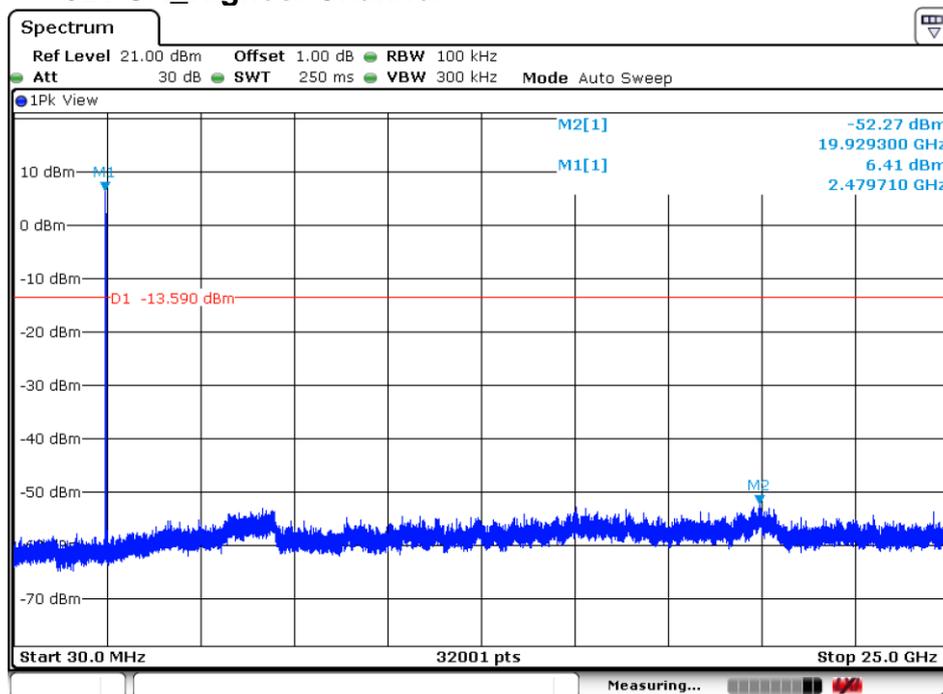


Date: 1.NOV.2019 21:31:50

4.10.1.9 8DPSK_Highest Channel



Date: 1.NOV.2019 21:30:13

Remark:





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

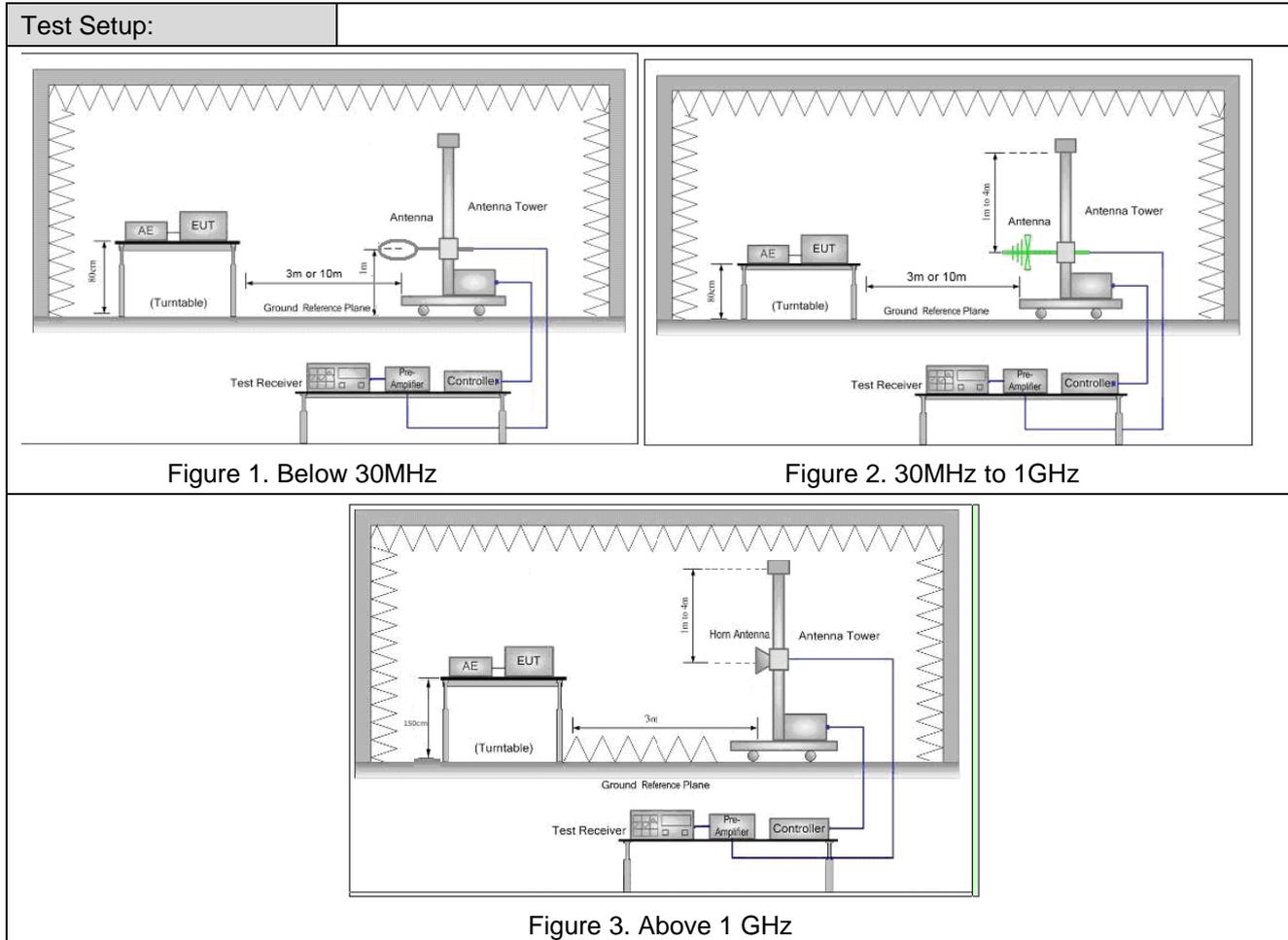
4.11 Radiated Spurious Emission

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
Peak		1MHz	10Hz	Average	
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
Remark: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.					



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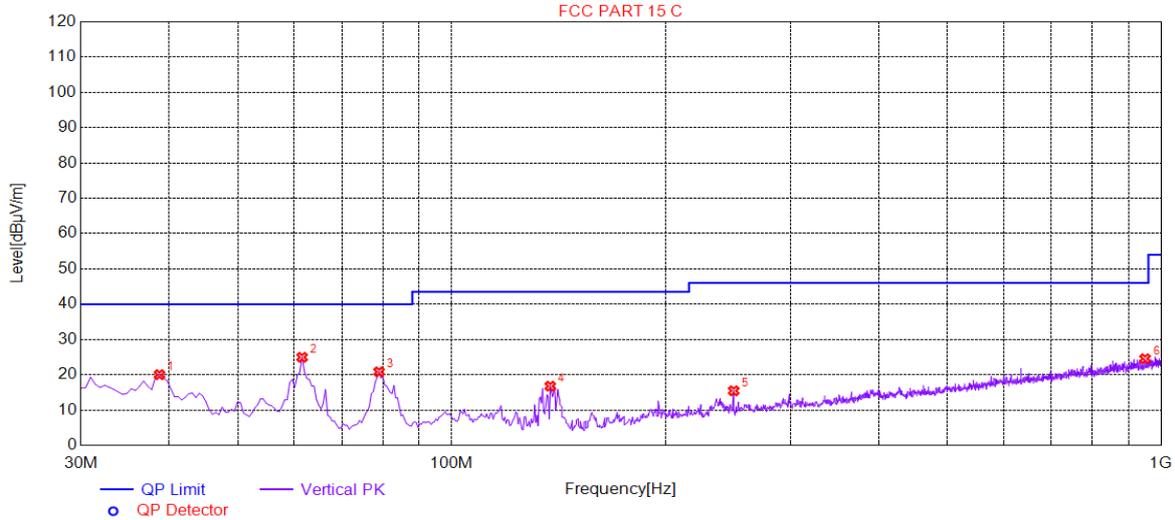
No.1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, China 518057 t (86-755) 26012053 f (86-755) 26710594 www.sgsgroup.com.cn
 中国·深圳·科技园中区M-10栋一号厂房 邮编: 518057 t (86-755) 26012053 f (86-755) 26710594 sgs.china@sgs.com

<p>Test Procedure:</p>	<ol style="list-style-type: none"> a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. h. Test the EUT in the lowest channel (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz) i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
<p>Exploratory Test Mode:</p>	<p>Non-hopping transmitting mode with all kind of modulation and all kind of data type Charge + Transmitting mode.</p>
<p>Final Test Mode:</p>	<p>Through Pre-scan, find the DH5 of data type and GFSK modulation is the worst case. Pretest the EUT at Charge + Transmitting mode For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.</p>
<p>Instruments Used:</p>	<p>Refer to section 5.10 for details</p>
<p>Test Results:</p>	<p>Pass</p>



4.11.1 Radiated Emission below 1GHz

4.11.1.1 Charge + Transmitting, Vertical



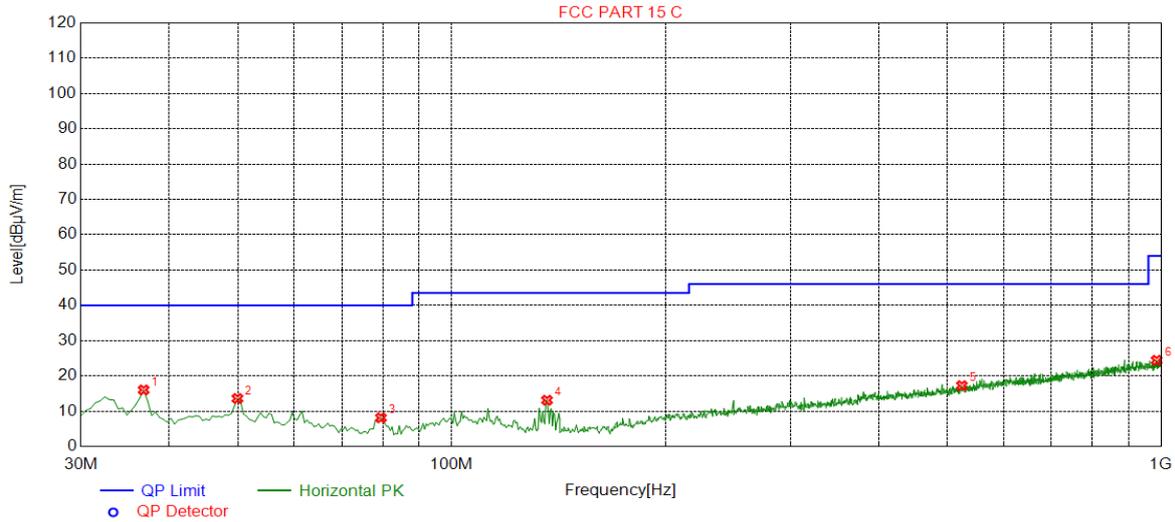
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	38.7344	20.02	-31.57	40.00	19.98	275	246	Vertical
2	61.5408	24.94	-32.04	40.00	15.06	245	122	Vertical
3	79.0095	20.82	-35.71	40.00	19.18	198	98	Vertical
4	137.7239	16.74	-35.11	43.50	26.76	243	243	Vertical
5	249.8149	15.44	-29.27	46.00	30.56	172	157	Vertical
6	949.5348	24.52	-14.48	46.00	21.48	224	35	Vertical



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4.11.1.2 Charge + Transmitting, Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	36.7934	16.01	-32.19	40.00	23.99	163	107	Horizontal
2	49.8949	13.59	-30.18	40.00	26.41	104	116	Horizontal
3	79.4947	8.11	-35.79	40.00	31.89	127	271	Horizontal
4	136.2681	13.10	-35.05	43.50	30.40	156	69	Horizontal
5	523.9770	17.23	-22.08	46.00	28.77	156	290	Horizontal
6	985.9280	24.41	-14.04	54.00	29.59	194	194	Horizontal

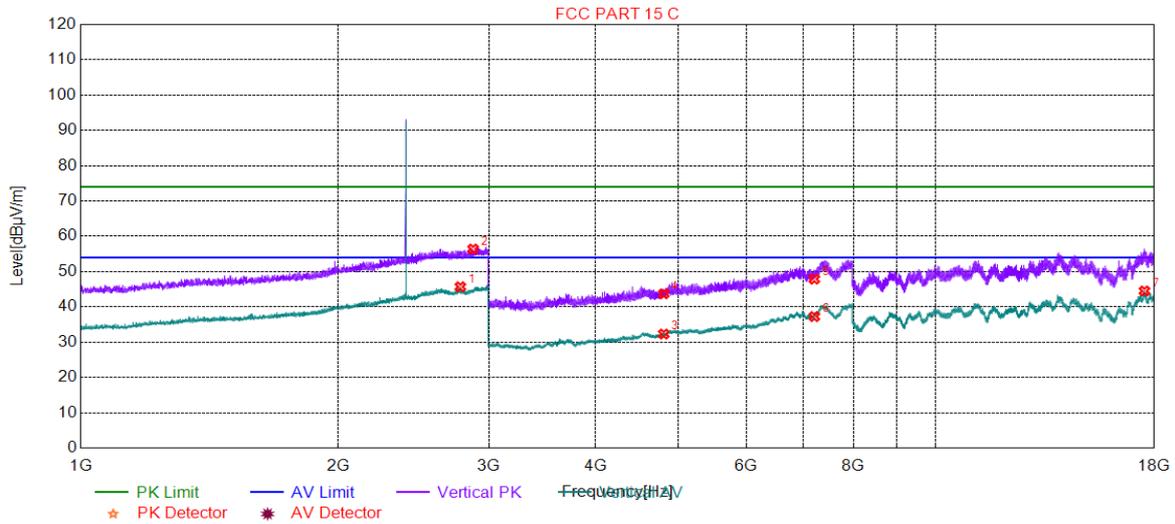


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4.11.2 Transmitter Emission above 1GHz

4.11.2.1 GFSK(DH5) _Lowest Channel _Vertical



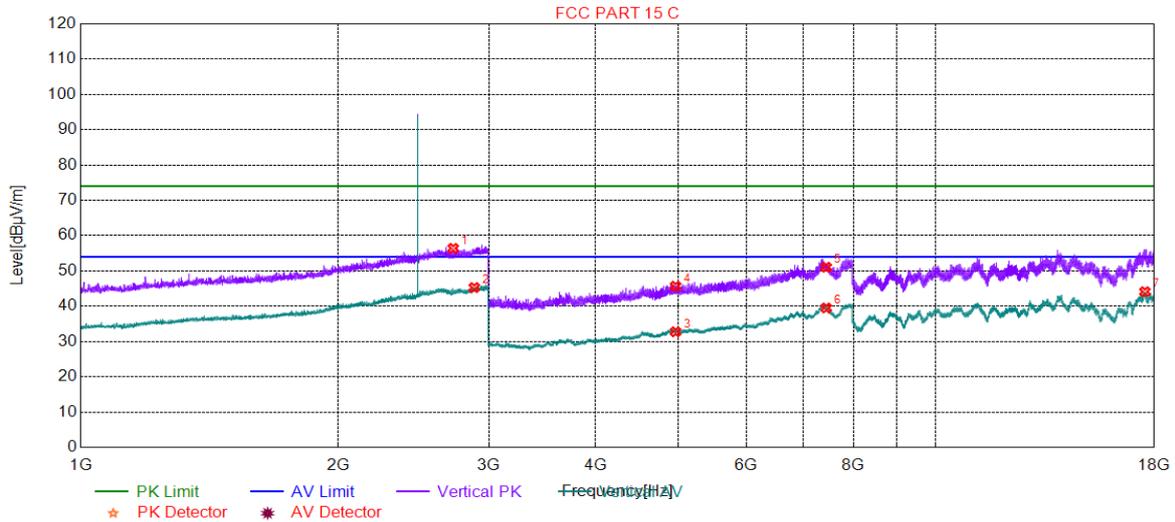
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2778.4446	45.69	10.51	54.00	8.31	236	107	Vertical
2	2875.4689	56.40	11.22	74.00	17.60	221	2	Vertical
3	4804.0000	32.30	-14.99	54.00	21.70	297	18	Vertical
4	4804.0000	43.71	-14.99	74.00	30.29	153	321	Vertical
5	7206.0000	47.87	-7.05	74.00	26.13	261	210	Vertical
6	7206.0000	37.24	-7.05	54.00	16.76	241	183	Vertical
7	17526.4763	44.50	0.69	54.00	9.50	184	0	Vertical



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4.11.2.2 GFSK(DH5) _Middle Channel _Vertical



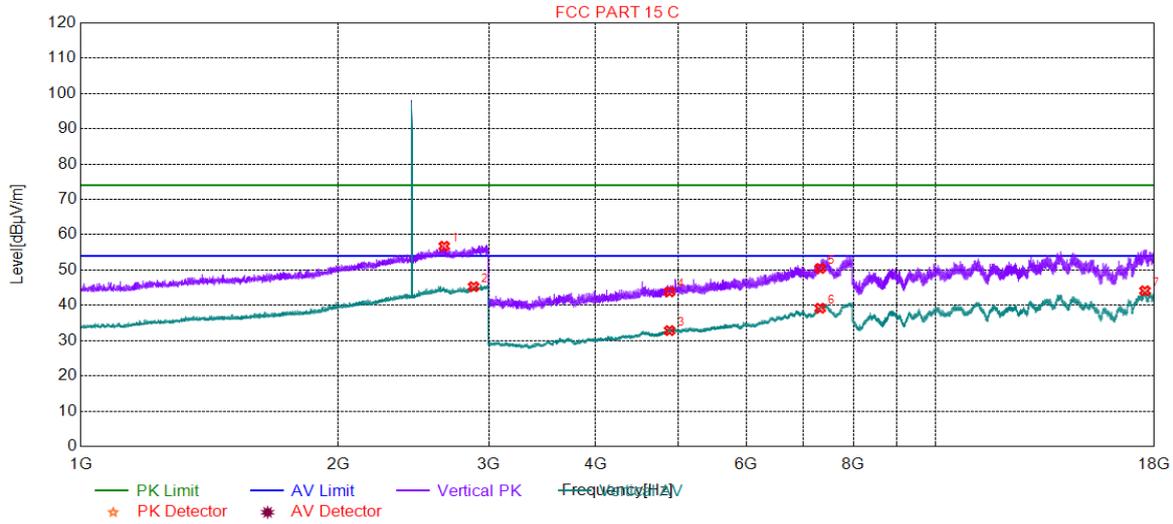
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2725.4314	56.40	10.19	74.00	17.60	254	69	Vertical
2	2884.4711	45.27	11.29	54.00	8.73	152	40	Vertical
3	4960.0000	32.74	-14.23	54.00	21.26	196	210	Vertical
4	4960.0000	45.66	-14.23	74.00	28.34	296	18	Vertical
5	7440.0000	51.03	-5.89	74.00	22.97	266	348	Vertical
6	7440.0000	39.50	-5.89	54.00	14.50	264	237	Vertical
7	17547.4774	44.10	0.96	54.00	9.90	259	292	Vertical



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4.11.2.3 GFSK(DH5) _Highest Channel _Vertical



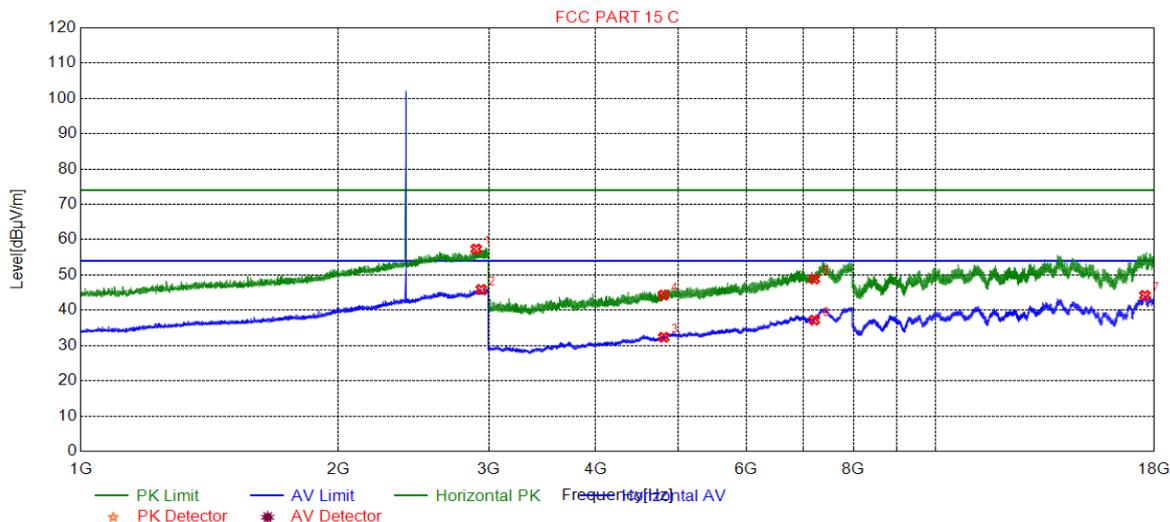
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2660.4151	56.75	10.21	74.00	17.25	180	216	Vertical
2	2879.4699	45.27	11.25	54.00	8.73	284	234	Vertical
3	4880.0000	32.83	-14.65	54.00	21.17	168	211	Vertical
4	4880.0000	43.81	-14.65	74.00	30.19	188	238	Vertical
5	7320.0000	50.44	-6.17	74.00	23.56	191	293	Vertical
6	7320.0000	39.17	-6.17	54.00	14.83	207	238	Vertical
7	17548.9774	44.10	0.98	54.00	9.90	237	0	Vertical



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4.11.2.4 GFSK(DH5) _Lowest Channel _Horizontal



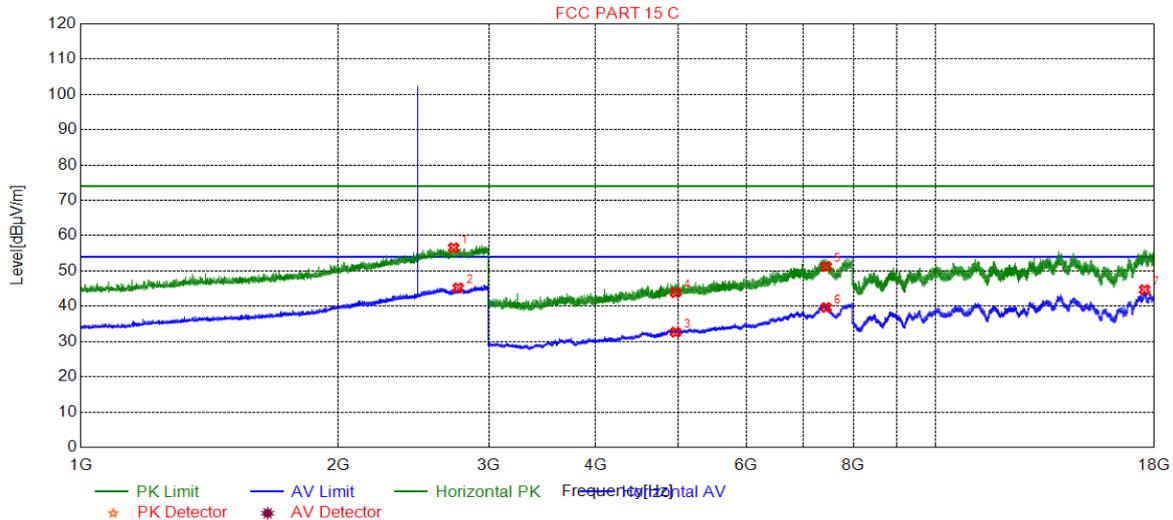
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2899.4749	57.34	11.41	74.00	16.66	173	72	Horizontal
2	2938.9847	45.90	11.39	54.00	8.10	128	45	Horizontal
3	4804.0000	32.33	-14.99	54.00	21.67	141	210	Horizontal
4	4804.0000	44.30	-14.99	74.00	29.70	100	346	Horizontal
5	7206.0000	48.84	-7.05	74.00	25.16	248	210	Horizontal
6	7206.0000	37.19	-7.05	54.00	16.81	149	318	Horizontal
7	17545.4773	44.20	0.93	54.00	9.80	247	291	Horizontal



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4.11.2.5 GFSK(DH5) _Middle Channel _ Horizontal



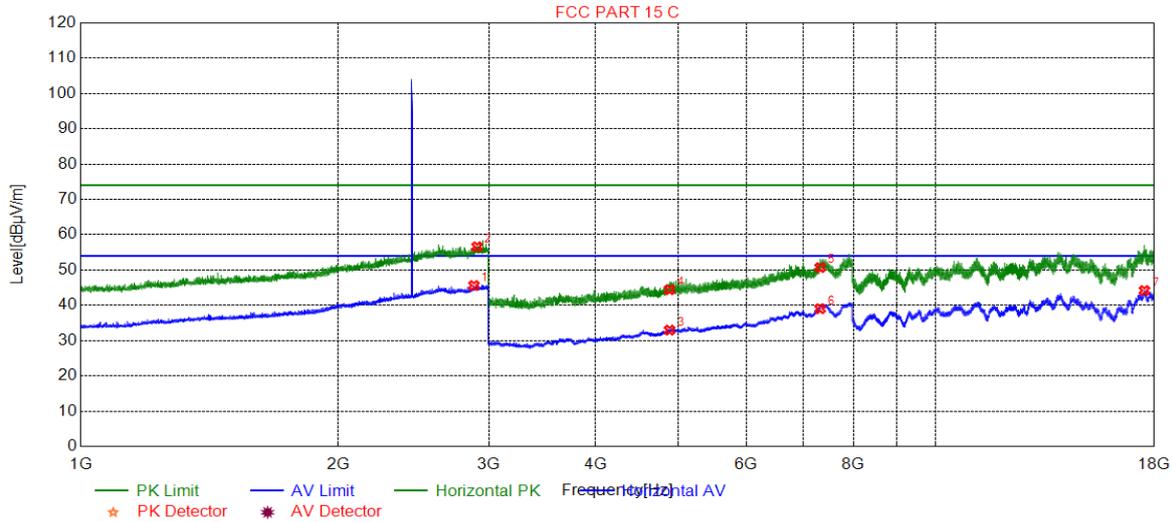
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2728.9322	56.56	10.21	74.00	17.44	217	167	Horizontal
2	2762.4406	45.19	10.41	54.00	8.81	124	181	Horizontal
3	4960.0000	32.63	-14.23	54.00	21.37	207	46	Horizontal
4	4960.0000	43.83	-14.23	74.00	30.17	134	46	Horizontal
5	7440.0000	51.24	-5.89	74.00	22.76	177	155	Horizontal
6	7440.0000	39.63	-5.89	54.00	14.37	120	155	Horizontal
7	17529.9765	44.67	0.73	54.00	9.33	214	0	Horizontal



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4.11.2.6 GFSK(DH5) _Highest Channel _ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2881.9705	45.60	11.27	54.00	8.40	190	170	Horizontal
2	2906.4766	56.58	11.41	74.00	17.42	129	200	Horizontal
3	4880.0000	32.96	-14.65	54.00	21.04	155	235	Horizontal
4	4880.0000	44.42	-14.65	74.00	29.58	205	207	Horizontal
5	7320.0000	50.67	-6.17	74.00	23.33	109	100	Horizontal
6	7320.0000	39.03	-6.17	54.00	14.97	223	360	Horizontal
7	17524.4762	44.18	0.66	54.00	9.82	117	342	Horizontal

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

$$\text{Final Test Level} = \text{Receiver Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Preamplifier Factor}$$

2) Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz and 18GHz to 25GHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

3) As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

4) All Modes have been tested, but only the worst case data displayed in this report.



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4.12 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205		
Test Method:	ANSI C63.10: 2013		
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m @3m)	Remark
	30MHz-88MHz	40.0	Quasi-peak Value
	88MHz-216MHz	43.5	Quasi-peak Value
	216MHz-960MHz	46.0	Quasi-peak Value
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			

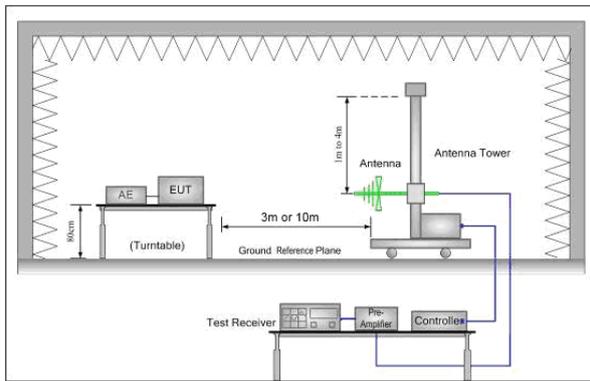


Figure 1. 30MHz to 1GHz

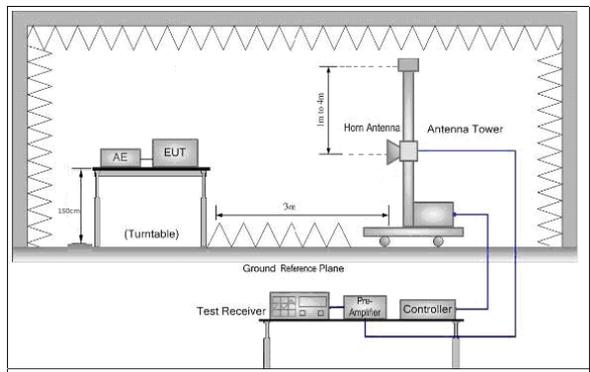


Figure 2. Above 1GHz

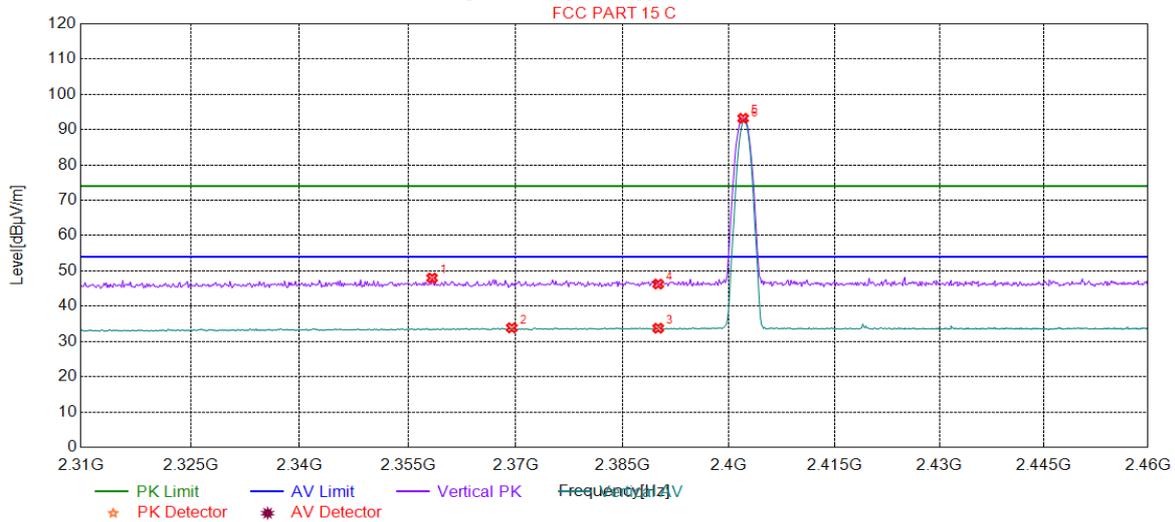


<p>Test Procedure:</p>	<ol style="list-style-type: none"> a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel h. Test the EUT in the lowest channel , the Highest channel i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. j. Repeat above procedures until all frequencies measured was complete.
<p>Exploratory Test Mode:</p>	<p>Non-hopping transmitting mode with all kind of modulation and all kind of data type Charge + Transmitting mode.</p>
<p>Final Test Mode:</p>	<p>Through Pre-scan, find the DH5 of data type and GFSK modulation is the worst case. Pretest the EUT at Charge + Transmitting mode, Only the worst case is recorded in the report.</p>
<p>Instruments Used:</p>	<p>Refer to section 5.10 for details</p>
<p>Test Results:</p>	<p>Pass</p>



4.12.1 Test plots

4.12.1.1 Worst Case Mode (GFSK(DH5)) _Lowest Channel _Vertical



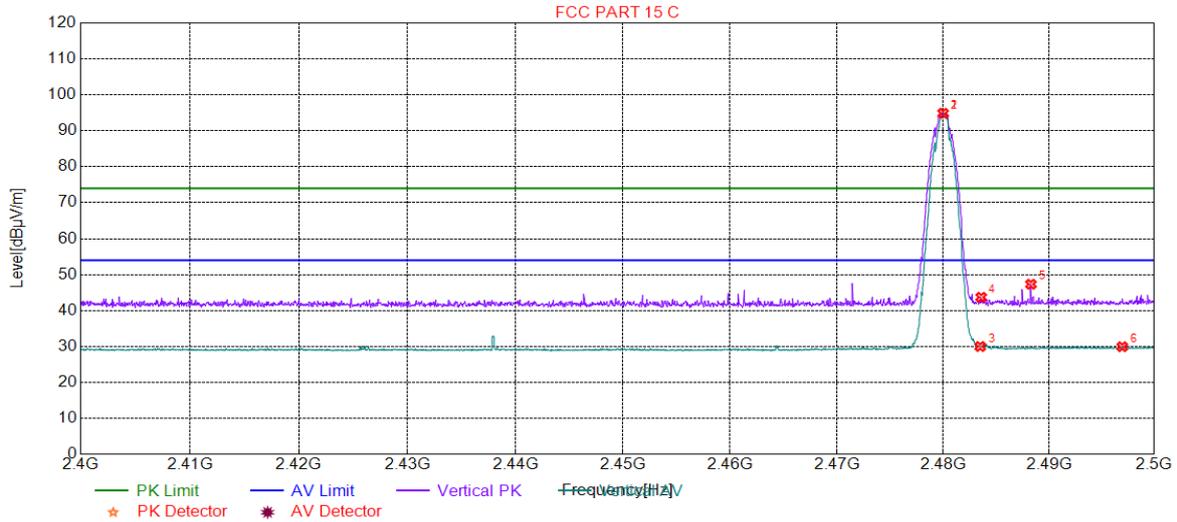
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2358.3483	47.98	9.09	74.00	26.02	265	302	Vertical
2	2369.4595	33.85	9.13	54.00	20.15	231	46	Vertical
3	2390.0000	33.75	9.20	54.00	20.25	151	243	Vertical
4	2390.0000	46.25	9.20	74.00	27.75	223	171	Vertical
5	2402.0000	93.22	9.24	74.00	-19.22	191	326	Vertical
6	2402.0000	92.47	9.24	54.00	-38.47	285	326	Vertical



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4.12.1.2 Worst Case Mode (GFSK(DH5)) _Highest Channel _Vertical



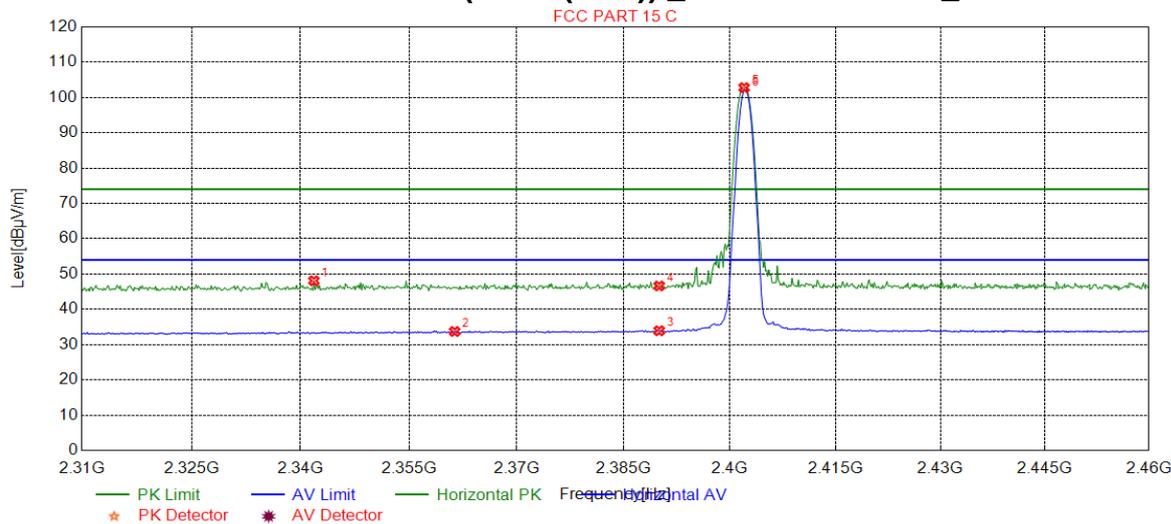
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2480.0000	94.88	9.49	74.00	-20.88	207	155	Vertical
2	2480.0000	94.74	9.49	54.00	-40.74	268	155	Vertical
3	2483.5000	30.00	9.50	54.00	24.00	268	308	Vertical
4	2483.5918	43.69	9.50	74.00	30.31	161	155	Vertical
5	2488.2941	47.32	9.51	74.00	26.68	165	106	Vertical
6	2496.9485	29.94	9.54	54.00	24.06	245	78	Vertical



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4.12.1.3 Worst Case Mode (GFSK(DH5)) _Lowest Channel _Horizontal



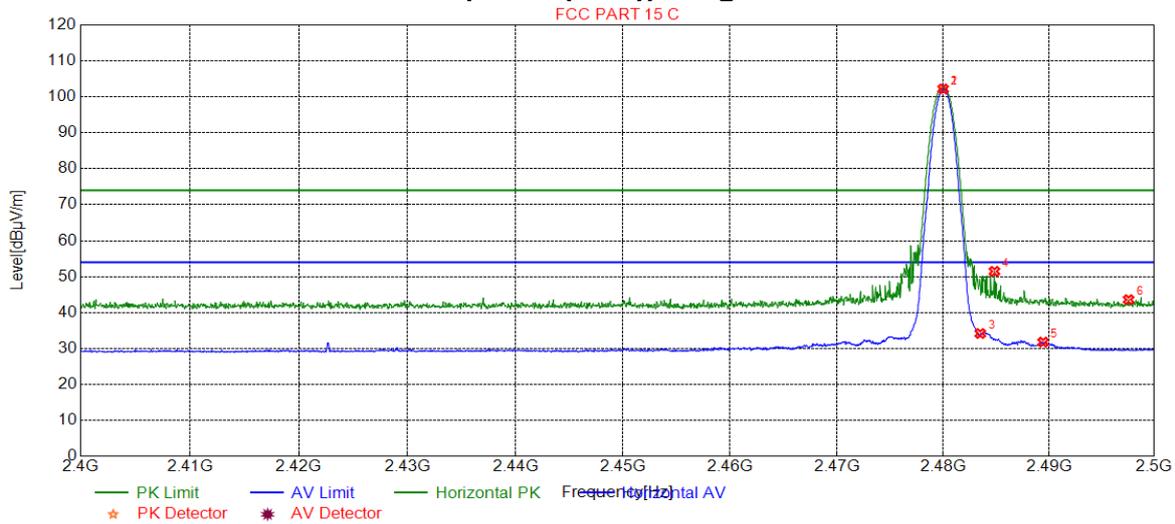
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2341.8318	48.08	9.04	74.00	25.92	110	67	Horizontal
2	2361.3514	33.69	9.10	54.00	20.31	194	332	Horizontal
3	2390.0000	33.92	9.20	54.00	20.08	235	67	Horizontal
4	2390.0000	46.62	9.20	74.00	27.38	135	208	Horizontal
5	2402.0000	102.81	9.24	74.00	-28.81	182	75	Horizontal
6	2402.0000	102.10	9.24	54.00	-48.10	106	70	Horizontal



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4.12.1.4 Worst Case Mode (GFSK(DH5)) _Highest Channel _ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2480.0000	102.21	9.49	74.00	-28.21	110	74	Horizontal
2	2480.0000	102.08	9.49	54.00	-48.08	138	68	Horizontal
3	2483.5000	34.17	9.50	54.00	19.83	187	233	Horizontal
4	2484.8424	51.45	9.50	74.00	22.55	181	173	Horizontal
5	2489.4447	31.77	9.52	54.00	22.23	200	80	Horizontal
6	2497.5488	43.58	9.54	74.00	30.42	211	118	Horizontal

Remark:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
All Modes have been tested, but only the worst case data displayed in this report.



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5 Measurement Uncertainty (95% confidence levels, k=2)

Lab A:

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	±0.75dB
2	RF power density, conducted	±2.84dB
3	Spurious emissions, conducted	±0.75dB
4	Temperature test	±1°C
5	Humidity test	±3%
6	DC and low frequency voltages	±0.5%

Lab B:

No.	Item	Measurement Uncertainty
1	Conduction Emission	± 3.0dB (150kHz to 30MHz)
2	Radiated Emission	± 4.8dB (Below 1GHz)
		± 4.8dB (1GHz to 6GHz)
		± 4.5dB (6GHz to 18GHz)
		± 5.02dB (Above 18GHz)



6 Equipment List

RF conducted test					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date	Cal.Duedate
				(yyyy-mm-dd)	(yyyy-mm-dd)
DC Power Supply	Agilent Technologies Inc	66311B	W009-09	2019/7/15	2020/7/15
Signal Analyzer	Rohde & Schwarz	FSV	W025-05	2019/1/13	2020/1/12
Coaxial Cable	SGS	N/A	SEM 031-01	2019/6/12	2020/6/11
Attenuator	Weinschel Associates	WA41	SEM 021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM 006-05	2019/7/14	2020/7/14
Temperature Chamber	GIANT FORCE	ICT-150-40-CP-AR	W027-03	2019/10/27	2020/10/27
Power Meter	Rohde & Schwarz	NRVS	SEM 014-02	2019/7/14	2020/7/14

CE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Shielding Room	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Artificial network	ROHDE&SCHWARZ	ENV216	XAW01-04-01	2019-07-16	2020-07-15
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2018-12-16	2019-12-15
Measurement Software	Tonscend	TS+ CE V2.5	XAW02-05-02	NCR	NCR
Radio communication analyzer	ROHDE&SCHWARZ	CMW 500	XAW01-03-02	2019-06-27	2020-06-26



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RSE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Semi-Anechoic Chamber	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
MXA signal analyzer	Keysight	N9020A	XAW01-06-01	2019-06-27	2020-06-26
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Receiving antenna (30MHz-3GHz)	Schwarzbeck	VULB 9163	XAW01-09-01	2019-10-13	2021-10-12
Receiving antenna (1GHz~18GHz)	Schwarzbeck	BBHA 9120D	XAW01-09-02	2019-10-13	2021-10-12
Receiving antenna (15GHz~40GHz)	Schwarzbeck	BBHA 9170	XAW01-09-03	2019-10-13	2021-10-12
Directional antenna rack controller	Max-Full	MF-7802BS	XAW03-03-01	NCR	NCR
High-speed antenna rack controller	Max-Full	MF-7802	XAW03-04-01	NCR	NCR
Filter bank	Tonscend	JS0806-F	XAW03-05-01	NCR	NCR
Filter bank	Tonscend	JS0806s	XAW03-05-02	NCR	NCR
Amplifier	Tonscend	TAP00903040	XAW01-41-01	2019-11-18	2020-11-17
				2018-12-10	2019-12-09
Amplifier	Tonscend	TAP01018048	XAW01-41-02	2019-11-18	2020-11-17
				2018-12-10	2019-12-09
Amplifier	Tonscend	TAP18040048	XAW01-41-03	2019-12-03	2020-12-02
				2018-12-10	2019-12-09
Amplifier	Shanghai Steed	YX28980930	XAW01-41-06	2019-11-18	2020-11-17
				2018-12-10	2019-12-09
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2018-12-16	2019-12-15
Measurement Software	Tonscend	TS+ RSE V3.0.0.2	XAW02-05-01	NCR	NCR
Radio communication analyzer	ROHDE&SCHWARZ	CMW 500	XAW01-03-02	2019-06-27	2020-06-26

7 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of Set-Up for ZR/2019/A0032.

The End

