

FCC Test Report

Report No.: AGC00770180102FE03

FCC ID : 2AE7RSTKEVO
APPLICATION PURPOSE : Original Equipment
PRODUCT DESIGNATION : Mobile Phone
BRAND NAME : STK
MODEL NAME : EVO
CLIENT : Santok Limited
DATE OF ISSUE : Jan. 30, 2018
STANDARD(S) : FCC Part 15 Rules
TEST PROCEDURE(S) : ANSI C63.10 (2013)
REPORT VERSION : V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd



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REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Jan. 30, 2018	Valid	Original Report

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1. VERIFICATION OF CONFORMITY

Applicant	Santok Limited
Address	Santok House, Unit L, Braintree Industrial Estate, Braintree Road, South Ruislip, Middlesex, United Kingdom
Manufacturer	Kingcomm Technology Co., Ltd
Address	Room C205-208.BC Area.West Sillcon Valley, Bao an Avenue, Shenzhen
Product Designation	Mobile Phone
Brand Name	STK
Test Model	EVO
Date of test	Jan. 09, 2018~Jan. 30, 2018
Deviation	None
Condition of Test Sample	Normal
Report Template	AGCRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance(Shenzhen) Co.,Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

Tested By

Donjon Huang

Donjon Huang(Huang Dongyang)

Jan. 30, 2018

Reviewed By

Bart Xie

Bart Xie(Xie Xiaobin)

Jan. 30, 2018

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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is "Mobile Phone" designed as a "Communication Device". It is designed by way of utilizing the FHSS technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	2.402 GHz to 2.480GHz
Bluetooth Version	V 2.1+EDR
Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK
Number of channels	79(For BR/EDR)
Hardware Version	FS280-MB-V0.1
Software Version	STK_EVO_DS_819_V0.0.2_16012018
Antenna Designation	PIFA Antenna
Antenna Gain	1.02dBi
Power Supply	DC3.7V by Battery

2.2. 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

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

2.4. 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

2.5. 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 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 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 (312.5us). The hopping sequence will always differ from the first one.

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

This submittal(s) (test report) is intended for **FCC ID: 2AE7RSTKEVO** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. 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.

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

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3. MEASUREMENT UNCERTAINTY

Conducted measurement: +/- 2.75dB

Radiated measurement: +/- 3.2dB

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4. DESCRIPTION OF TEST MODES

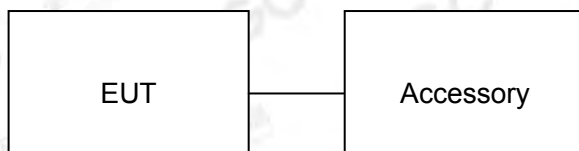
NO.	TEST MODE DESCRIPTION
1	Low channel GFSK
2	Middle channel GFSK
3	High channel GFSK
4	Low channel $\pi/4$ -DQPSK
5	Middle channel $\pi/4$ -DQPSK
6	High channel $\pi/4$ -DQPSK
7	Low channel 8DPSK
8	Middle channel 8DPSK
9	High channel 8DPSK
10	Normal Hopping
<p>Note:</p> <p>1. All the test modes can be supply by Built-in Li-ion battery, only the result of the worst case was recorded in the report, if no other cases.</p> <p>2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.</p>	

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5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Configuration:



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	Mobile Phone	EVO	FCC ID: 2AE7RSTKEVO	EUT
2	Adapter	HJ-0501000B3-US	DC 5.0V/1A 0.15A	Accessory
3	Battery	EVO	DC3.7V/ 1400mAh	Accessory
4	USB Cable	N/A	N/A	Accessory
5	Earphone	N/A	N/A	Accessory

5.3. 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	Conduction Emission	Compliant
§15.247	Number of Hopping Frequency	Compliant
§15.247	Time of Occupancy	Compliant
§15.247	Frequency Separation	Compliant

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6. TEST FACILITY

Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2F., Bldg.2, No.1-4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang, Bao'an District B112-B113, Bldg.12, Baoan Bldg Materials Center, No.1 of Xixiang Inner Ring Road, Baoan District, Shenzhen 518012
NVLAP LAB CODE	600153-0
Designation Number	CN5028
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by National Voluntary Laboratory Accreditation program, NVLAP Code 600153-0

ALL TEST EQUIPMENT LIST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	Jun.20, 2017	Jun.19, 2018
LISN	R&S	ESH2-Z5	100086	Aug.21, 2017	Aug.20, 2018
TEST RECEIVER	R&S	ESCI	10096	Jun.20, 2017	Jun.19, 2018
EXA Signal Analyzer	Aglient	N9010A	MY53470504	Dec.08, 2017	Dec.07, 2018
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Sep.20, 2017	Sep.19, 2018
preamplifier	ChengYi	EMC184045SE	980508	Sep.15, 2017	Sep.14, 2018
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May.18, 2017	May.17, 2019
Broadband Preamplifier	SCHWARZBECK	BBV 9718	9718-205	Jun.20, 2017	Jun.19, 2018
ANTENNA	SCHWARZBECK	VULB9168	D69250	Sep.28, 2017	Sep.27, 2018
SIGNAL ANALYZER	Agilent	N9020A	MY52090123	Sep. 21, 2017	Sep. 20, 2018
USB Wideband Power Sensor	Agilent	U2021XA	MY54110007	Sep. 21, 2017	Sep. 20, 2018

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7. PEAK OUTPUT POWER

7.1. 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. RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW.
4. Record the maximum power from the Spectrum Analyzer.

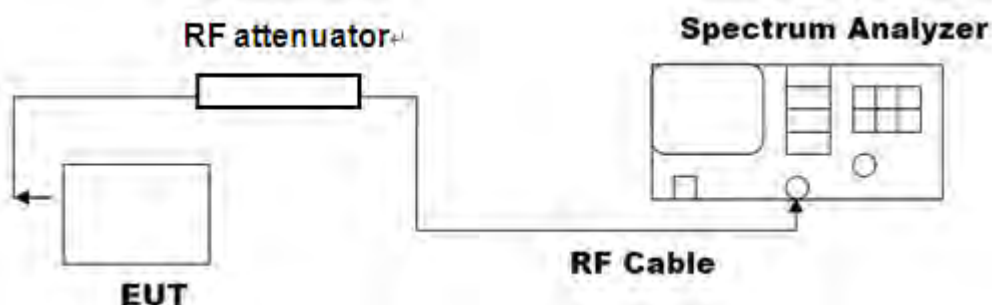
For average power test:

1. Connect EUT RF output port to power probe through an RF attenuator.
2. Connect the power probe to the PC.
3. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
4. Record the maximum power from the software.

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

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

PEAK POWER TEST SETUP



7.3. LIMITS AND MEASUREMENT RESULT

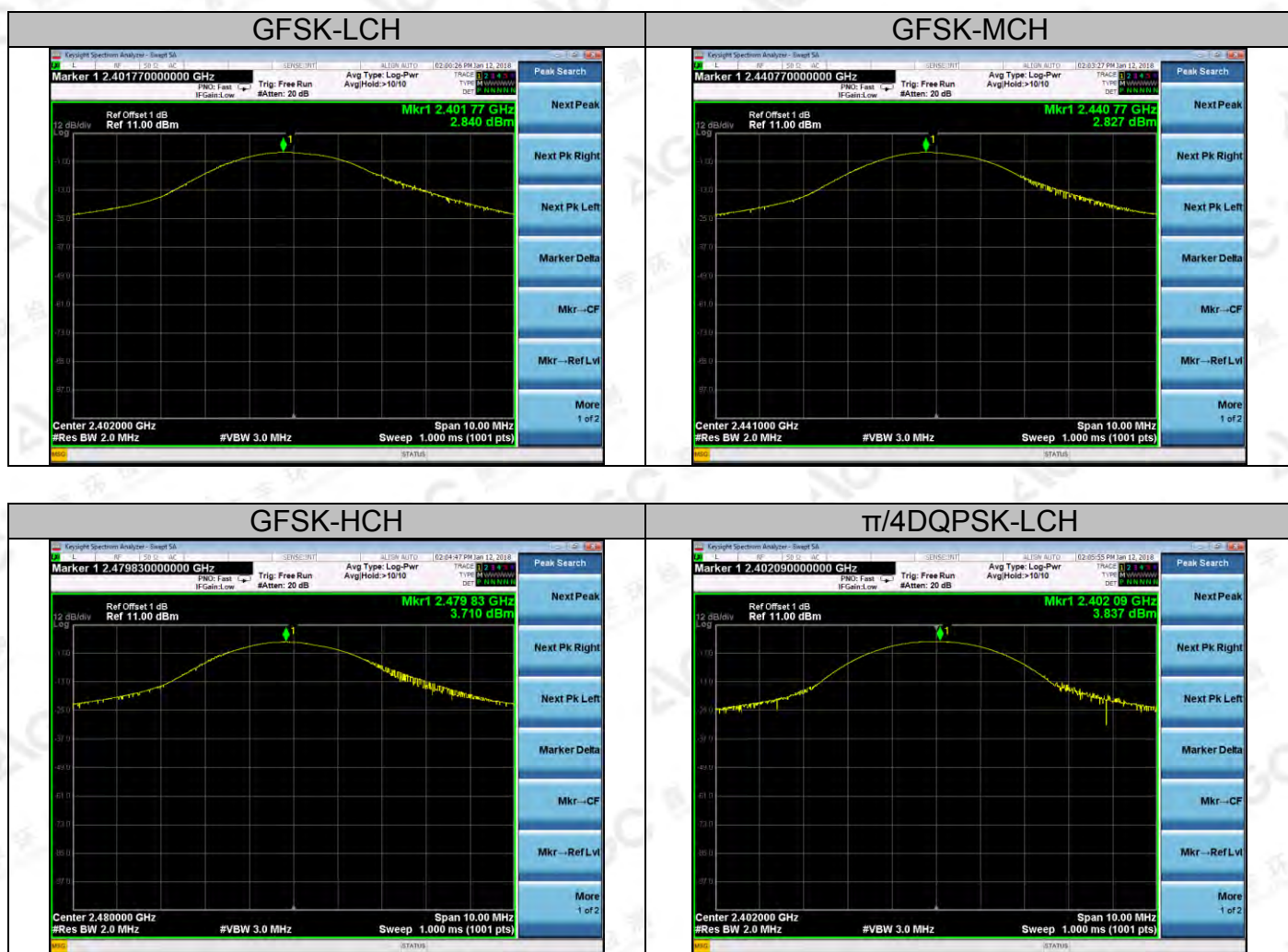
Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
GFSK	2.402	2.840	30	Pass
	2.441	2.827	30	Pass
	2.480	3.710	30	Pass

Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
π /4-DQPSK	2.402	3.837	30	Pass
	2.441	3.735	30	Pass
	2.480	4.060	30	Pass

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Mode	Frequency (GHz)	Peak Power (dBm)	Applicable Limits (dBm)	Pass or Fail
8DPSK	2.402	4.285	30	Pass
	2.441	4.040	30	Pass
	2.480	4.806	30	Pass

Test Graph



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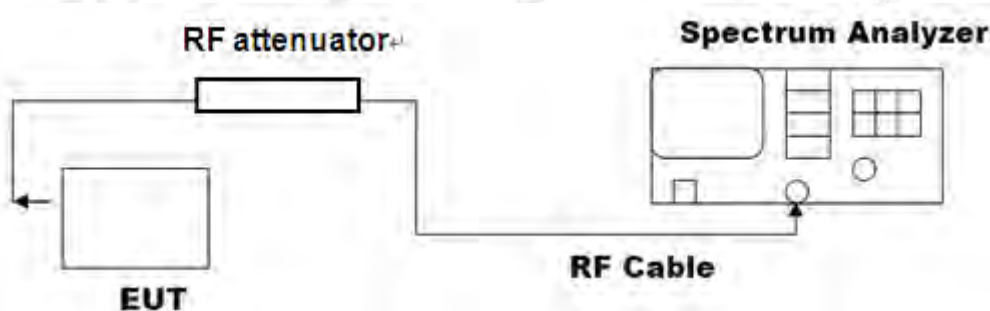
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8. 20DB BANDWIDTH

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

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

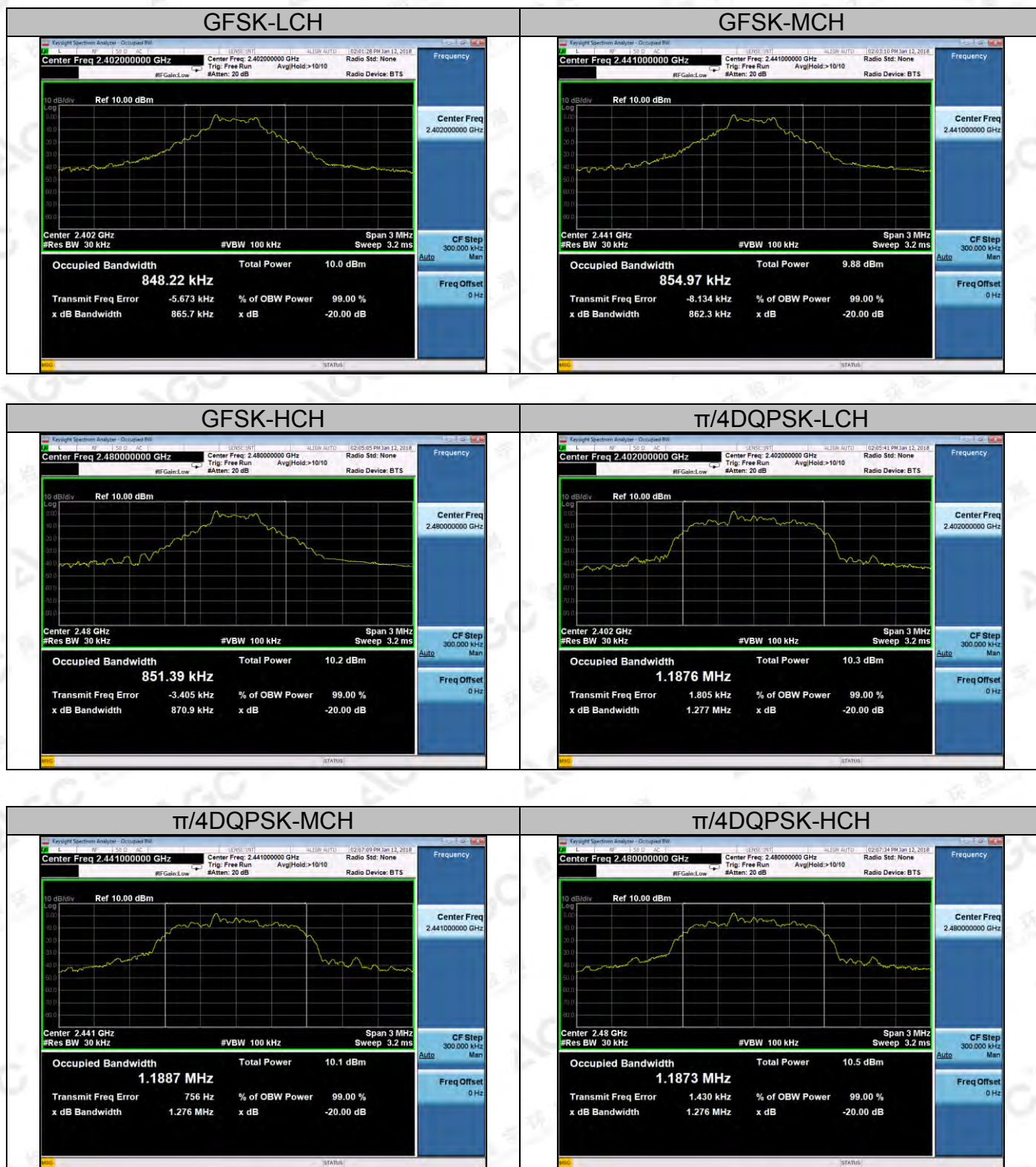


8.3. LIMITS AND MEASUREMENT RESULTS

Mode	Channel.	20dB Bandwidth [KHz]	Verdict
GFSK	LCH	865.7	PASS
GFSK	MCH	862.3	PASS
GFSK	HCH	870.9	PASS
$\pi/4$ DQPSK	LCH	1277	PASS
$\pi/4$ DQPSK	MCH	1276	PASS
$\pi/4$ DQPSK	HCH	1276	PASS
8DPSK	LCH	1291	PASS
8DPSK	MCH	1290	PASS
8DPSK	HCH	1290	PASS

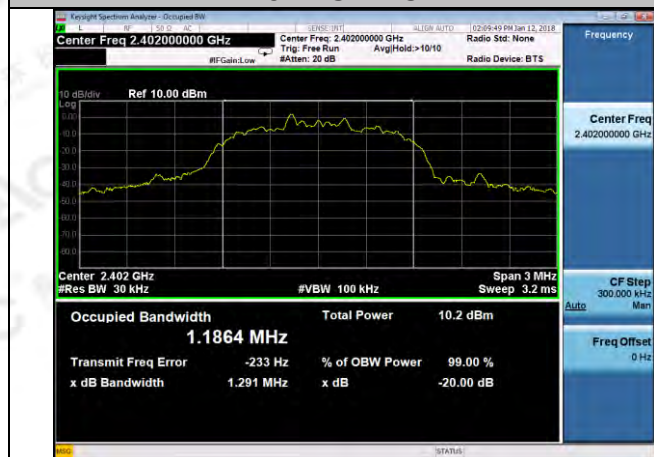
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Test Graph

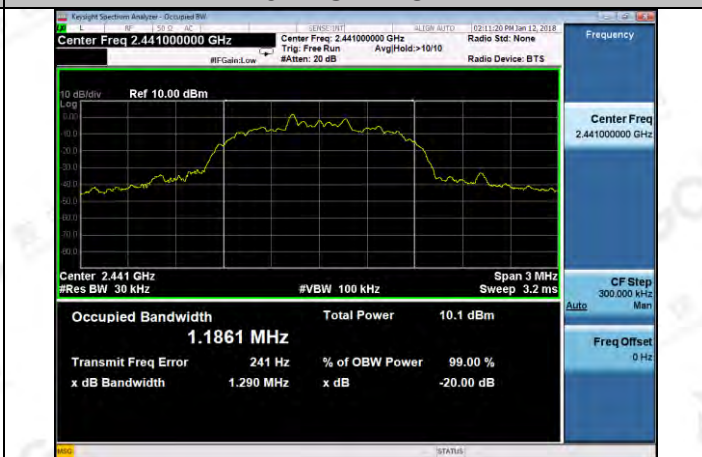


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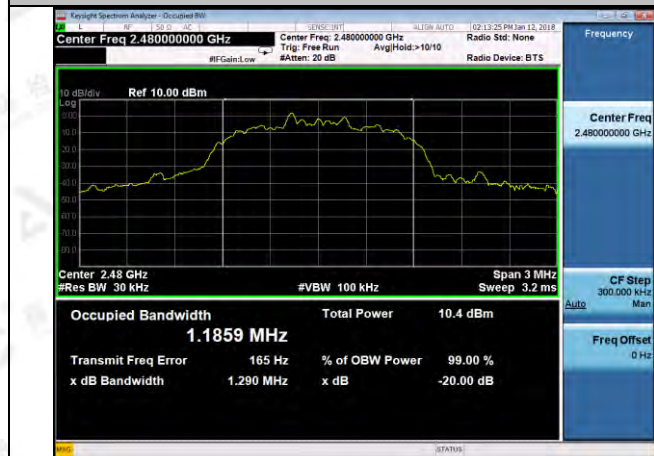
8DPSK-LCH



8DPSK-MCH



8DPSK-HCH



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9. CONDUCTED SPURIOUS EMISSION

9.1. 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.

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

The same as described in section 8.2

9.3. MEASUREMENT EQUIPMENT USED

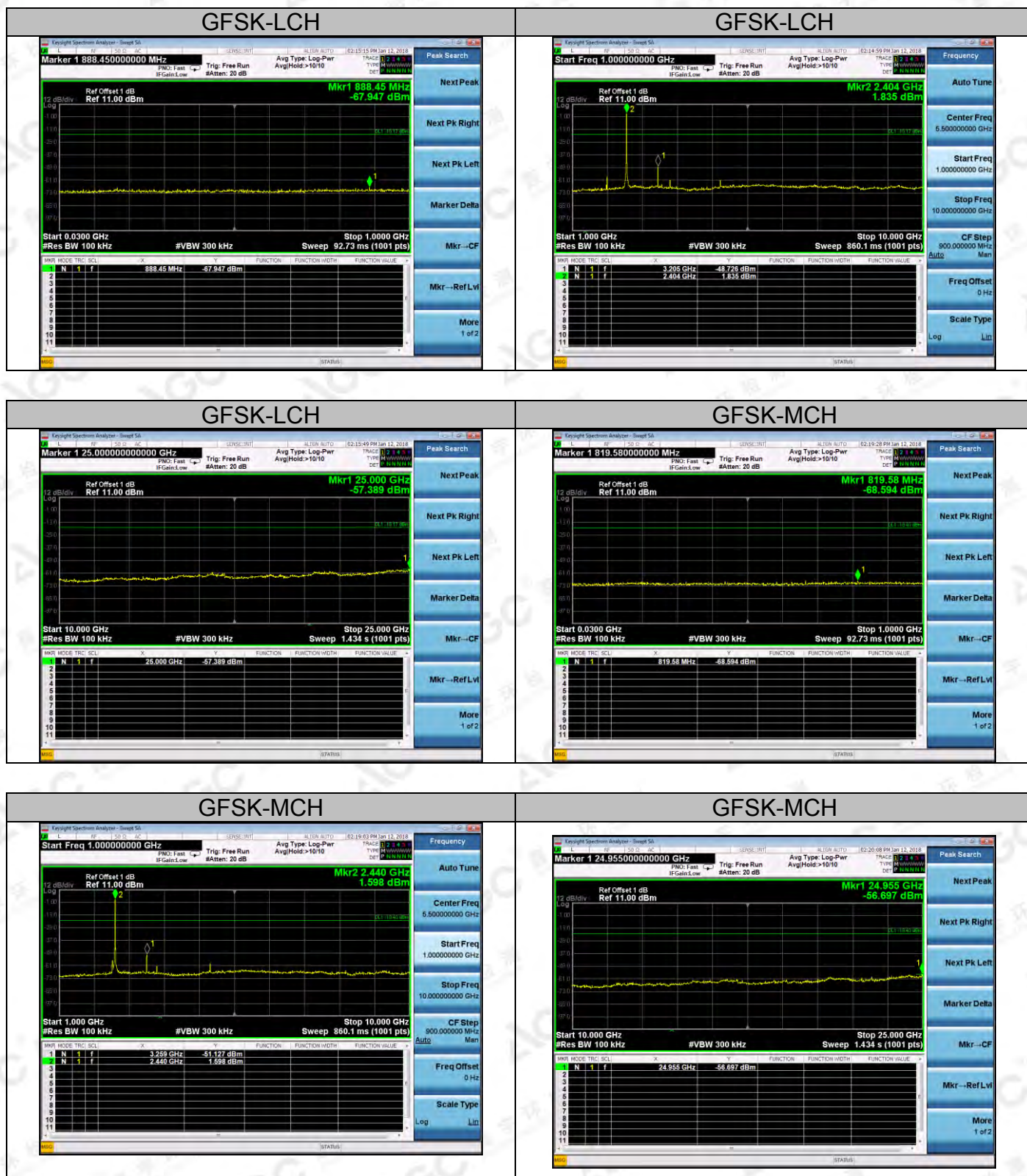
The same as described in section 6

9.4. LIMITS AND MEASUREMENT RESULT

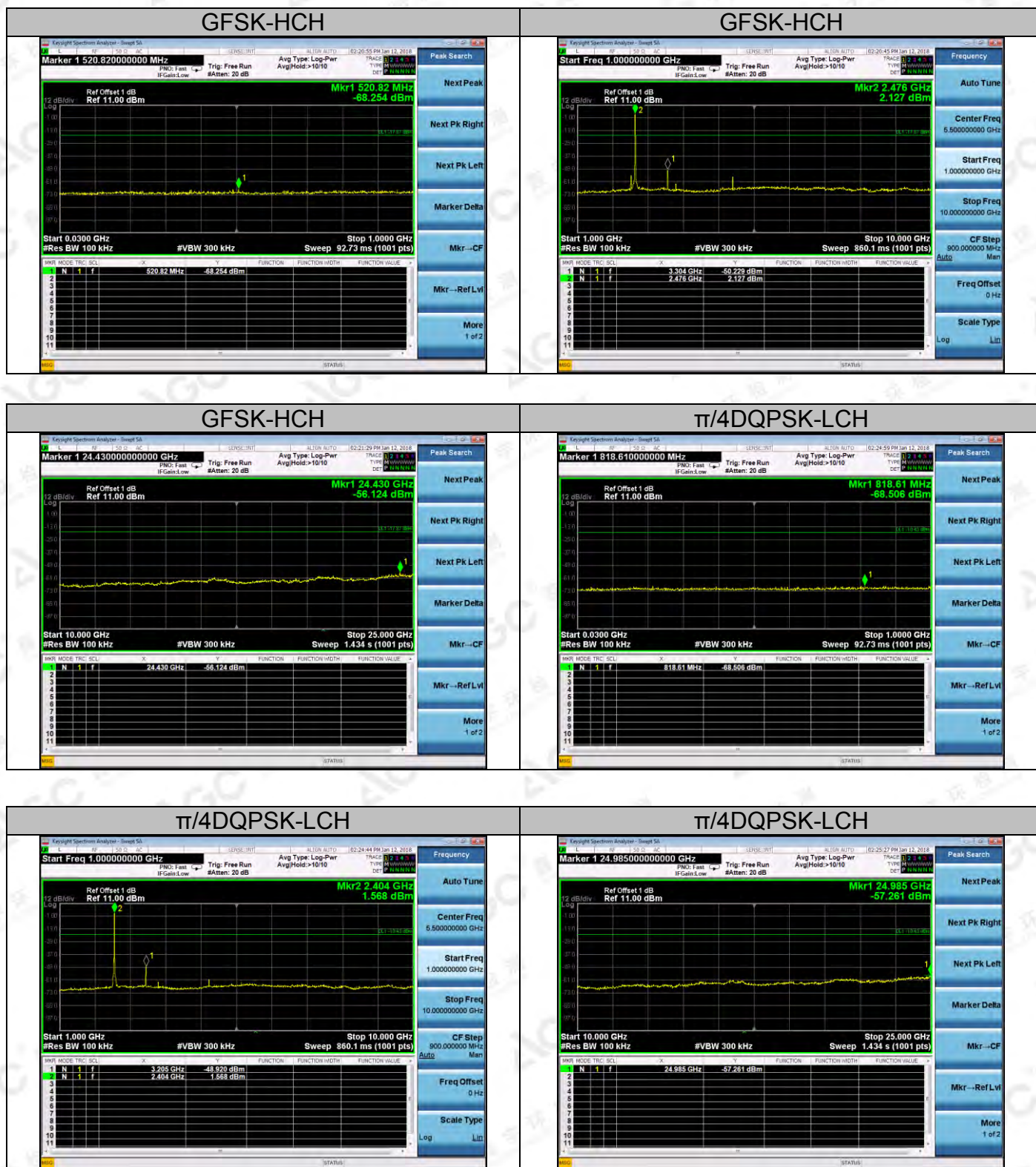
LIMITS AND MEASUREMENT RESULT		
Applicable Limits	Measurement Result	
	Test Data	Criteria
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below 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))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

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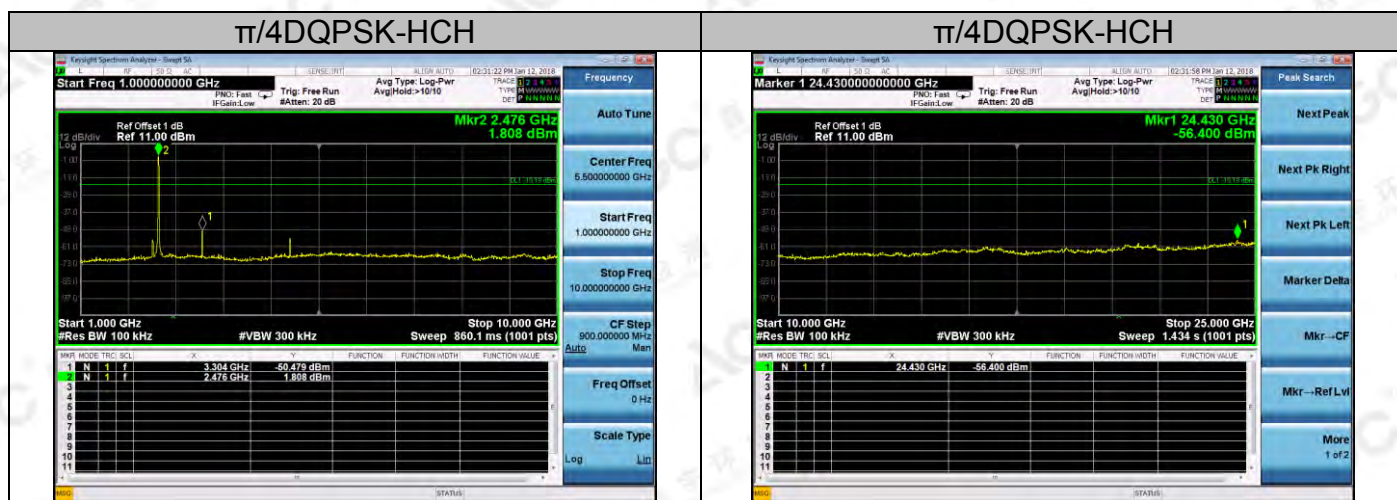
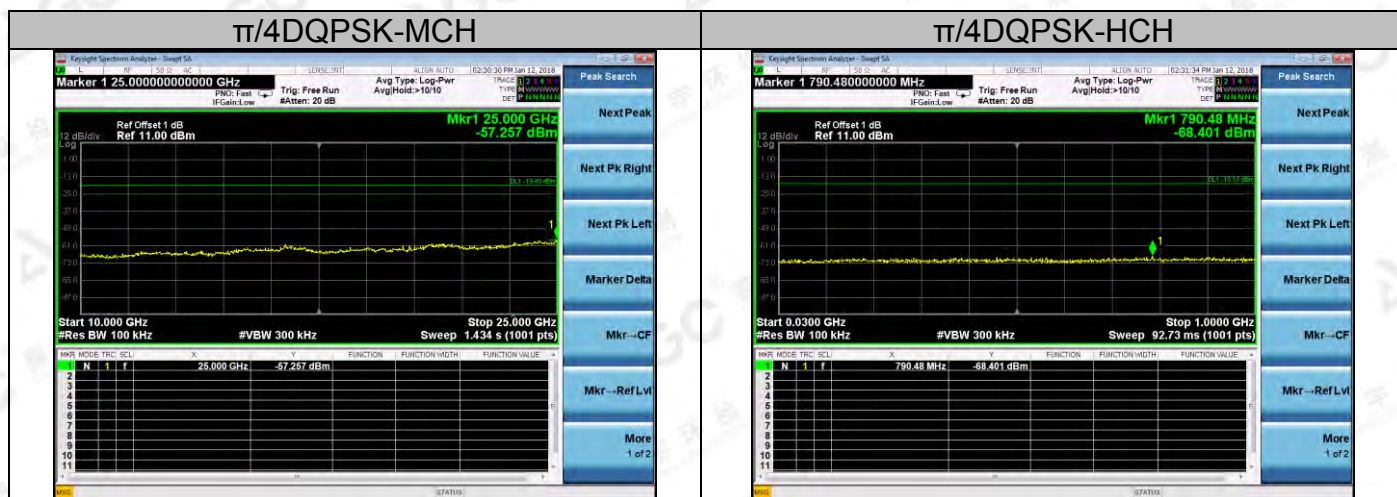
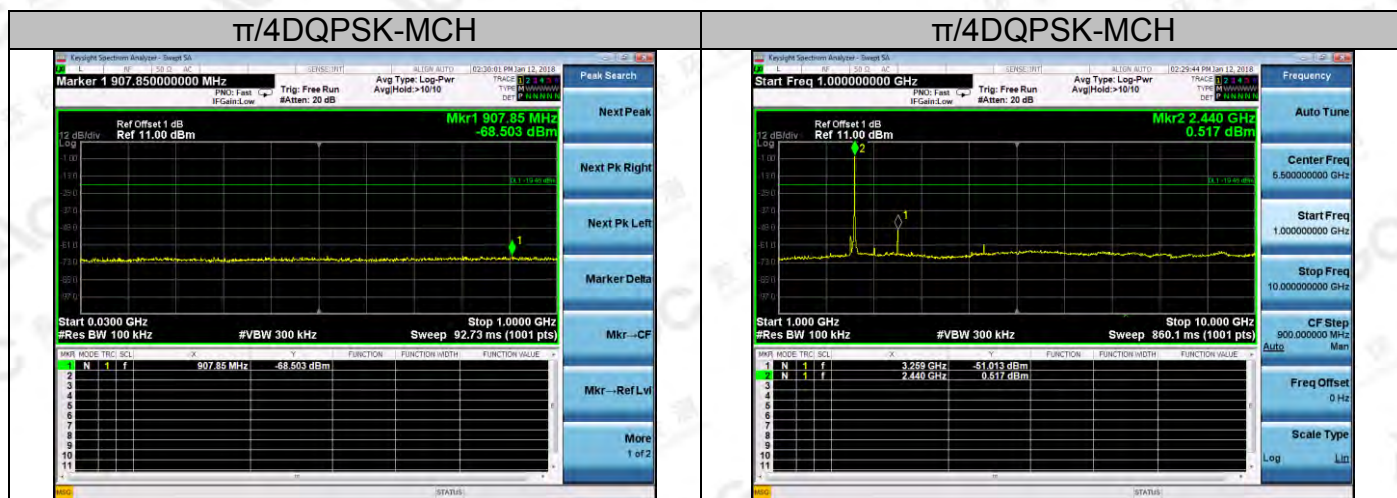
Test Graph



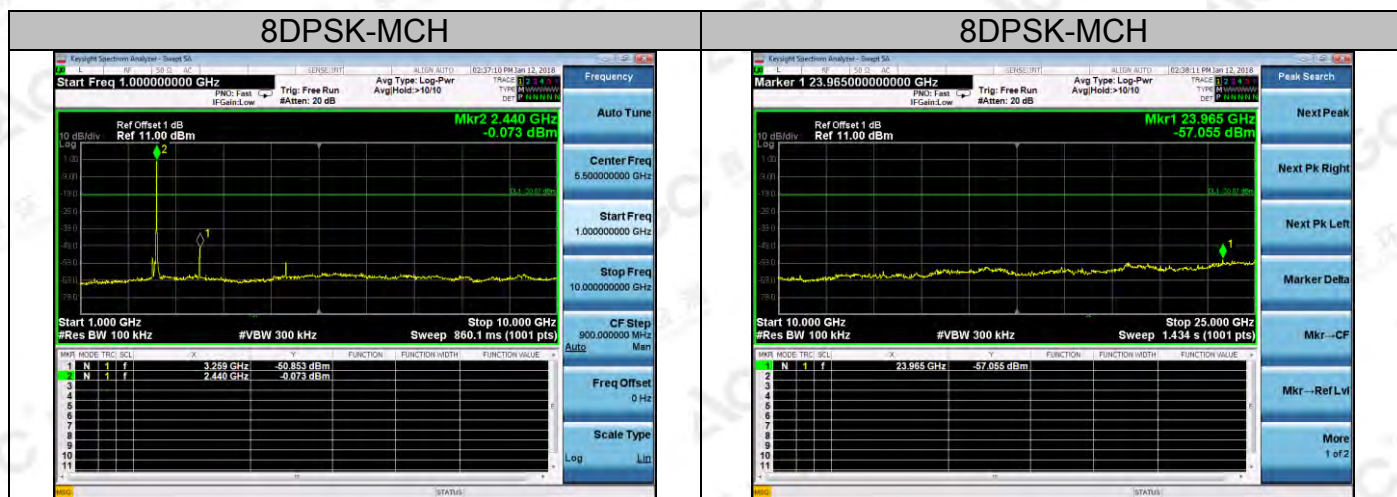
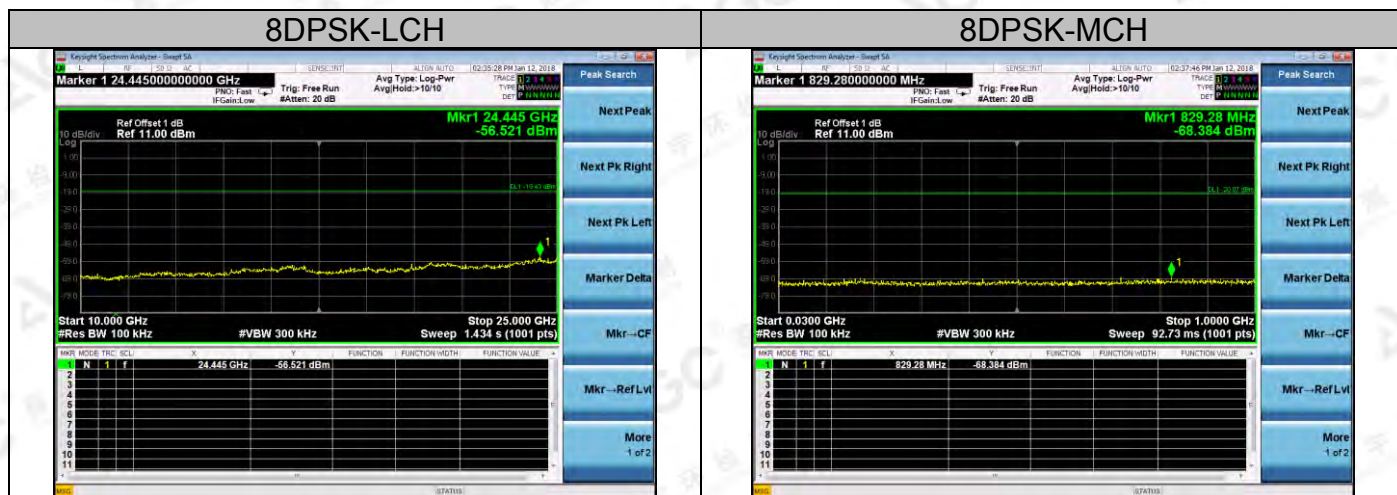
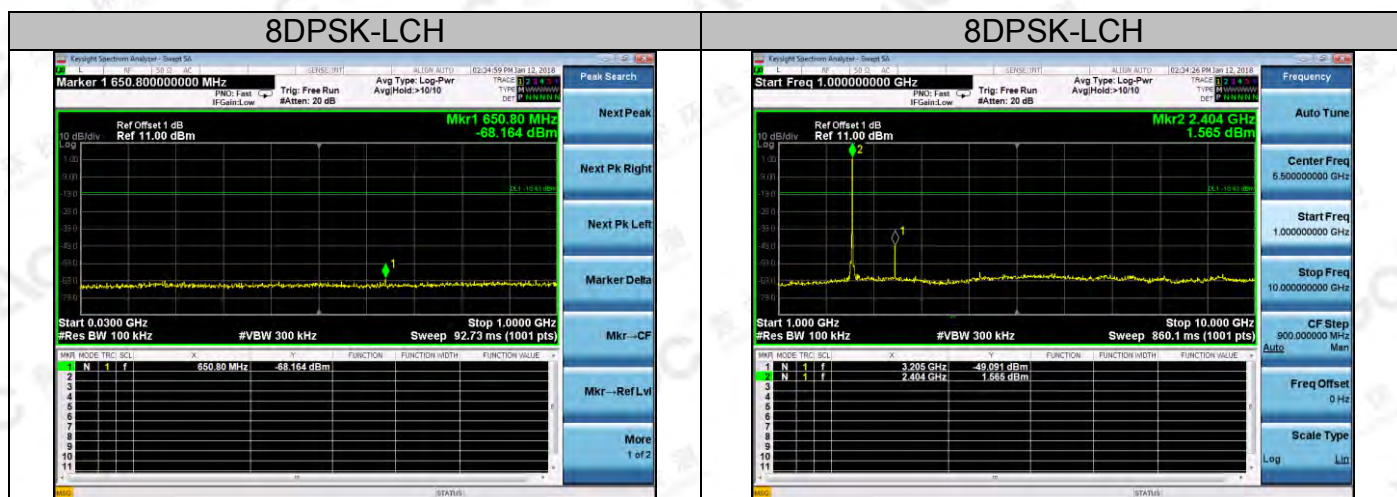
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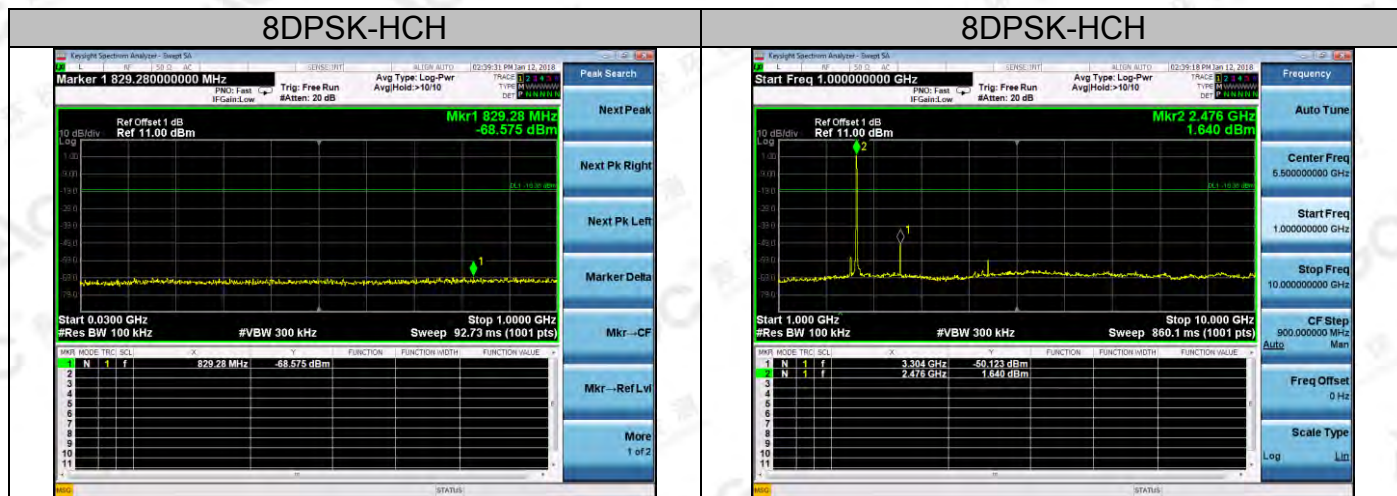
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10. RADIATED EMISSION

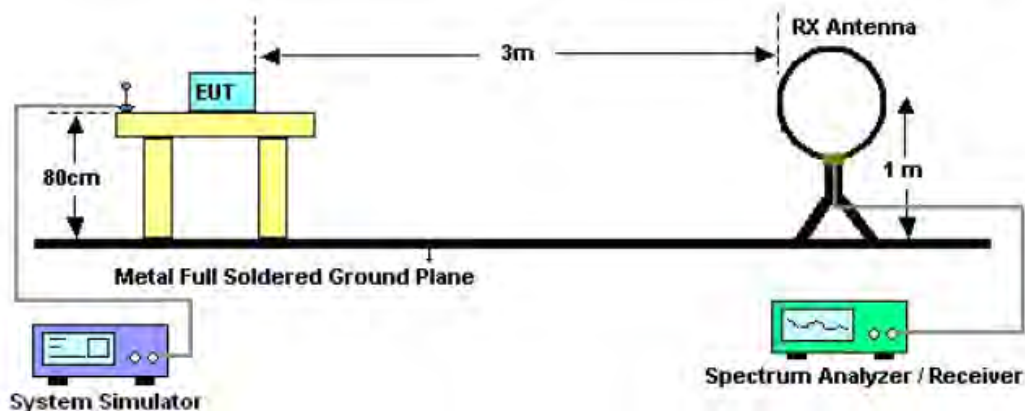
10.1. MEASUREMENT PROCEDURE

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.

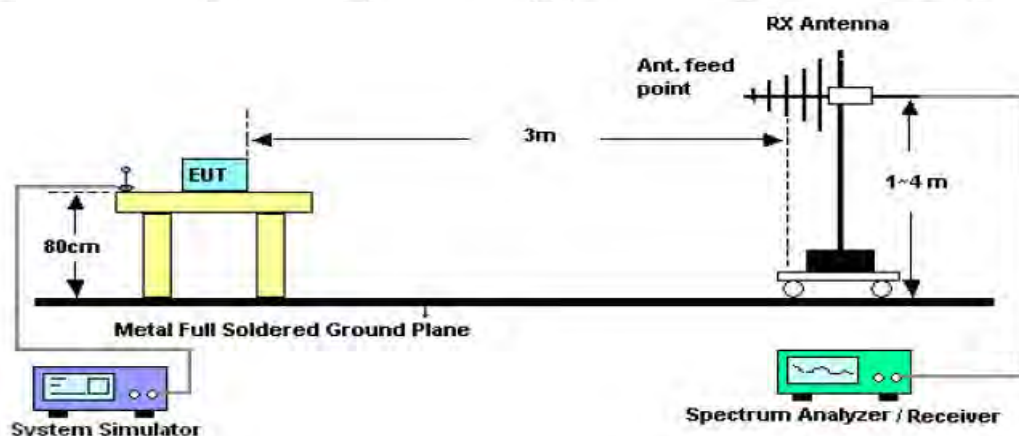
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10.2. TEST SETUP

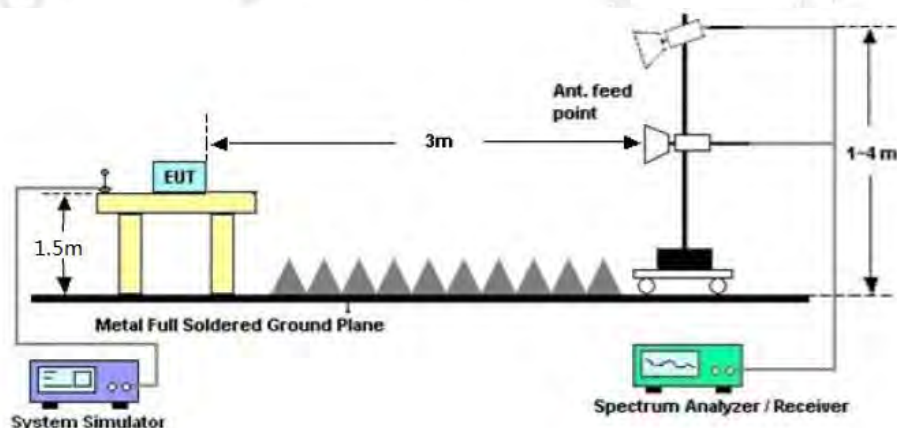
RADIATED EMISSION TEST-SETUP FREQUENCY BELOW 30MHZ



RADIATED EMISSION TEST SETUP 30MHZ-1000MHZ



RADIATED EMISSION TEST SETUP ABOVE 1000MHZ



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10.3. 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

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10.4. TEST RESULT

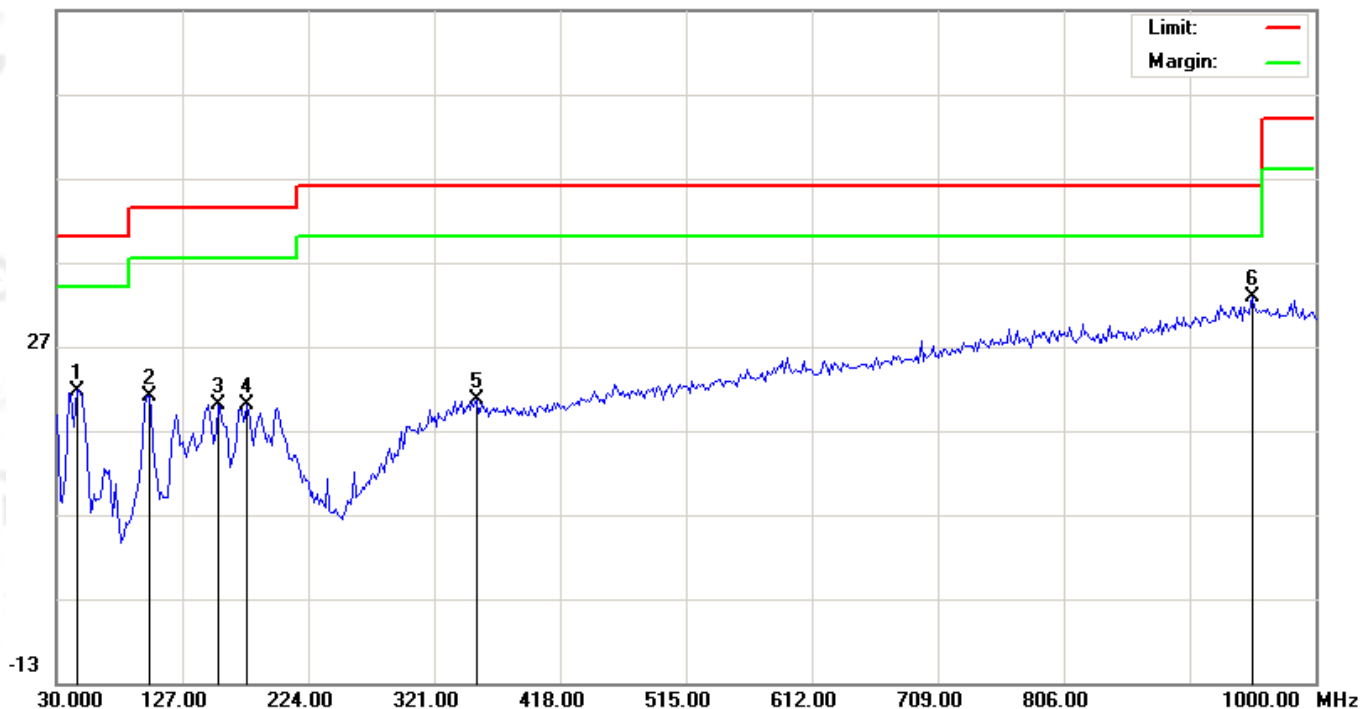
RADIATED EMISSION BELOW 30MHZ

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



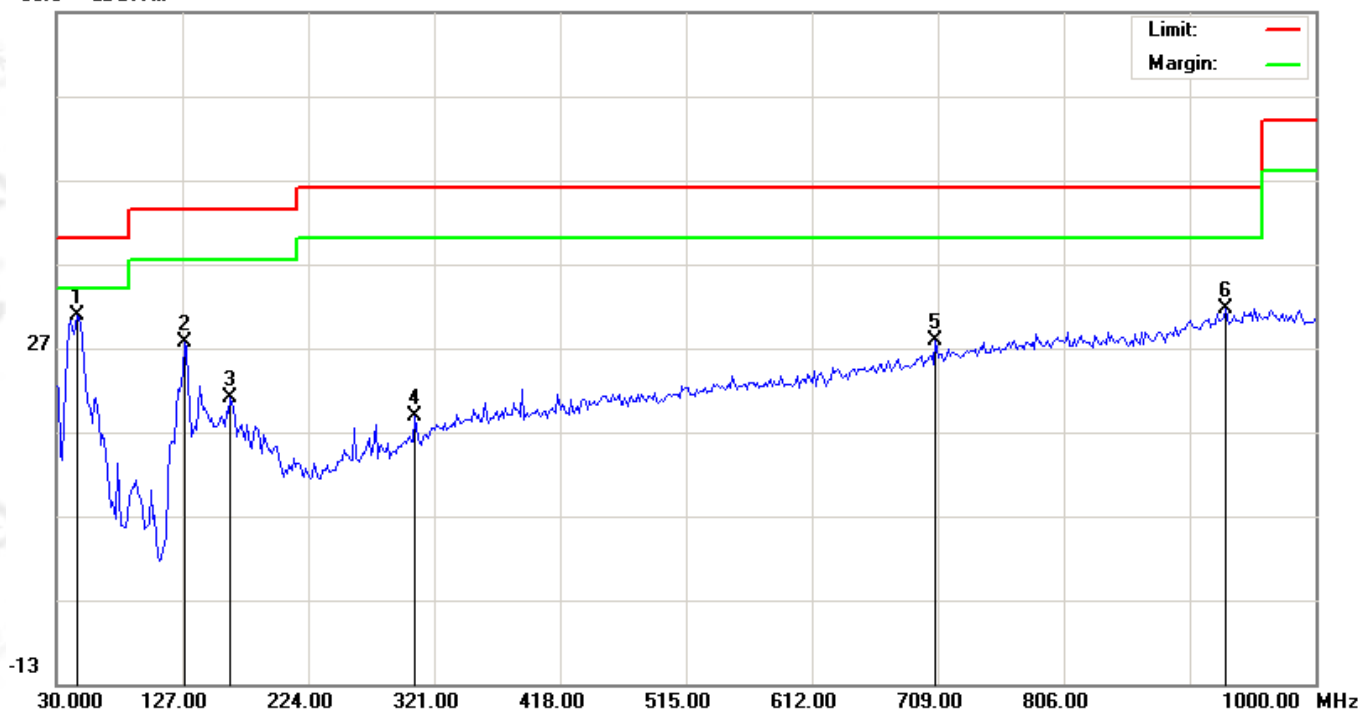
No.	Mk	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		cm	degree	
1		46.1667	10.20	11.49	21.69	40.00	-18.31	peak			
2		101.1333	10.86	10.22	21.08	43.50	-22.42	peak			
3		154.4832	8.40	11.67	20.07	43.50	-23.43	peak			
4		177.1167	8.96	10.96	19.92	43.50	-23.58	peak			
5		353.3333	1.91	18.76	20.67	46.00	-25.33	peak			
6	*	951.5000	2.82	29.99	32.81	46.00	-13.19	peak			

RESULT: PASS

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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	*	46.1667	22.31	8.49	30.80	40.00	-9.20	peak			
2		128.6167	17.25	10.45	27.70	43.50	-15.80	peak			
3		164.1833	5.88	15.07	20.95	43.50	-22.55	peak			
4		306.4500	2.98	15.84	18.82	46.00	-27.18	peak			
5		707.3832	2.34	25.40	27.74	46.00	-18.26	peak			
6		930.4833	2.18	29.46	31.64	46.00	-14.36	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.

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RADIATED EMISSION TEST- (ABOVE 1GHZ)

Frequency (MHz)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Low Channel (2402 MHz)					
4804	57.37	74	-16.63	Pk	Vertical
4804	41.07	54	-12.93	AV	Vertical
4804	58.22	74	-15.78	Pk	Horizontal
4804	40.92	54	-13.08	AV	Horizontal
Mid Channel (2441 MHz)					
4882	59.77	74	-14.23	Pk	Vertical
4882	40.65	54	-13.35	AV	Vertical
4882	59.45	74	-14.55	Pk	Horizontal
4882	38.01	54	-15.99	AV	Horizontal
High Channel (2480 MHz)					
4960	58.38	74	-15.62	pk	Vertical
4960	39.23	54	-14.77	AV	Vertical
4960	59.76	74	-14.24	pk	Horizontal
4960	38.65	54	-15.35	AV	Horizontal

RESULT: PASS
Note:

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

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11. BAND EDGE EMISSION

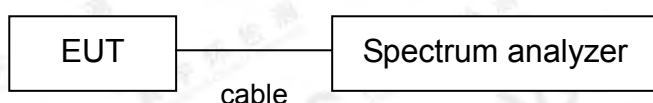
11.1. MEASUREMENT PROCEDURE

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.

11.2. TEST SET-UP

Radiated same as 10.2

Conducted set up



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11.3. Radiated TEST RESULT

Frequency	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	Type	
GFSK					
2399.9	49.72	74	-24.28	peak	Vertical
2399.9	41.06	54	-12.94	AVG	Vertical
2399.9	50.41	74	-23.59	peak	Horizontal
2399.9	33.50	54	-20.50	AVG	Horizontal
2483.6	49.30	74	-24.70	peak	Vertical
2483.6	39.11	54	-14.89	AVG	Vertical
2483.6	51.50	74	-22.50	peak	Horizontal
2483.6	40.32	54	-13.68	AVG	Horizontal
π/4-DQPSK					
2399.9	48.46	74	-25.54	peak	Vertical
2399.9	42.09	54	-11.91	AVG	Vertical
2399.9	50.26	74	-23.74	peak	Horizontal
2399.9	39.78	54	-14.22	AVG	Horizontal
2483.6	49.49	74	-24.51	peak	Vertical
2483.6	38.50	54	-15.50	AVG	Vertical
2483.6	50.14	74	-23.86	peak	Horizontal
2483.6	37.85	54	-16.15	AVG	Horizontal
8DPSK					
2399.9	48.81	74	-25.19	peak	Vertical
2399.9	43.30	54	-10.70	AVG	Vertical
2399.9	50.38	74	-23.62	peak	Horizontal
2399.9	36.52	54	-17.48	AVG	Horizontal
2483.6	49.45	74	-24.55	peak	Vertical
2483.6	40.06	54	-13.94	AVG	Vertical
2483.6	50.39	74	-23.61	peak	Horizontal
2483.6	42.65	54	-11.35	AVG	Horizontal

RESULT: PASS

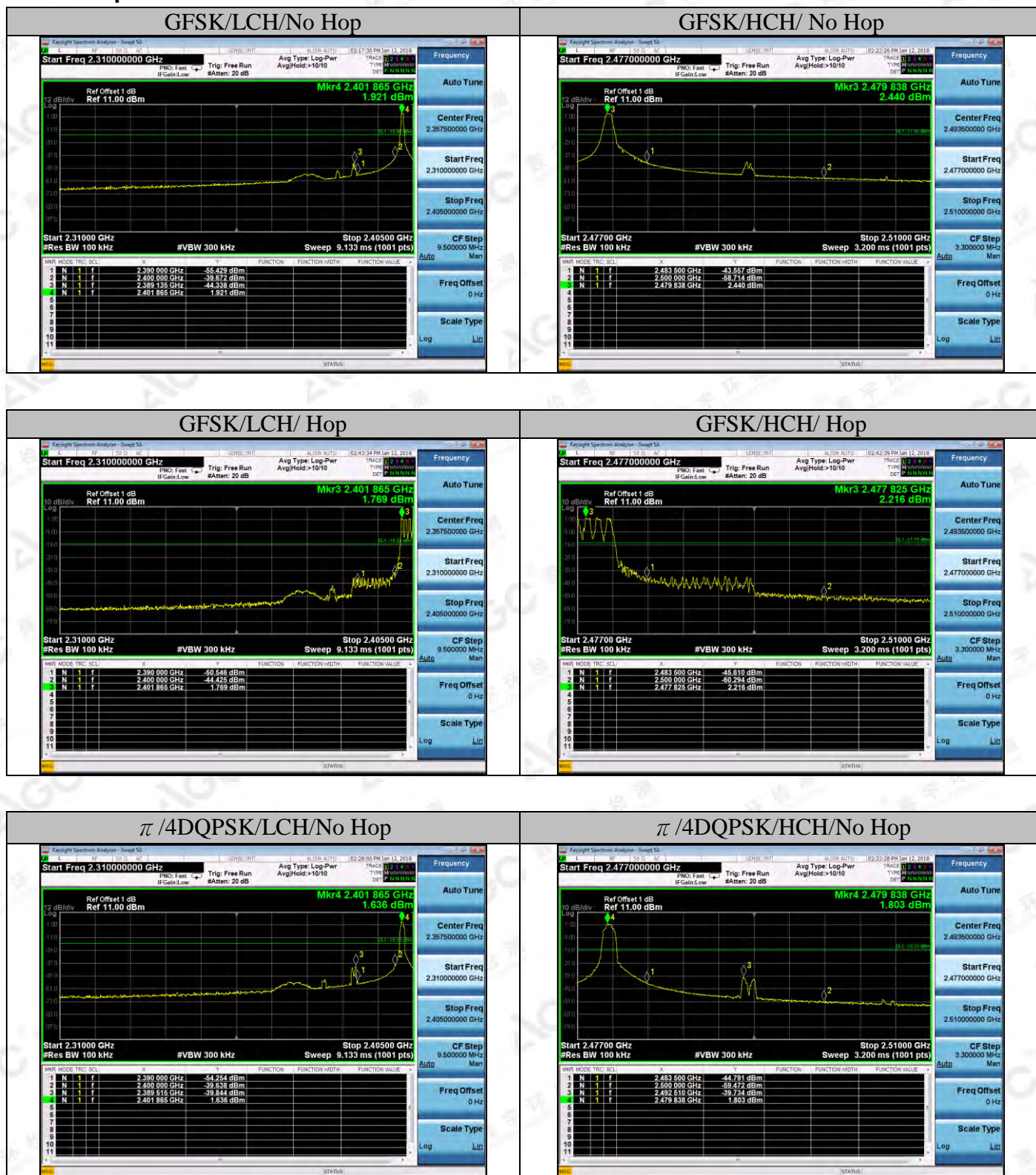
Note: The other modes radiation emission have enough 20dB margin.

Margin = Emission Level – Limit

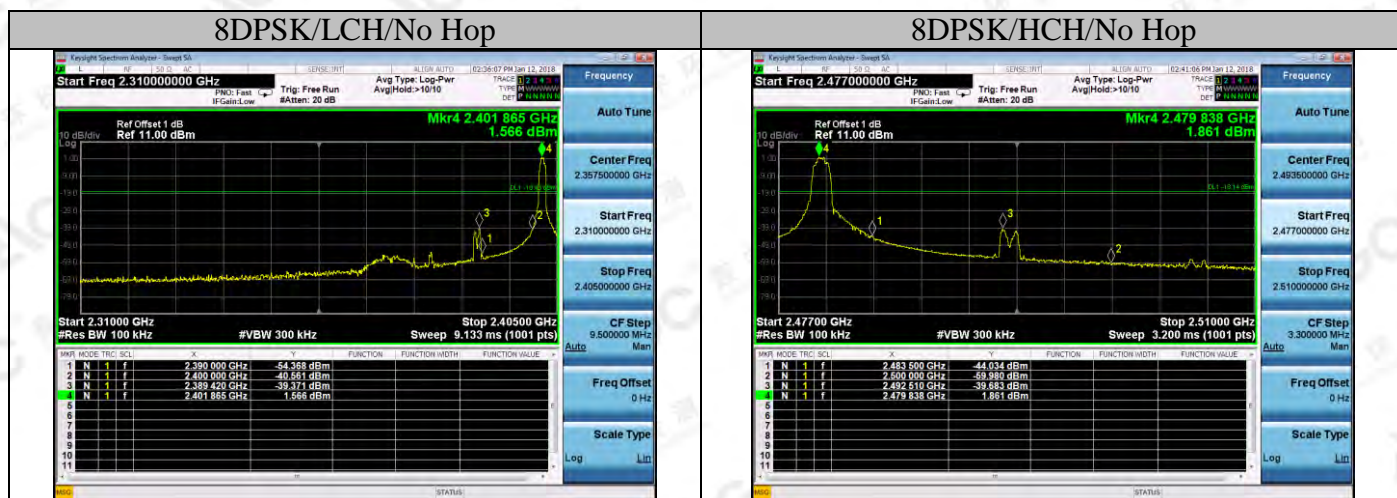
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11.4 Conducted TEST RESULT

Test Graph



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

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12. NUMBER OF HOPPING FREQUENCY

12.1. 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.

12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

12.3. MEASUREMENT EQUIPMENT USED

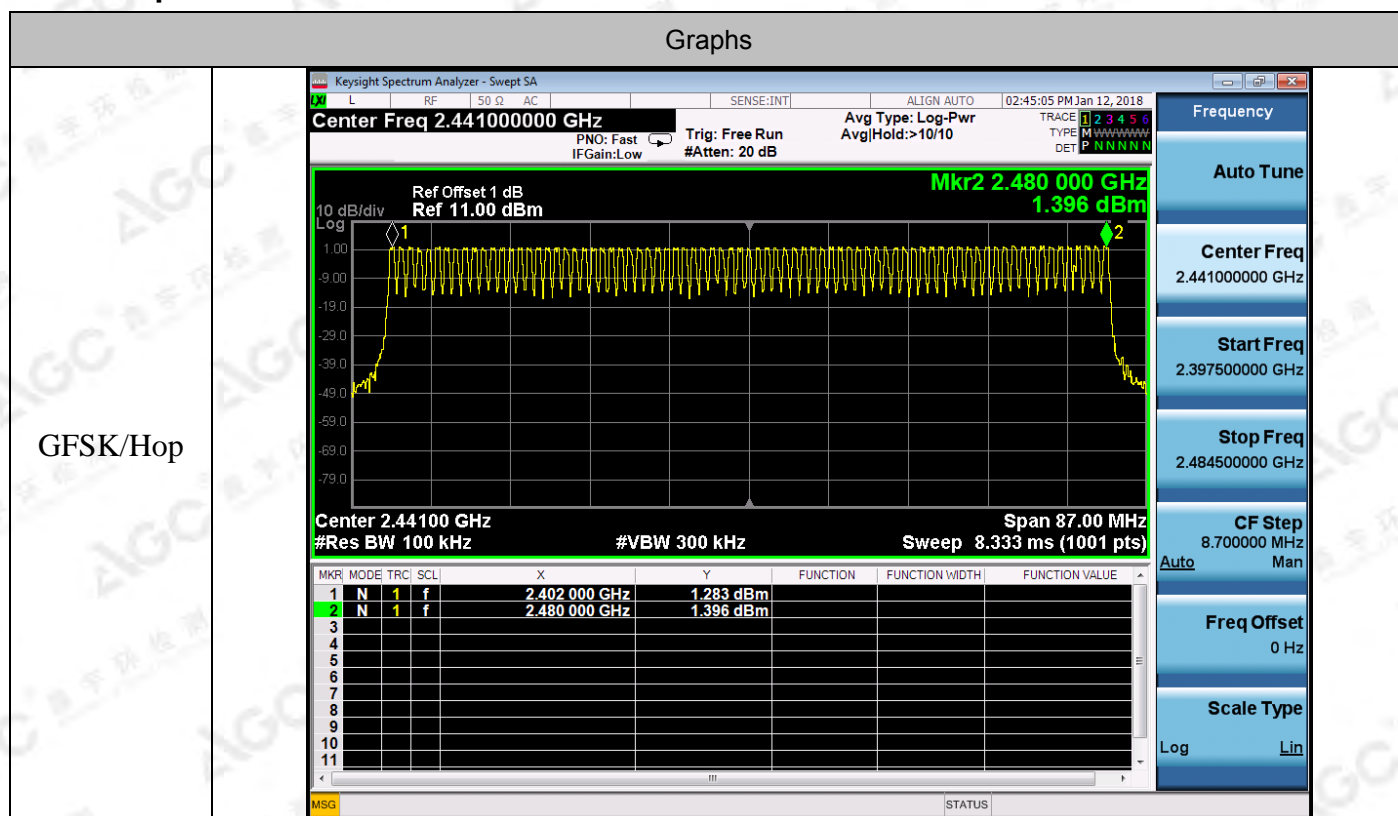
The same as described in section 6

12.4. LIMITS AND MEASUREMENT RESULT

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



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13. TIME OF OCCUPANCY (DWELL TIME)

13.1. 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 \leq channel spacing and where possible RBW should be set $\gg 1/T$, 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; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4. Detector function: Peak. Trace: Max hold.
5. Use the marker-delta function to determine the transmit time per hop.
6. Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) \times (period specified in the requirements / analyzer sweep time)

7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

13.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

13.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

13.4. LIMITS AND MEASUREMENT RESULT

Channel.	Burst Width [ms/hop/ch]	Dwell Time[ms]	Verdict	Limit (ms)
LCH	2.960	315.733728	PASS	400
MCH	2.960	315.733728	PASS	400
HCH	2.960	315.733728	PASS	400

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

The dwell time is calculated with the following formula:

$$\text{Dwell time} = t_{\text{pulse}} \times n_{\text{hops}} / \text{number of channels} \times 31.6 \text{ s}$$

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 ($n_{\text{hops}} = 266.667$ 1/s)

Test Graph



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14. FREQUENCY SEPARATION

14.1. 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) \geq 1% of the span Video (or Average) Bandwidth (VBW) \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold

14.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 6.2

14.3. MEASUREMENT EQUIPMENT USED

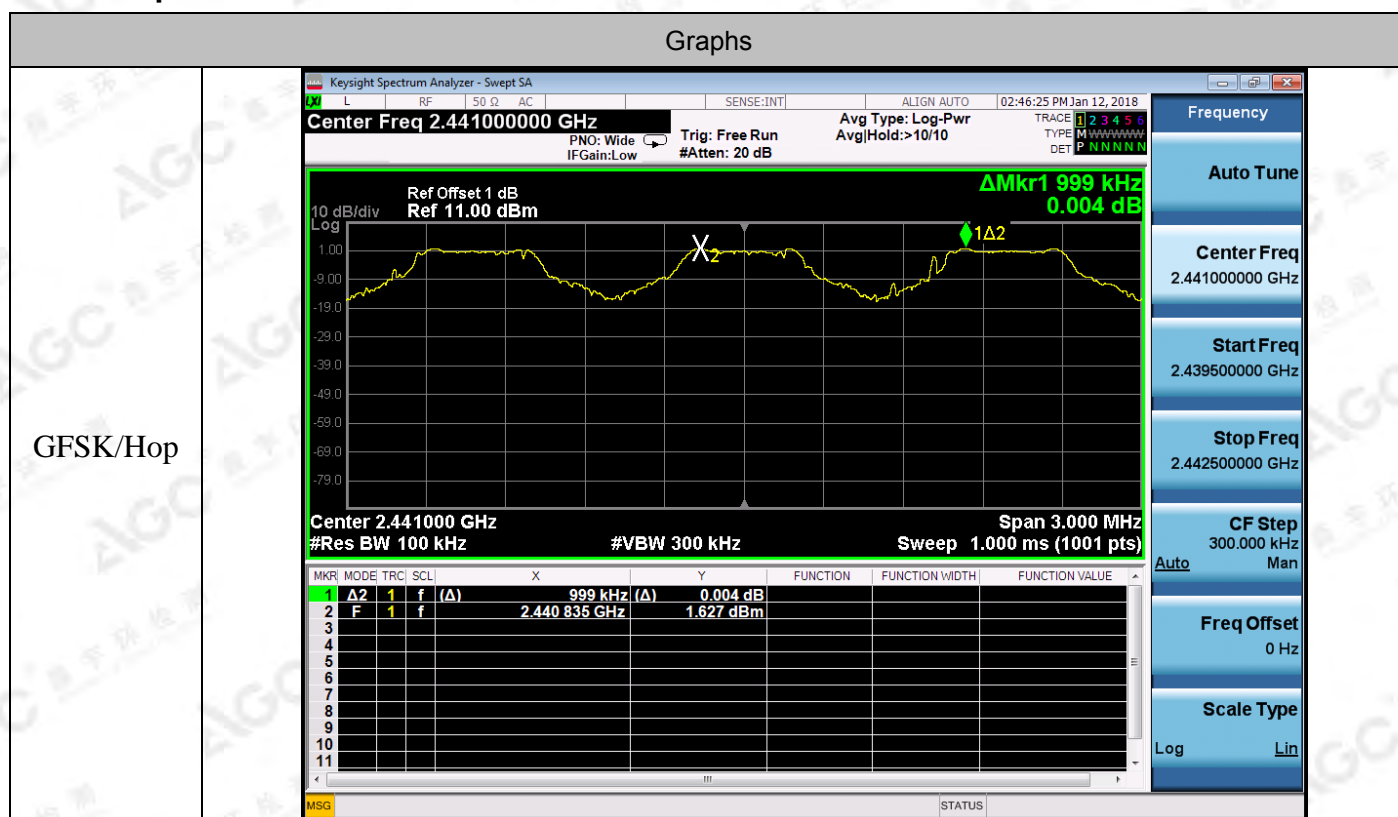
The same as described in section 6.3

14.4. LIMITS AND MEASUREMENT RESULT

Mode	Channel.	Carrier Frequency Separation [MHz]	Verdict
GFSK	Hop	0.999	PASS

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

Test Graph



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15. FCC LINE CONDUCTED EMISSION TEST

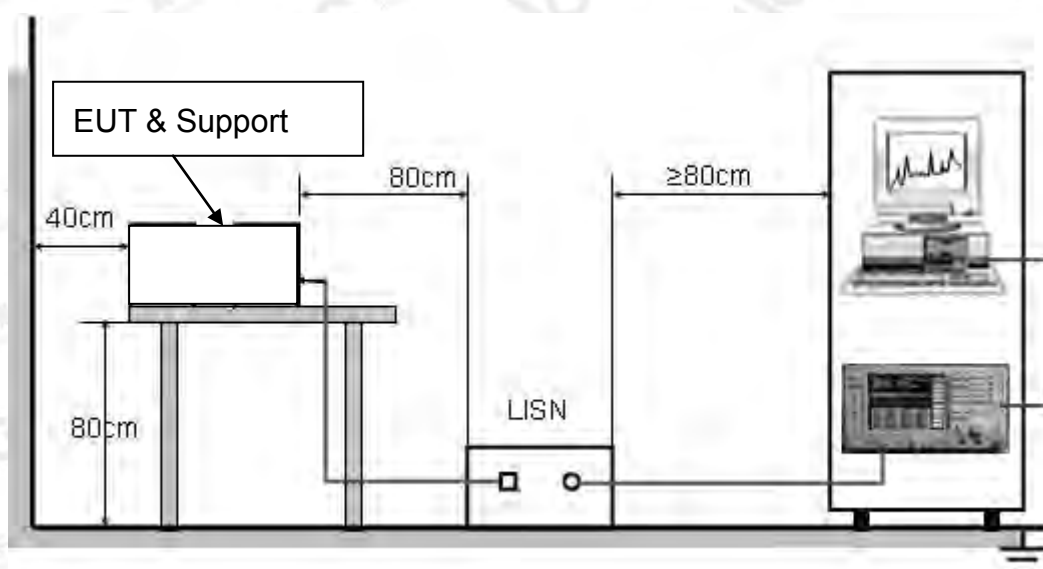
15.1. LIMITS OF LINE CONDUCTED EMISSION TEST

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.

15.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST



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15.3. 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/60Hz power 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.

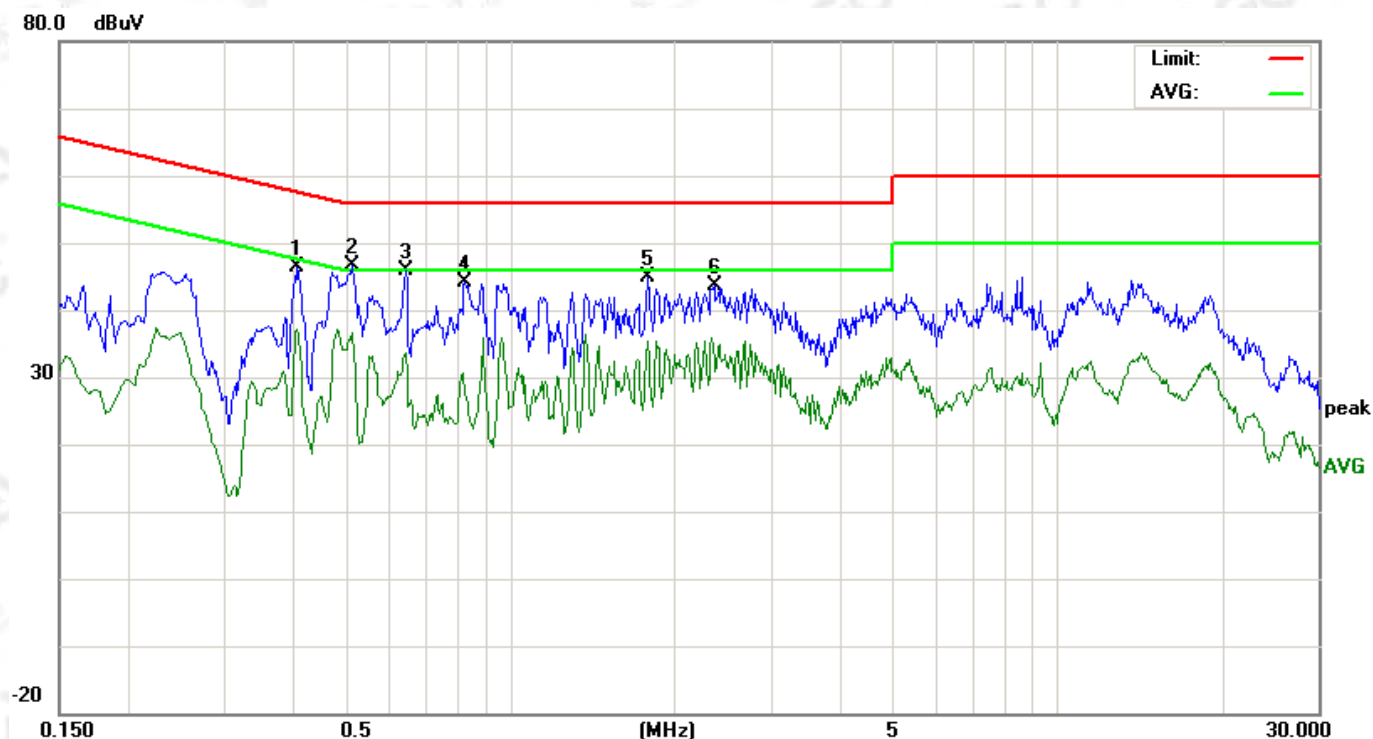
15.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

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.

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15.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST

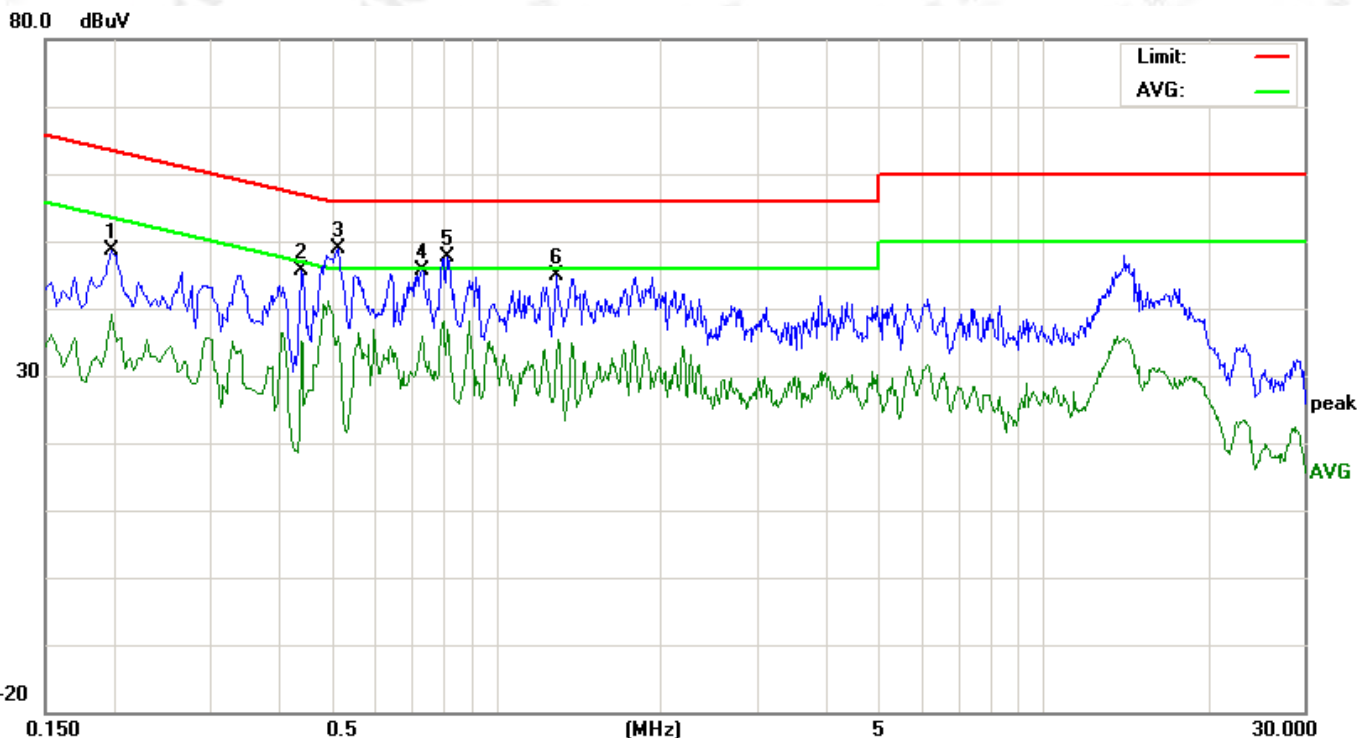
LINE CONDUCTED EMISSION TEST LINE 1-L



No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor (dB)	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG		Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.4100	35.97		26.81	10.34	46.31		37.15	57.65	47.65	-11.34	-10.50	P	
2	0.5140	36.23		26.32	10.39	46.62		36.71	56.00	46.00	-9.38	-9.29	P	
3	0.6460	35.60		23.33	10.33	45.93		33.66	56.00	46.00	-10.07	-12.34	P	
4	0.8300	33.77		17.24	10.32	44.09		27.56	56.00	46.00	-11.91	-18.44	P	
5	1.7900	34.62		24.96	10.29	44.91		35.25	56.00	46.00	-11.09	-10.75	P	
6	2.3660	33.28		21.83	10.37	43.65		32.20	56.00	46.00	-12.35	-13.80	P	

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LINE CONDUCTED EMISSION TEST LINE 2-N



No.	Freq. (MHz)	Reading_Level (dBuV)			Correct Factor (dB)	Measurement (dBuV)			Limit (dBuV)		Margin (dB)		P/F	Comment
		Peak	QP	AVG		Peak	QP	AVG	QP	AVG	QP	AVG		
1	0.1980	38.42		28.93	10.21	48.63		39.14	63.69	53.69	-15.06	-14.55	P	
2	0.4420	35.21		24.79	10.36	45.57		35.15	57.02	47.02	-11.45	-11.87	P	
3	0.5140	38.42		25.51	10.39	48.81		35.90	56.00	46.00	-7.19	-10.10	P	
4	0.7340	35.18		25.52	10.33	45.51		35.85	56.00	46.00	-10.49	-10.15	P	
5	0.8139	37.30		26.50	10.30	47.60		36.80	56.00	46.00	-8.40	-9.20	P	
6	1.2940	34.42		21.97	10.38	44.80		32.35	56.00	46.00	-11.20	-13.65	P	

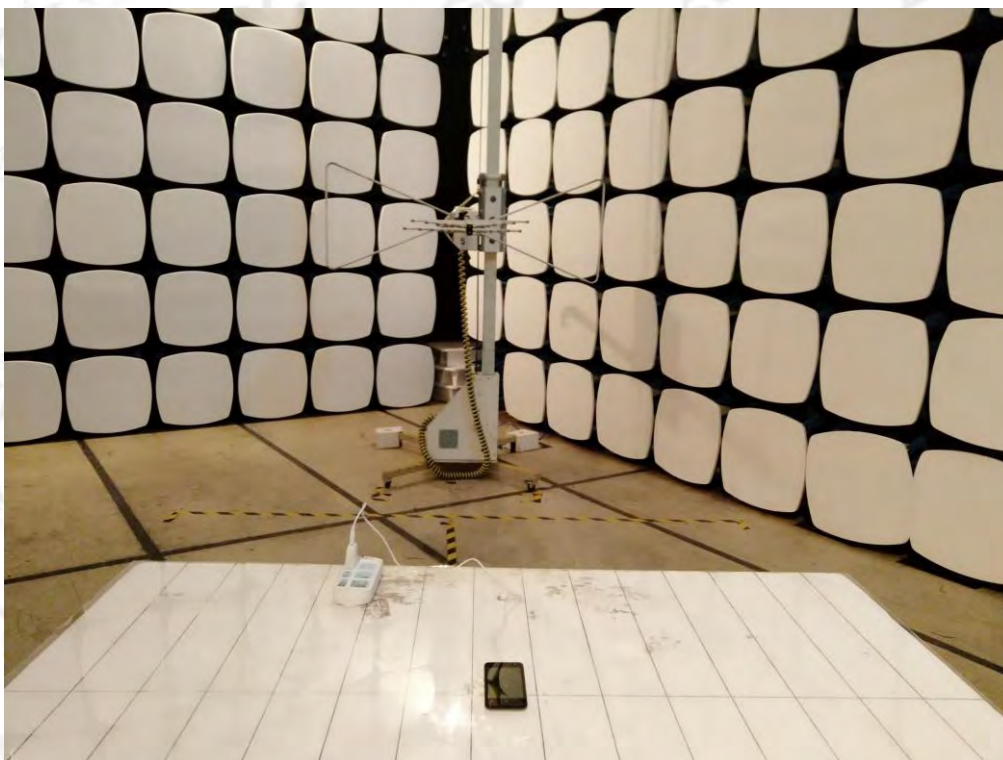
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APPENDIX A: PHOTOGRAPHS OF TEST SETUP

FCC LINE CONDUCTED EMISSION TEST SETUP



FCC RADIATED EMISSION TEST SETUP



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----END OF REPORT----

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