00	10.80
3	1.2804	10.09	40.21	56.00	15.79	30.09	46.00	15.91
4	2.7753	10.21	36.72	56.00	19.28	26.29	46.00	19.71
5	4.8564	10.26	35.10	56.00	20.90	24.35	46.00	21.65
6	17.9918	10.03	31.53	60.00	28.47	21.76	50.00	28.24

1

LINE CONDUCTED EMISSION TEST LINE 2-N



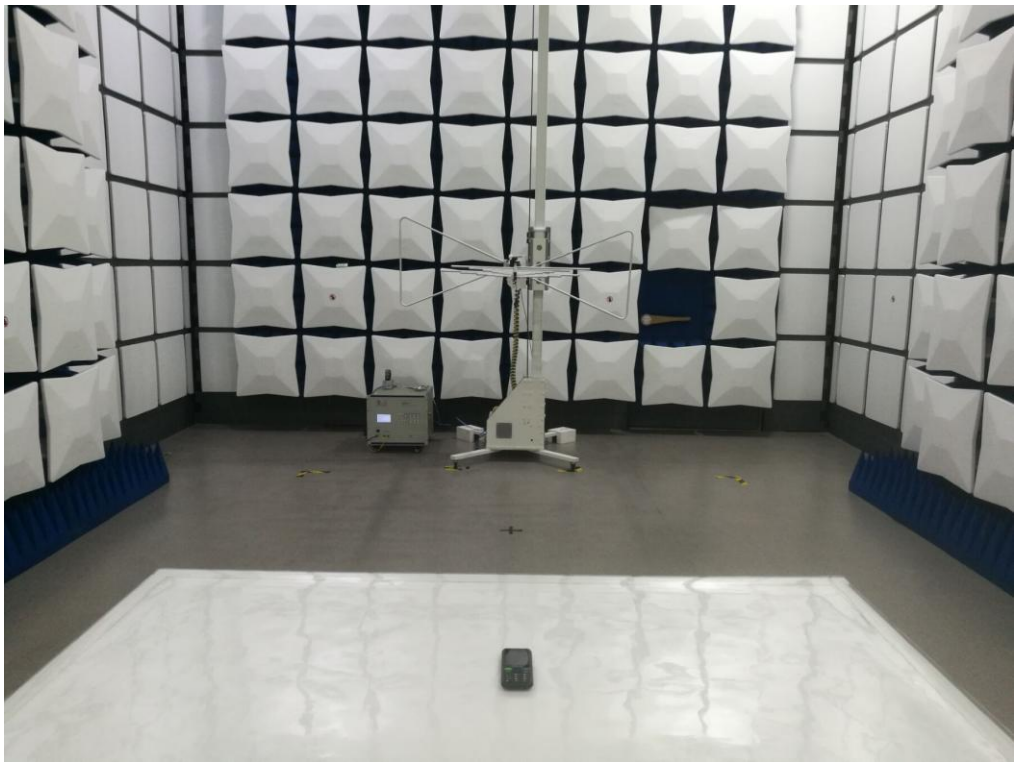
Suspected List						
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector
1	0.5955	47.96	10.05	56.00	8.04	PK
2	1.2750	43.95	10.09	56.00	12.05	PK
3	1.7430	41.06	10.14	56.00	14.94	PK
4	2.3370	41.55	10.18	56.00	14.45	PK
5	2.8455	41.75	10.21	56.00	14.25	PK
6	3.9120	41.39	10.25	56.00	14.61	PK

Final Data List								
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]
1	0.5930	10.05	46.72	56.00	9.28	44.13	46.00	1.87
2	1.2686	10.09	42.41	56.00	13.59	38.28	46.00	7.72
3	1.7350	10.13	38.55	56.00	17.45	35.52	46.00	10.48
4	2.3254	10.18	38.69	56.00	17.31	35.15	46.00	10.85
5	2.8328	10.21	38.31	56.00	17.69	34.27	46.00	11.73
6	3.8858	10.25	38.06	56.00	17.94	32.51	46.00	13.49

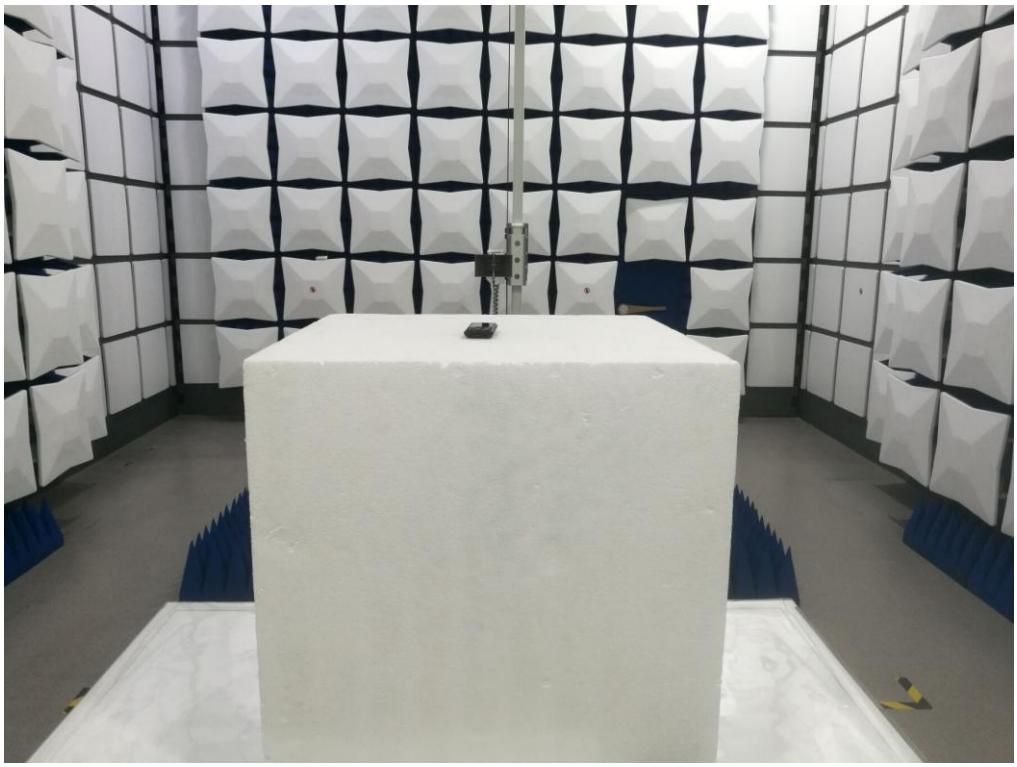
APPENDIX A: PHOTOGRAPHS OF TEST SETUP

LINE CONDUCTED EMISSION TEST SETUP

RADIATED EMISSION TEST SETUP



RADIATED EMISSION ABOVE 1G TEST SETUP



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