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ReGrow Helmet Inc

TEST REPORT

REPORT NUMBER
190700234TWN-001

ISSUE DATE

May 11, 2020

PAGES
33

DOCUMENT CONTROL NUMBER

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Radio Spectrum
TEST REPORT

Applicant:	**ReGrow Helmet Inc** **Unit 105, 264 Queens Quay West Toronto, Ontario Canada M5J 1B5**
Product:	**Regrow Helmet with BT4.0 & WiFi**
Model No.:	**RGH1**
Brand Name:	**Regrow Helmet**
FCC ID:	**2AUSE-RGH1**
Test Method/ Standard:	**47 CFR FCC Part 15.249 & ANSI C63.10 2013**
Test By:	**Intertek Testing Services Taiwan Ltd.,** **Hsinchu Laboratory** **No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,** **Shiang-Shan District, Hsinchu City, Taiwan**

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Revision History

Report No.	Issue Date	Revision Summary
190700234TWN-001	May 11, 2020	Original report

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Summary of Tests

Test	Reference	Results
20dB Bandwidth	15.215(c)	Pass
Radiated Emission test	15.249(c), 15.209	Pass
Emission on the Band Edge	15.249(d)	Pass
Conducted Emission of AC Power	15.207	Pass
Antenna Requirement	15.203	Pass

1. General Information

1.1 Identification of the EUT

Product:	Regrow Helmet with BT4.0 & WiFi
Model No.:	RGH1
Operating Frequency:	79 channels
Channel Number:	2402+1k MHz, k＝0~78
Access scheme:	GFSK, π/4DQSP, 8DPSK
Rated Power:	DC 12V from adapter
Power Cord:	N/A
Sample receiving date:	May 27, 2019
Sample condition:	Workable
Test Date(s):	Jun. 18, 2019 ~ Jul. 12, 2019

1.2 Antenna description

Antenna Gain : -0.9 dBi
Antenna Type : Chip Antenna
Connector Type : Fixed

1.3 Peripherals equipment

No.	Model no.	Specification
Adapter	EM1024QU	I/P: 100-240V~, 1.0~0.5A, 50-60Hz O/P: 12V, 2A

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Notebook PC	DELL	Latitude E5420	HXYJBT1	USB shielded cable 0.8 meter

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

TX mode: EUT use 「Tera Term」 entering test mode to change different channel and modulation.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	26	℃
Relative Humidity:	59	%
Atmospheric Pressure:	1008	hPa

3.2 Test setup & procedure

Step 1: The 20dB bandwidth was measured using a 50 ohm spectrum analyzer
Step 2: The span range for the SA display shall be between two times and five times the OBW.
Step 3: The nominal IF filter bandwidth (3 dB RBW) should be approximately 1 % to 5 % of the OBW, unless otherwise specified, depending on the applicable requirement.
Step 4: The test was performed at 1 channel. The maximum 20dB modulation bandwidth is in the following Table.

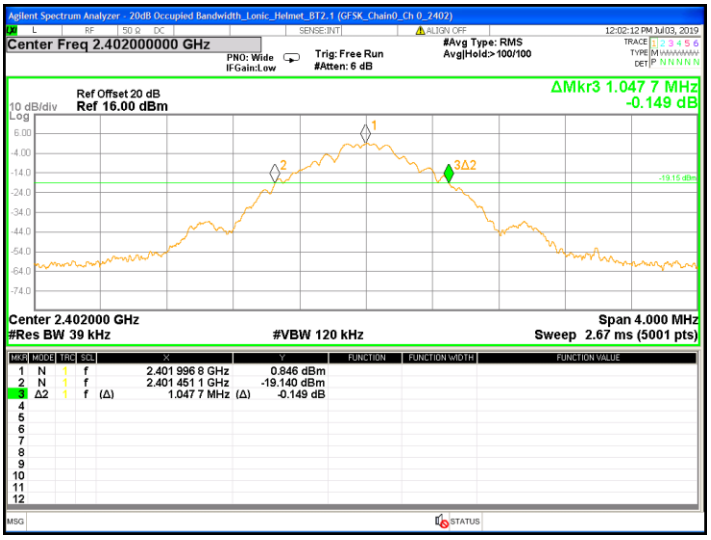
3.3 Measured data of modulated bandwidth test results

Single TX

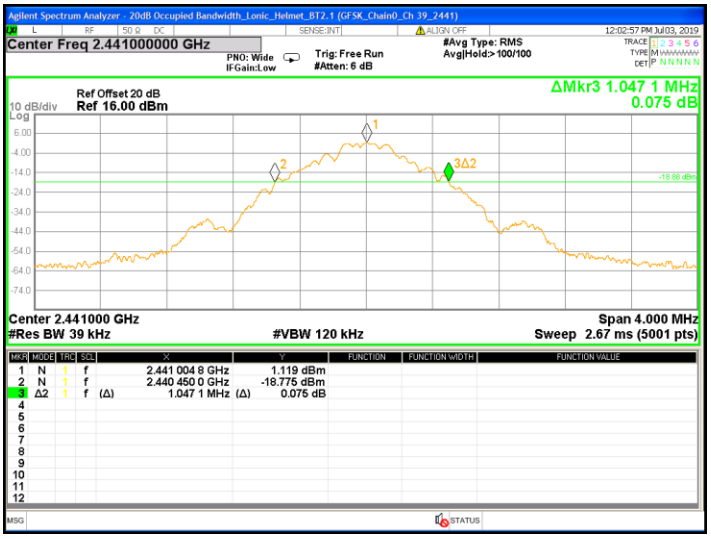
Mode	Frequency (MHz)	20dB Occupied Bandwidth (MHz)
GFSK	2402	1.048
	2441	1.047
	2480	1.049
π/4-DQPSK	2402	1.356
	2441	1.360
	2480	1.362
8DQPSK	2402	1.376
	2441	1.376
	2480	1.374

Please see the plot below.

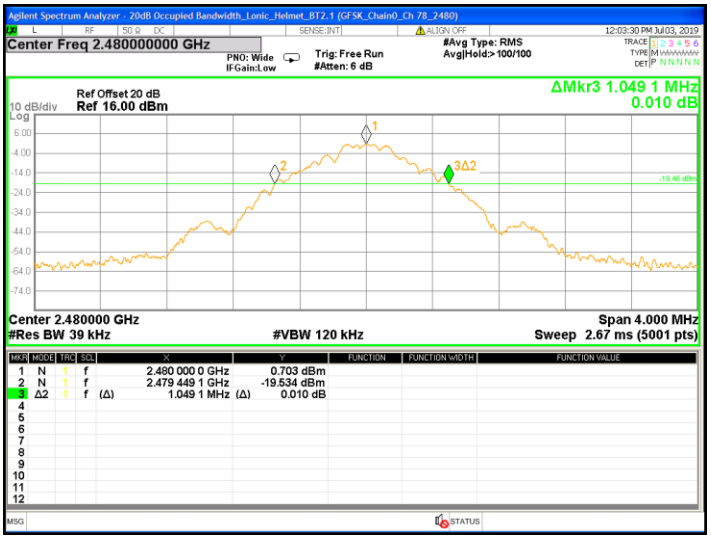
20dB Bandwidth @ GFSK_Channel 0



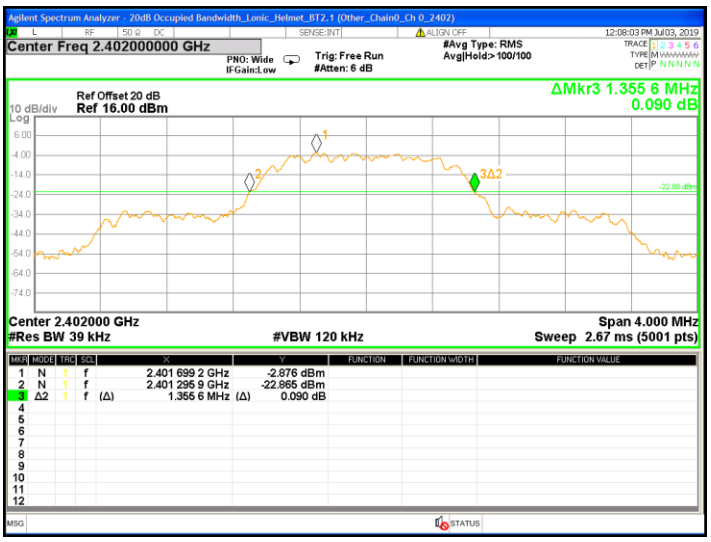
20dB Bandwidth @ GFSK_Channel 39



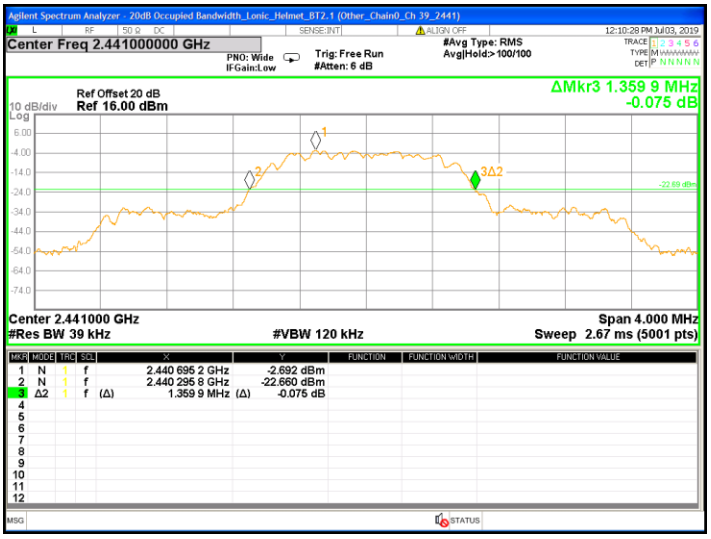
20dB Bandwidth @ GFSK_Channel 78



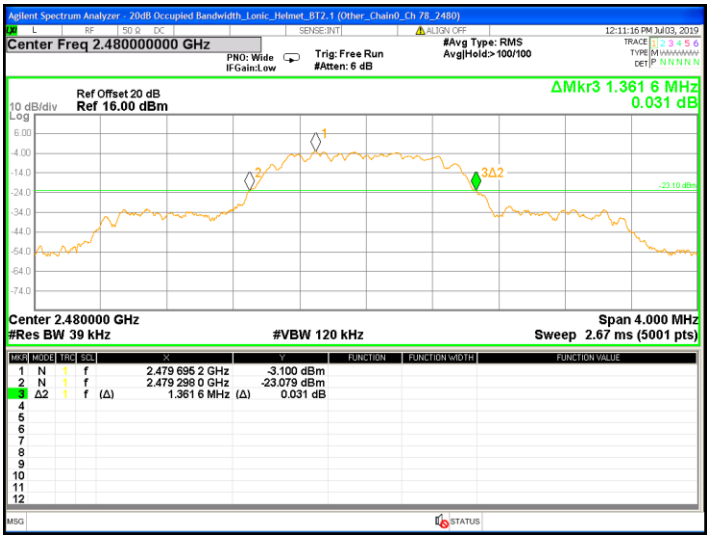
20dB Bandwidth @ π/4-DQPSK_Channel 0



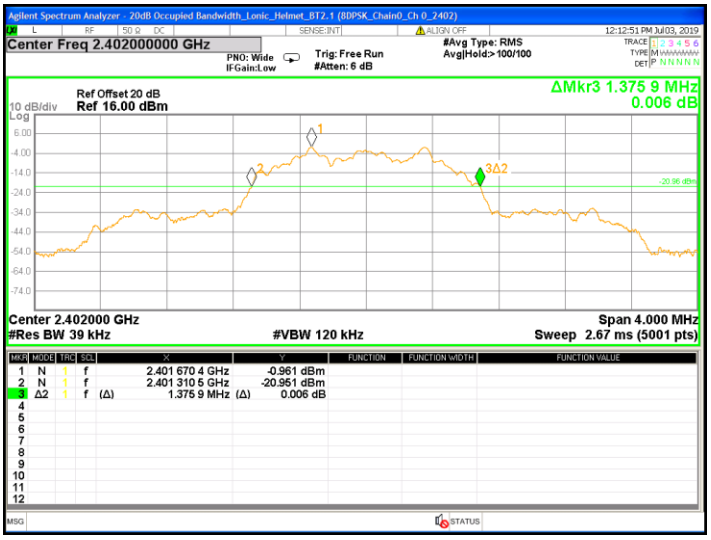
20dB Bandwidth @ π/4-DQPSK_Channel 39



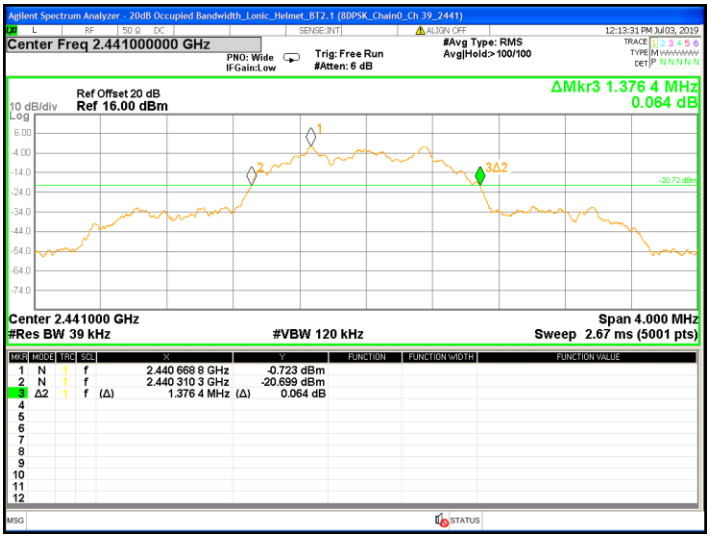
20dB Bandwidth @ π/4-DQPSK_Channel 78



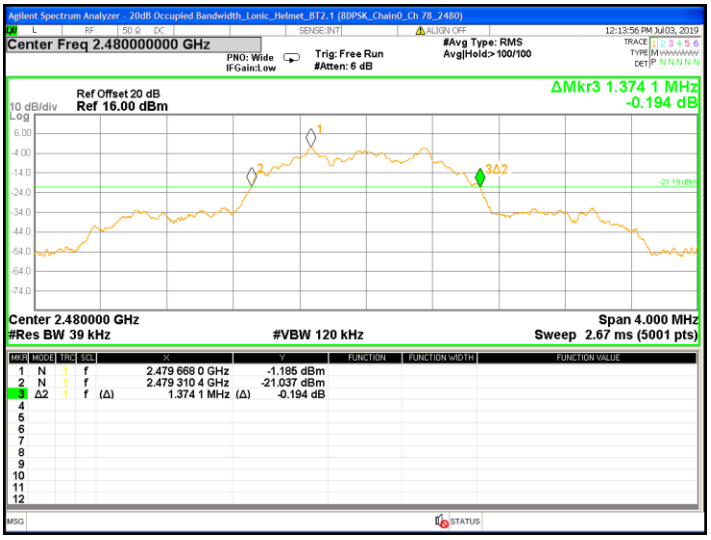
20dB Bandwidth @ 8DQPSK_Channel 0



20dB Bandwidth @ 8DQPSK_Channel 39



20dB Bandwidth @ 8DQPSK_Channel 78



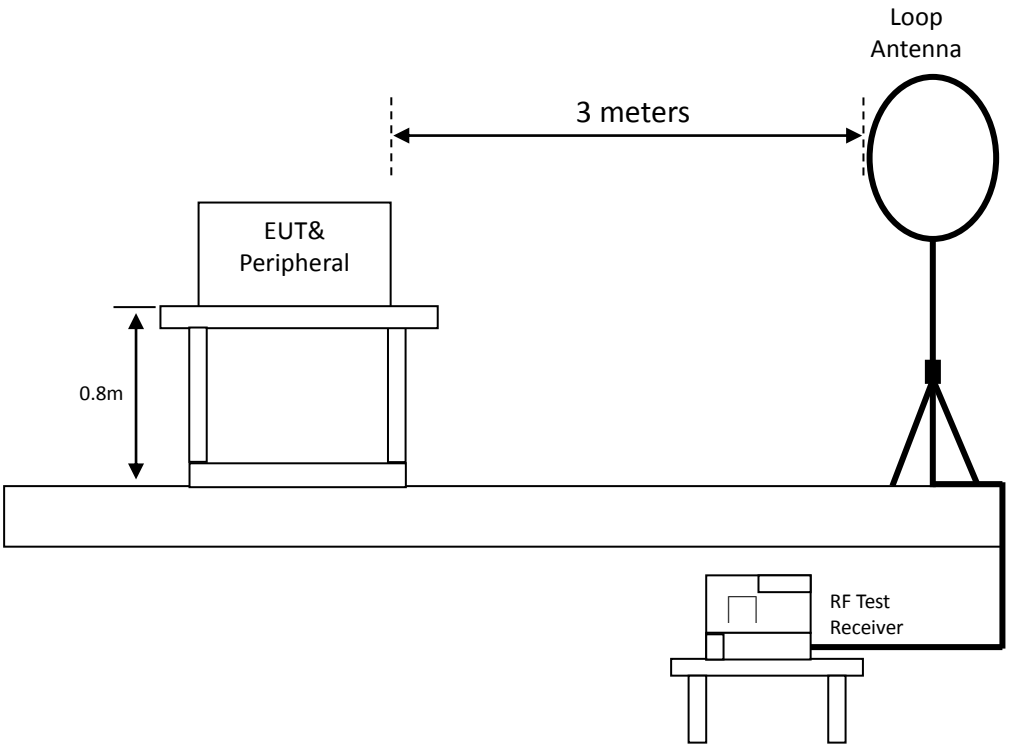
4. Radiated emission test FCC 15.249 (C)

4.1 Operating environment

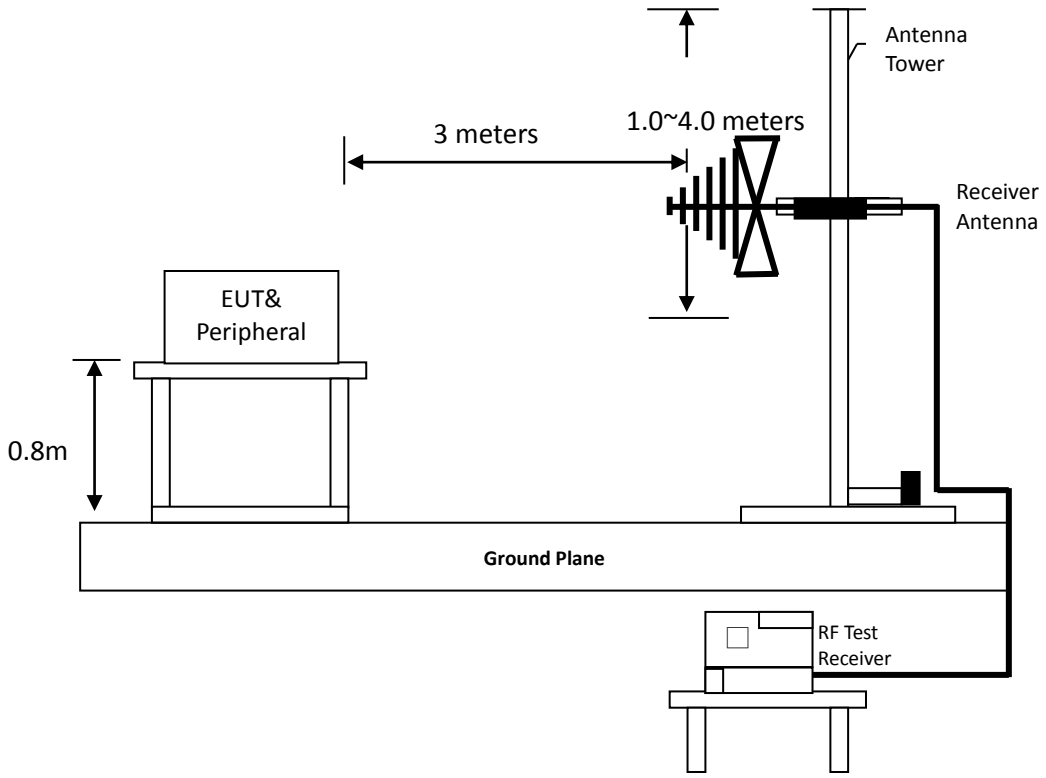
Temperature:	25	℃
Relative Humidity:	59	%
Atmospheric Pressure:	1008	hPa

4.2 Test setup & procedure

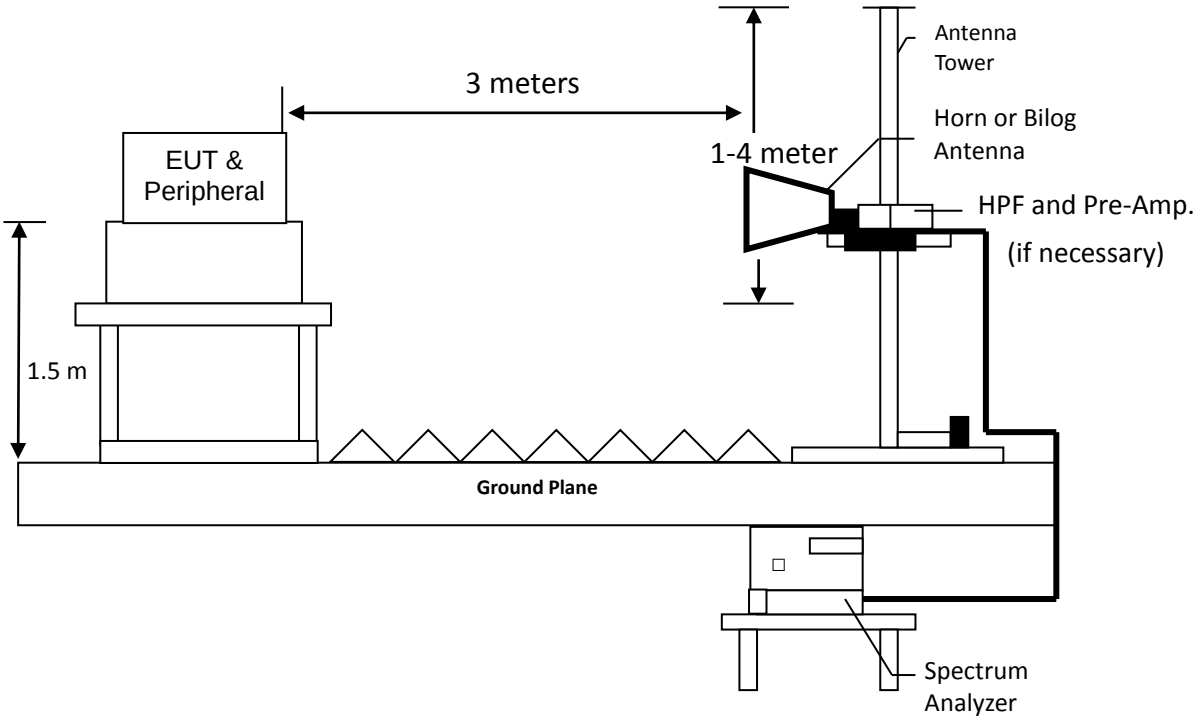
Radiated emission from 9kHz to 30MHz uses Loop Antenna:



Radiated emission below 1GHz using Bilog Antenna



Radiated emission above 1GHz using Horn Antenna



Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1 MHz RBW/ 3 MHz VBW) recorded also on the report.
The EUT for testing is arranged on a turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

4.3 Emission limit

4.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m@3m)	(dBuV/m@3m)	(uV/m@3m)	(dBuV/m@3m)
2400-2483.5	50	94	500	54

4.3.2 General radiated emission limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

Frequency MHz	15.209 Limits (dBµV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

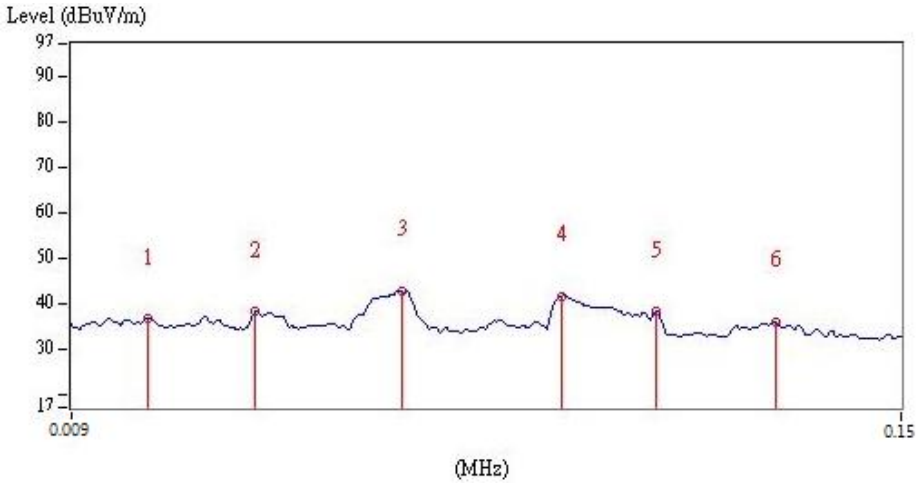
Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

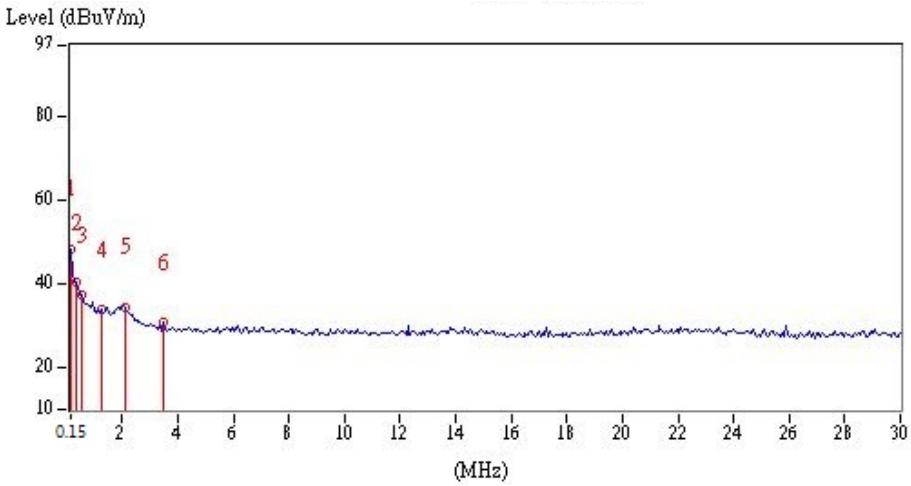
4.4 Radiated spurious emission test data

4.4.1 Measurement results: frequency range from 9 kHz to 30 MHz

EUT: RGH1

Polarity (circle)	Frequency (MHz)	Detection value	Factor (dB/m)	Reading (dBµV)	Value (dBµV/m)	Limit @ 3m (dBµV/m)	Tolerance (dB)
Plane	0.02	PK	18.82	17.62	36.44	121.58	-85.14
Plane	0.04	PK	18.85	19.19	38.04	115.56	-77.52
Plane	0.07	PK	18.54	24.10	42.64	110.70	-68.06
Plane	0.09	PK	18.32	23.09	41.41	108.52	-67.11
Plane	0.11	PK	18.26	19.88	38.14	106.78	-68.64
Plane	0.13	PK	18.27	17.63	35.90	105.33	-69.43
Plane	0.15	PK	18.27	30.16	48.43	104.08	-55.65
Plane	0.33	PK	18.33	21.97	40.30	97.23	-56.93
Plane	0.57	QP	18.43	18.94	37.37	72.49	-35.12
Plane	1.28	QP	18.73	15.08	33.81	65.46	-31.65
Plane	2.12	QP	18.84	15.55	34.38	69.54	-35.16
Plane	3.49	QP	19.09	11.67	30.76	69.54	-38.78


Level (dBuV/m)
97
90
80
70
60
50
40
30
17
1
2
3
4
5
6
0.009
0.15
(MHz)


Level (dBuV/m)
97
80
60
40
20
10
1
2
3
4
5
6
0.15
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
(MHz)

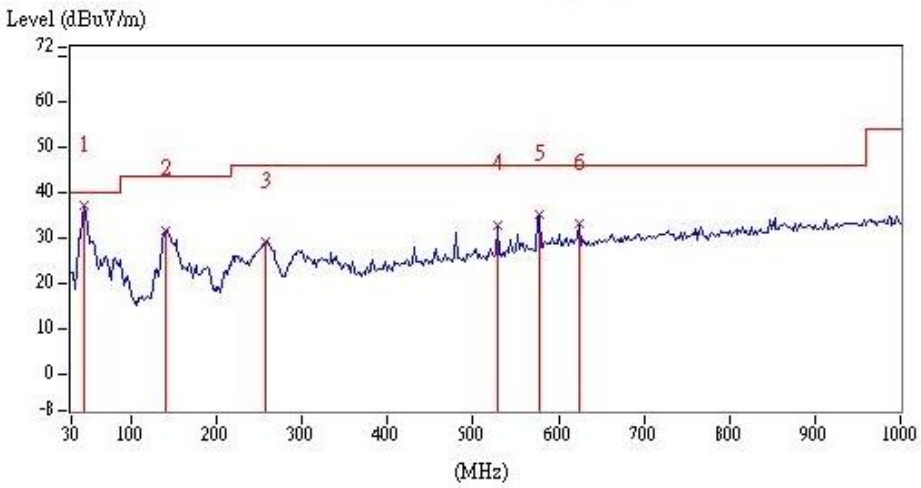
4.4.2 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under GFSK, π/4DQSP, & 8-DPSK continuously transmitting mode. Channel 0, 39, 78 were verified. The worst case occurred at GFSK TX Channel 78

EUT: RGH1
Worst case: GFSK TX Channel 78

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Vertical	45.52	QP	20.36	16.71	37.07	40.00	-2.93
Vertical	140.58	QP	19.80	11.84	31.65	43.50	-11.85
Vertical	256.98	QP	20.47	8.59	29.06	46.00	-16.94
Vertical	528.58	QP	26.59	6.31	32.90	46.00	-13.10
Vertical	577.08	QP	27.72	7.31	35.03	46.00	-10.97
Vertical	623.64	QP	28.63	4.38	33.01	46.00	-12.99

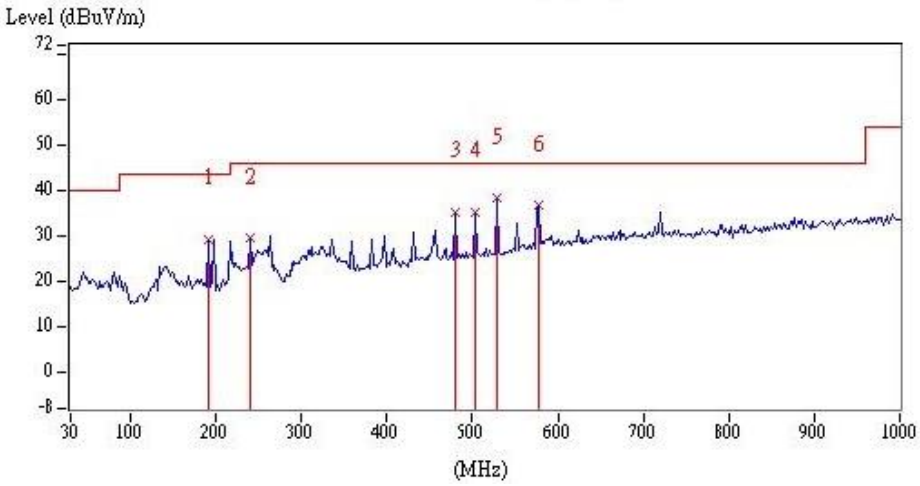
Remark: Corr. Factor = Antenna Factor + Cable Loss



EUT: RGH1
Worst case: GFSK TX Channel 78

Ant. Pol. (H/V)	Frequency (MHz)	Spectrum Analyzer Detector	Correction Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
Horizontal	191.02	QP	17.92	11.44	29.36	43.50	-14.14
Horizontal	239.52	QP	20.20	9.36	29.56	46.00	-16.44
Horizontal	480.08	QP	25.75	9.50	35.25	46.00	-10.75
Horizontal	503.36	QP	26.12	9.24	35.37	46.00	-10.63
Horizontal	528.58	QP	26.59	11.78	38.37	46.00	-7.63
Horizontal	577.08	QP	27.72	8.94	36.66	46.00	-9.34

Remark: Corr. Factor = Antenna Factor + Cable Loss



4.4.3 Measurement results: frequency above 1GHz

EUT: RGH1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBµV)	Corrected Reading (dBµV/m)	Limit @ 3 m (dBµV/m)	Margin (dB)
GFSK_Ch0	4804	PK	V	8.30	36.68	44.98	74.00	-29.02
	4804	PK	H	8.30	35.65	43.95	74.00	-30.05
GFSK_Ch39	4882	PK	V	8.66	39.06	47.72	74.00	-26.28
	4882	PK	H	8.66	37.61	46.27	74.00	-27.73
GFSK_Ch78	4960	PK	V	9.02	40.73	49.74	74.00	-24.26
	4960	PK	H	9.02	37.00	46.01	74.00	-27.99
π/4-DQPSK_Ch0	4804	PK	V	8.30	36.29	44.60	74.00	-29.40
	4804	PK	H	8.30	35.61	43.91	74.00	-30.09
π/4-DQPSK_Ch39	4882	PK	V	8.66	37.83	46.49	74.00	-27.51
	4882	PK	H	8.66	36.56	45.22	74.00	-28.78
π/4-DQPSK_Ch78	4960	PK	V	9.02	40.99	50.01	74.00	-23.99
	4960	PK	H	9.02	36.90	45.92	74.00	-28.08
8DPSK_Ch0	4804	PK	V	8.30	36.45	44.75	74.00	-29.25
	4804	PK	H	8.30	36.62	44.92	74.00	-29.08
8DPSK_Ch39	4882	PK	V	8.66	38.35	47.01	74.00	-26.99
	4882	PK	H	8.66	37.17	45.83	74.00	-28.17
8DPSK_Ch78	4960	PK	V	9.02	39.84	48.86	74.00	-25.14
	4960	PK	H	9.02	36.21	45.23	74.00	-28.77

Remark: Correction Factor = Antenna Factor + Cable Loss + High Pass Filter Loss - Pre_Amplifier Gain

4.4.4 Measurement results: Fundamental

EUT: RGH1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
GFSK_Ch0	2402	PK	V	34.51	56.24	90.75	114.00	-23.25
		AV	V	34.51	55.70	90.21	94.00	-3.79
		PK	H	34.51	58.96	93.47	114.00	-20.53
		AV	H	34.51	58.34	92.85	94.00	-1.15
GFSK_Ch39	2441	PK	V	34.61	54.97	89.58	114.00	-24.42
		AV	V	34.61	54.40	89.01	94.00	-4.99
		PK	H	34.61	58.91	93.52	114.00	-20.48
		AV	H	34.61	58.37	92.98	94.00	-1.02
GFSK_Ch78	2480	PK	V	34.70	56.10	90.81	114.00	-23.19
		AV	V	34.70	55.59	90.29	94.00	-3.71
		PK	H	34.70	59.33	94.04	114.00	-19.96
		AV	H	34.70	58.80	93.50	94.00	-0.50
π/4-DQPSK_Ch0	2402	PK	V	34.51	52.94	87.45	114.00	-26.55
		AV	V	34.51	52.40	86.91	94.00	-7.09
		PK	H	34.51	55.74	90.25	114.00	-23.75
		AV	H	34.51	55.22	89.73	94.00	-4.27
π/4-DQPSK_Ch39	2441	PK	V	34.61	54.15	88.75	114.00	-25.25
		AV	V	34.61	53.61	88.22	94.00	-5.78
		PK	H	34.61	58.05	92.66	114.00	-21.34
		AV	H	34.61	57.51	92.12	94.00	-1.88
π/4-DQPSK_Ch78	2480	PK	V	34.70	55.31	90.01	114.00	-23.99
		AV	V	34.70	54.75	89.45	94.00	-4.55
		PK	H	34.70	58.37	93.07	114.00	-20.93
		AV	H	34.70	57.82	92.52	94.00	-1.48
8DPSK_Ch0	2402	PK	V	34.51	53.06	87.57	114.00	-26.43
		AV	V	34.51	52.52	87.03	94.00	-6.97
		PK	H	34.51	55.91	90.43	114.00	-23.57
		AV	H	34.51	55.40	89.91	94.00	-4.09
8DPSK_Ch39	2441	PK	V	34.61	54.43	89.04	114.00	-24.96
		AV	V	34.61	53.89	88.50	94.00	-5.50
		PK	H	34.61	58.06	92.67	114.00	-21.33
		AV	H	34.61	57.54	92.15	94.00	-1.85
8DPSK_Ch78	2480	PK	V	34.70	55.38	90.08	114.00	-23.92
		AV	V	34.70	54.82	89.52	94.00	-4.48
		PK	H	34.70	58.53	93.24	114.00	-20.76
		AV	H	34.70	58.03	92.73	94.00	-1.27

Remark: Correction Factor = Antenna Factor + Cable Loss

5. Radiated emission on the band edge FCC 15.249(d)

5.1 Operating environment

Temperature:	27	℃
Relative Humidity:	67	%
Atmospheric Pressure:	1008	hPa

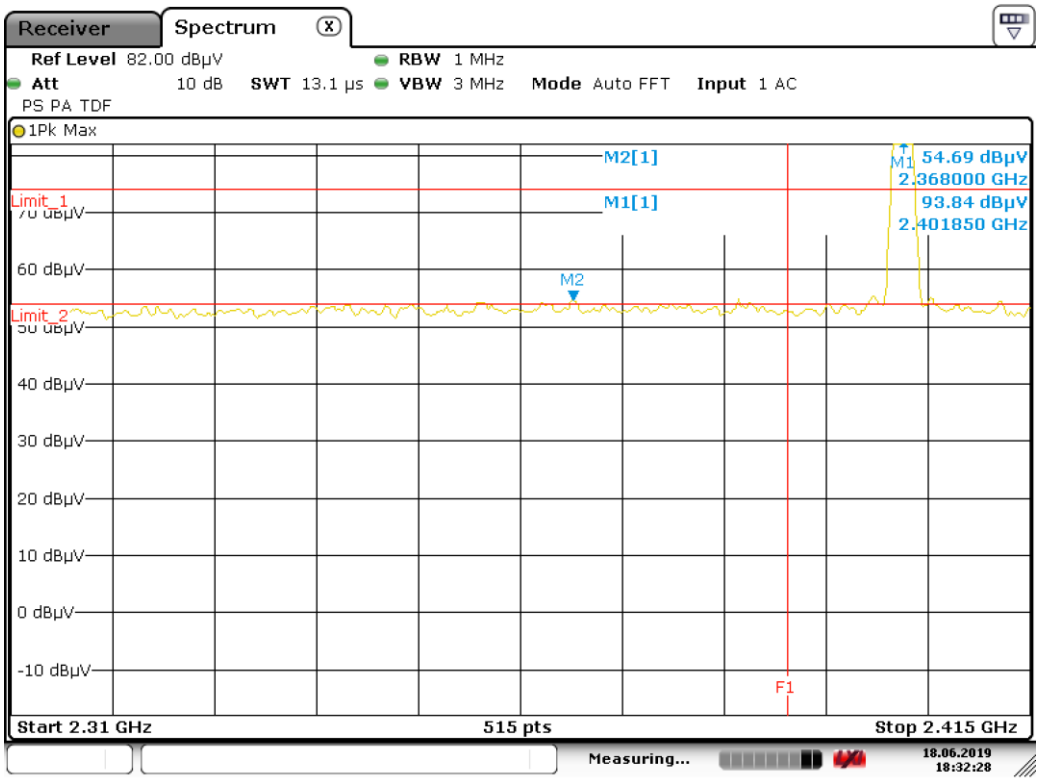
5.2 Radiated emission on the band edge test data

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Restricted band (MHz)
GFSK	2368.00	PK	H	34.43	20.26	54.69	74	-19.31	2310~2390
	2380.44	AV	H	34.46	7.04	41.50	54	-12.50	
	2493.30	PK	H	34.73	20.70	55.43	74	-18.57	2483.5~2500
	2488.74	AV	H	34.72	7.23	41.95	54	-12.05	
π/4-DQPSK	2371.88	PK	H	34.44	21.20	55.64	74	-18.36	2310~2390
	2365.97	AV	H	34.42	7.17	41.59	54	-12.41	
	2491.51	PK	H	34.73	20.35	55.08	74	-18.92	2483.5~2500
	2483.50	AV	H	34.71	7.11	41.82	54	-12.18	
8DQPSK	2386.15	PK	H	34.47	20.33	54.80	74	-19.20	2310~2390
	2366.17	AV	H	34.42	7.11	41.53	54	-12.47	
	2487.55	PK	H	34.72	21.13	55.85	74	-18.15	2483.5~2500
	2483.50	AV	H	34.71	7.10	41.81	54	-12.19	

Remark: Correction Factor = Antenna Factor + Cable Loss

Bandedge @ mode GFSK Ch0 Peak



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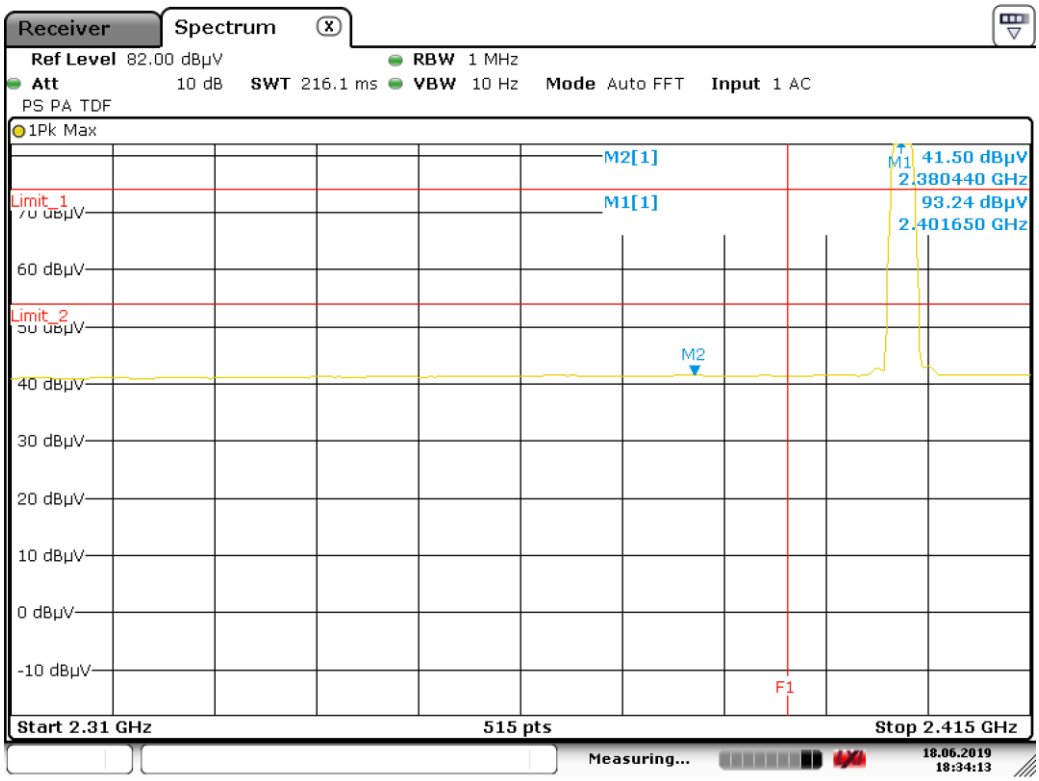
Bandedge @ mode GFSK Ch0 Average



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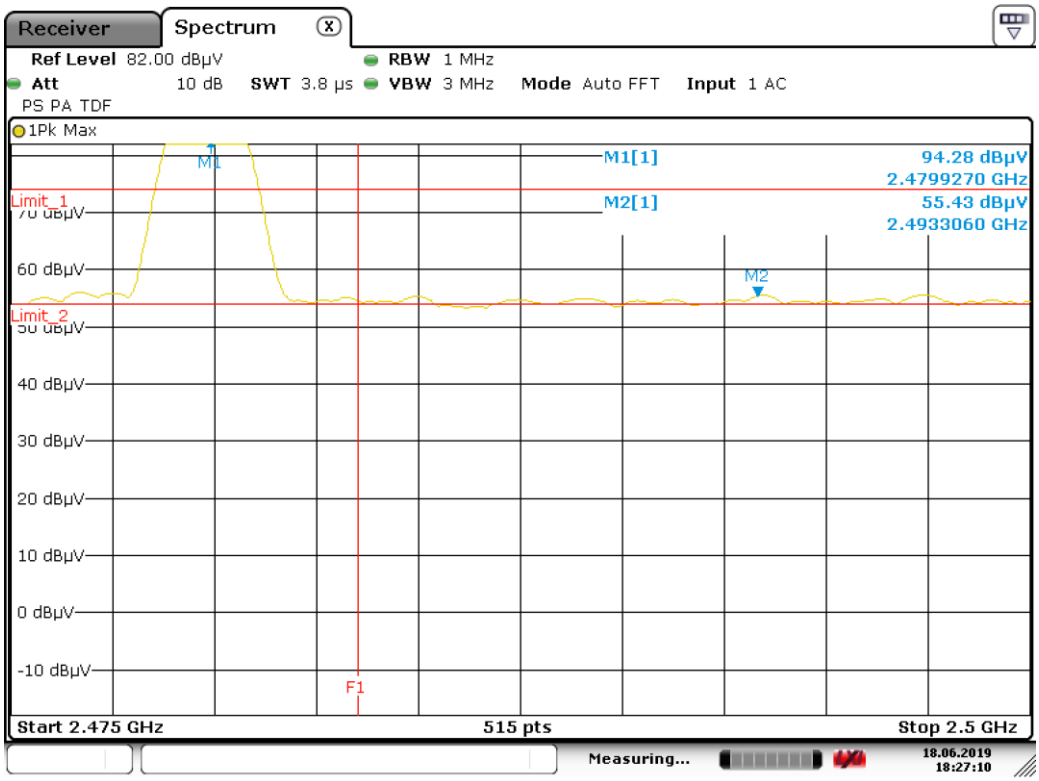
Bandedge @ mode GFSK Ch78 Peak



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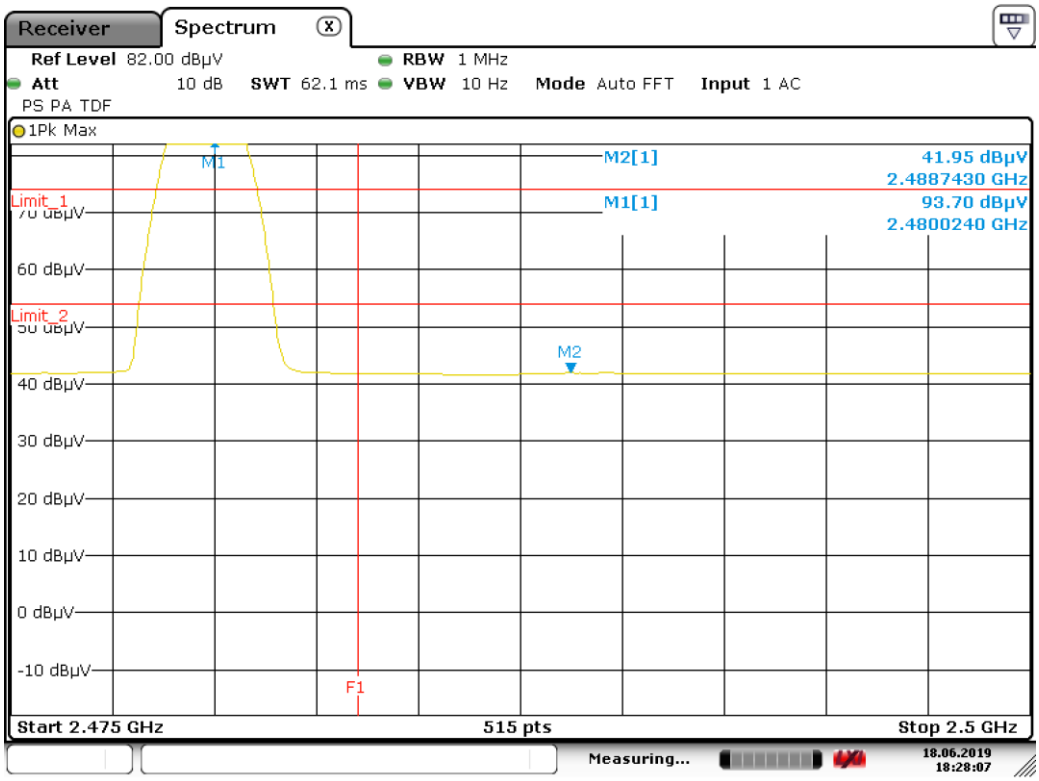

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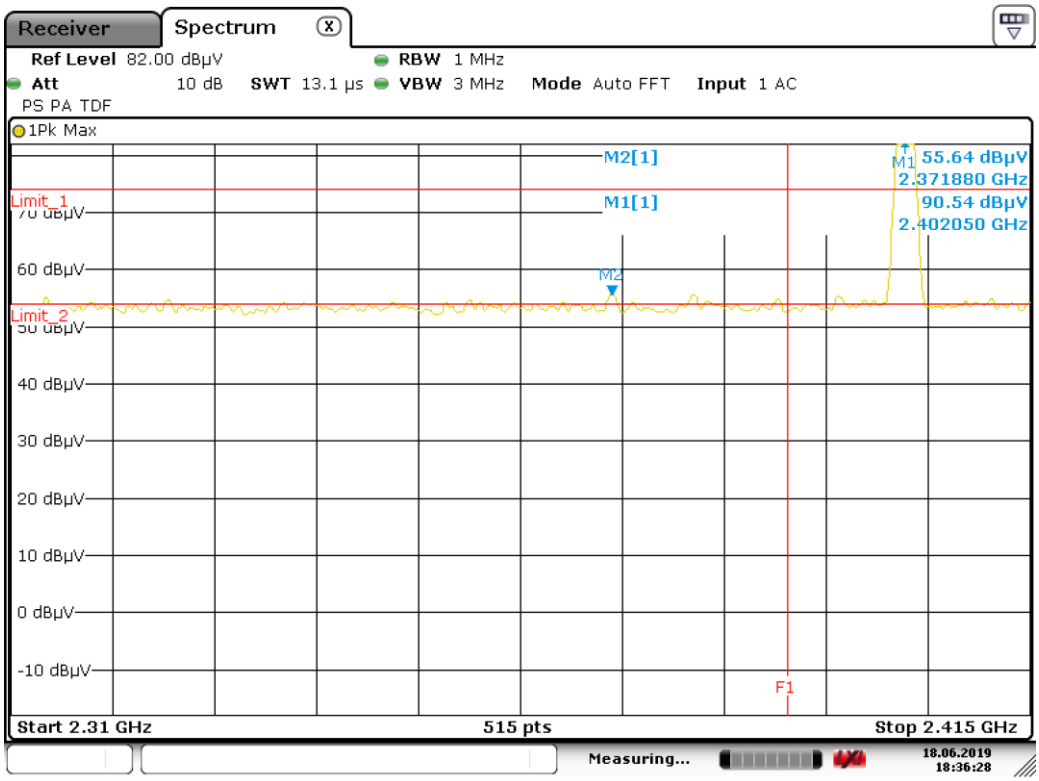

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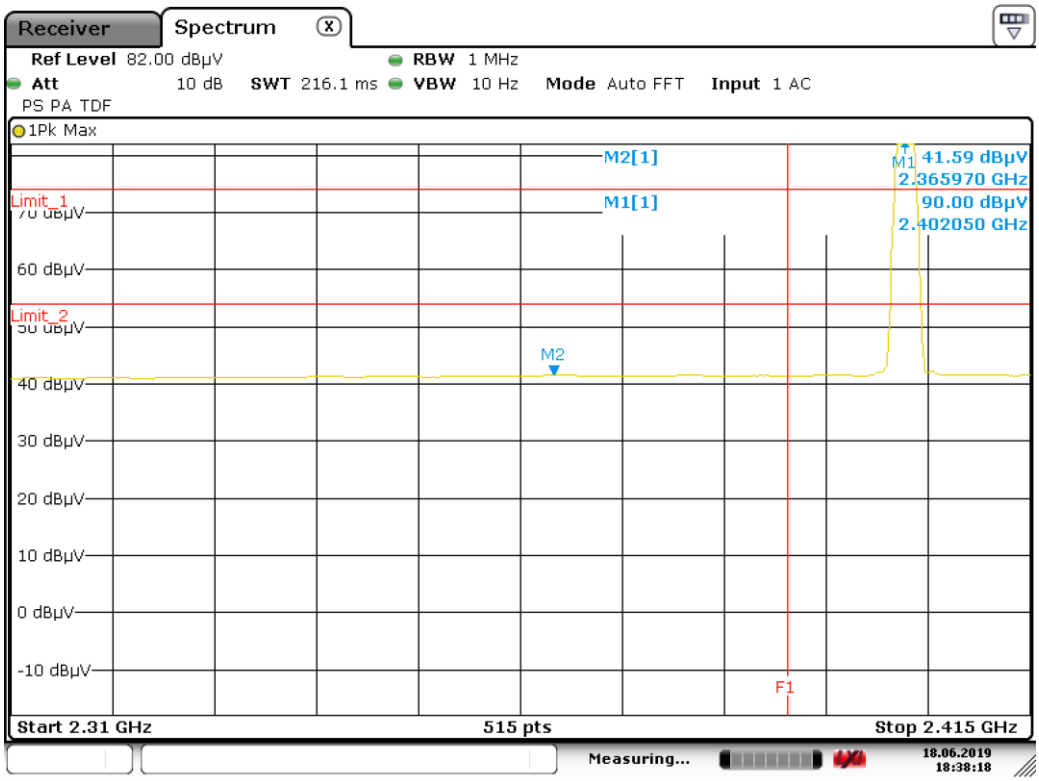

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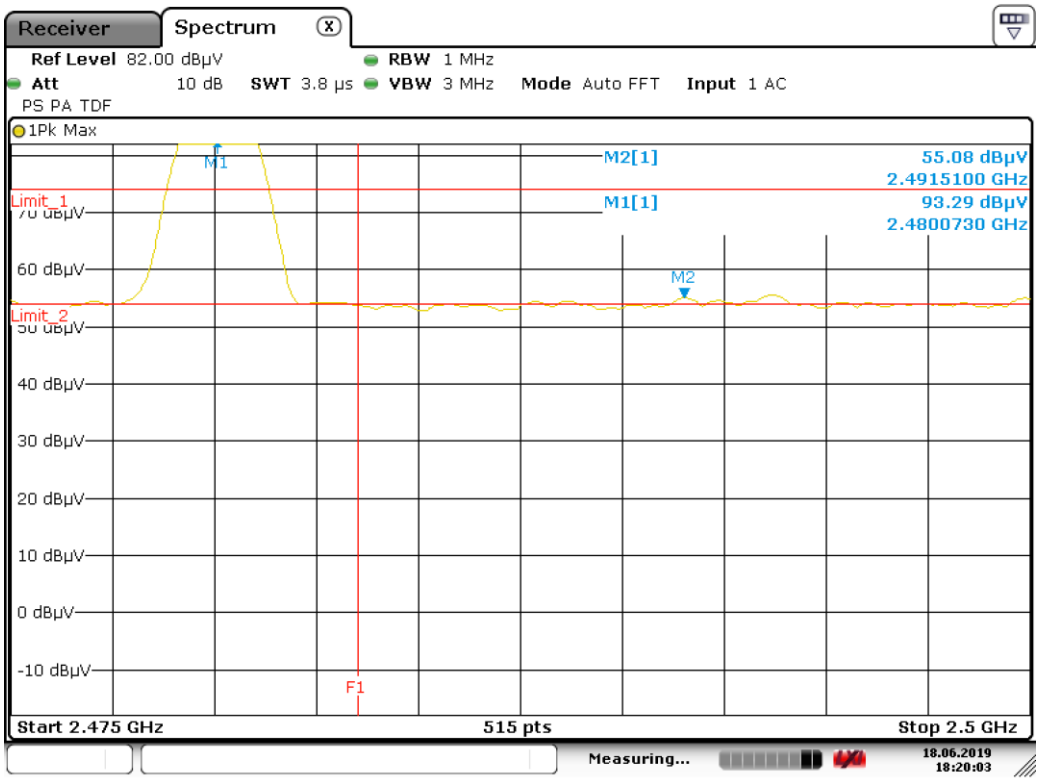

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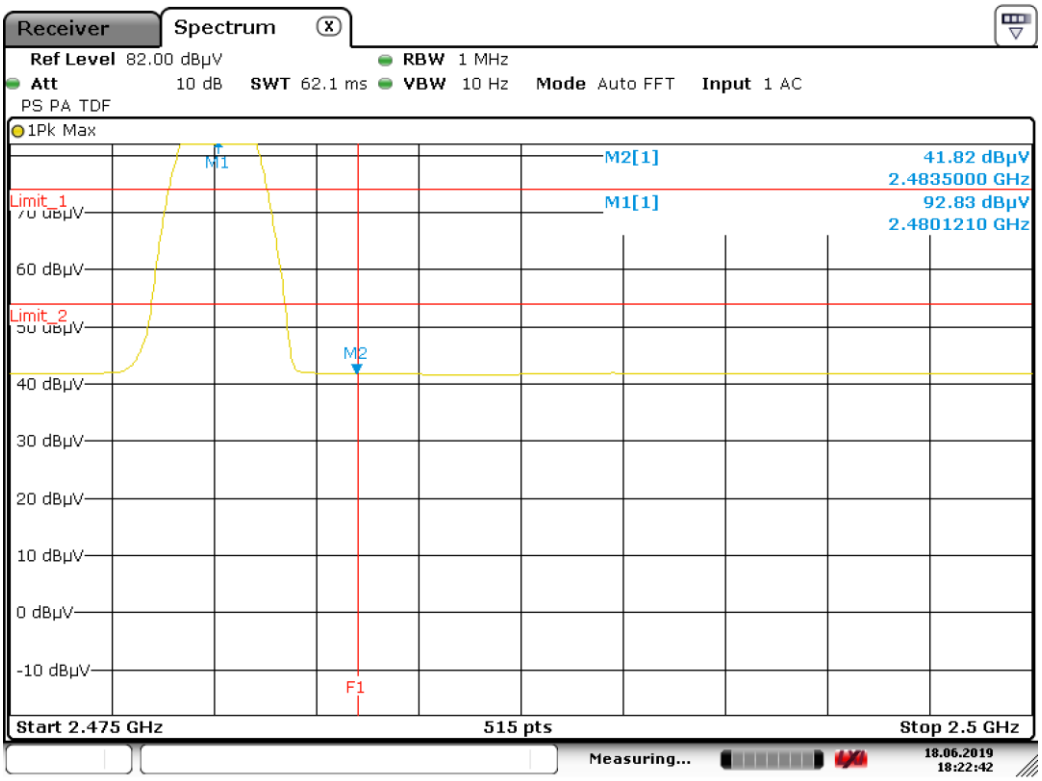
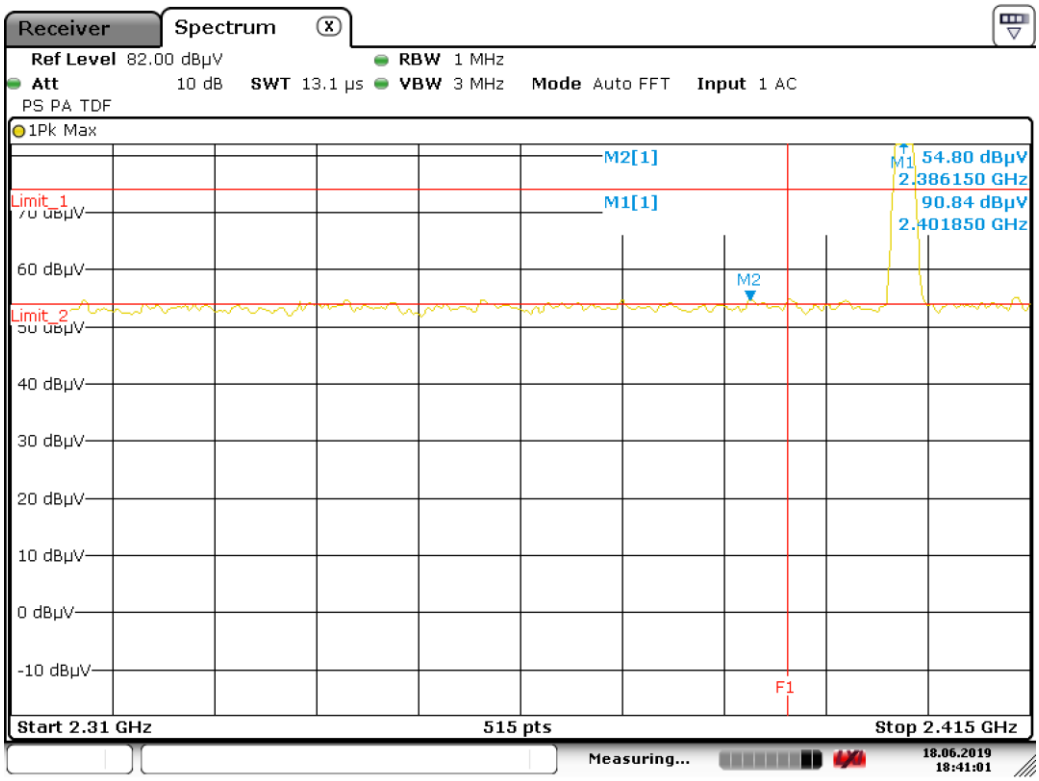


Date: 18.JUN.2019 18:22:42

Bandedge @ mode 8DPSK Ch0 Peak



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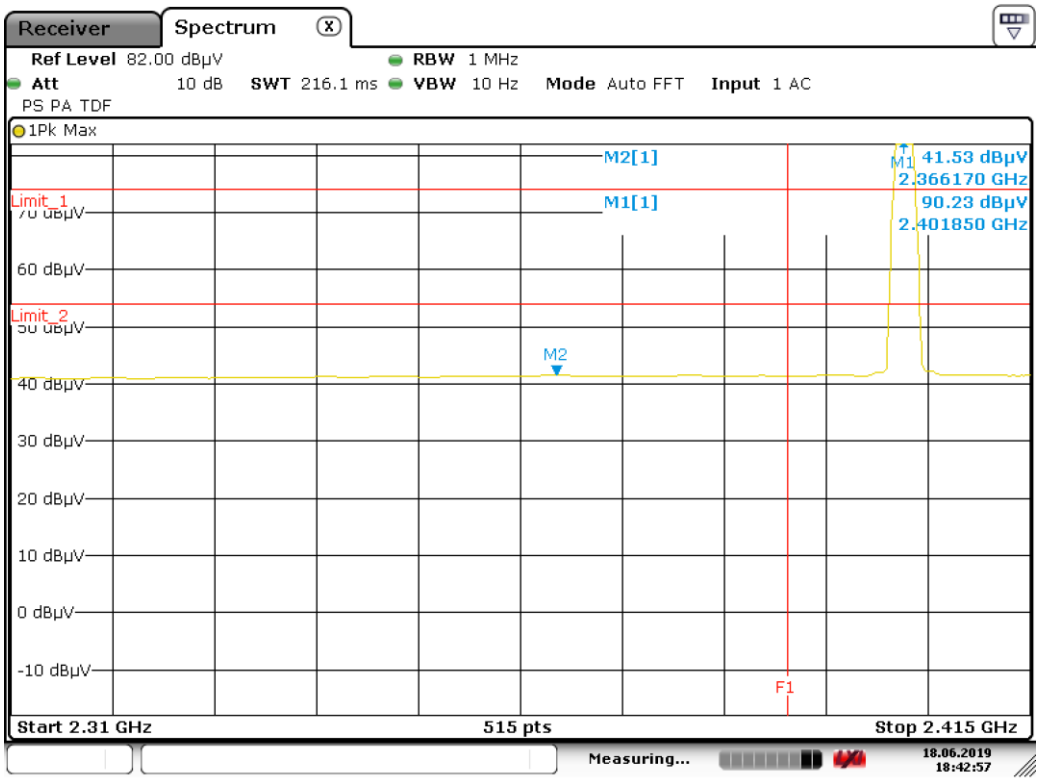

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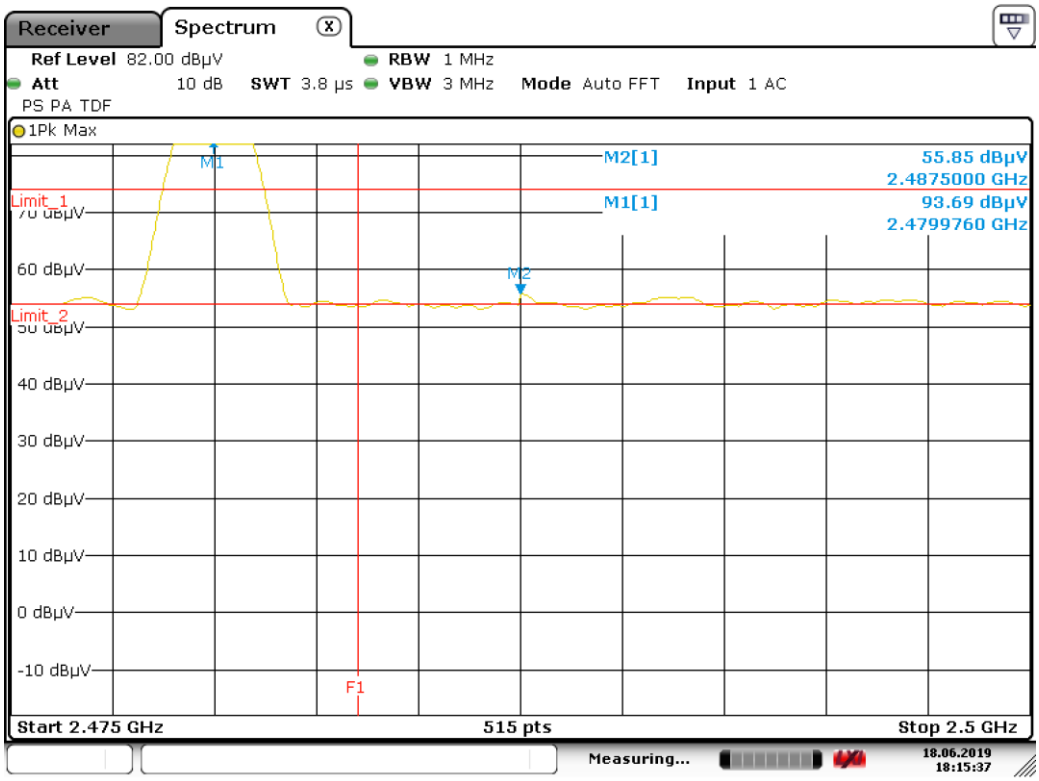

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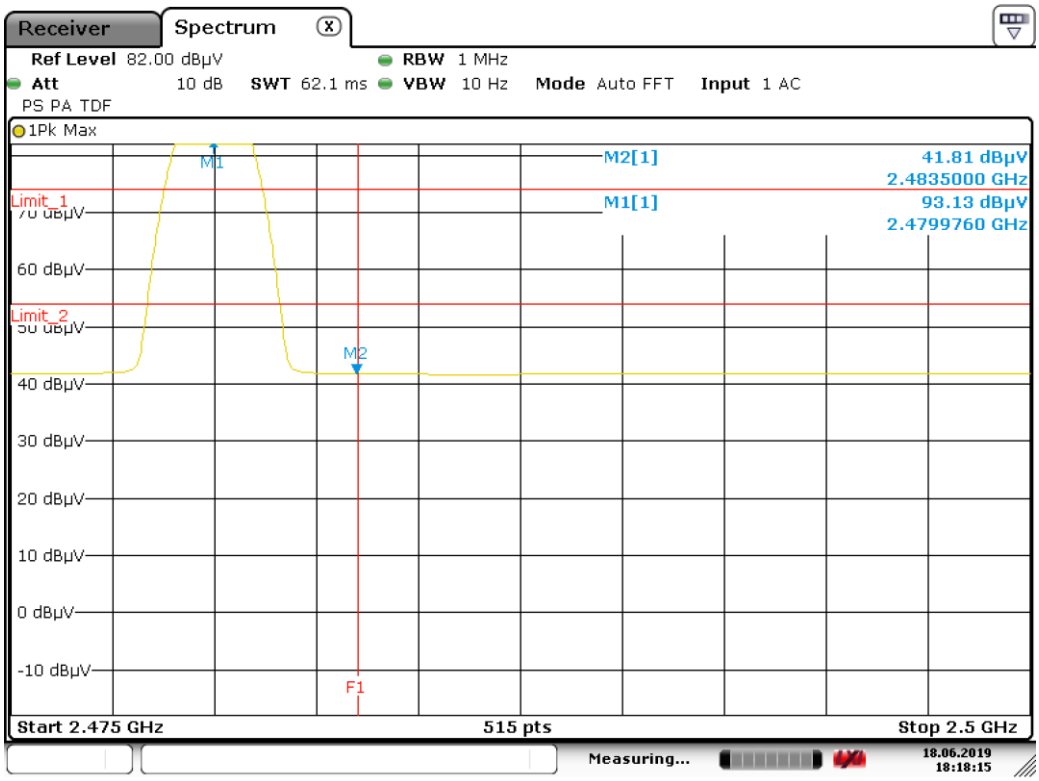


Date: 18.JUN.2019 18:18:16

6. AC Power Line Conducted Emission

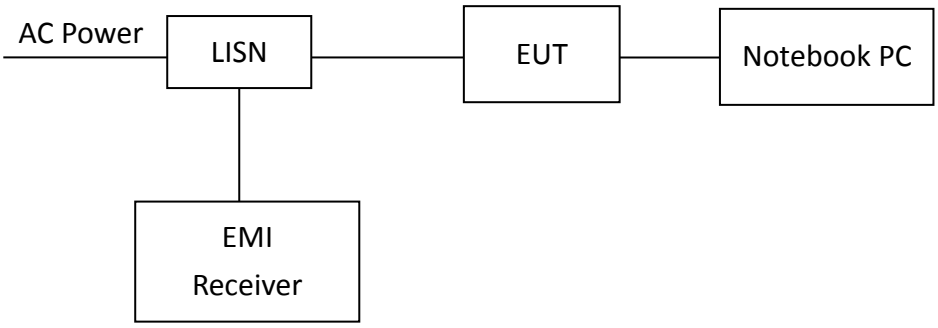
6.1 Measuring instrument setting

Receiver Function	Setting
Detector	QP
Start frequency	0.15MHz
Stop frequency	30MHz
IF bandwidth	9 kHz
Attenuation	10dB

6.2 Test Procedure

Step 1	Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
Step 2	Connect EUT or host of EUT to the power mains through a line impedance stabilization network.
Step 3	All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance.
Step 4	The frequency range from 150 kHz to 30MHz was searched.
Step 5	Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode.
Step 6	The measurement has to be done between each power line and ground at the power terminal.

6.3 Test Diagram



6.4 Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56	56 – 46
0.50~5.00	56	46
5.00~30.0	60	50

6.5 Operating Environment Condition

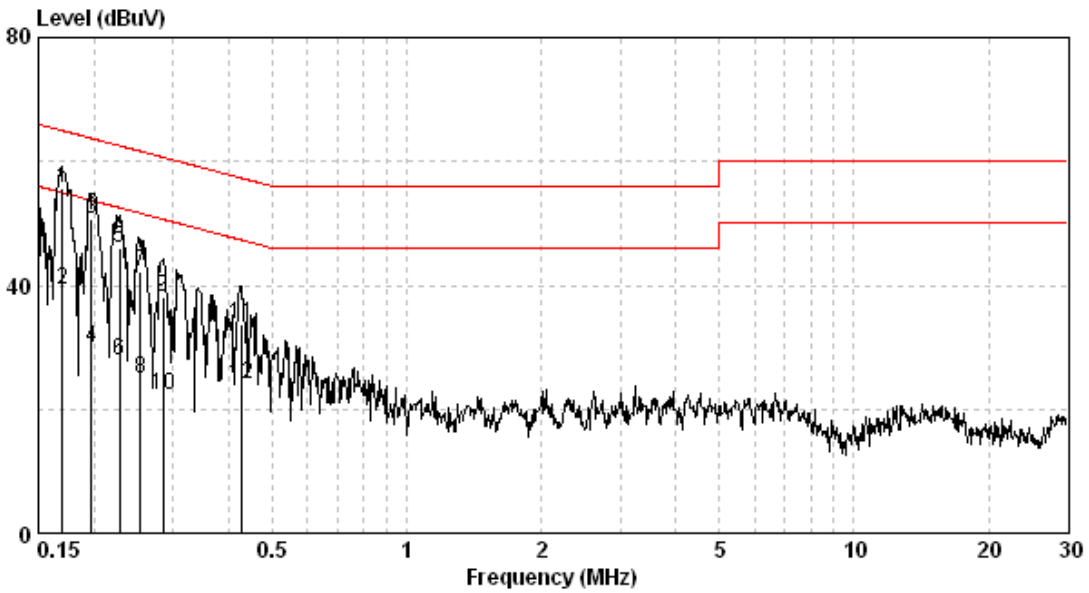
Temperature (℃) :	26
Relative Humidity (%) :	61
Atmospheric Pressure (hPa) :	1008
Test Date :	2019/07/12

6.6 Test Results

Phase: Live Line
Model No.: RGH1
Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.169	9.70	45.99	55.69	64.99	29.53	39.23	54.99	-9.30	-15.76
0.198	9.69	40.94	50.63	63.71	20.30	29.99	53.71	-13.09	-23.72
0.228	9.69	36.45	46.14	62.52	18.21	27.90	52.52	-16.38	-24.62
0.253	9.69	32.64	42.33	61.64	15.21	24.90	51.64	-19.32	-26.74
0.285	9.69	28.50	38.19	60.68	12.59	22.28	50.68	-22.48	-28.40
0.428	9.70	23.86	33.56	57.29	14.46	24.16	47.29	-23.73	-23.13

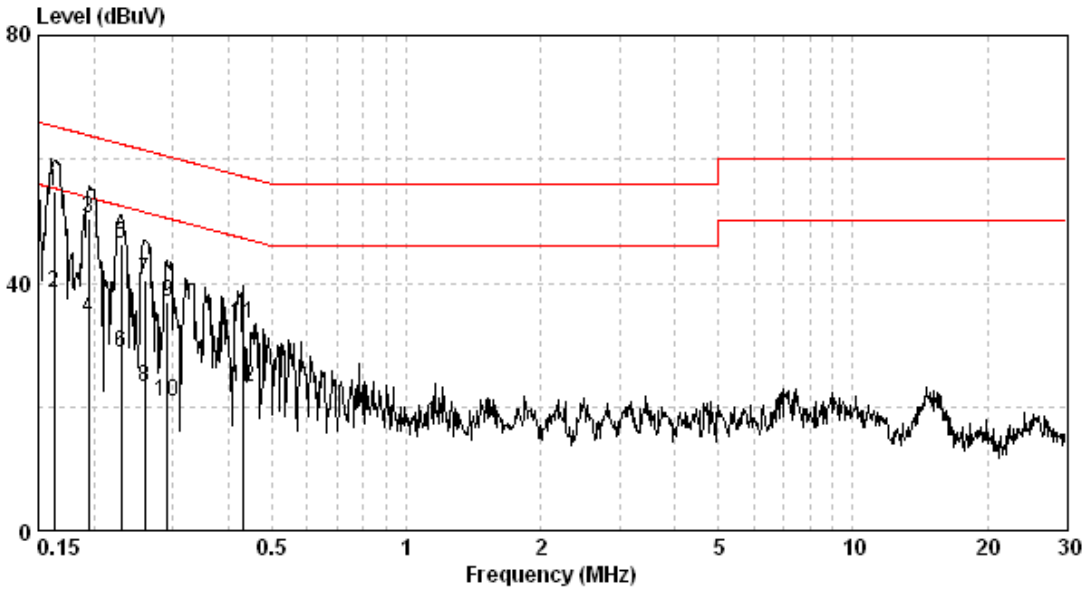
Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral Line
Model No.: RGH1
Test Condition: Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.162	9.71	45.04	54.75	65.34	28.59	38.30	55.34	-10.59	-17.04
0.194	9.71	40.70	50.41	63.84	24.48	34.19	53.84	-13.43	-19.66
0.230	9.71	36.47	46.18	62.44	19.03	28.74	52.44	-16.26	-23.70
0.260	9.71	30.87	40.58	61.42	13.58	23.29	51.42	-20.84	-28.13
0.292	9.71	27.35	37.06	60.46	11.06	20.77	50.46	-23.39	-29.69
0.431	9.71	23.72	33.43	57.24	13.36	23.07	47.24	-23.81	-24.17

Remark:
1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Appendix A: Test equipment list

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
ESCI EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2018/11/14	2019/11/13
Spectrum Analyzer	Rohde & Schwarz	FSP30	100137	2018/09/03	2019/09/02
Signal Analyzer	Agilent	N9030A	MY51380492	2018/08/24	2019/08/23
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2019/04/19	2020/04/17
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2019/06/05	2020/06/03
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2019/02/01	2020/01/31
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2018/08/28	2019/08/27
Power Meter	Anritsu	ML2495A	0844001	2018/10/29	2019/10/28
Power Sensor	Anritsu	MA2411B	0738452	2018/10/29	2019/10/28
966-2(A) Cable 9kHz~26.5GHz	SUHNER	SMA / EX 100	N/A	2018/08/07	2019/08/06
966-2(B) Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 104P	CB0005	2018/08/07	2019/08/06
RF Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 102	CB0006	2019/05/02	2020/04/30
Hight Pass Filter	Wainwright	WHKX3.0/18G-12SS	N/A	2019/05/30	2020/05/28
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2019/02/23	2020/02/22

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI	100059	2018/11/07	2019/11/06
Two-Line V-Network	R&S	ENV216	101159	2018/06/01	2019/05/31
Two-Line -V-Network	R&S	ESH3-Z5	825562/003	2018/09/03	2019/09/02
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2019/05/02	2020/04/30
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

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

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.2 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.28 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	4.29 dB
Vertically polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Horizontally polarized Radiated disturbances from 18GHz~26.5GHz in a semi-anechoic chamber at a distance of 1m	2.45 dB
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	2.99 dB
Emission on the Band Edge Test	4.29 dB
20dB Bandwidth	7.69 %
AC Power Line Conducted Emission	2.59 dB

Note: The statement of conformity to this test service with decision rule not includes the measurement uncertainty. The identified critical influencing factors are based on the standard requirements and controlled.