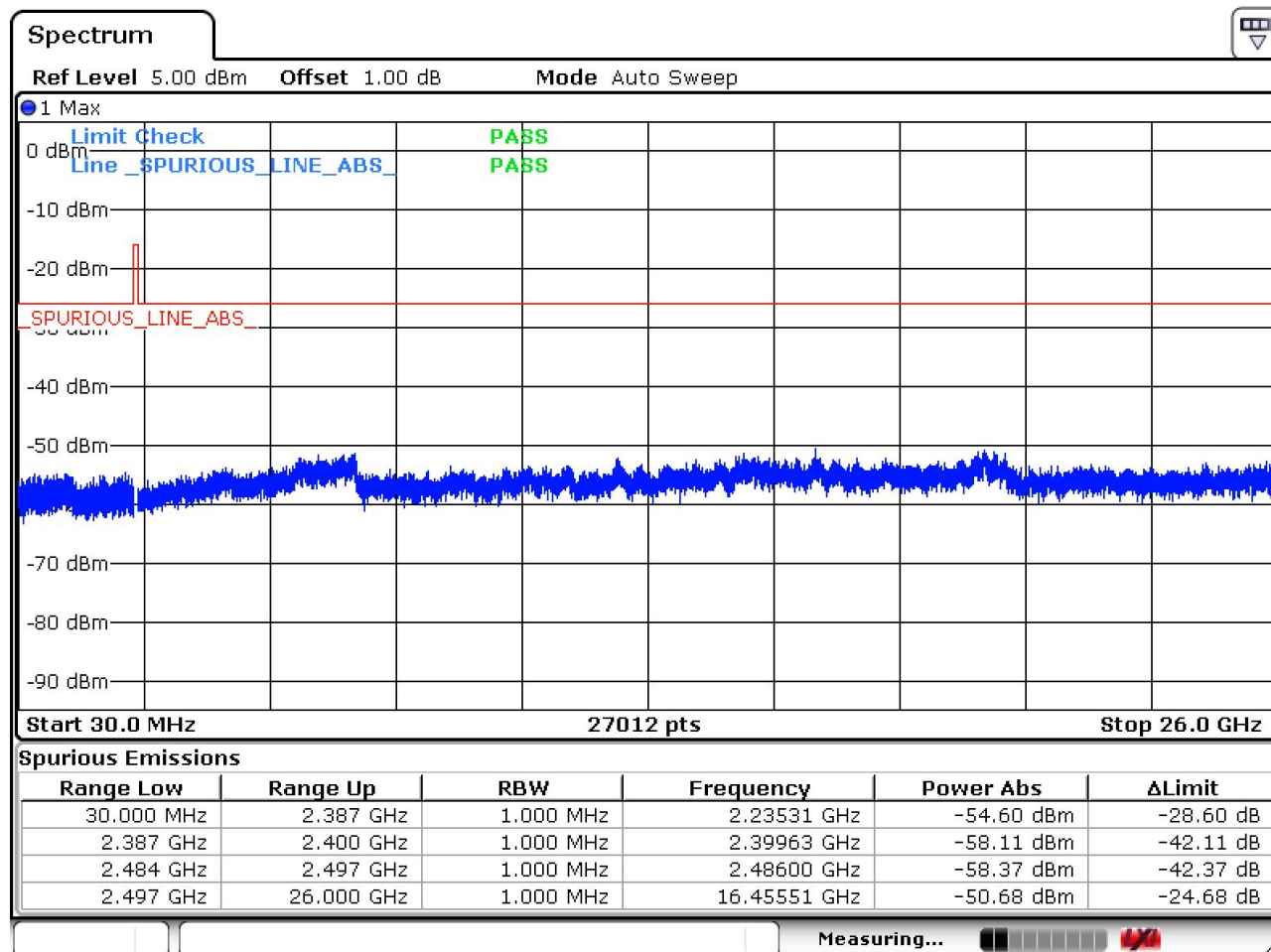


4.10.7.2 Middle Channel



Date: 21.APR.2020 13:13:23

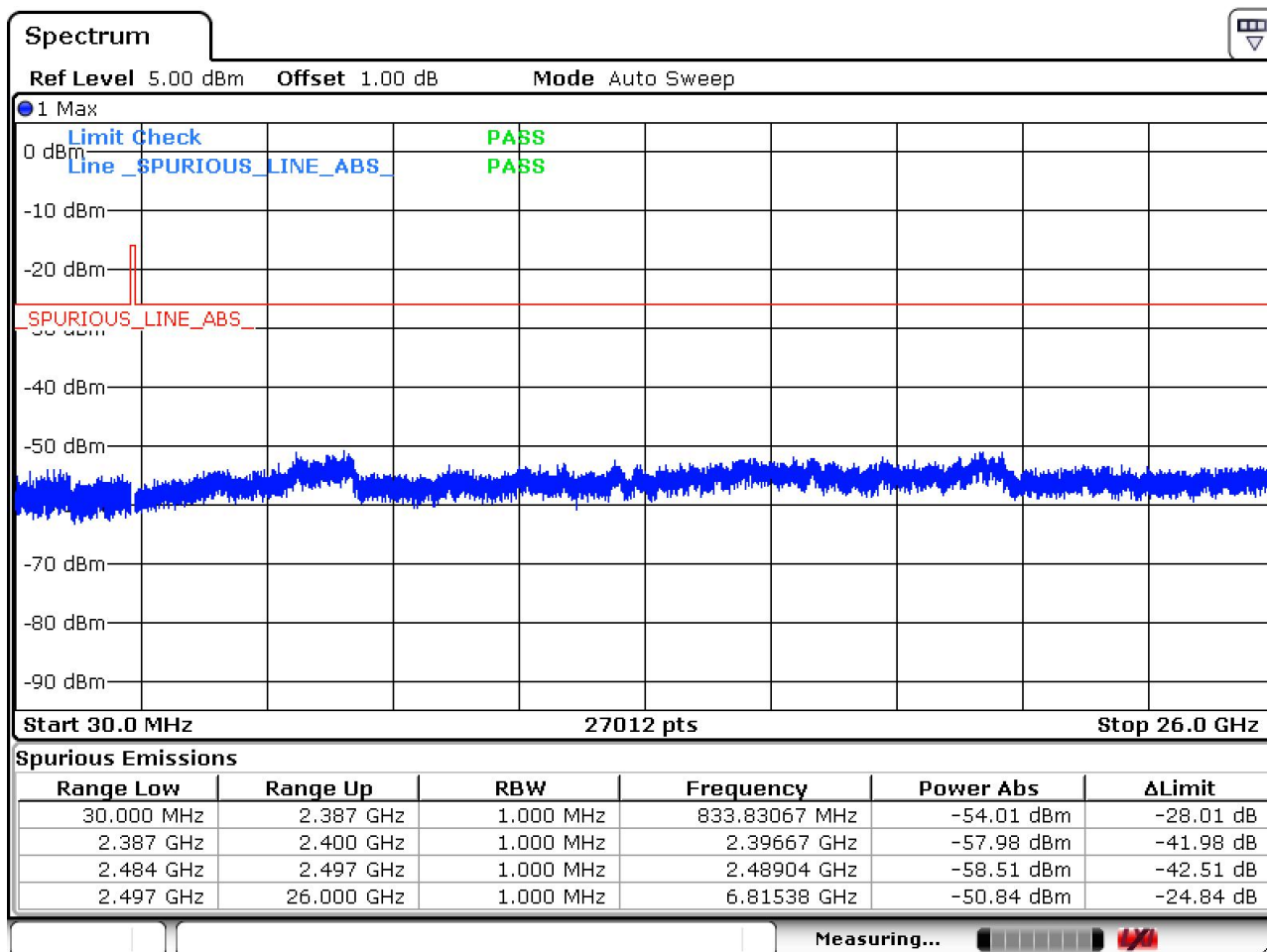


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4.10.7.3 Highest Channel



Date: 21.APR.2020 13:13:28



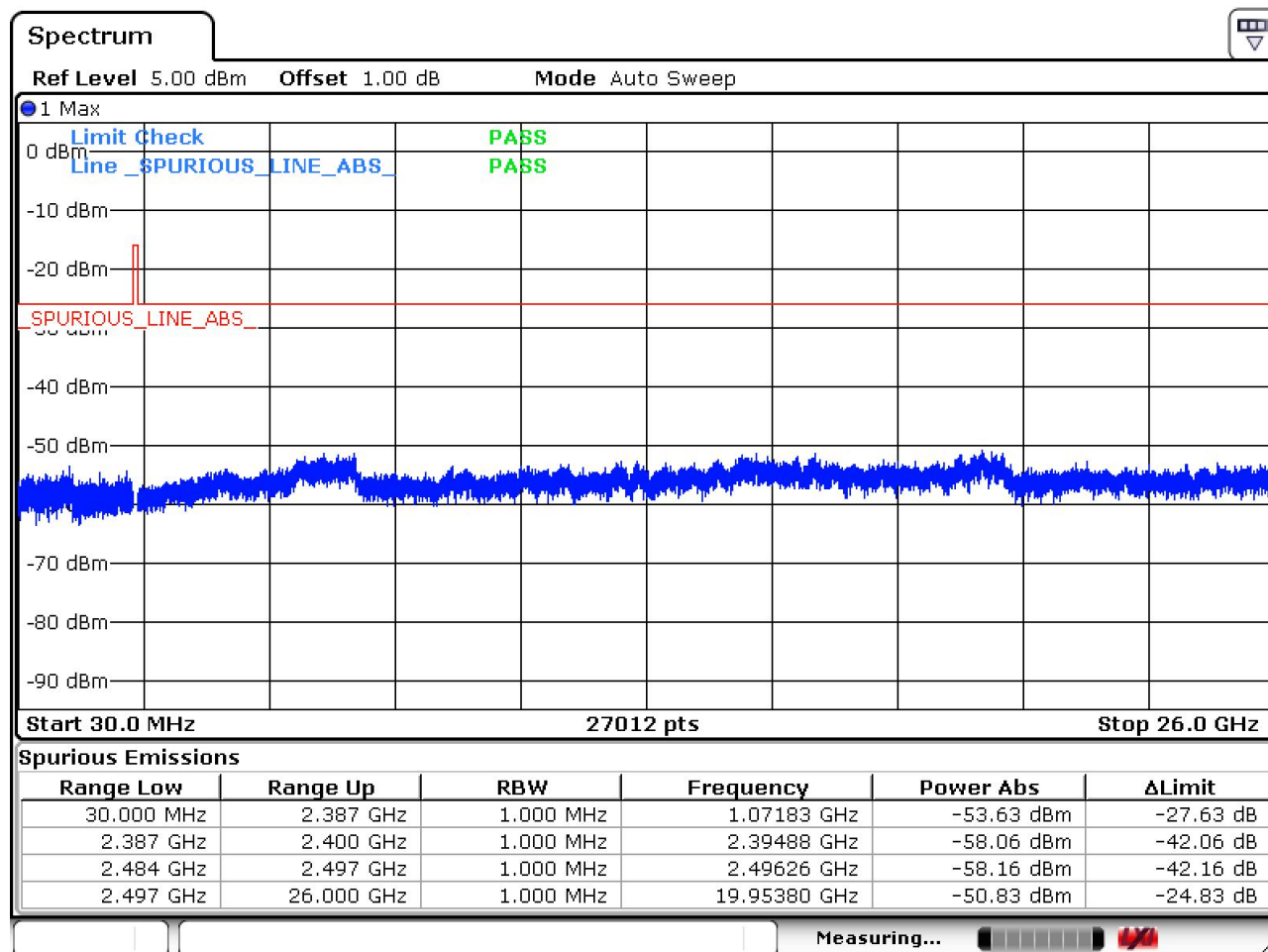
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4.10.8 Test plots (UHD 2MHz 8PSK High Power)

4.10.8.1 Lowest Channel



Date: 21.APR.2020 13:13:34

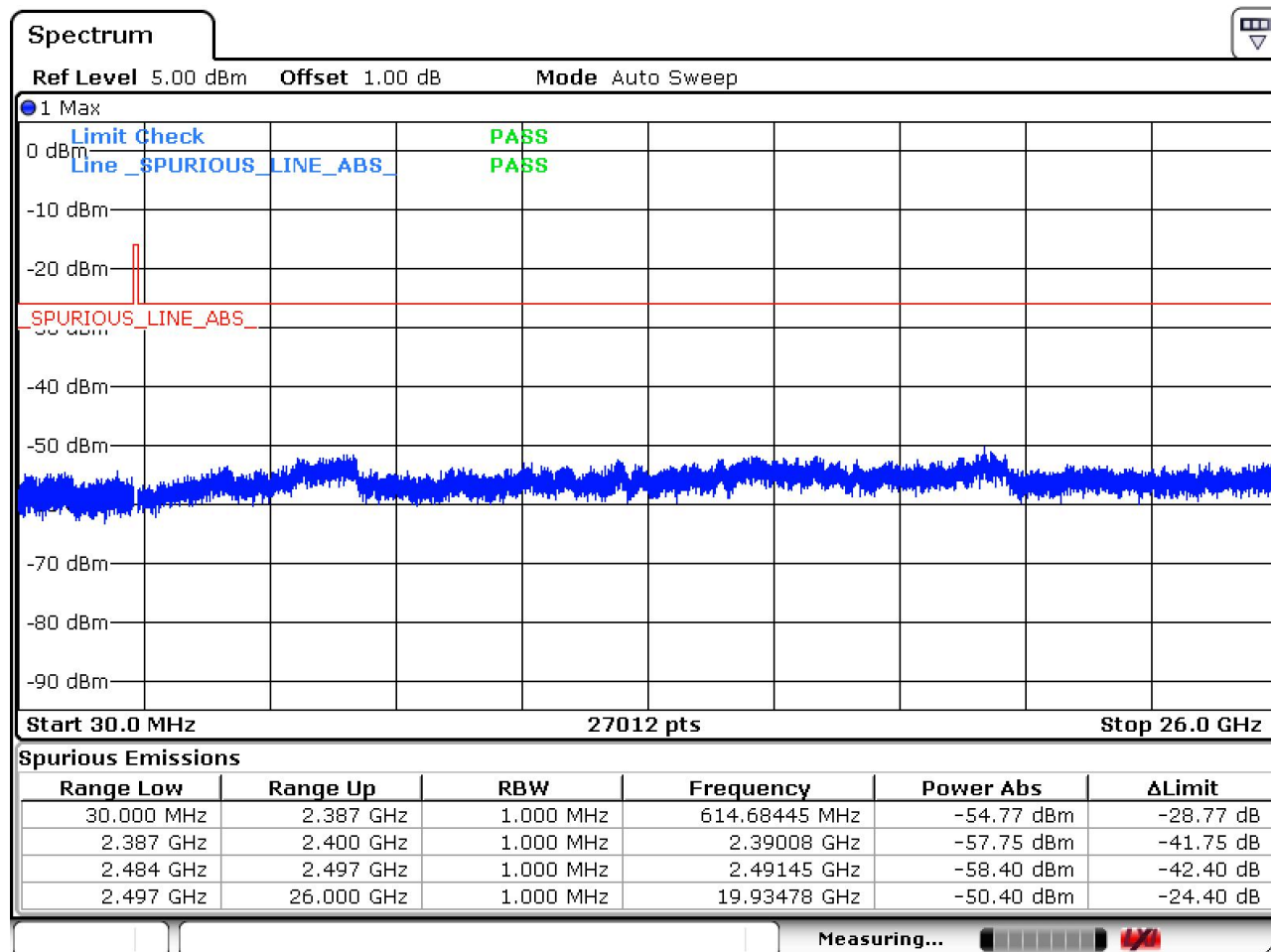


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4.10.8.2 Middle Channel



Date: 21.APR.2020 13:13:39

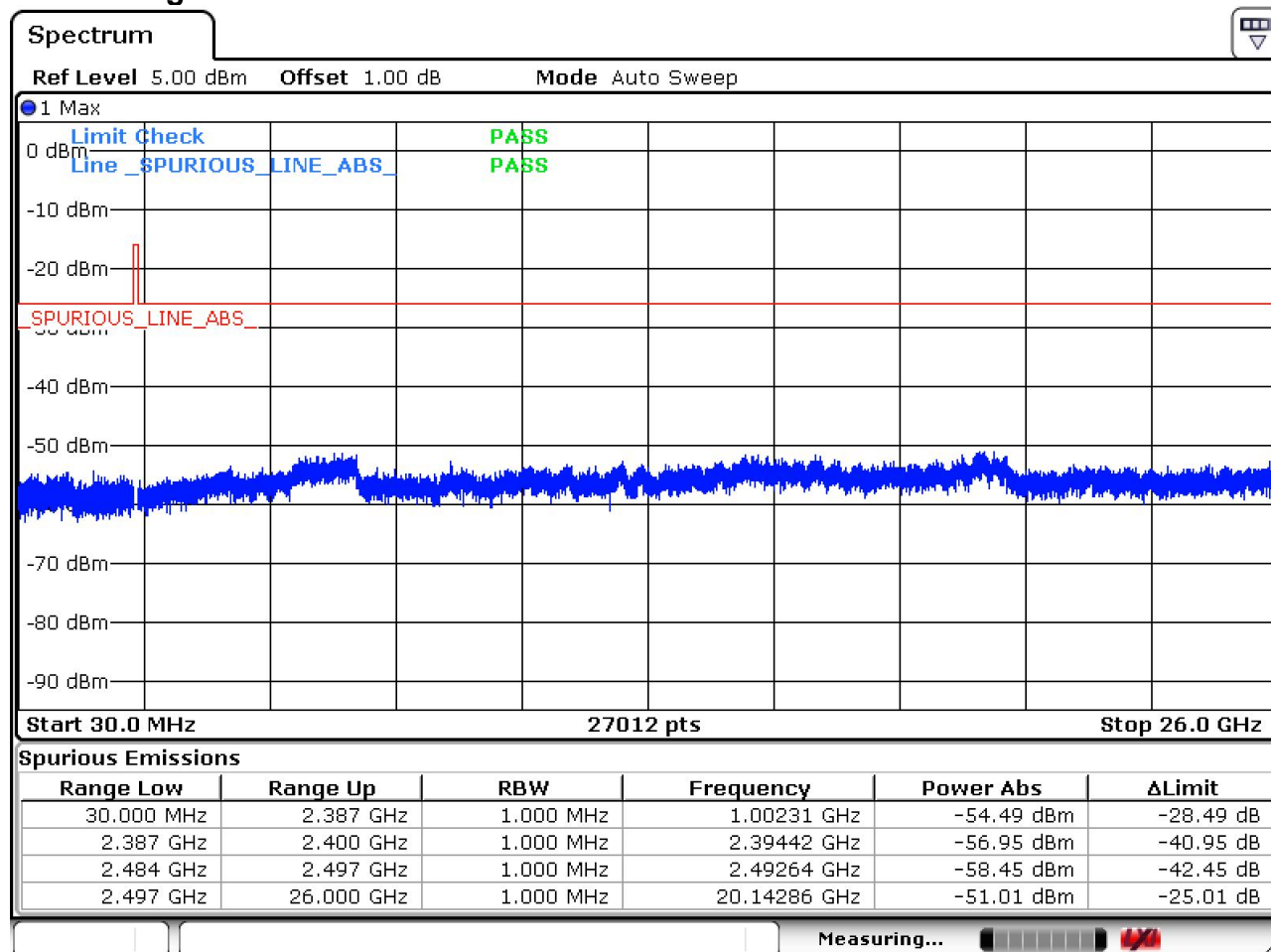


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4.10.8.3 Highest Channel



Date: 21.APR.2020 13:13:43



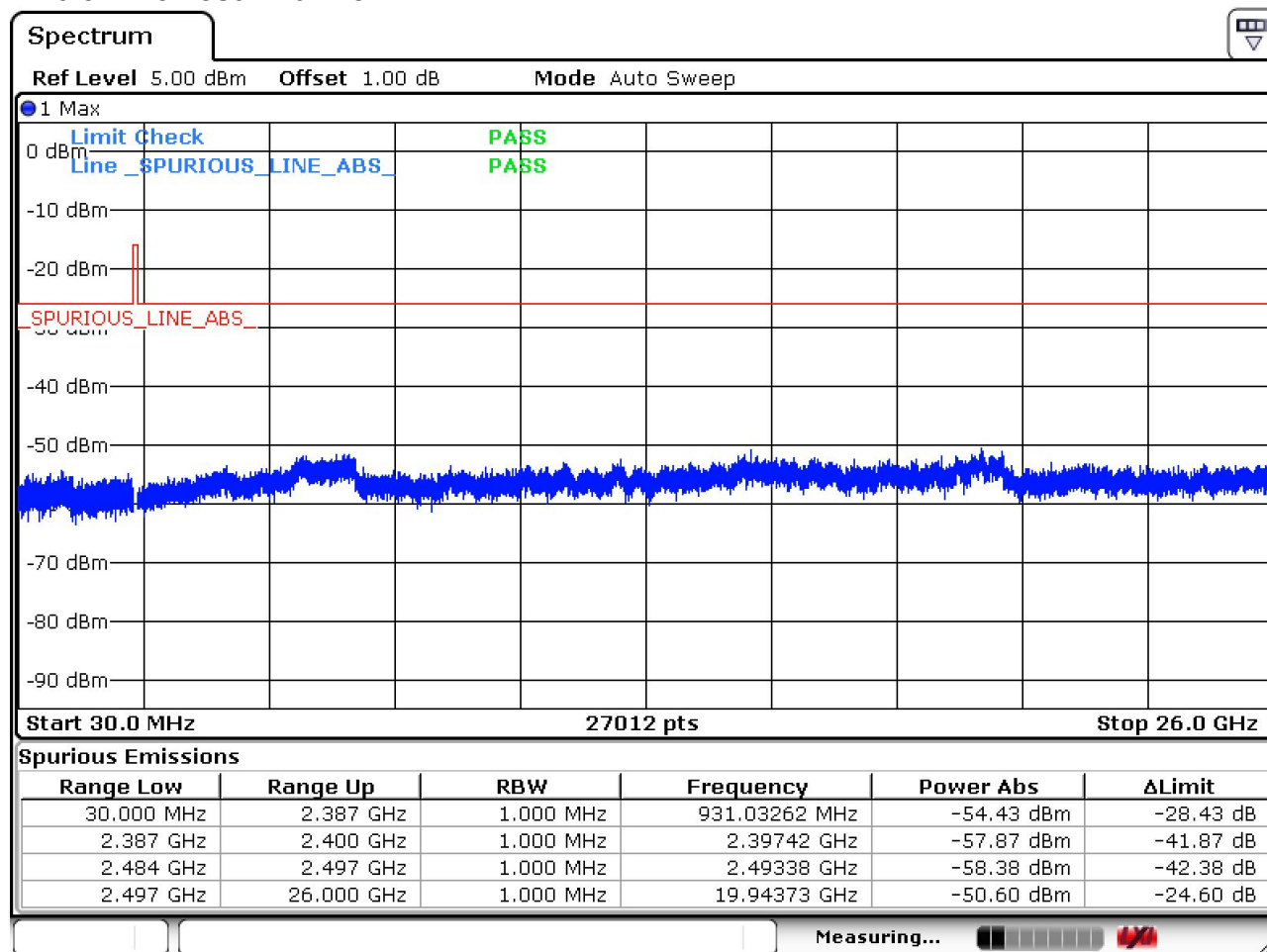
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4.10.9 Test plots (UHD 4MHz)

4.10.9.1 Lowest Channel



Date: 21.APR.2020 13:13:48

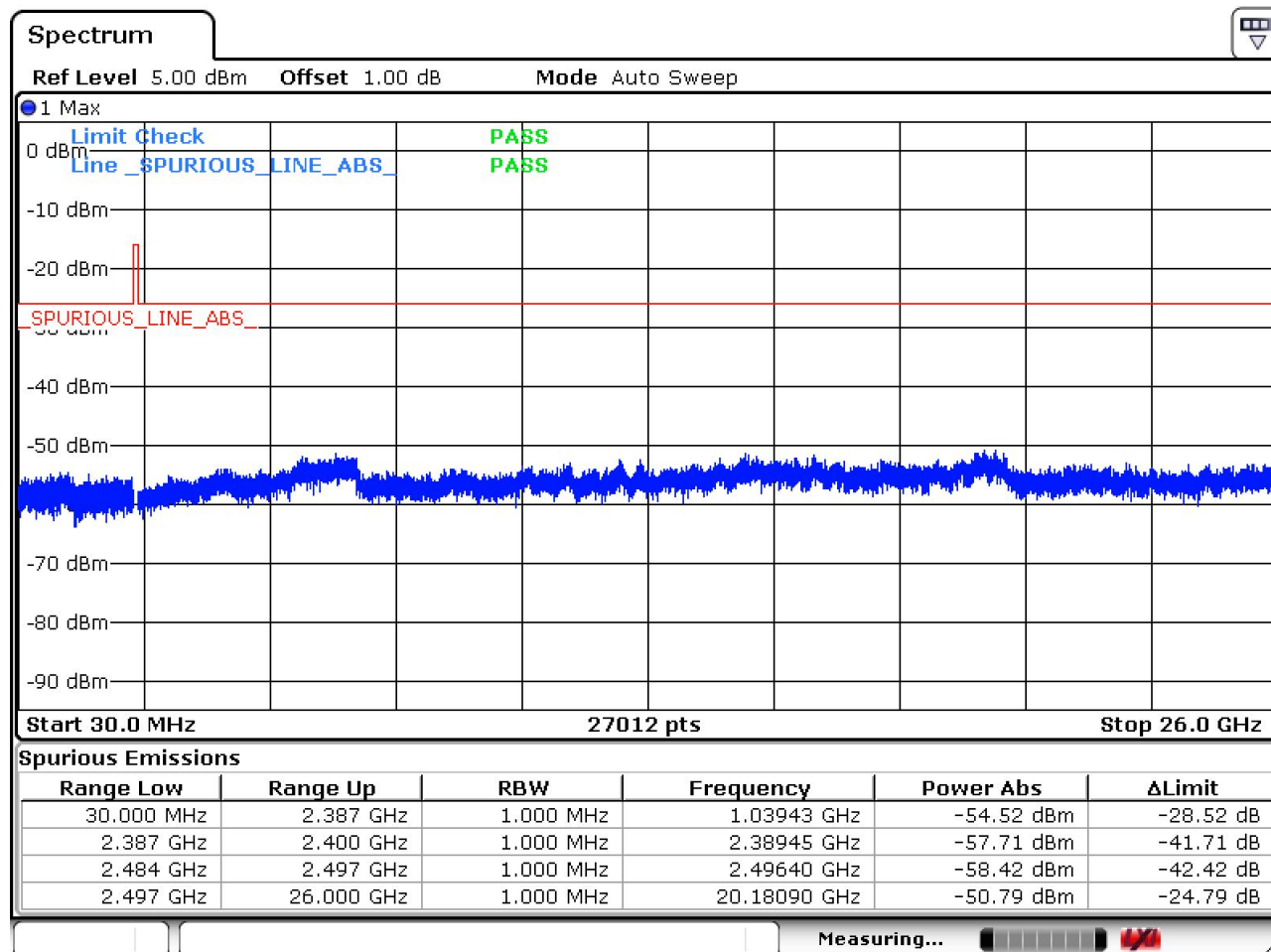


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4.10.9.2 Middle Channel



Date: 21.APR.2020 13:13:53

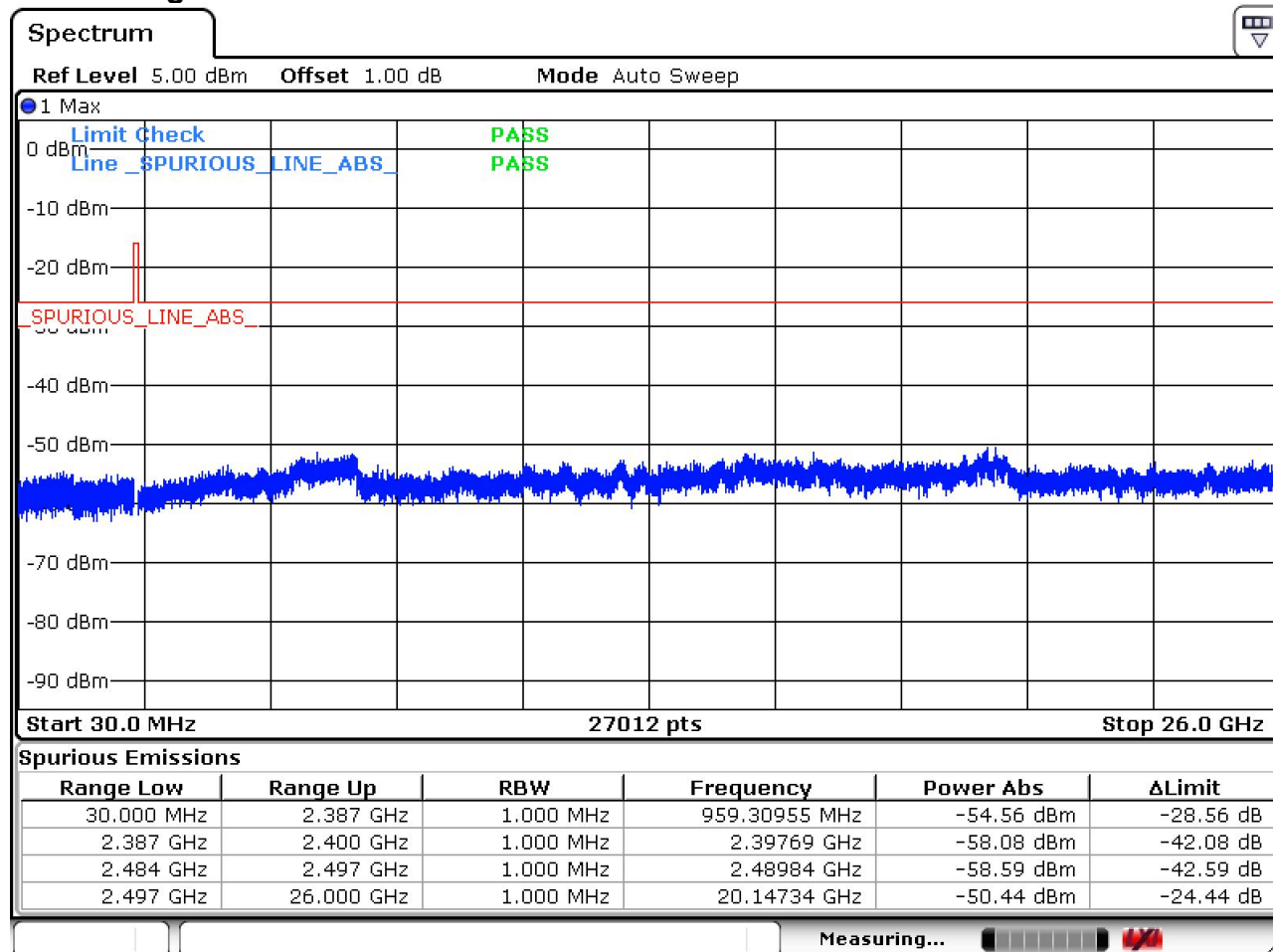


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4.10.9.3 Highest Channel



Date: 21.APR.2020 13:13:57



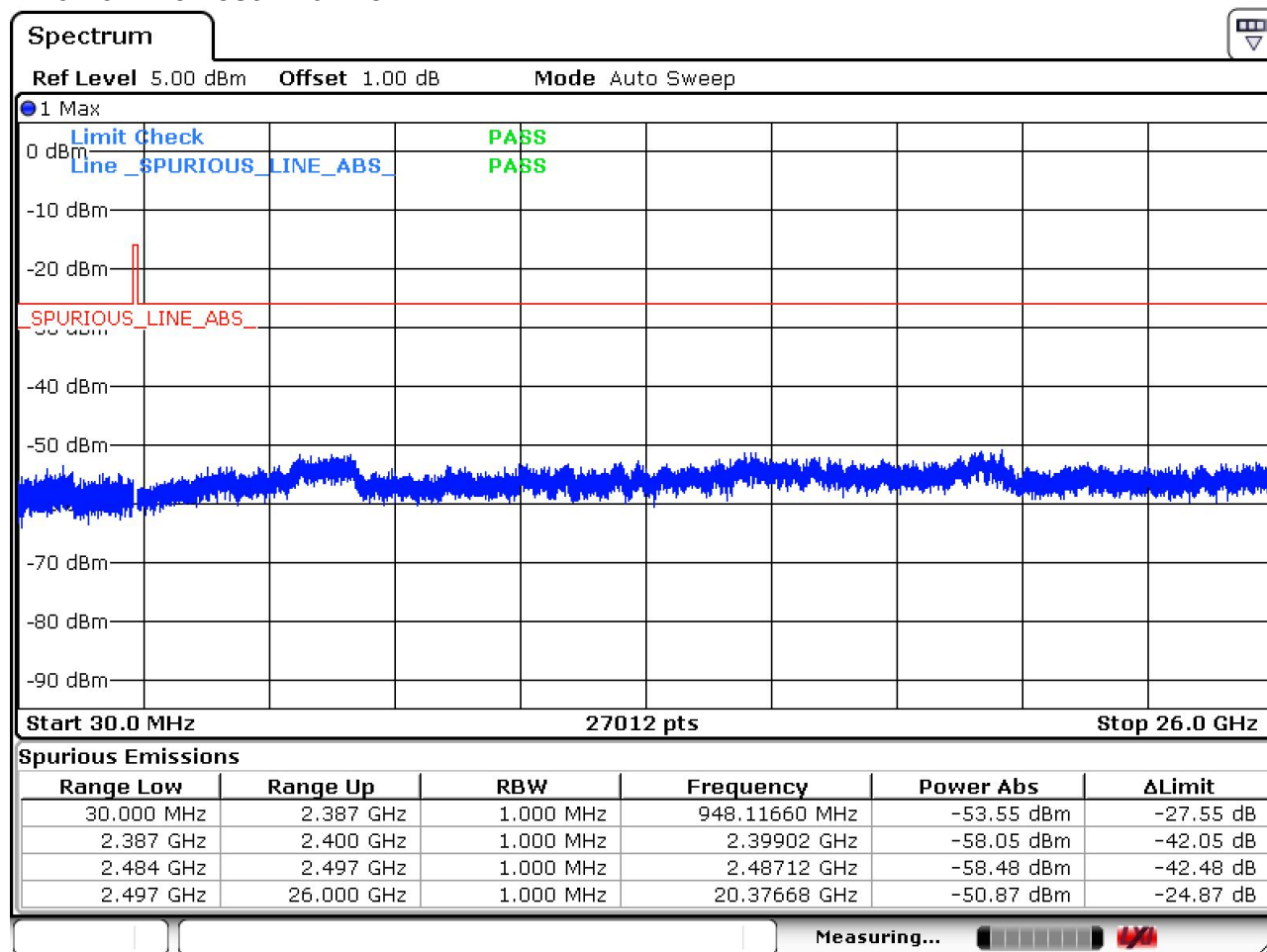
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4.10.10 Test plots (UHD 4MHz High Power)

4.10.10.1 Lowest Channel



Date: 21.APR.2020 13:14:01

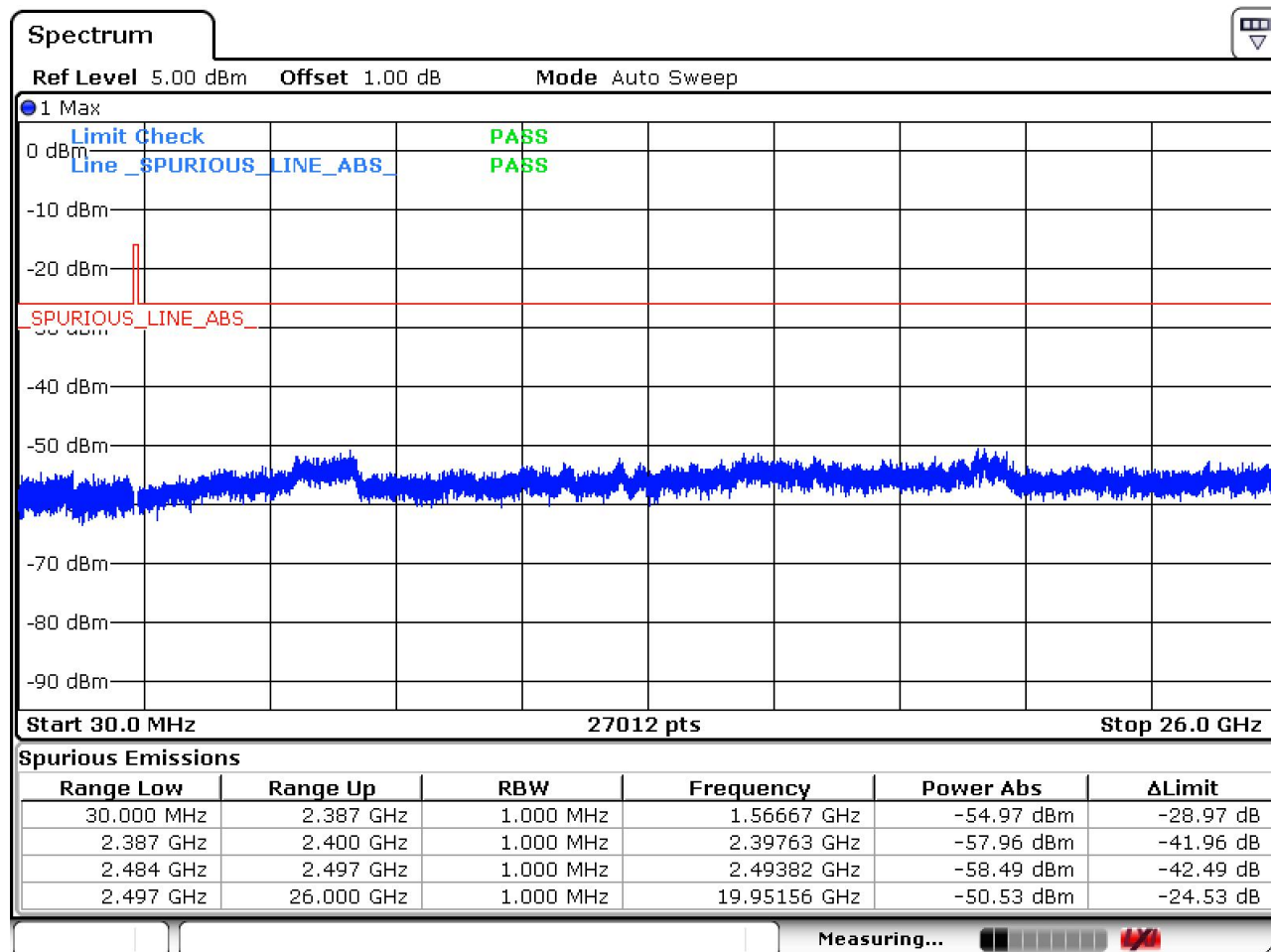


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4.10.10.2 Middle Channel



Date: 21.APR.2020 13:14:05

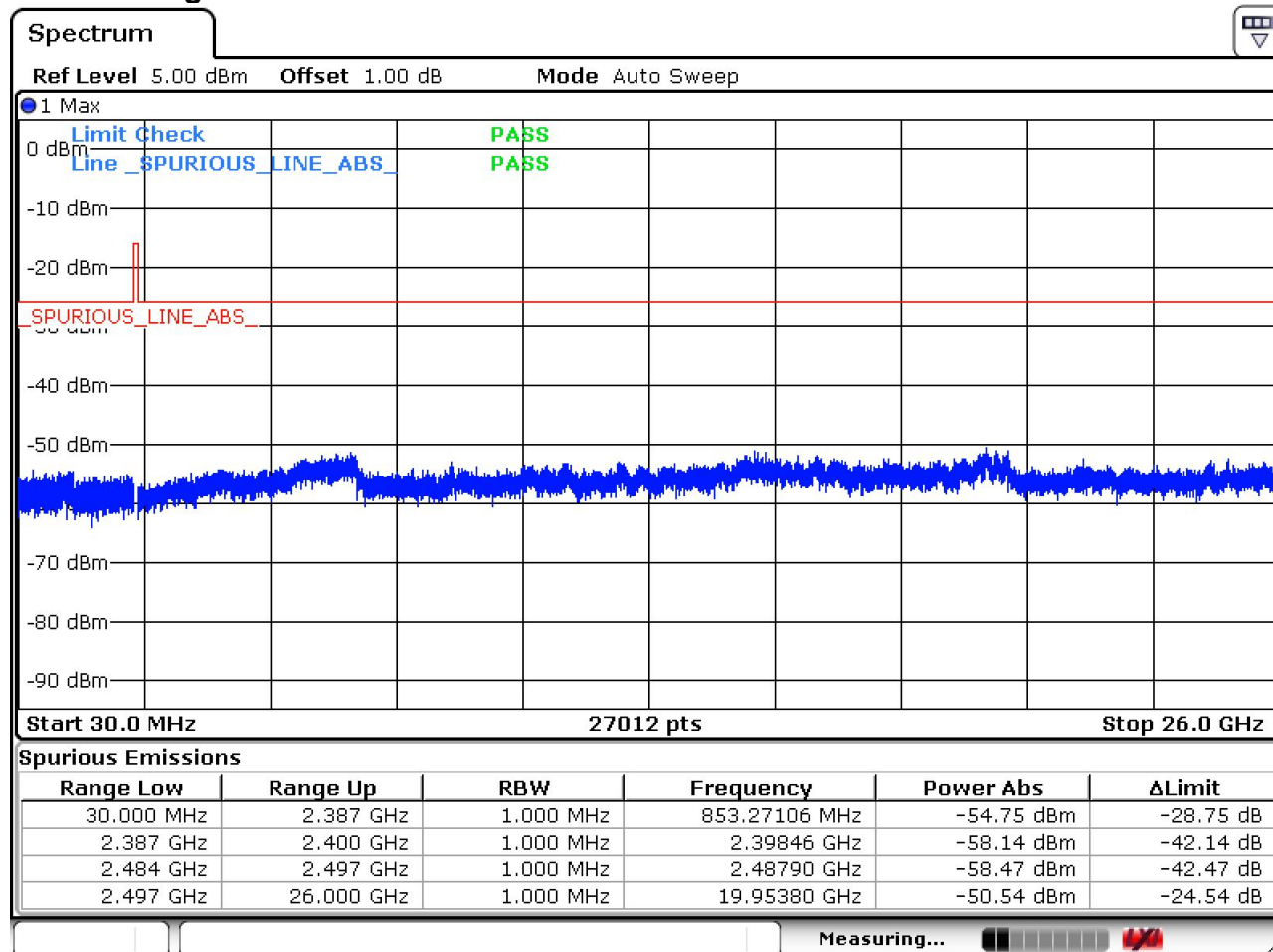


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4.10.10.3 Highest Channel



Date: 21.APR.2020 13:14:10

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.



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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
Limit:		Peak	1MHz	10Hz	Average
	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.					



Test Setup:

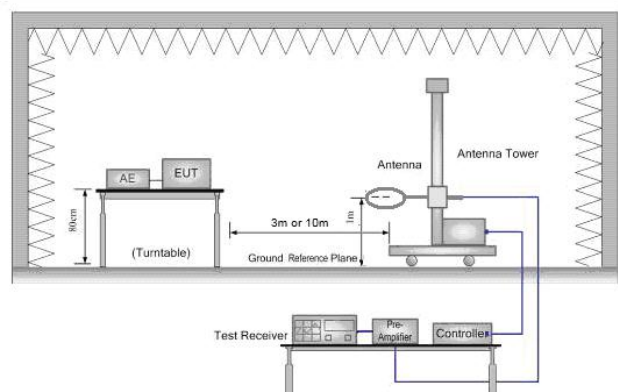


Figure 1. Below 30MHz

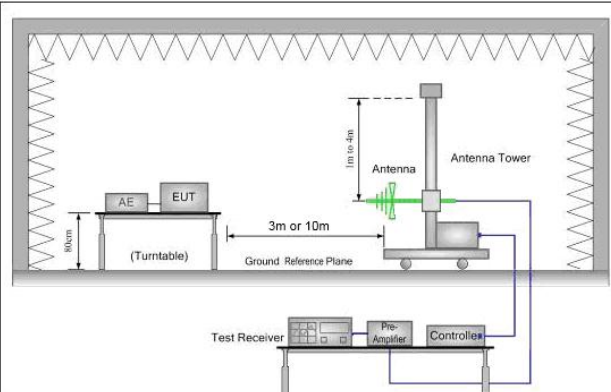


Figure 2. 30MHz to 1GHz

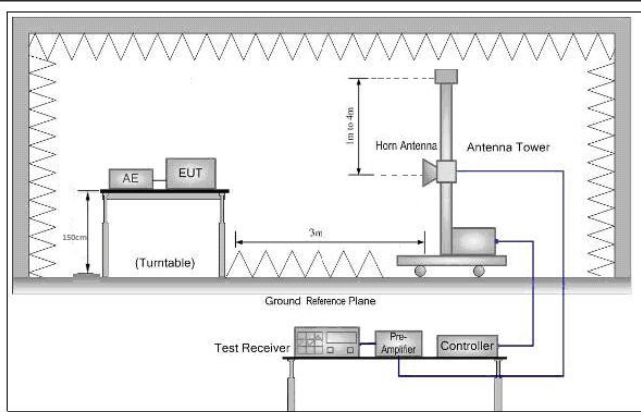


Figure 3. Above 1 GHz



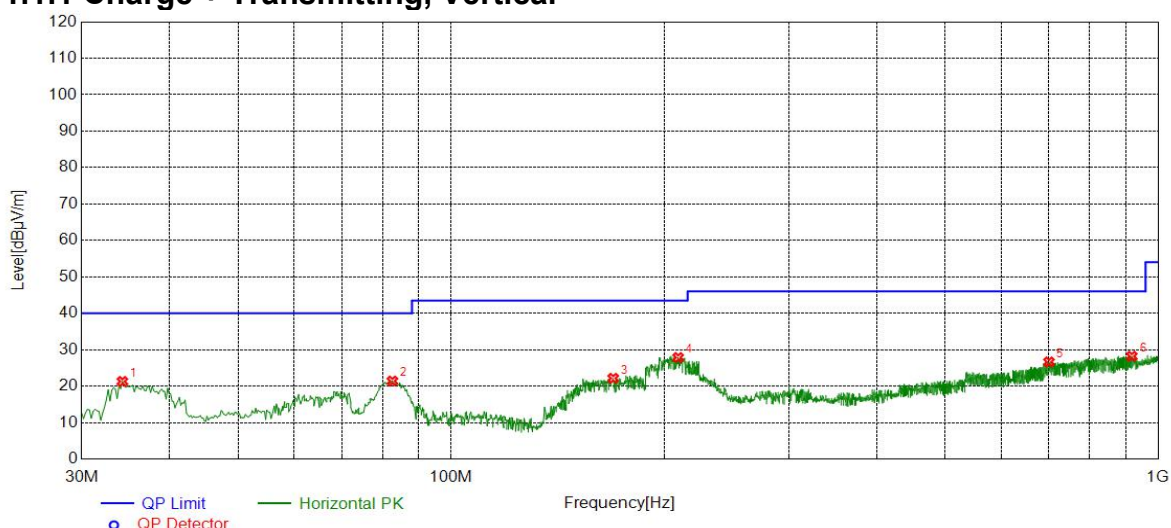
Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating 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. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=100 kHz for $f < 1 \text{ GHz}$, RBW=1MHz for $f > 1 \text{ GHz}$; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak (3) For average measurement: use duty cycle correction factor method per 15.35(c). Duty cycle = On time/100 milliseconds On time = $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$ Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + $20 * \log(\text{Duty cycle})$ f. 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. g. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. h. 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. i. Test the EUT in the lowest channel (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz) j. 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. k. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type



	Charge + Transmitting mode.
Final Test Mode:	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.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

4.11.1 Radiated Emission below 1GHz

4.11.1.1 Charge + Transmitting, Vertical

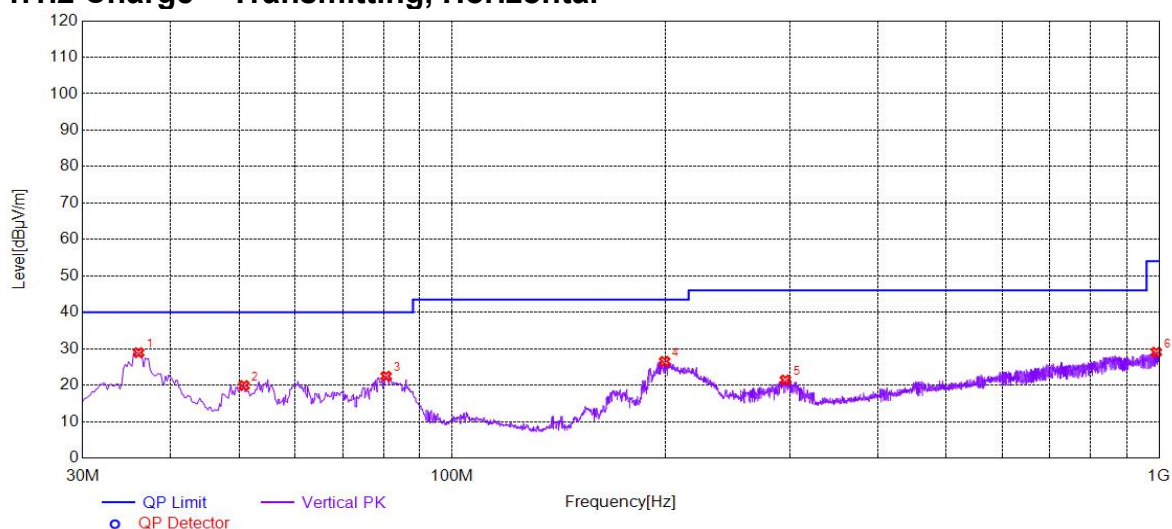


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	34.2689	21.29	-29.98	40.00	18.71	200	242	Horizontal
2	82.5845	21.41	-35.52	40.00	18.59	200	260	Horizontal
3	169.5139	22.16	-34.07	43.50	21.34	200	117	Horizontal
4	209.4859	27.86	-30.99	43.50	15.64	100	304	Horizontal
5	700.9862	26.64	-19.49	46.00	19.36	200	173	Horizontal
6	917.9216	28.22	-15.83	46.00	17.78	100	325	Horizontal



4.11.1.2 Charge + Transmitting, Horizontal



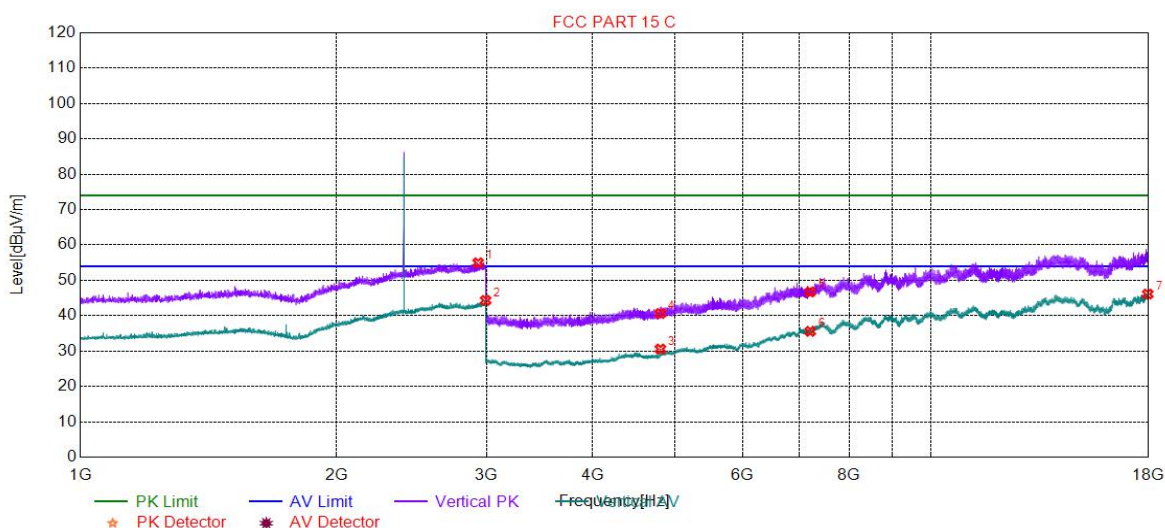
Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	36.0152	28.92	-29.63	40.00	11.08	100	14	Vertical
2	50.7622	19.89	-30.48	40.00	20.11	100	293	Vertical
3	80.6441	22.48	-35.99	40.00	17.52	200	335	Vertical
4	199.7840	26.52	-31.20	43.50	16.98	200	346	Vertical
5	296.0272	21.42	-28.41	46.00	24.58	100	354	Vertical
6	991.0742	29.06	-14.91	54.00	24.94	200	9	Vertical



4.11.2 Transmitter Emission above 1GHz

4.11.2.1 Lowest Channel _Vertical

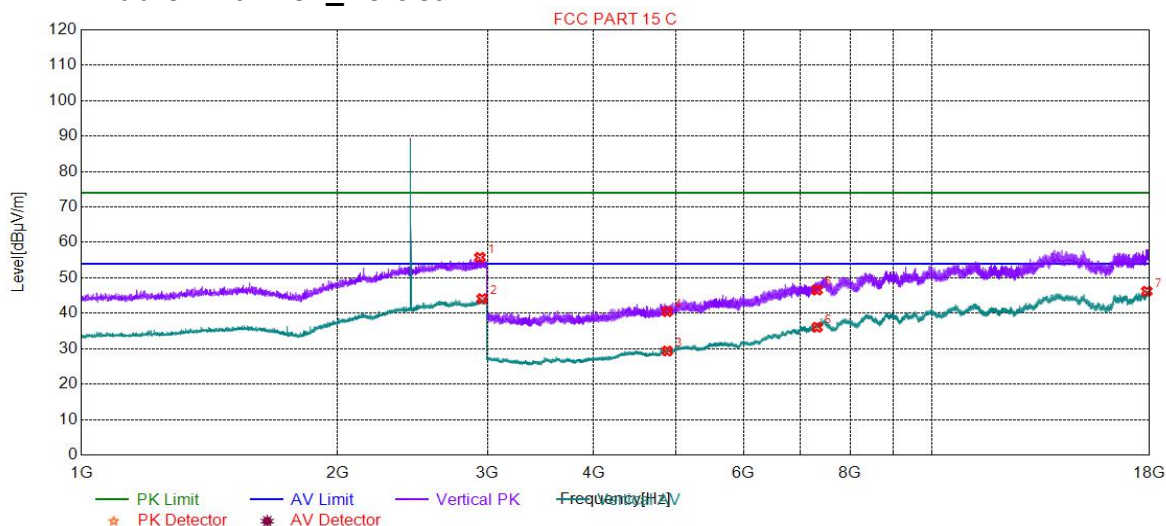


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2933.4834	54.96	9.50	74.00	19.04	150	270	Vertical
2	2993.4984	44.34	9.48	54.00	9.66	150	70	Vertical
3	4804.0000	30.58	-18.30	54.00	23.42	150	252	Vertical
4	4804.0000	40.63	-18.30	74.00	33.37	150	72	Vertical
5	7206.0000	46.74	-10.09	74.00	27.26	150	136	Vertical
6	7206.0000	35.59	-10.09	54.00	18.41	150	91	Vertical
7	17957.6479	46.13	0.71	54.00	7.87	150	292	Vertical



4.11.2.2 Middle Channel _Vertical

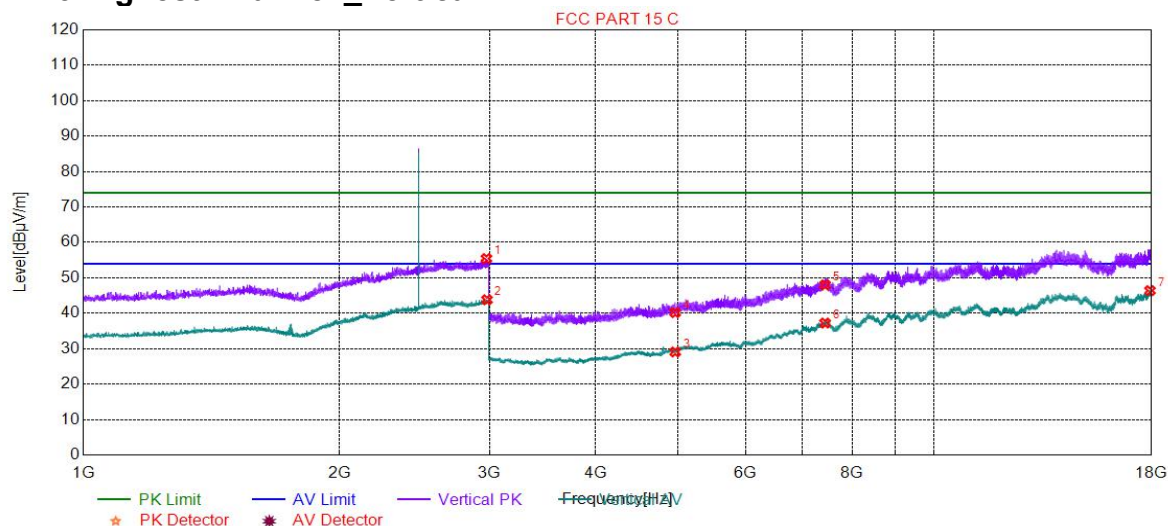


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2939.9850	55.78	9.57	74.00	18.22	150	142	Vertical
2	2957.4894	44.14	9.65	54.00	9.86	150	56	Vertical
3	4880.0000	29.34	-17.97	54.00	24.66	150	127	Vertical
4	4880.0000	40.47	-17.97	74.00	33.53	150	72	Vertical
5	7320.0000	46.55	-9.72	74.00	27.45	150	240	Vertical
6	7320.0000	36.04	-9.72	54.00	17.96	150	89	Vertical
7	17863.0432	46.22	0.20	54.00	7.78	150	89	Vertical



4.11.2.3 Highest Channel _Vertical

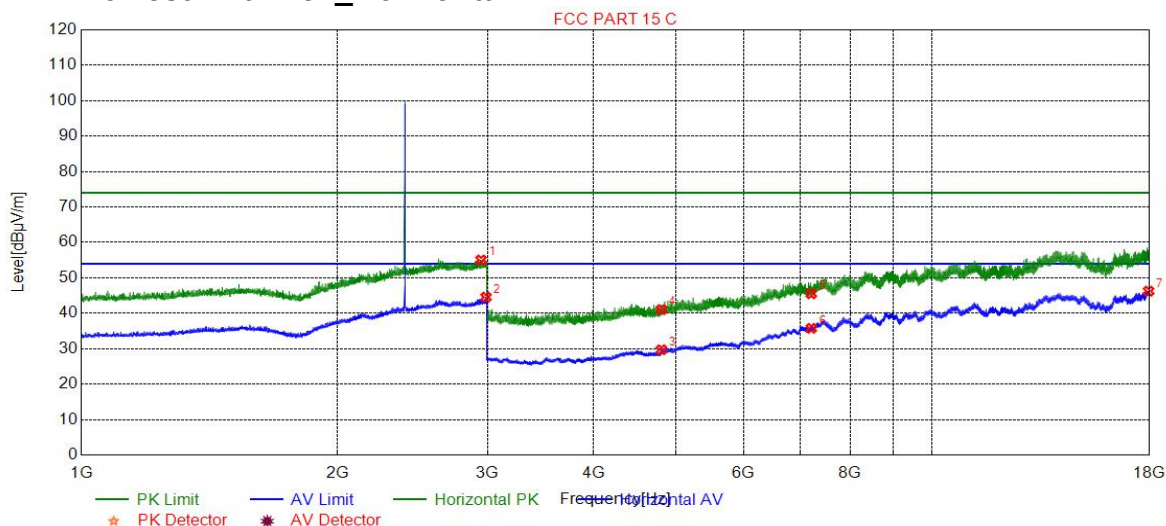


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2975.9940	55.44	9.56	74.00	18.56	150	54	Vertical
2	2980.9952	43.81	9.54	54.00	10.19	150	54	Vertical
3	4960.0000	29.09	-17.47	54.00	24.91	150	351	Vertical
4	4960.0000	40.19	-17.47	74.00	33.81	150	18	Vertical
5	7440.0000	48.00	-9.35	74.00	26.00	150	92	Vertical
6	7440.0000	37.25	-9.35	54.00	16.75	150	142	Vertical
7	17919.1460	46.40	0.70	54.00	7.60	150	192	Vertical



4.11.2.4 Lowest Channel _Horizontal

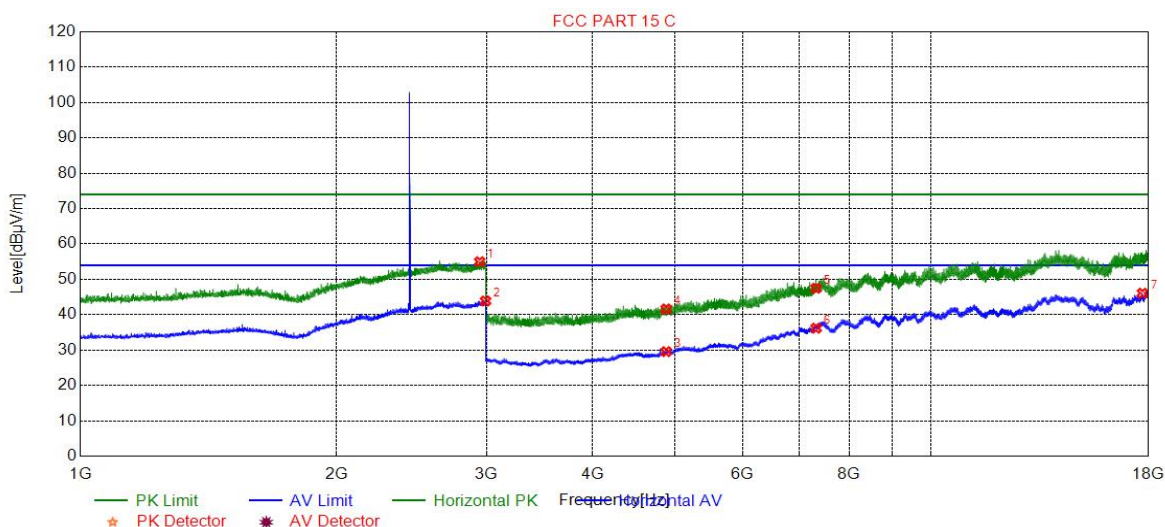


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2948.4871	55.05	9.66	74.00	18.95	150	52	Horizontal
2	2988.4971	44.56	9.50	54.00	9.44	150	214	Horizontal
3	4804.0000	29.71	-18.30	54.00	24.29	150	57	Horizontal
4	4804.0000	41.06	-18.30	74.00	32.94	150	360	Horizontal
5	7206.0000	45.51	-10.09	74.00	28.49	150	193	Horizontal
6	7206.0000	35.76	-10.09	54.00	18.24	150	1	Horizontal
7	17950.4975	46.25	0.71	54.00	7.75	150	93	Horizontal



4.11.2.5 Middle Channel _ Horizontal

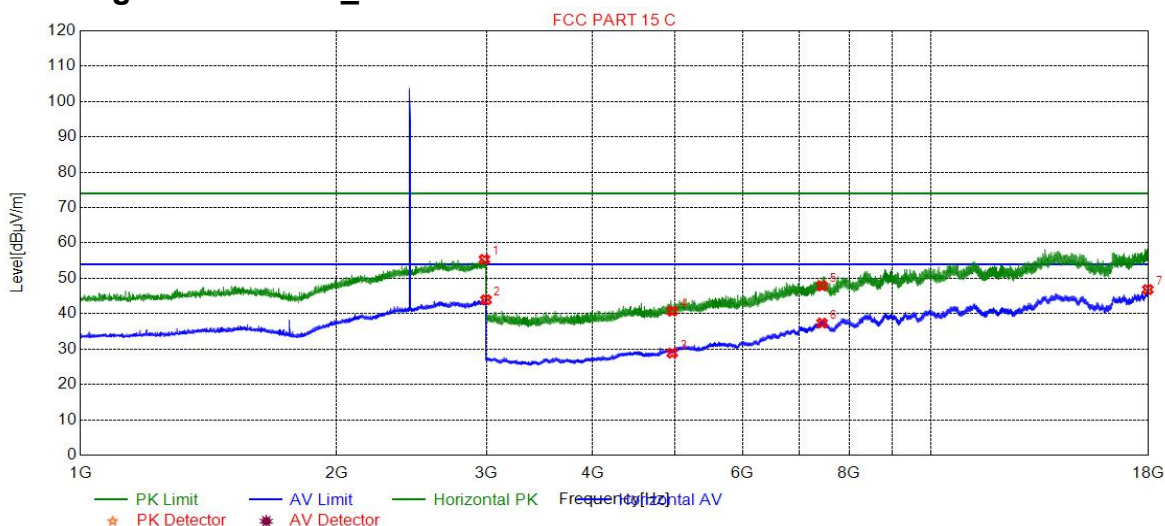


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2946.4866	55.00	9.64	74.00	19.00	150	192	Horizontal
2	2992.9983	43.89	9.48	54.00	10.11	150	18	Horizontal
3	4880.0000	29.57	-17.97	54.00	24.43	150	202	Horizontal
4	4880.0000	41.62	-17.97	74.00	32.38	150	85	Horizontal
5	7320.0000	47.48	-9.72	74.00	26.52	150	243	Horizontal
6	7320.0000	36.20	-9.72	54.00	17.80	150	242	Horizontal
7	17704.0852	46.08	1.28	54.00	7.92	150	91	Horizontal



4.11.2.6 Highest Channel _ Horizontal



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2983.9960	55.37	9.52	74.00	18.63	150	50	Horizontal
2	2996.9993	43.92	9.46	54.00	10.08	150	320	Horizontal
3	4960.0000	28.87	-17.47	54.00	25.13	150	55	Horizontal
4	4960.0000	40.72	-17.47	74.00	33.28	150	215	Horizontal
5	7440.0000	47.89	-9.35	74.00	26.11	150	185	Horizontal
6	7440.0000	37.36	-9.35	54.00	16.64	150	242	Horizontal
7	17959.8480	46.83	0.71	54.00	7.17	150	242	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:

Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – 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.



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
	960MHz-1GHz	54.0	Quasi-peak Value
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			

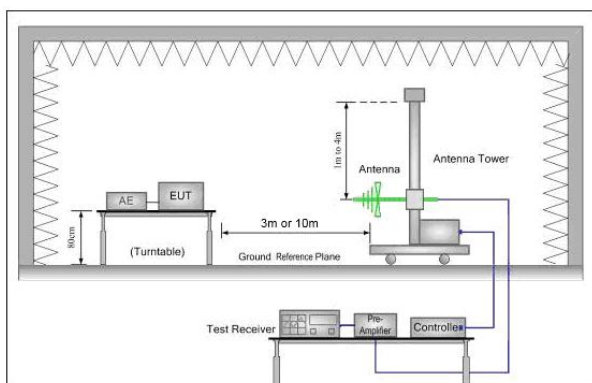


Figure 1. 30MHz to 1GHz

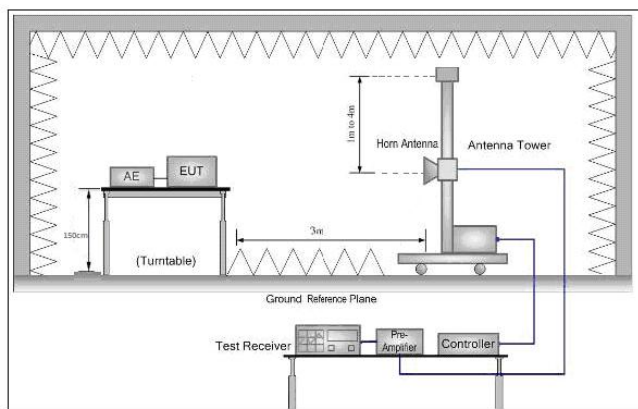


Figure 2. Above 1 GHz

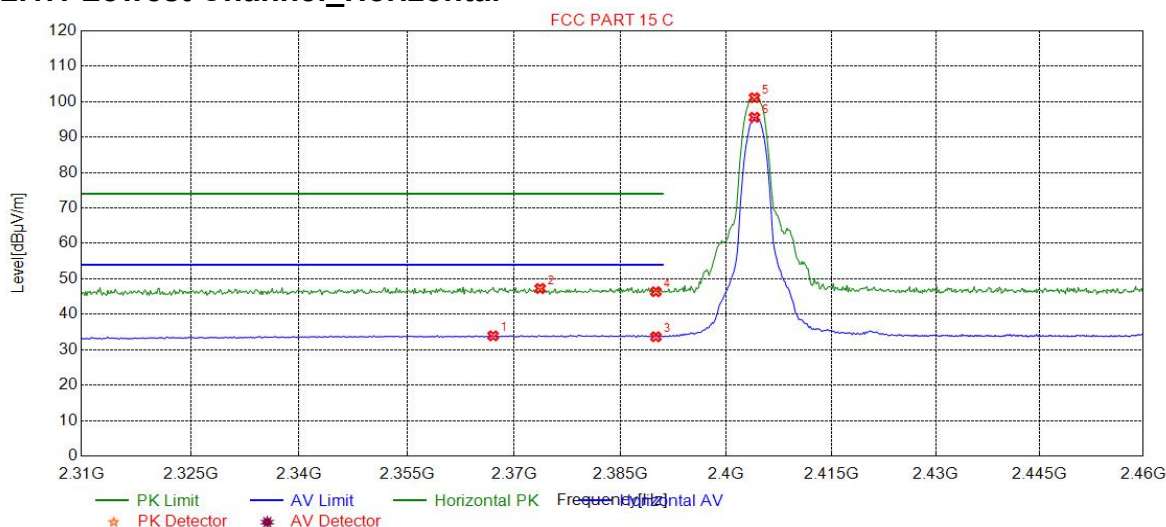


Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating 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.
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type Charge + Transmitting mode.
Final Test Mode:	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.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass



4.12.1 Test plots

4.12.1.1 Lowest Channel_Horizontal

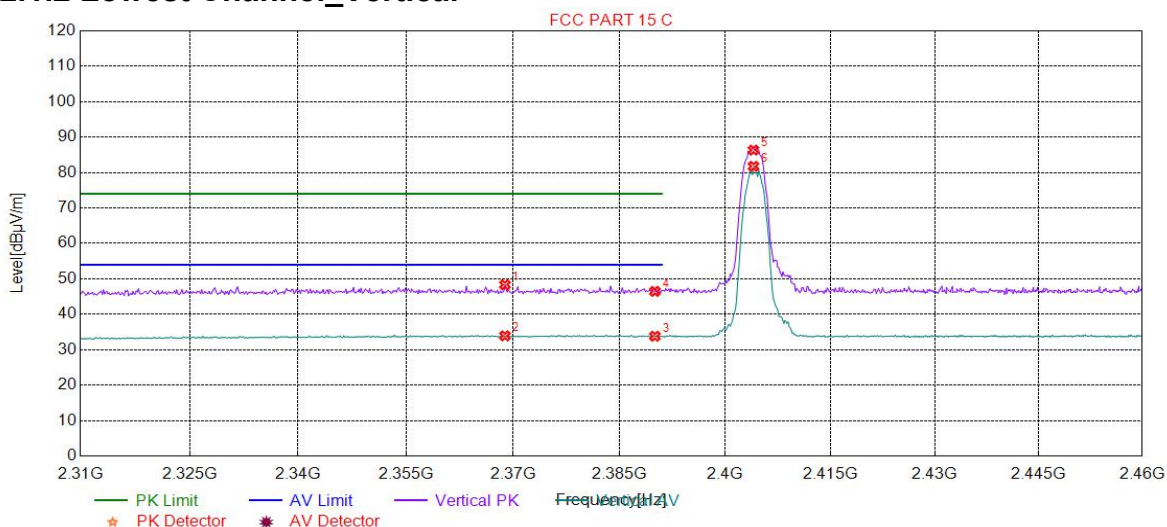


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2367.0571	33.93	7.79	54.00	20.07	150	276	Horizontal
2	2373.6637	47.29	7.79	74.00	26.71	150	304	Horizontal
3	2390.0000	33.66	7.77	54.00	20.34	150	243	Horizontal
4	2390.0000	46.38	7.77	74.00	27.62	150	332	Horizontal
5	2404.0000	101.12	7.78	0.00	-101.12	150	52	Horizontal
6	2404.0000	95.59	7.78	0.00	-95.59	150	60	Horizontal



4.12.1.2 Lowest Channel_Vertical

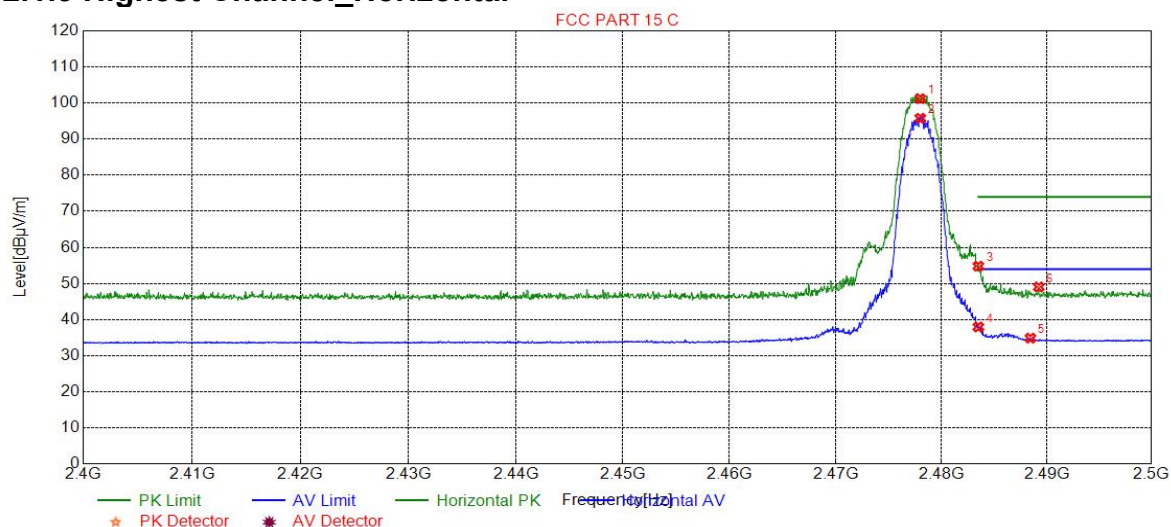


Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2368.8589	48.33	7.79	74.00	25.67	150	33	Vertical
2	2368.8589	33.92	7.79	54.00	20.08	150	224	Vertical
3	2390.0000	33.81	7.77	54.00	20.19	150	52	Vertical
4	2390.0000	46.47	7.77	74.00	27.53	150	81	Vertical
5	2404.0000	86.34	7.78	0.00	-86.34	150	228	Vertical
6	2404.0000	81.76	7.78	0.00	-81.76	150	228	Vertical



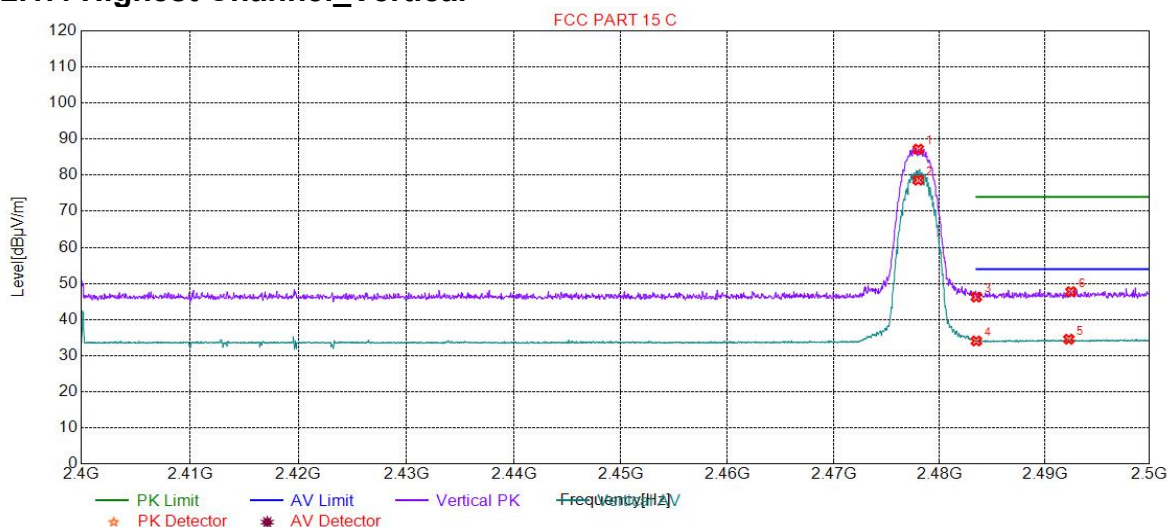
4.12.1.3 Highest Channel_Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2478.0000	101.19	8.00	0.00	-101.19	150	244	Horizontal
2	2478.0000	95.77	8.00	0.00	-95.77	150	249	Horizontal
3	2483.5000	54.80	8.01	74.00	19.20	150	244	Horizontal
4	2483.5000	37.94	8.01	54.00	16.06	150	249	Horizontal
5	2488.4442	34.86	8.02	54.00	19.14	150	41	Horizontal
6	2489.2446	49.04	8.02	74.00	24.96	150	293	Horizontal



4.12.1.4 Highest Channel_Vertical



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2478.0000	87.22	8.00	0.00	-87.22	150	275	Vertical
2	2478.0000	78.62	8.00	0.00	-78.62	150	14	Vertical
3	2483.5000	46.22	8.01	74.00	27.78	150	325	Vertical
4	2483.5000	34.07	8.01	54.00	19.93	150	275	Vertical
5	2492.2961	34.56	8.02	54.00	19.44	150	357	Vertical
6	2492.4962	47.74	8.02	74.00	26.26	150	72	Vertical

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.



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

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	$\pm 0.75\text{dB}$
2	RF power density, conducted	$\pm 2.84\text{dB}$
3	Spurious emissions, conducted	$\pm 0.75\text{dB}$
4	Radiated Spurious emission test	$\pm 4.5\text{dB}$ (30MHz-1GHz)
		$\pm 4.8\text{dB}$ (1GHz-25GHz)
5	Conduct emission test	$\pm 3.12\text{ dB}$ (9KHz- 30MHz)
6	Temperature test	$\pm 1^{\circ}\text{C}$
7	Humidity test	$\pm 3\%$
8	DC and low frequency voltages	$\pm 0.5\%$

