



FCC TEST REPORT

**Test report
On Behalf of
Inspire Mobile
For
Rugged IP PTT
Model No.: IM-550**

FCC ID: 2AR6HIMP-R01W

Prepared for : Inspire Mobile
Rm1412, Daeryung Techno-Town 15th, 401, Simin-daero, Dongan-gu, Anyang-si,
Gyeonggi-do, 14057, Korea

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: Dec. 28, 2018~Jan. 18, 2019

Date of Report: Jan. 18, 2019

Report Number: HK1901140095E

**TEST RESULT CERTIFICATION**

Applicant's name : Inspire Mobile
Address..... : Rm1412, Daeryung Techno-Town 15th, 401, Simin-daero, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
Manufacture's Name..... : Inspire Mobile
Address..... : Rm1412, Daeryung Techno-Town 15th, 401, Simin-daero, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
Factory's Name : Shenzhen Bee Technology co., Ltd
Address..... : 4 Floor, A Building, Chuangjin No.1, No.125 Chuangye 2nd road, Baoan District, Shenzhen
Product description : Rugged IP PTT
Brand Name : IM-550
Mode Name : IM-550
Standards : FCC Rules and Regulations Part 15 Subpart C Section 15.247
ANSI C63.10: 2013

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Date of Test

Date (s) of performance of tests..... **Dec. 28, 2018~Jan. 18, 2019**

Date of Issue **Jan. 18, 2019**

Test Result **Pass**

Testing Engineer :

(Gary Qian)

Technical Manager :

(Eden Hu)

Authorized Signatory :

(Jason Zhou)



Revision	Issue Date	Revisions	Revised By
V1.0	Jan. 18, 2019	Initial Issue	Jason Zhou



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1. VERIFICATION OF CONFORMITY

1.1. PRODUCT DESCRIPTION

Equipment	Rugged IP PTT
Model Name	IM-550
Hardware Version	K2_US_Main_Rev1.0
Software Version	D08
FCC ID	2AR6HIMP-R01W
Antenna Type	FPC Antenna
Antenna Gain	1.2dBi
BT Operation frequency	2.402 GHz to 2.480GHz
Bluetooth Version	V4.0
Number of Channels	79(For BR/EDR)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Power Supply	DC3.8V by Battery

**1.2. TABLE OF CARRIER FREQUENCIES**

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 or multislotted 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 sent on the same frequency, it is sent on the next frequency of the hopping sequence.

1.4. EXAMPLE OF A HOPPING SEQUENCE 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 24 MSB's of the 48 BD_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 synchronization with other units only offsets are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most cases it is implemented as 28-bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With these input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behavior:

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 transmissions is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). 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: 2AR6HIMP-R01W** 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	± 0.01 ppm	(1)
Radiated Emission 30~1000MHz	± 4.10 dB	(1)
Radiated Emission Above 1GHz	± 4.32 dB	(1)
Conducted Disturbance 0.15~30MHz	± 3.20 dB	(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 $\pi/4$ -DQPSK
5	Middle channel $\pi/4$ -DQPSK
6	High channel $\pi/4$ -DQPSK
7	Low channel 8DPSK
8	Middle channel 8DPSK
9	High channel 8DPSK
10	Normal Hopping

Note:

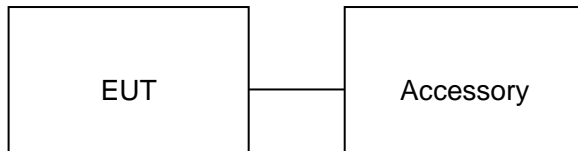
1. All the test modes can be supply by Built-in Li-ion battery, only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.



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	Rugged IP PTT	IM-550	2AR6HIMP-R01W	EUT
2	Adapter	M050200E111U1	DC 5.0V 2A	Accessory
3	Battery	K2	DC3.8V/ 3600mAh	Accessory
4	USB	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 HUAKE 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. 26, 2019
Power Sensor	Agilent	E9327A	HKE-113	Dec. 26, 2019
RF cable	Times	1-40G	HKE-034	Dec. 26, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 26, 2019
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019
RF Cable (9KHz-26.5GHz)	Tonscend	170660	N/A	Dec. 26, 2019
Signal generator	Agilent	N5183A	HKE-071	Dec. 26, 2019
Receiver	R&S	ESCI-7	HKE-010	Dec. 26, 2019
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019
Preamplifier	EMCI	EMC051845SE	HKE-015	Dec. 26, 2019
Preamplifier	Agilent	83051A	HKE-016	Dec. 26, 2019
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 26, 2019
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Dec. 26, 2019
Horn antenna	Schwarzbeck	9120D	HKE-013	Dec. 26, 2019
Antenna Mast	Keleto	CC-A-4M	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 26, 2019
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. 26, 2019



6. PEAK OUTPUT POWER

6.1. MEASUREMENT PROCEDURE

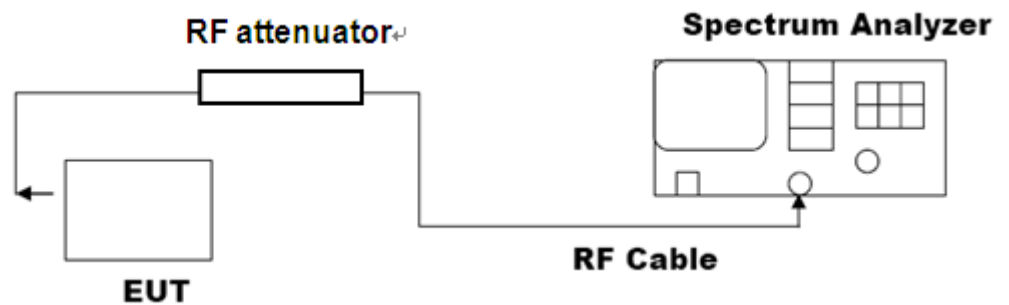
For peak power test:

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 \geq 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	3.64	30	Pass
	2.441	2.35	30	Pass
	2.480	1.95	30	Pass

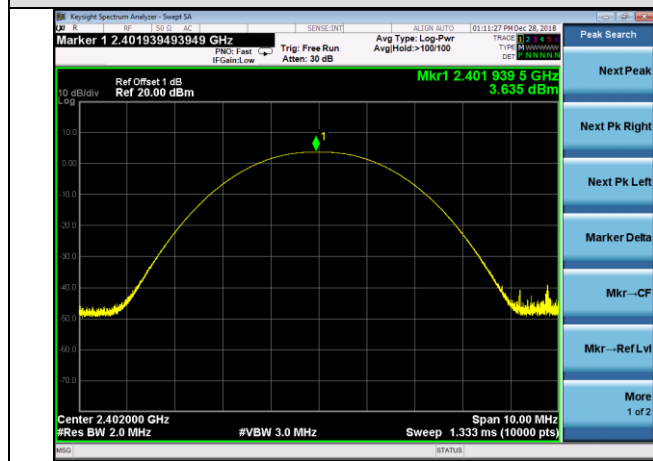
Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
π /4-DQPSK	2.402	3.24	30	Pass
	2.441	1.91	30	Pass
	2.480	1.62	30	Pass

Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
8DPSK	2.402	1.63	30	Pass
	2.441	1.41	30	Pass
	2.480	0.02	30	Pass

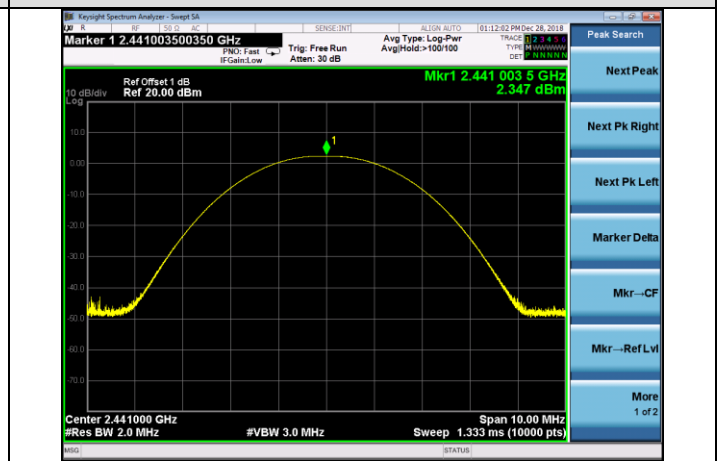


Test Graph

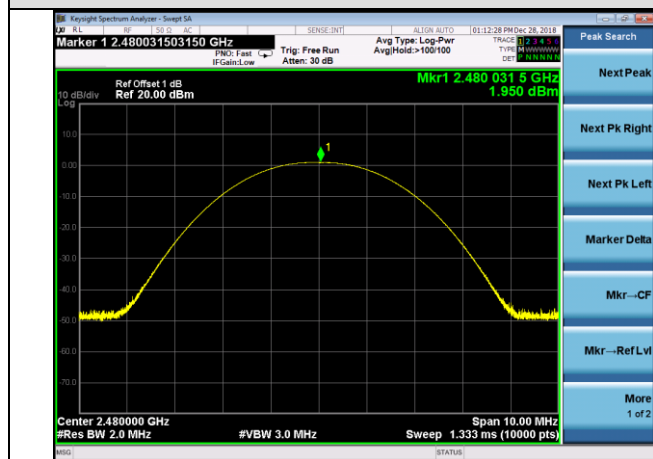
GFSK-LCH



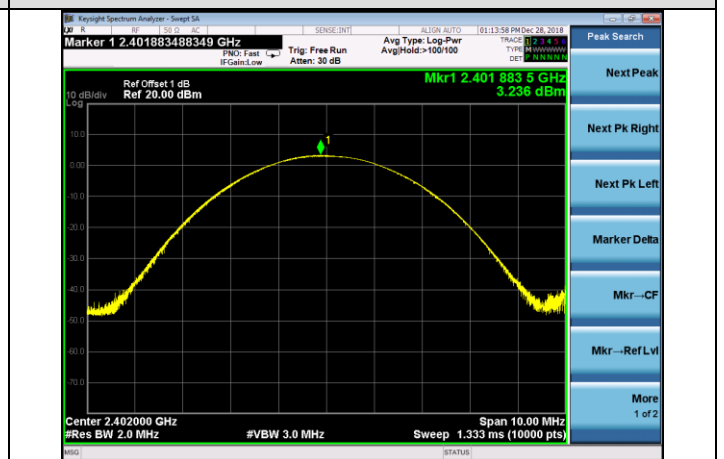
GFSK-MCH



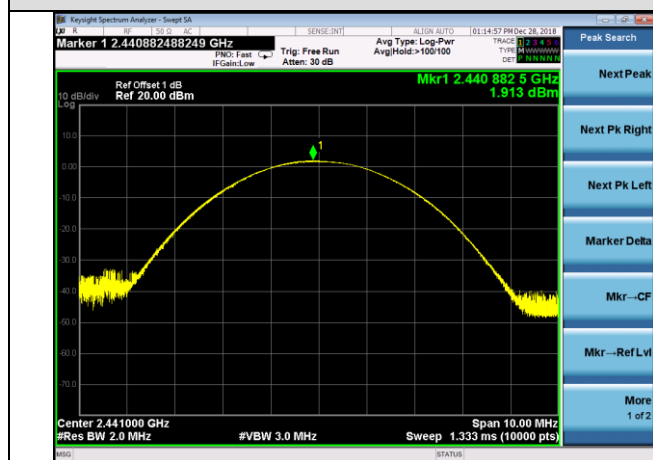
GFSK-HCH



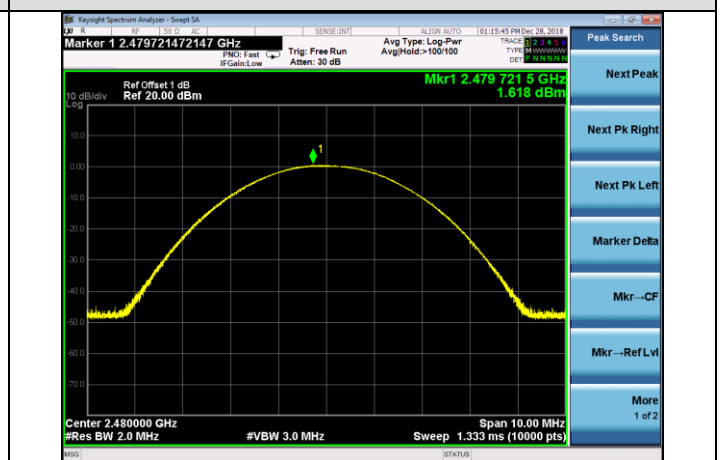
$\pi/4$ DQPSK-LCH



$\pi/4$ DQPSK-MCH

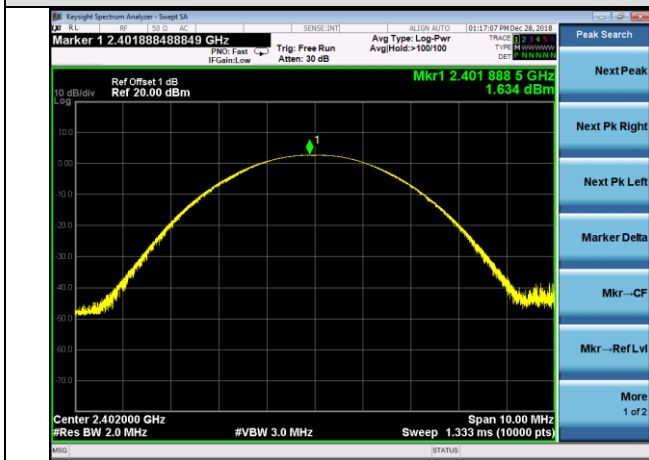


$\pi/4$ DQPSK-HCH

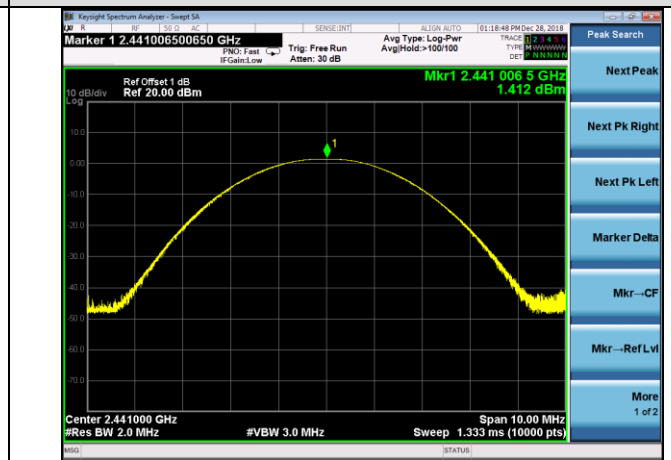




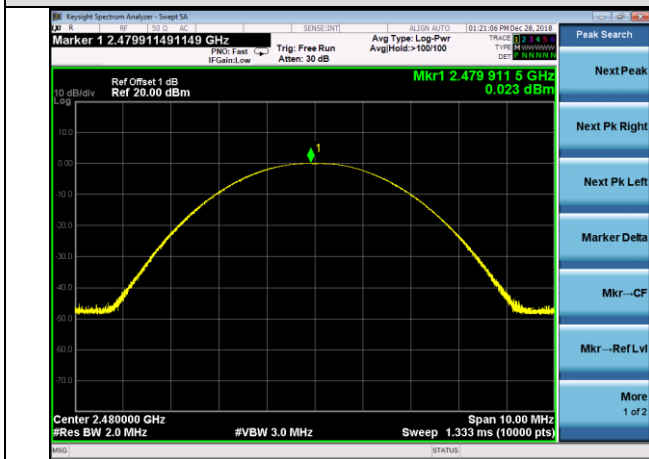
8DPSK-LCH



8DPSK-MCH



8DPSK-HCH



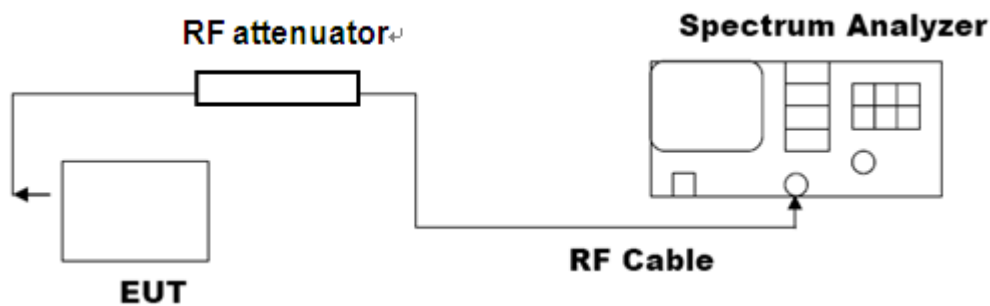


7. 20DB BANDWIDTH

7.1. 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 hopping channel
RBW \geq 1% of the 20 dB bandwidth, VBW \geq RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

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

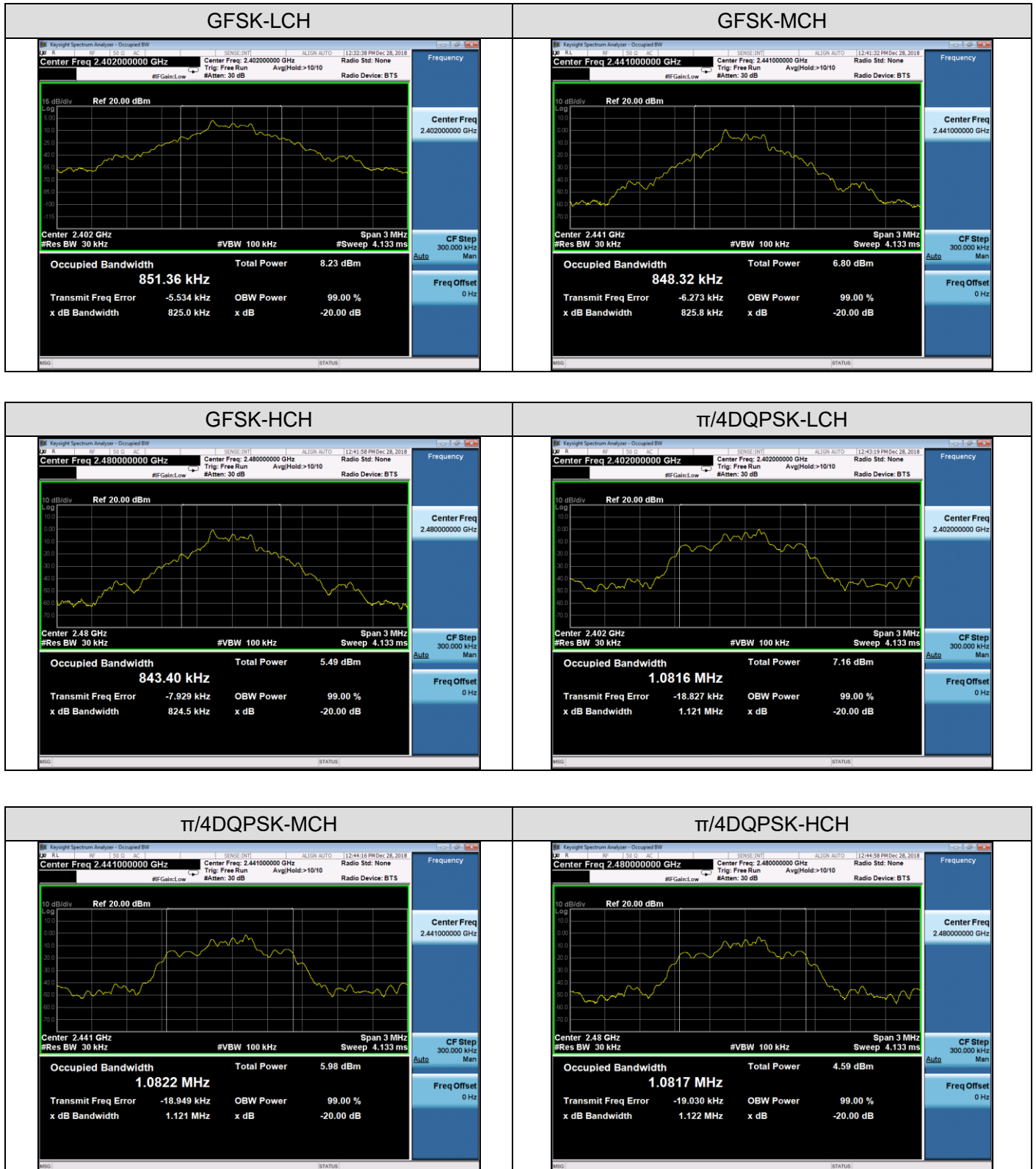


7.3. LIMITS AND MEASUREMENT RESULTS

Mode	Channel.	20dB Bandwidth [KHz]	Verdict
GFSK	LCH	825.0	PASS
GFSK	MCH	825.8	PASS
GFSK	HCH	824.5	PASS
$\pi/4$ DQPSK	LCH	1121	PASS
$\pi/4$ DQPSK	MCH	1121	PASS
$\pi/4$ DQPSK	HCH	1122	PASS
8DPSK	LCH	1125	PASS
8DPSK	MCH	1124	PASS
8DPSK	HCH	1124	PASS

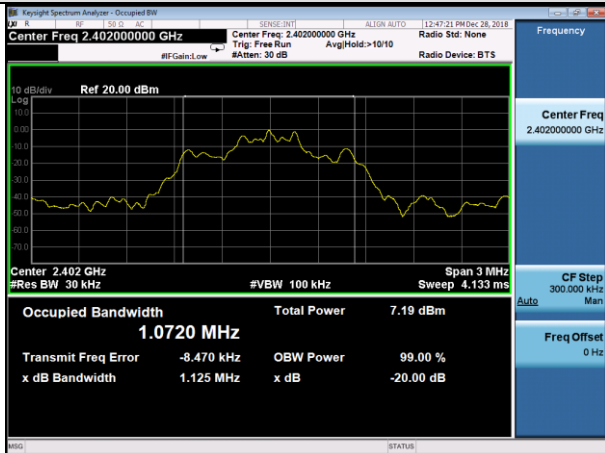


Test Graph

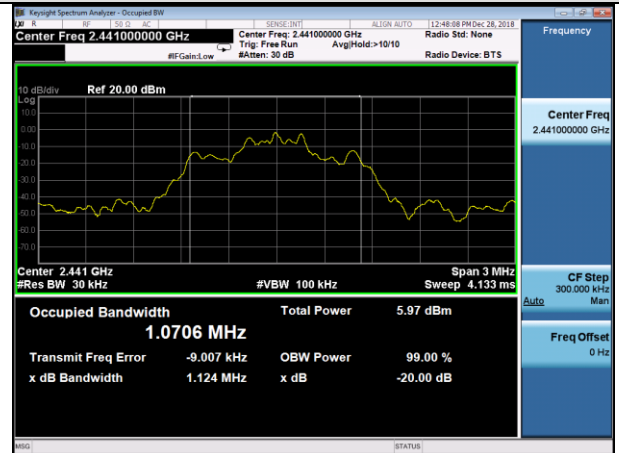




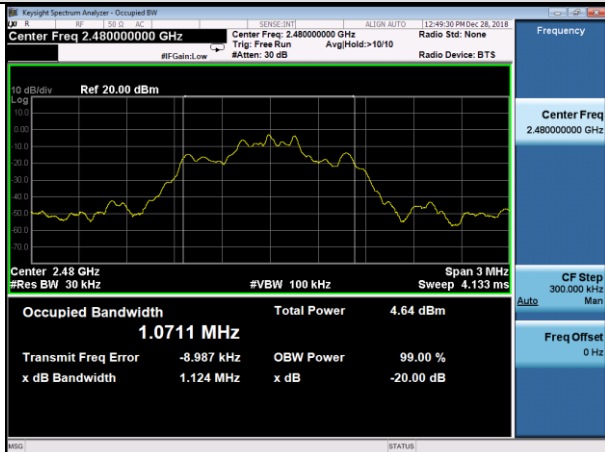
8DPSK-LCH



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 \geq 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

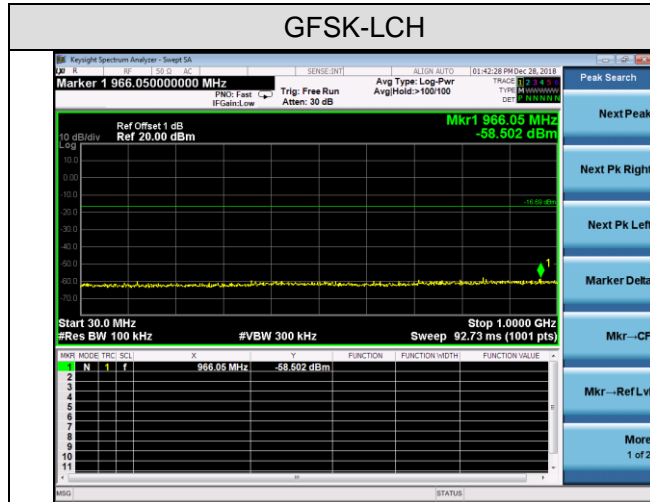
8.4. LIMITS AND MEASUREMENT RESULT

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

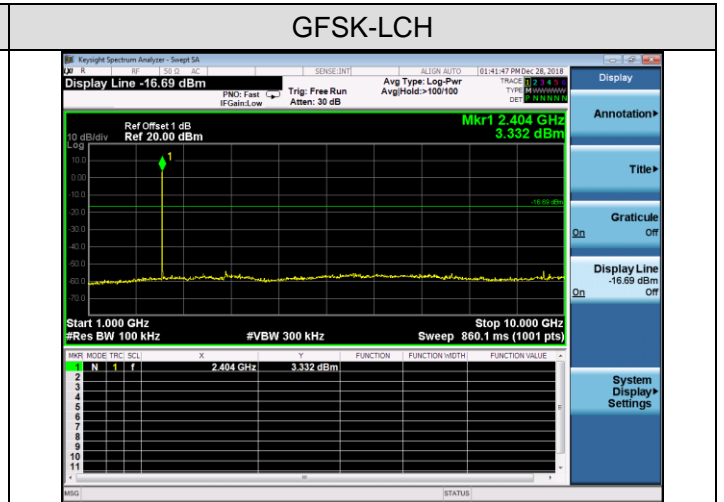


Test Graph

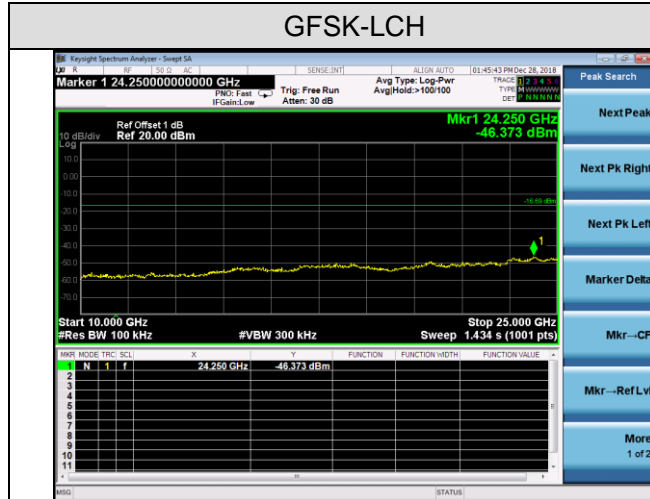
GFSK-LCH



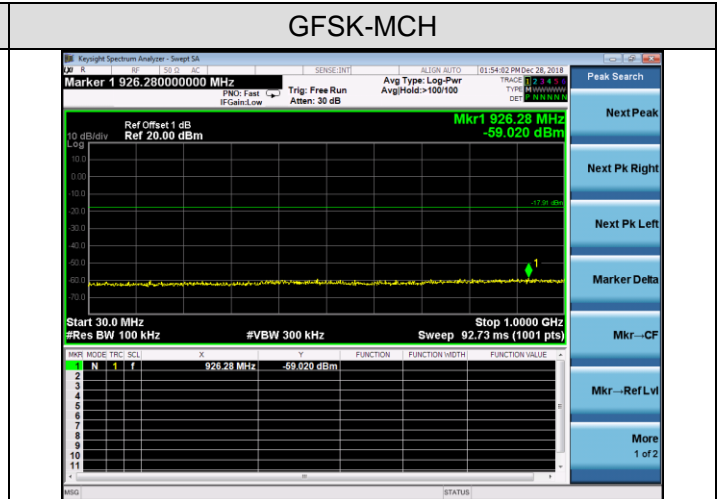
GFSK-LCH



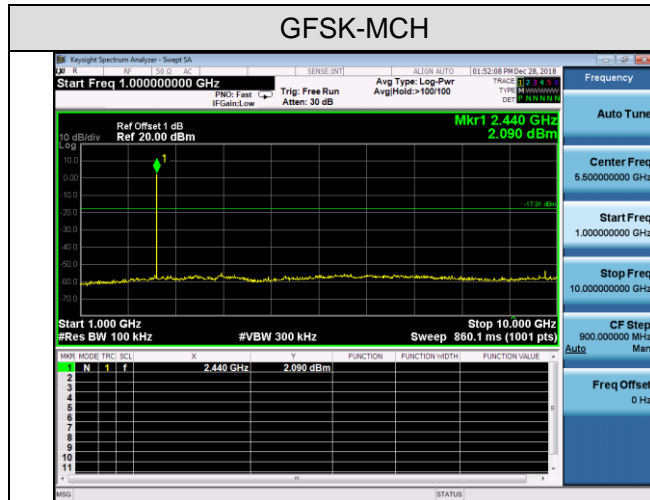
GFSK-LCH



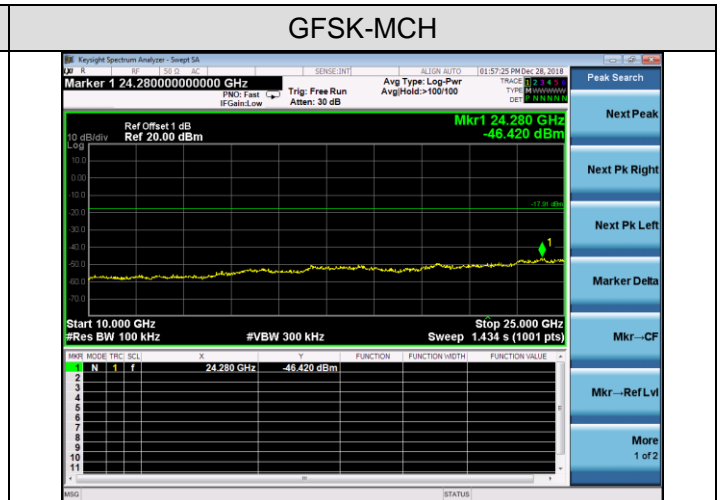
GFSK-MCH



GFSK-MCH

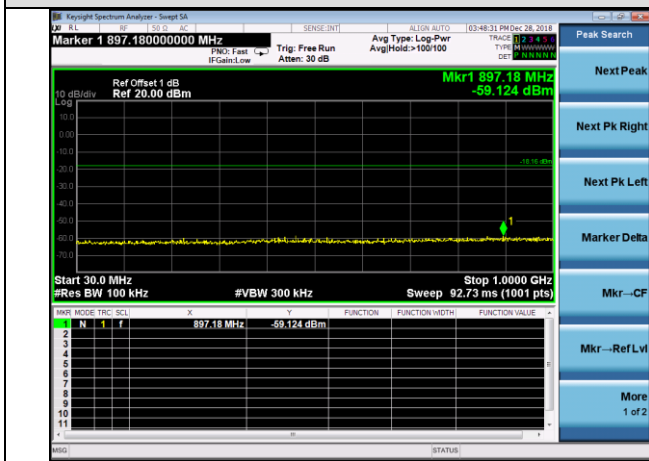


GFSK-MCH

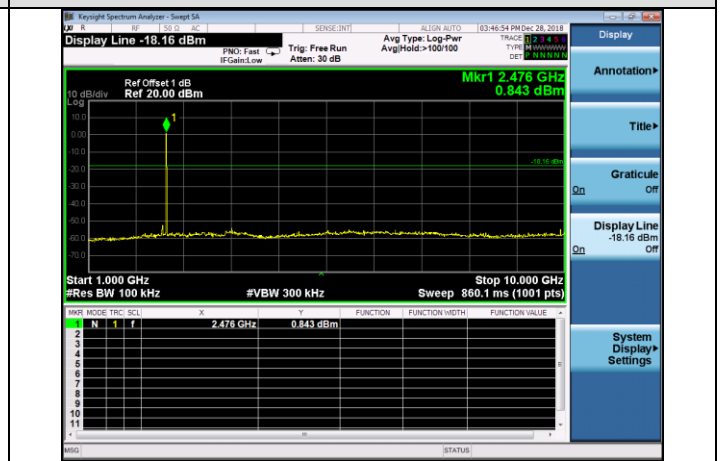




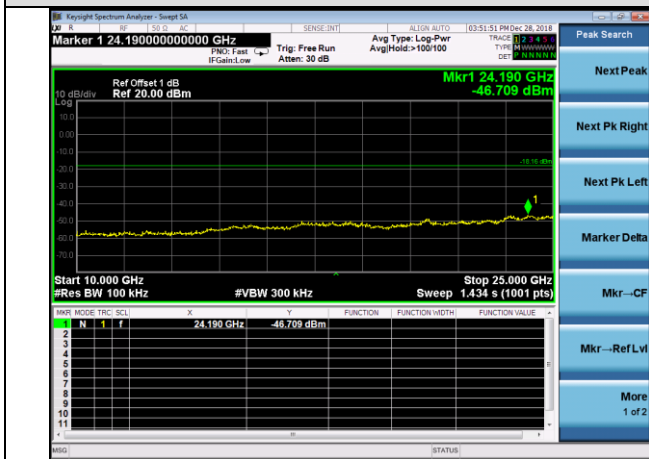
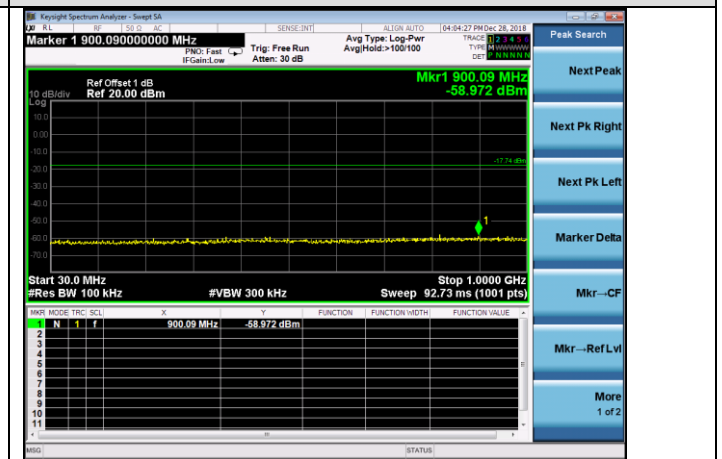
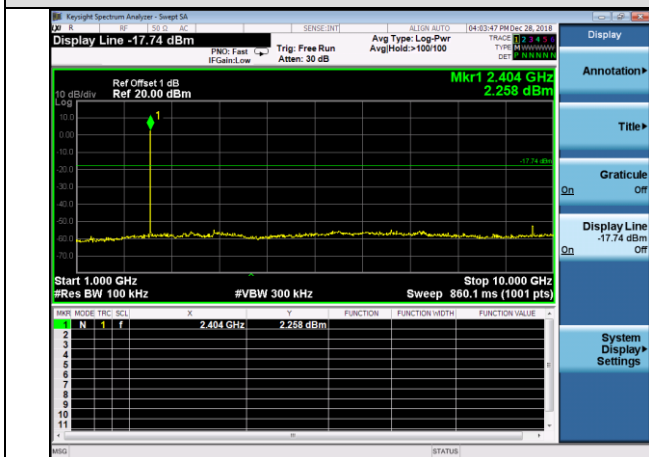
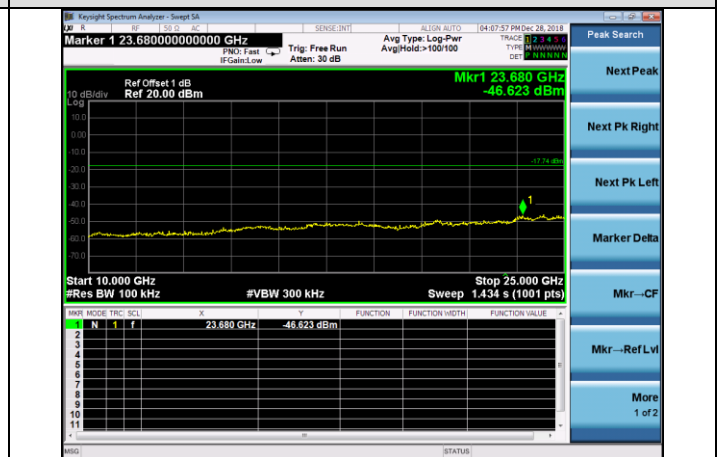
GFSK-HCH

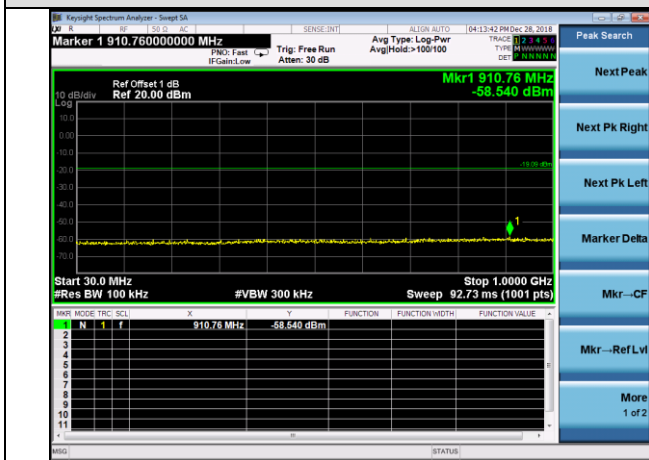
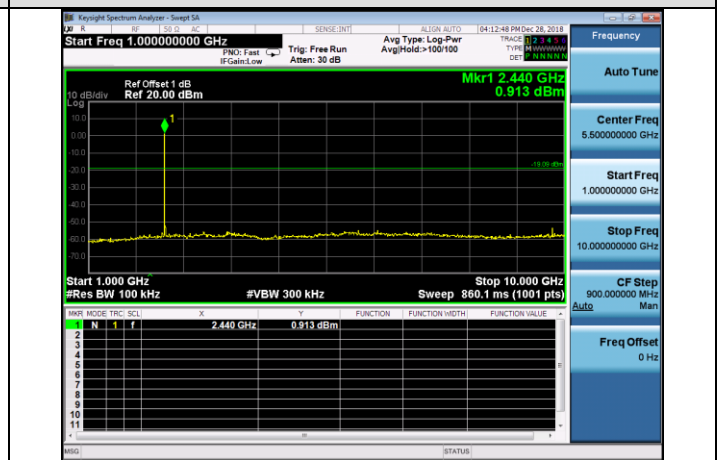
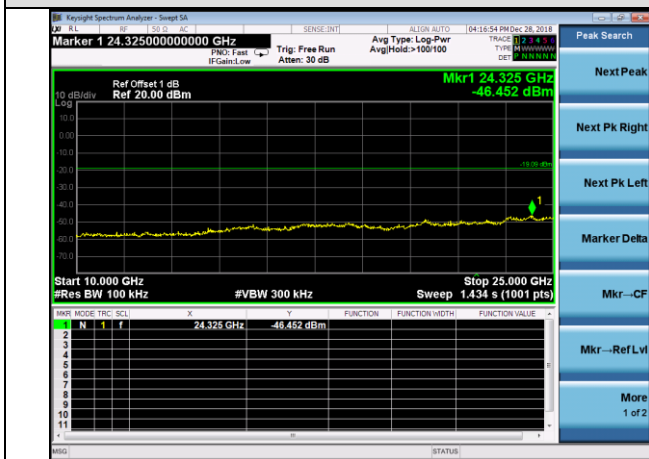
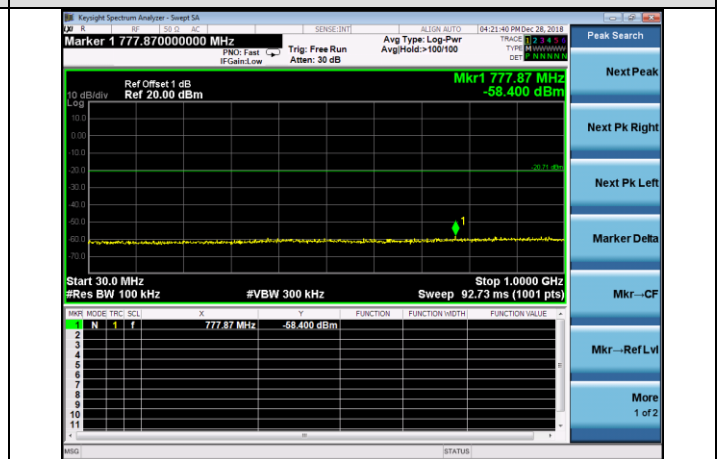
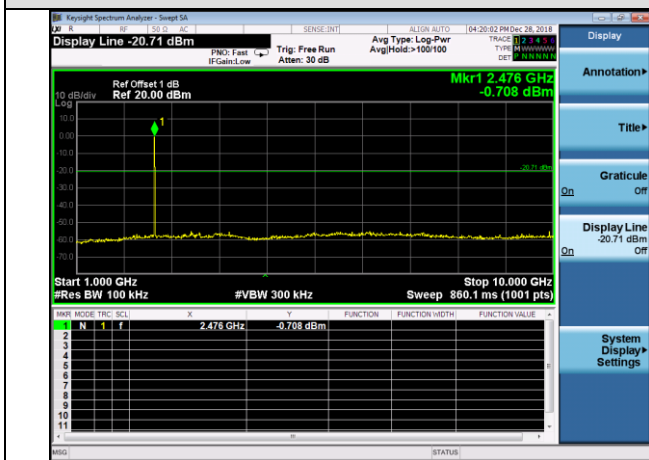
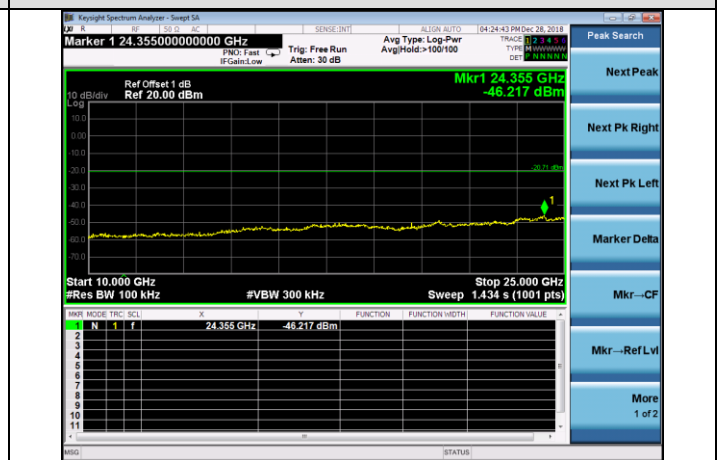


GFSK-HCH



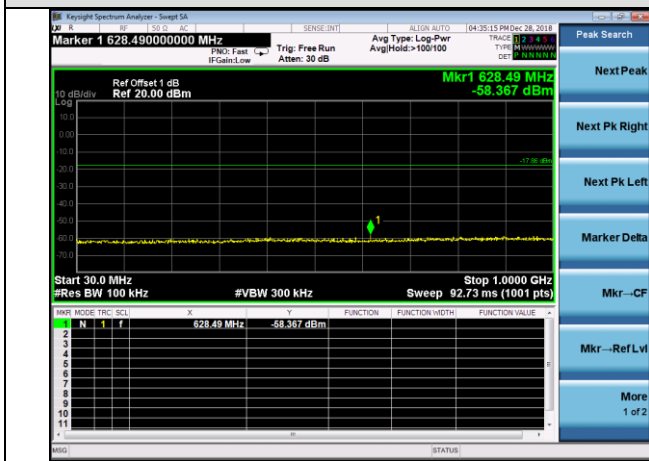
GFSK-HCH

 $\pi/4$ DQPSK-LCH $\pi/4$ DQPSK-LCH $\pi/4$ DQPSK-LCH

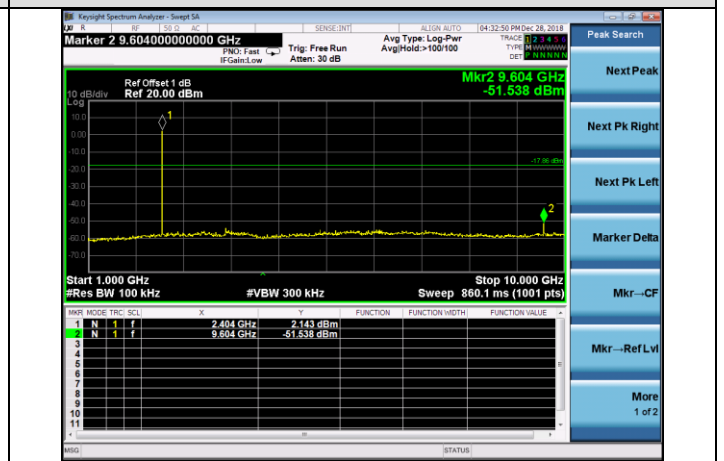
 π /4DQPSK-MCH π /4DQPSK-MCH π /4DQPSK-MCH π /4DQPSK-HCH π /4DQPSK-HCH π /4DQPSK-HCH



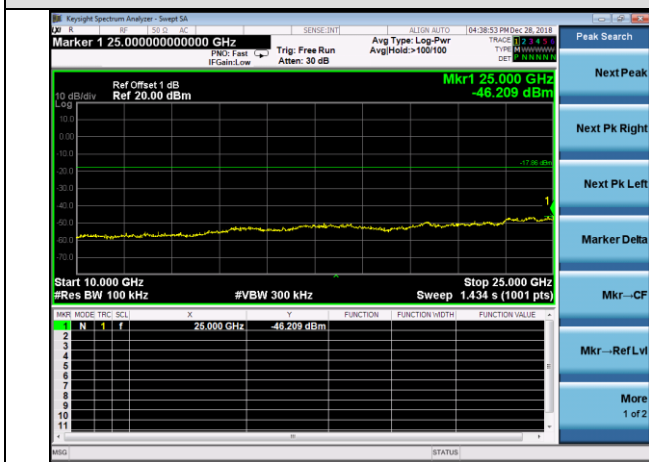
8DPSK-LCH



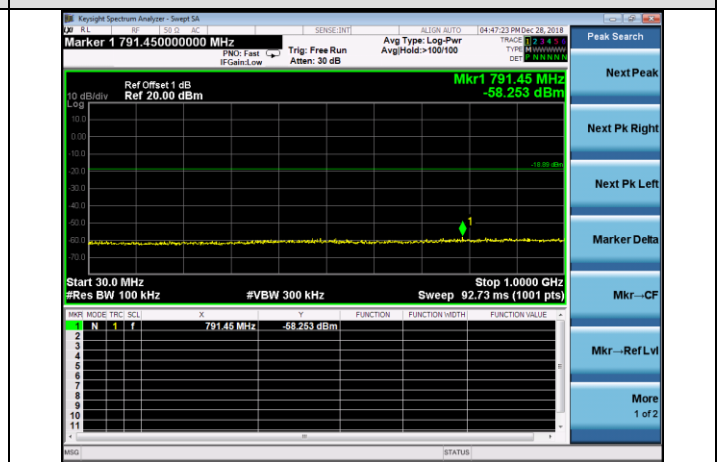
8DPSK-LCH



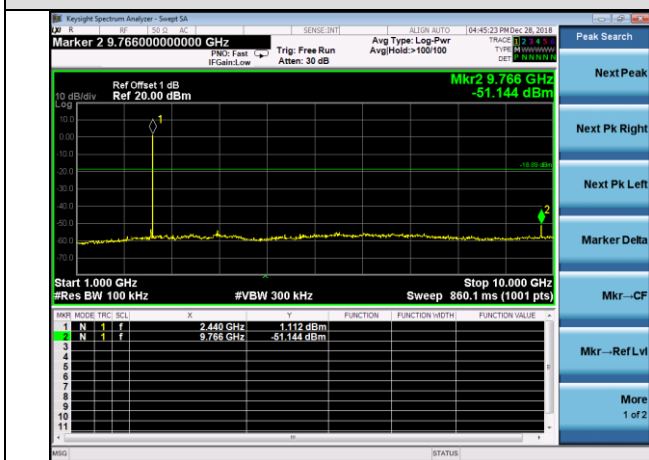
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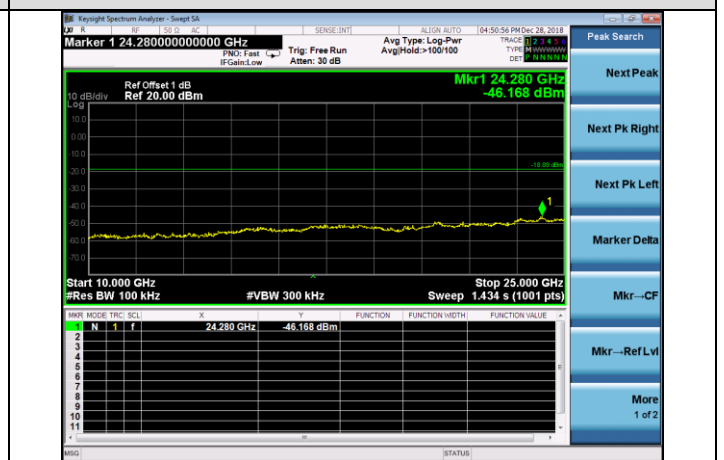
8DPSK-MCH



8DPSK-MCH

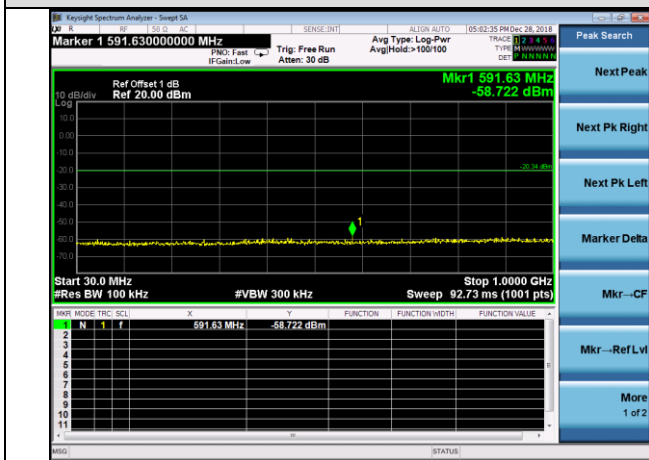


8DPSK-MCH

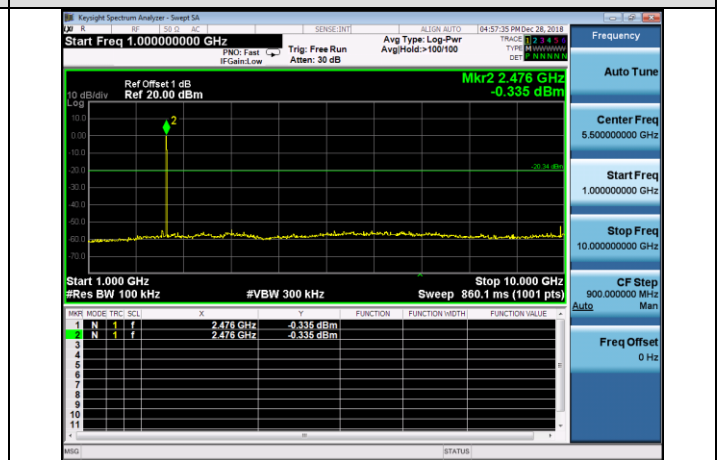




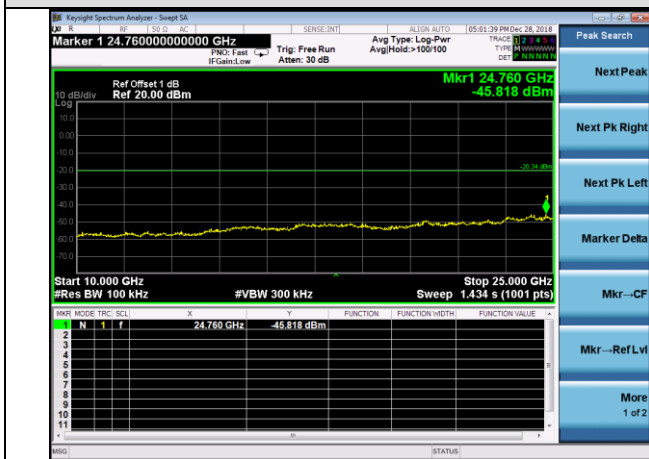
8DPSK-HCH



8DPSK-HCH



8DPSK-HCH





9. RADIATED EMISSION

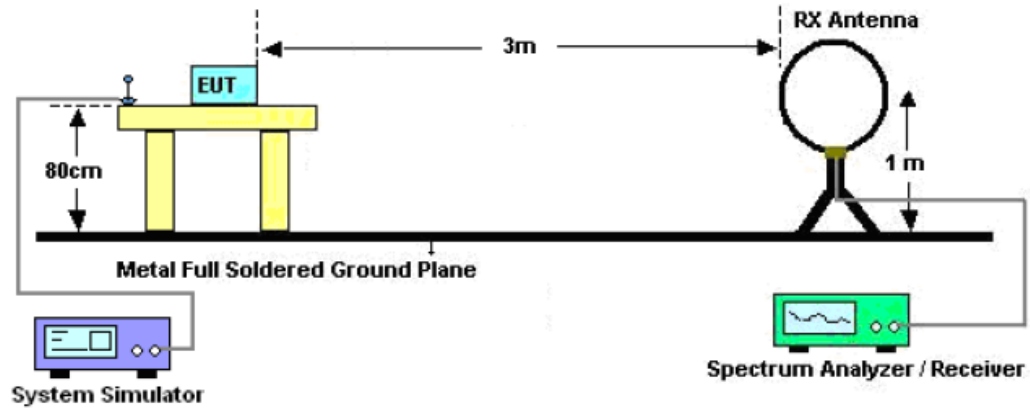
9.1. MEASUREMENT PROCEDURE

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.

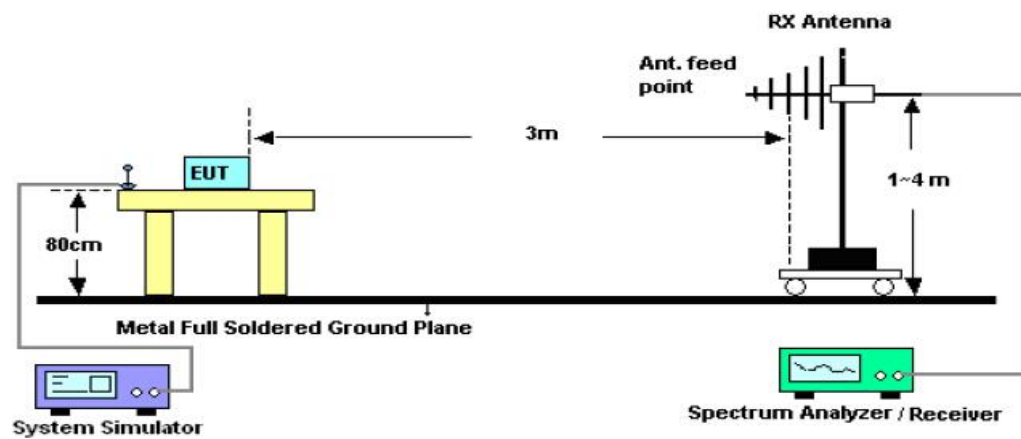


9.2. TEST SETUP

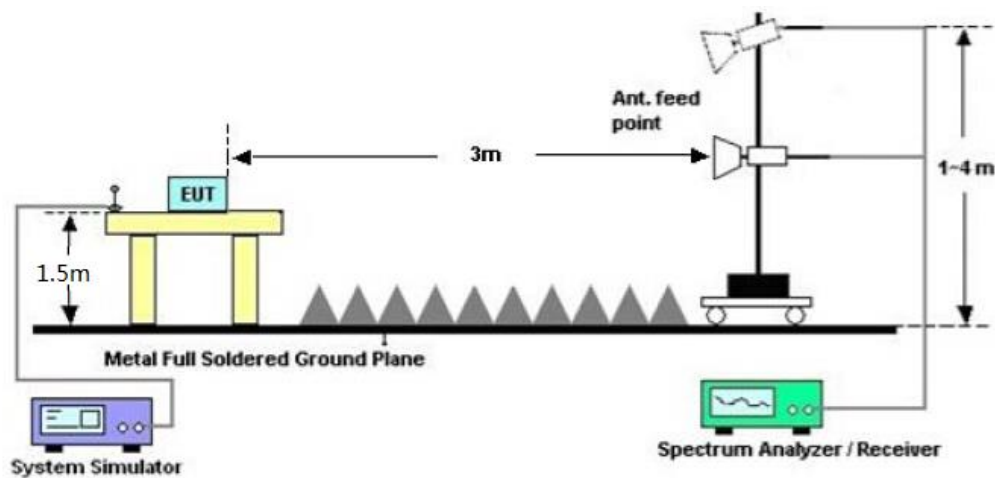
RADIATED EMISSION TEST-SETUP FREQUENCY BELOW 30MHZ



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

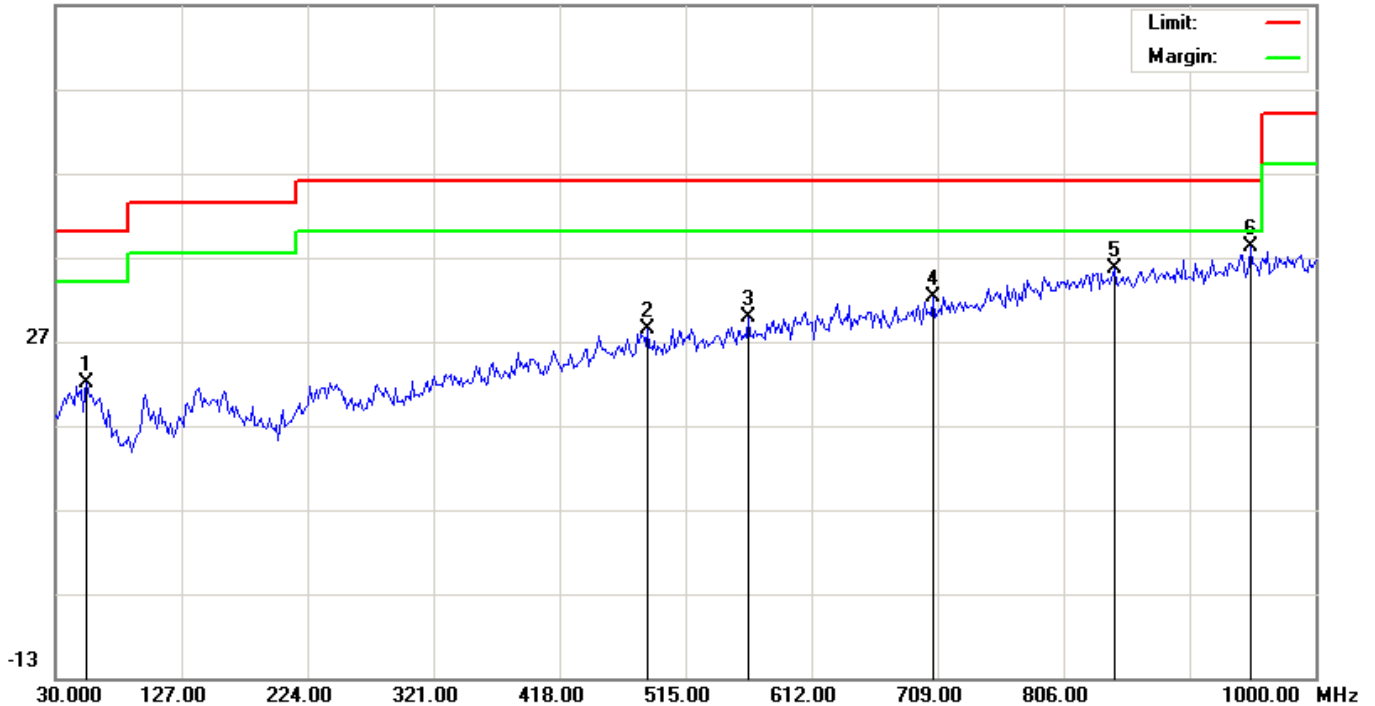
RADIATED EMISSION BELOW 30MHZ

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

RADIATED EMISSION BELOW 1GHZ

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

66.9 dBuV/m



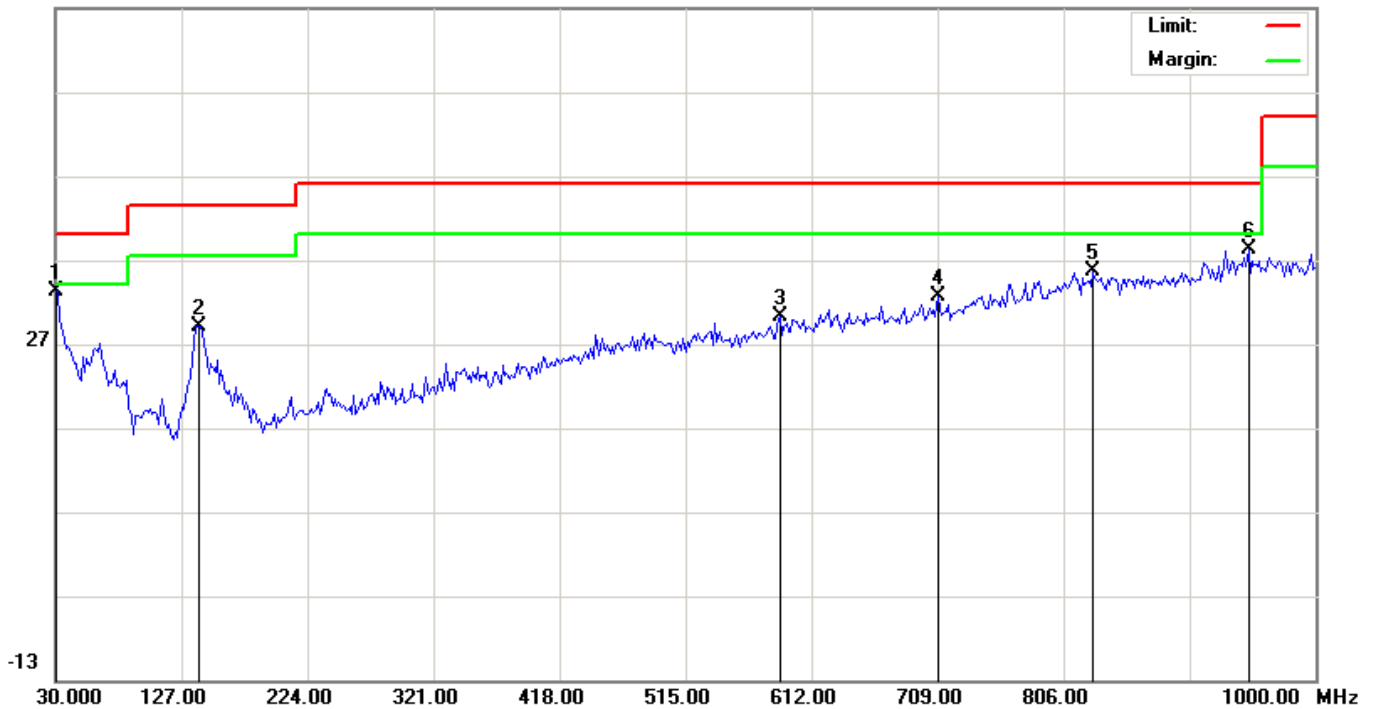
No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		54.2500	1.08	21.01	22.09	40.00	-17.91	peak			
2		485.9000	1.50	26.82	28.32	46.00	-17.68	peak			
3		563.5000	1.28	28.45	29.73	46.00	-16.27	peak			
4		705.7667	1.25	30.89	32.14	46.00	-13.86	peak			
5		844.8000	1.77	33.84	35.61	46.00	-10.39	peak			
6	*	949.8833	3.01	35.17	38.18	46.00	-7.82	peak			

RESULT: PASS



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

66.9 dBuV/m



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	*	30.0000	14.69	18.60	33.29	40.00	-6.71	peak			
2		139.9333	8.87	20.20	29.07	43.50	-14.43	peak			
3		587.7500	1.23	28.96	30.19	46.00	-15.81	peak			
4		709.0000	1.64	30.97	32.61	46.00	-13.39	peak			
5		828.6333	1.94	33.60	35.54	46.00	-10.46	peak			
6		948.2667	3.11	35.15	38.26	46.00	-7.74	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	Emission Level	Limits	Margin	Detector Type	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)		
Low Channel (2402 MHz)					
4804	51.59	74	-22.41	Pk	Vertical
4804	35.41	54	-18.59	AV	Vertical
4804	49.32	74	-24.68	Pk	Horizontal
4804	39.41	54	-14.59	AV	Horizontal
Mid Channel (2441 MHz)					
4882	53.00	74	-21.00	Pk	Vertical
4882	37.37	54	-16.63	AV	Vertical
4882	50.61	74	-23.39	Pk	Horizontal
4882	38.72	54	-15.28	AV	Horizontal
High Channel (2480 MHz)					
4960	50.78	74	-23.22	pk	Vertical
4960	34.19	54	-19.81	AV	Vertical
4960	51.05	74	-22.95	pk	Horizontal
4960	39.57	54	-14.43	AV	Horizontal

RESULT: PASS**Note:**

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