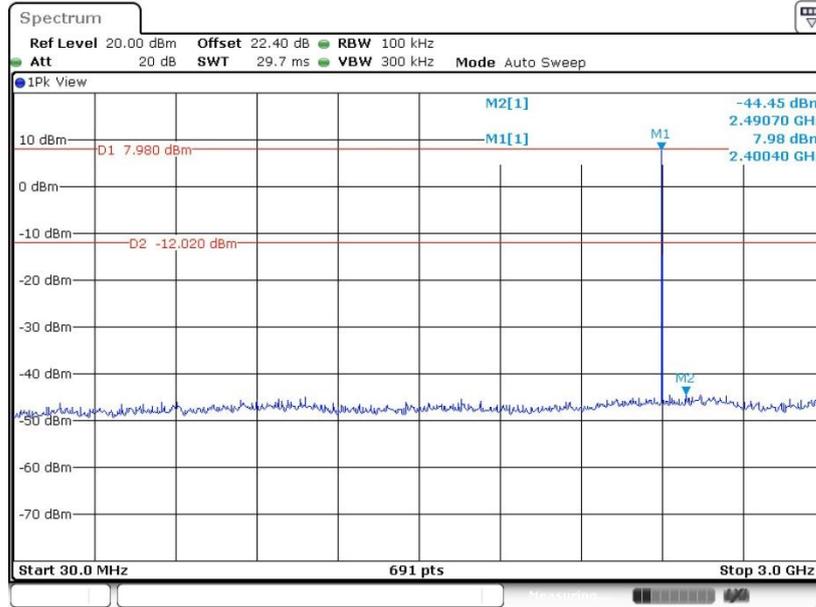




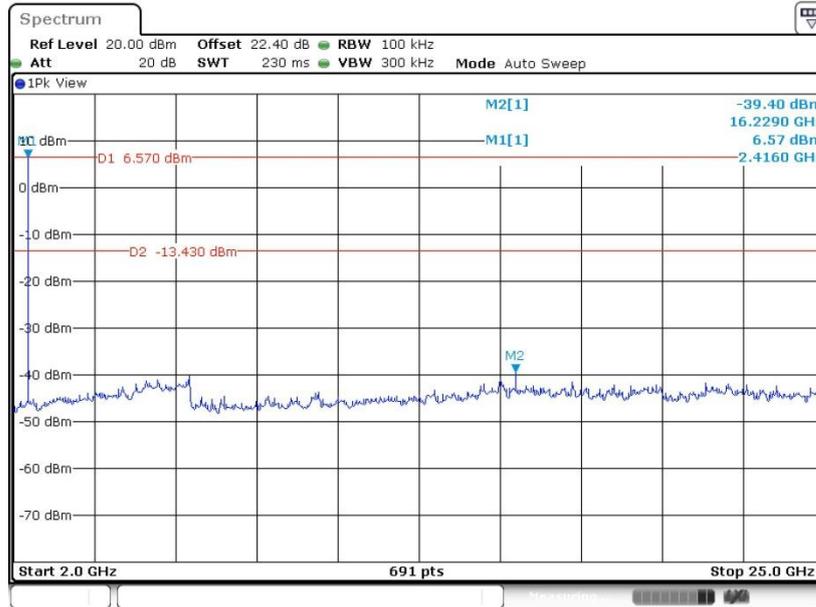
### 3.7.5 Test Result of Conducted Spurious Emission

<1Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz

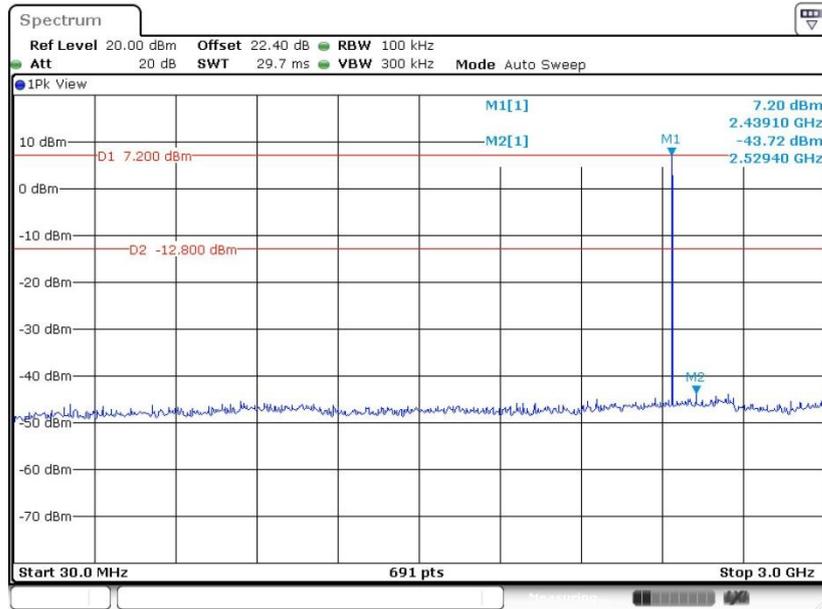


1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



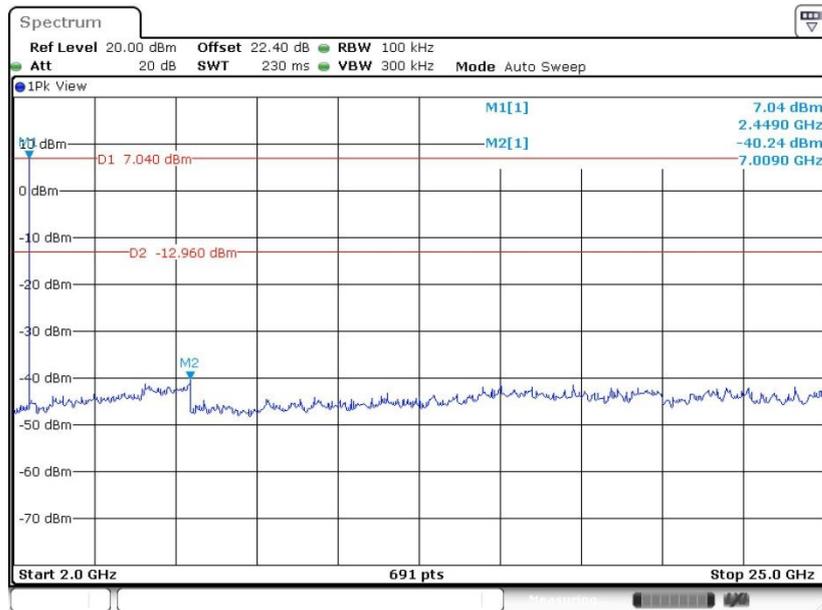


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10.SEP.2019 23:28:48

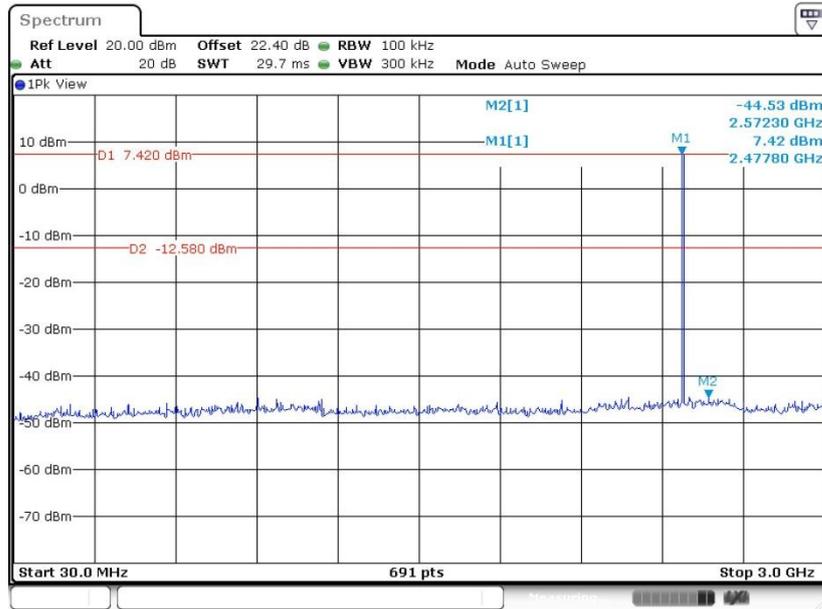
CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10.SEP.2019 23:29:20

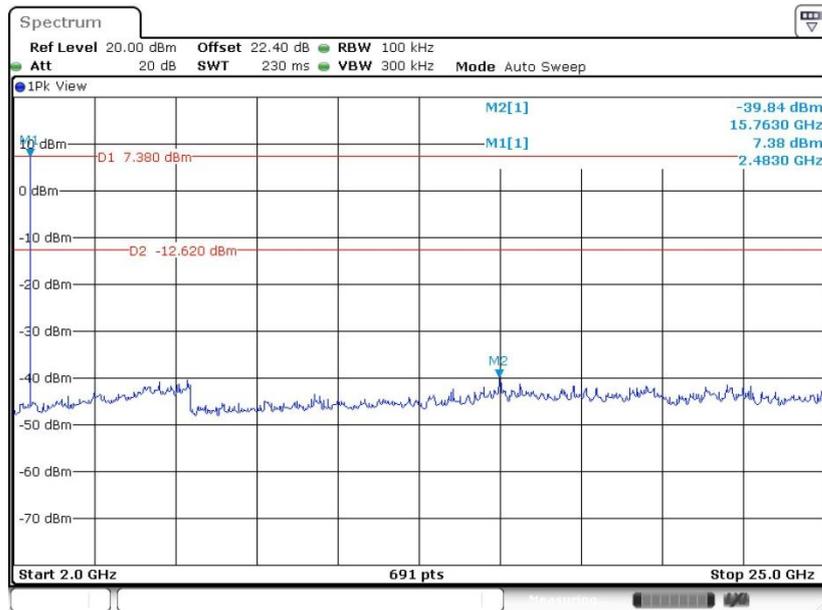


CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10.SEP.2019 23:35:03

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

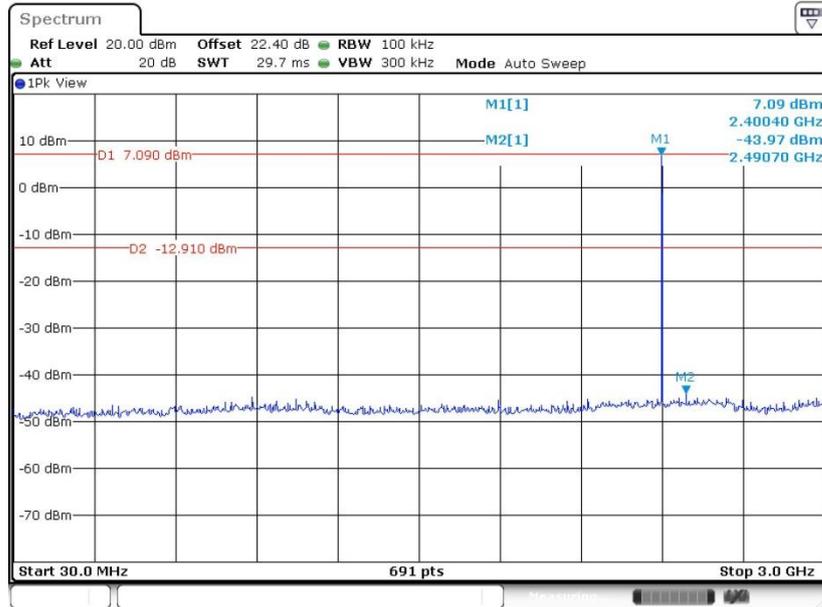


Date: 10.SEP.2019 23:35:32



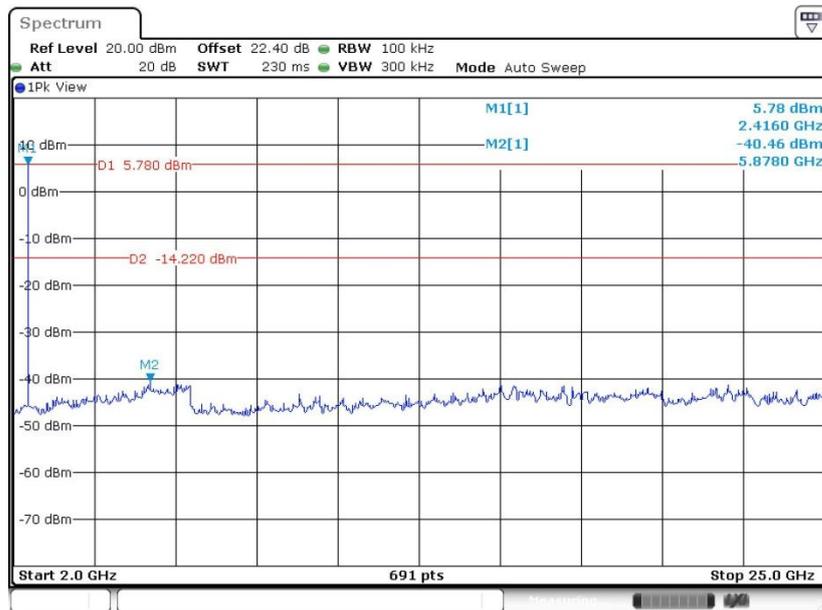
<2Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 10.SEP.2019 23:48:36

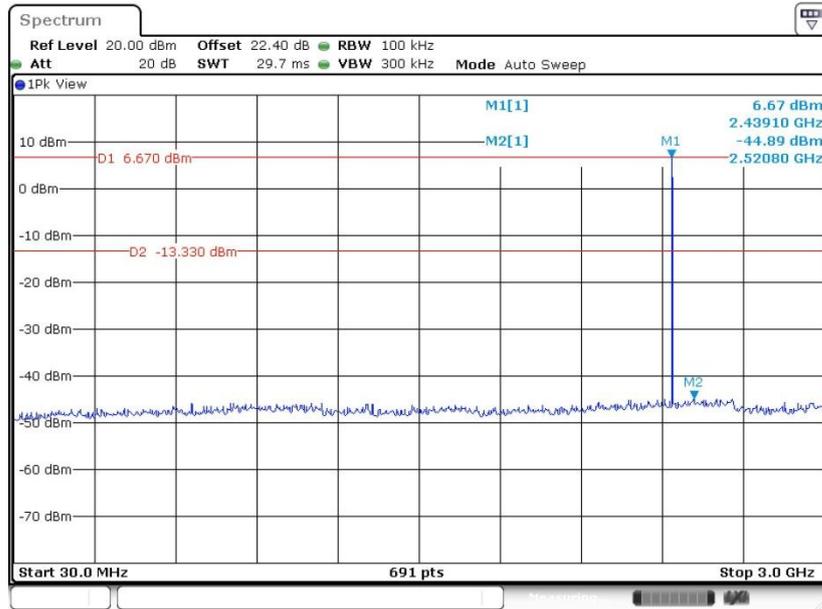
CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 10.SEP.2019 23:49:04

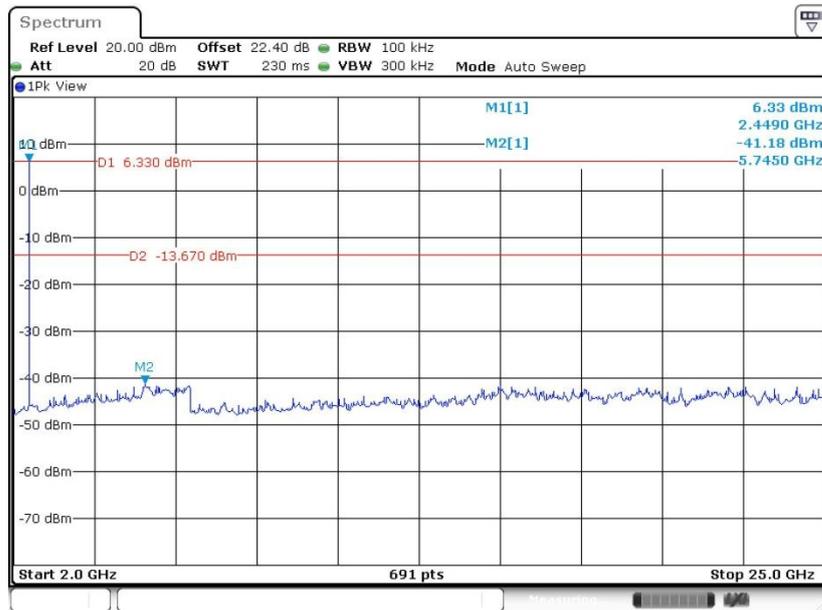


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 10.SEP.2019 23:46:58

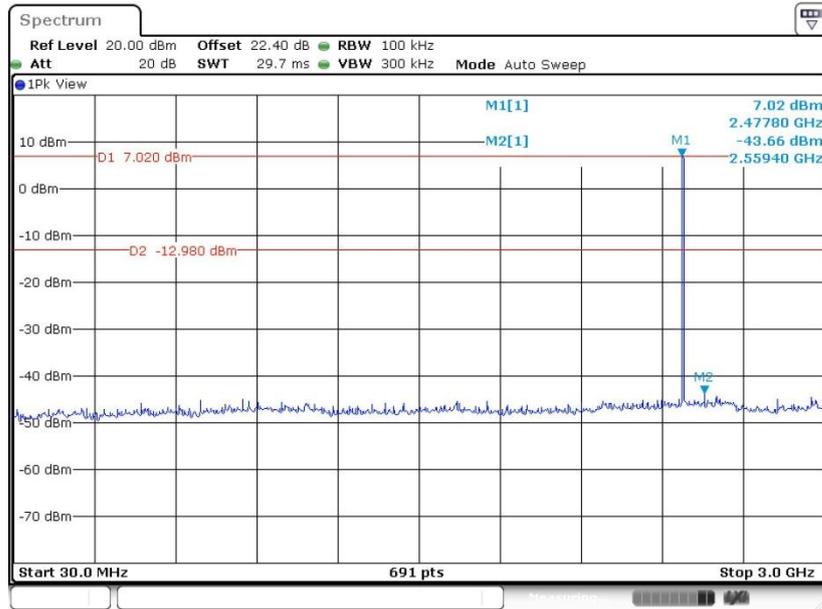
CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 10.SEP.2019 23:47:27

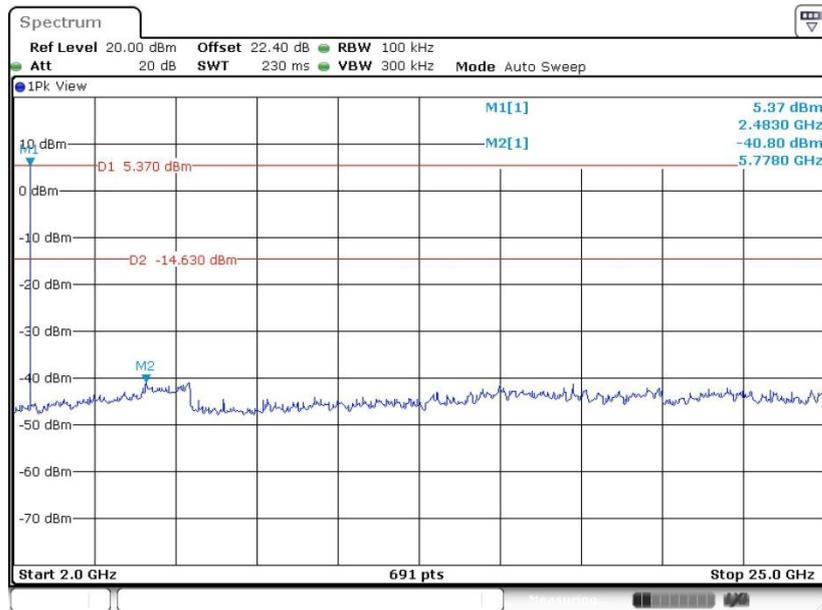


CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 10.SEP.2019 23:56:20

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

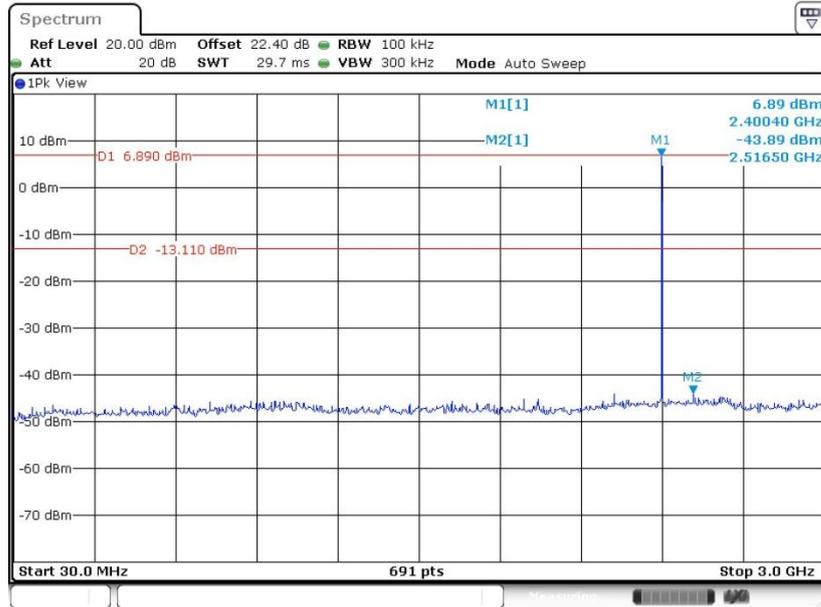


Date: 10.SEP.2019 23:56:48



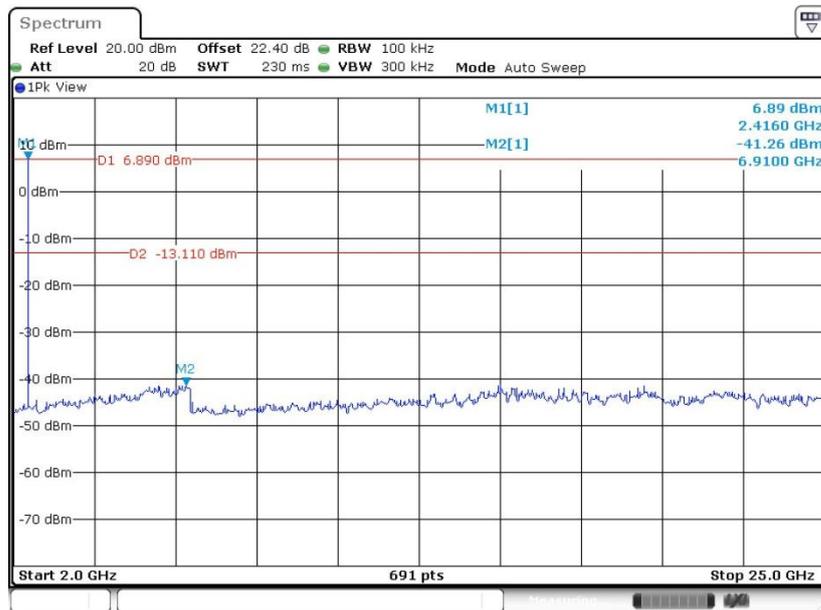
<3Mbps>

CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 11.SEP.2019 00:08:30

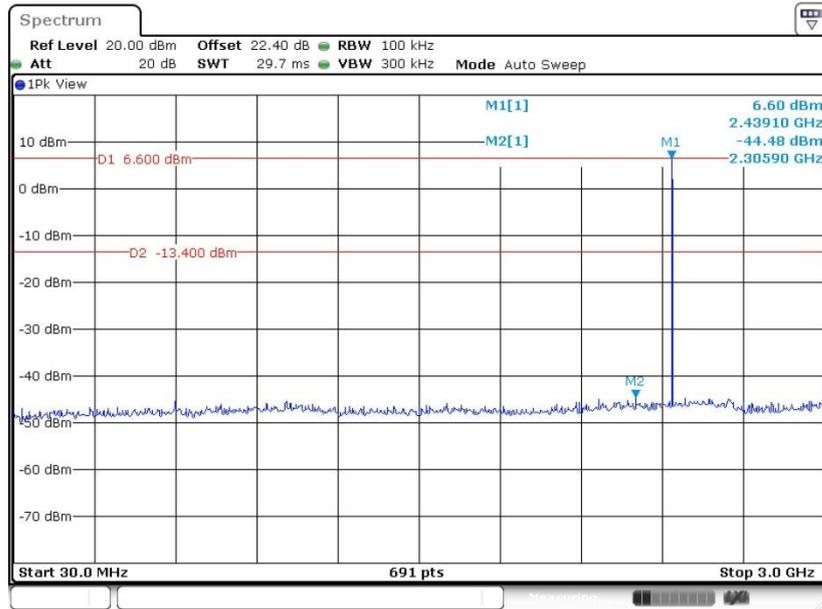
CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



Date: 11.SEP.2019 00:09:01

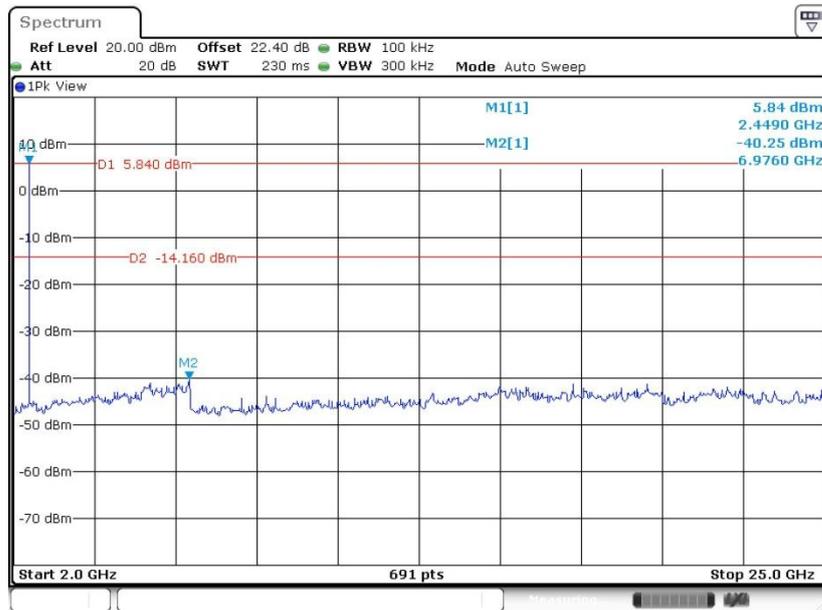


CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 11.SEP.2019 00:14:33

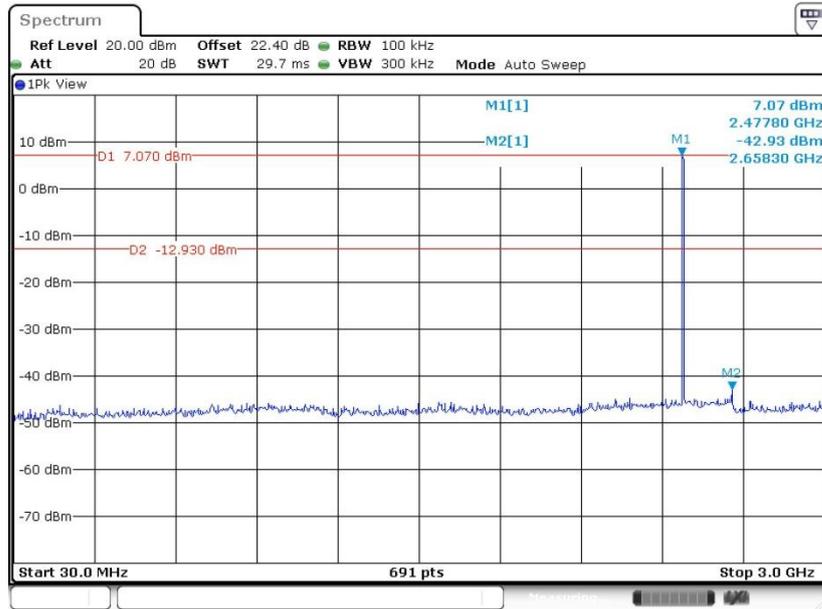
CSE Plot on Ch 39 between 2 GHz ~ 25 GHz



Date: 11.SEP.2019 00:15:00

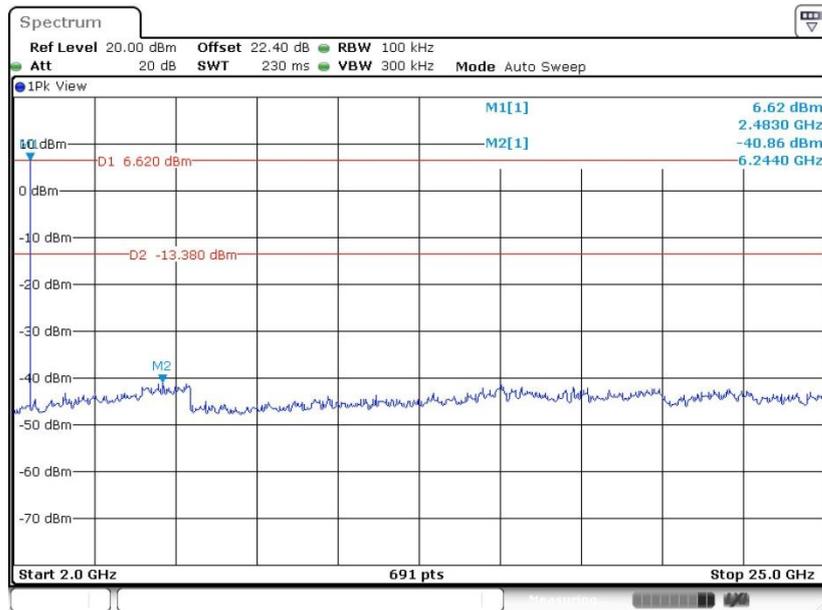


CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 11.SEP.2019 00:20:31

CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



Date: 11.SEP.2019 00:20:58



### 3.8 Radiated Band Edges and Spurious Emission Measurement

#### 3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/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

#### 3.8.2 Measuring Instruments

See list of measuring equipment of this test report.

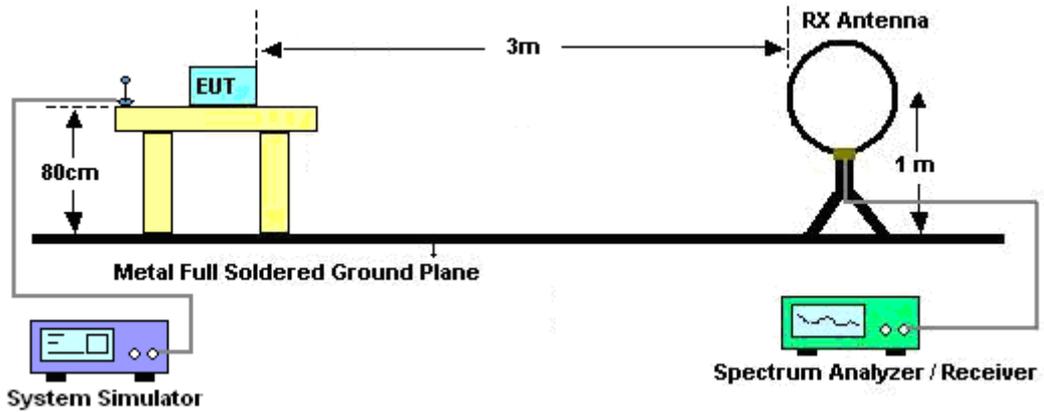
**3.8.3 Test Procedures**

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. 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 +  $20 * \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

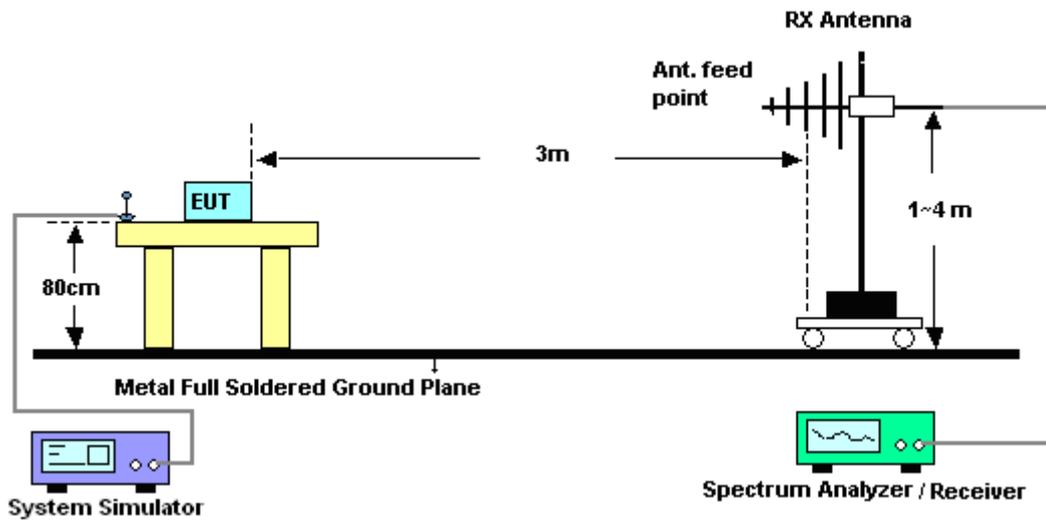
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.79dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.8.4 Test Setup

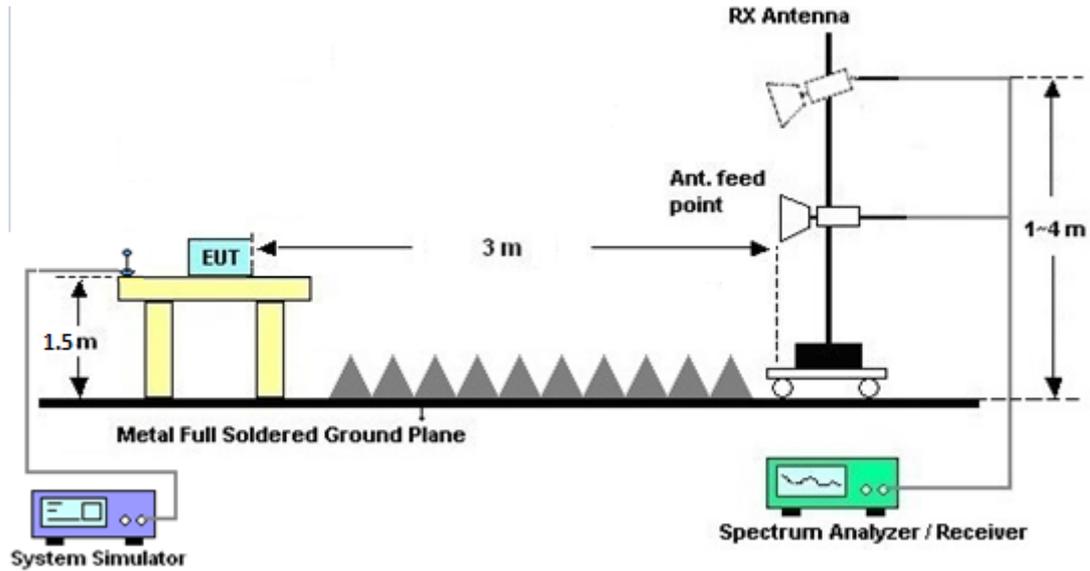
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



### 3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

### 3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

### 3.8.7 Duty Cycle

Please refer to Appendix E.

### 3.8.8 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)

Please refer to Appendix C and D.



### 3.9 AC Conducted Emission Measurement

#### 3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

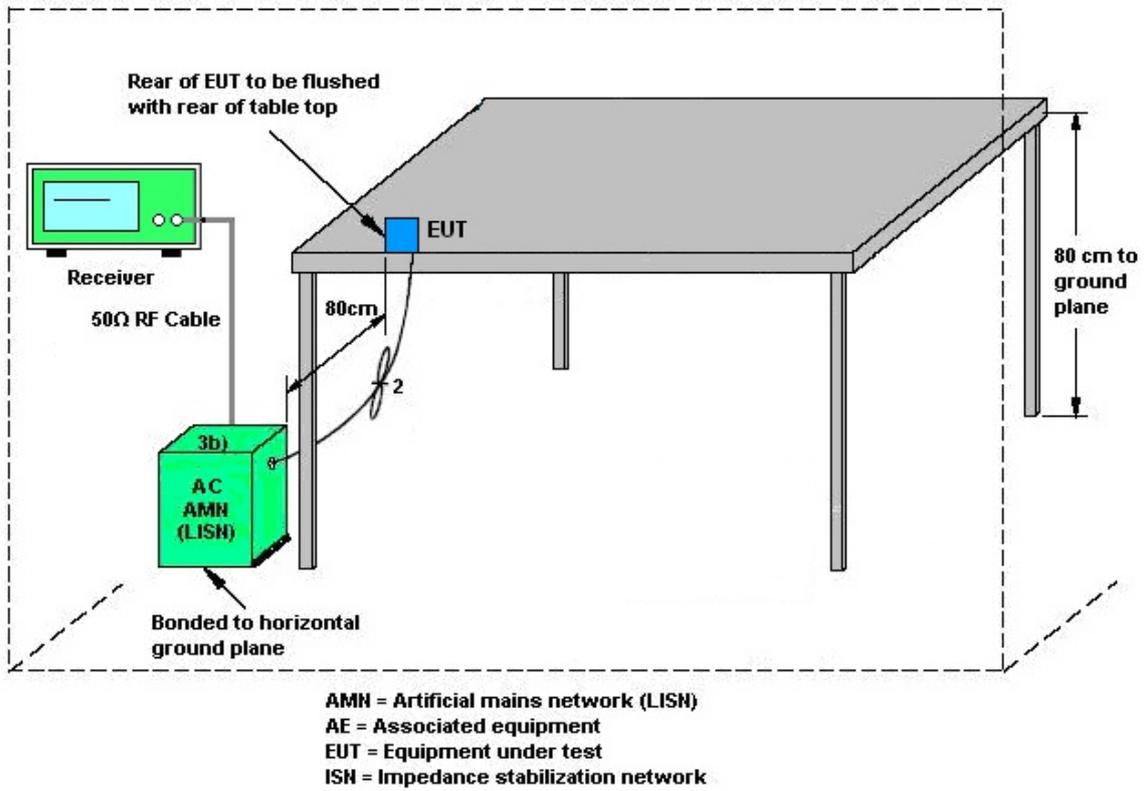
#### 3.9.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.9.4 Test Setup



### 3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



## **3.10 Antenna Requirements**

### **3.10.1 Standard Applicable**

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

### **3.10.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.10.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	E4416A	GB41292344	N/A	Dec. 27, 2018	Sep. 09, 2019~ Sep. 11, 2019	Dec. 26, 2019	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US40441548	50MHz~18GHz	Dec. 27, 2018	Sep. 09, 2019~ Sep. 11, 2019	Dec. 26, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100057	9kHz-40GHz	Nov. 21, 2018	Sep. 09, 2019~ Sep. 11, 2019	Nov. 20, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101397	10Hz~40GHz	Nov. 13, 2018	Sep. 09, 2019~ Sep. 11, 2019	Nov. 12, 2019	Conducted (TH05-HY)
Switch Box & RF Cable	EM	EMSW18	SW1070903	N/A	Dec 19,2018	Sep. 09, 2019~ Sep. 11, 2019	Dec 18 2019	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jan. 07, 2019	Sep. 26, 2019~ Oct. 02, 2019	Jan. 06, 2020	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	37059&01	30MHz~1GHz	Oct. 13, 2018	Sep. 26, 2019~ Oct. 02, 2019	Oct. 12, 2019	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1328	1GHz ~ 18GHz	Nov. 09, 2018	Sep. 26, 2019~ Oct. 02, 2019	Nov. 08, 2019	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz ~ 40GHz	Dec. 05, 2018	Sep. 26, 2019~ Oct. 02, 2019	Dec. 04, 2019	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 25, 2019	Sep. 26, 2019~ Oct. 02, 2019	Mar. 24, 2020	Radiation (03CH12-HY)
Preamplifier	Agilent	8449B	3008A02375	1GHz~26.5GHz	May 27, 2019	Sep. 26, 2019~ Oct. 02, 2019	May 26, 2020	Radiation (03CH12-HY)
Preamplifier	Jet-Power	JPA0118-55-303K	1710001800054002	1GHz~18GHz	Aug. 06, 2019	Sep. 26, 2019~ Oct. 02, 2019	Aug. 05, 2020	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Sep. 26, 2019~ Oct. 02, 2019	Dec. 05, 2019	Radiation (03CH12-HY)
Spectrum Analyzer	Keysight	N9010A	MY55370526	10Hz~44GHz	Mar. 19, 2019	Sep. 26, 2019~ Oct. 02, 2019	Mar. 18, 2020	Radiation (03CH12-HY)
Filter	Wainwright	WLKS1200-12SS	SN1	1.2 GHz Lowpass	Mar. 22, 2019	Sep. 26, 2019~ Oct. 02, 2019	Mar. 21, 2020	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-2700-3000-18000-60ST	SN2	3GHz High Pass	Jul. 15, 2019	Sep. 26, 2019~ Oct. 02, 2019	Jul. 14, 2020	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30M~40GHz	Feb. 26, 2019	Sep. 26, 2019~ Oct. 02, 2019	Feb. 25, 2020	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30M~40GHz	Feb. 26, 2019	Sep. 26, 2019~ Oct. 02, 2019	Feb. 25, 2020	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Sep. 26, 2019~ Oct. 02, 2019	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Sep. 26, 2019~ Oct. 02, 2019	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Sep. 26, 2019~ Oct. 02, 2019	N/A	Radiation (03CH12-HY)



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Nov. 05, 2019	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 12, 2018	Nov. 05, 2019	Nov. 11, 2019	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Mar. 19, 2019	Nov. 05, 2019	Mar. 18, 2020	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 14, 2018	Nov. 05, 2019	Nov. 13, 2019	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 09, 2018	Nov. 05, 2019	Nov. 08, 2019	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Nov. 05, 2019	N/A	Conduction (CO05-HY)
LF Cable	HUBER + SUHNER	RG-214/U	LF01	N/A	Dec. 31, 2018	Nov. 05, 2019	Dec. 30, 2019	Conduction (CO05-HY)
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	N/A	Dec. 31, 2018	Nov. 05, 2019	Dec. 30, 2019	Conduction (CO05-HY)



## 5 Uncertainty of Evaluation

### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	2.20
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### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.10
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### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.20
---	------

### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.70
---	------

**Appendix A. Test Result of Conducted Test Items**

Test Engineer:	Shiming Liu/Owen Yang	Temperature:	21~25	°C
Test Date:	2019/9/9~2019/9/11	Relative Humidity:	51~54	%

<b>TEST RESULTS DATA</b>									
<b>20dB and 99% Occupied Bandwidth and Hopping Channel Separation</b>									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	20db BW (MHz)	99% Bandwidth (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
DH	1Mbps	1	0	2402	0.784	0.735	0.999	0.5229	Pass
DH	1Mbps	1	39	2441	0.819	0.732	0.999	0.5461	Pass
DH	1Mbps	1	78	2480	0.782	0.732	1.003	0.5210	Pass
2DH	2Mbps	1	0	2402	1.242	1.140	1.003	0.8278	Pass
2DH	2Mbps	1	39	2441	1.242	1.137	0.999	0.8278	Pass
2DH	2Mbps	1	78	2480	1.237	1.137	1.003	0.8249	Pass
3DH	3Mbps	1	0	2402	1.211	1.120	0.999	0.8075	Pass
3DH	3Mbps	1	39	2441	1.211	1.120	0.999	0.8075	Pass
3DH	3Mbps	1	78	2480	1.211	1.120	0.994	0.8075	Pass

<b>TEST RESULTS DATA</b>						
<b>Dwell Time</b>						
Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Nomal	79	106.67	2.90	0.31	0.4	Pass
AFH	20	53.33	2.90	0.15	0.4	Pass

<b>TEST RESULTS DATA</b>					
<b>Peak Power Table</b>					
DH	CH.	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
DH1	0	1	8.05	20.97	Pass
	39	1	7.35	20.97	Pass
	78	1	7.94	20.97	Pass
2DH1	0	1	7.16	20.97	Pass
	39	1	6.42	20.97	Pass
	78	1	7.01	20.97	Pass
3DH1	0	1	7.36	20.97	Pass
	39	1	6.64	20.97	Pass
	78	1	7.20	20.97	Pass

<b>TEST RESULTS DATA</b>				
<b>Average Power Table</b>				
<b>(Reporting Only)</b>				
DH	CH.	NTX	Average Power (dBm)	Duty Factor (dB)
DH1	0	1	7.81	5.25
	39	1	7.11	5.25
	78	1	7.66	5.25
2DH1	0	1	5.38	5.13
	39	1	4.64	5.13
	78	1	5.20	5.13
3DH1	0	1	5.40	5.16
	39	1	4.67	5.16
	78	1	5.23	5.16

<b>TEST RESULTS DATA</b>			
<b>Number of Hopping Frequency</b>			
Number of Hopping (Channel)	Adaptive Frequency Hopping (Channel)	Limits (Channel)	Pass/Fail
79	20	> 15	Pass



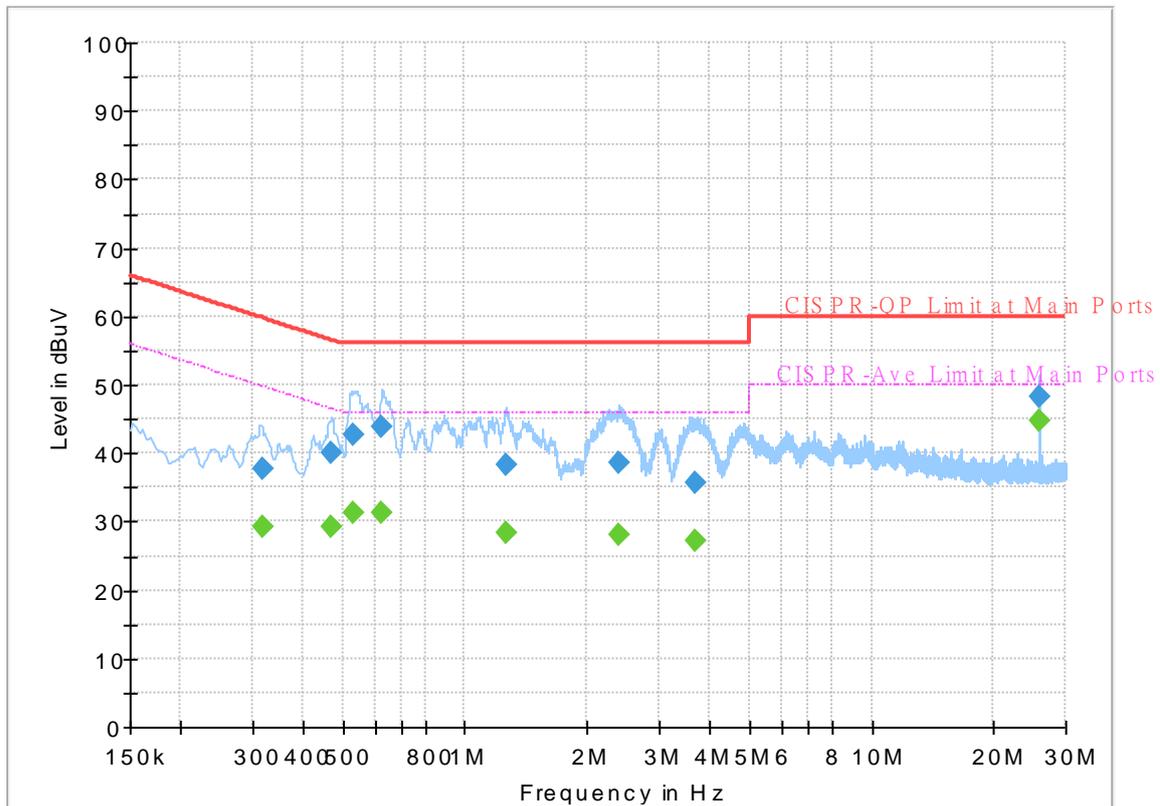
## Appendix B. AC Conducted Emission Test Results

Test Engineer :	Howard Huang and Tom Lee	Temperature :	24.2~25.6°C
		Relative Humidity :	45.6~52.3%

## EUT Information

Report NO : 902401  
 Test Mode : Mode 4  
 Test Voltage : 120Vac/60Hz  
 Phase : Line

Full Spectrum



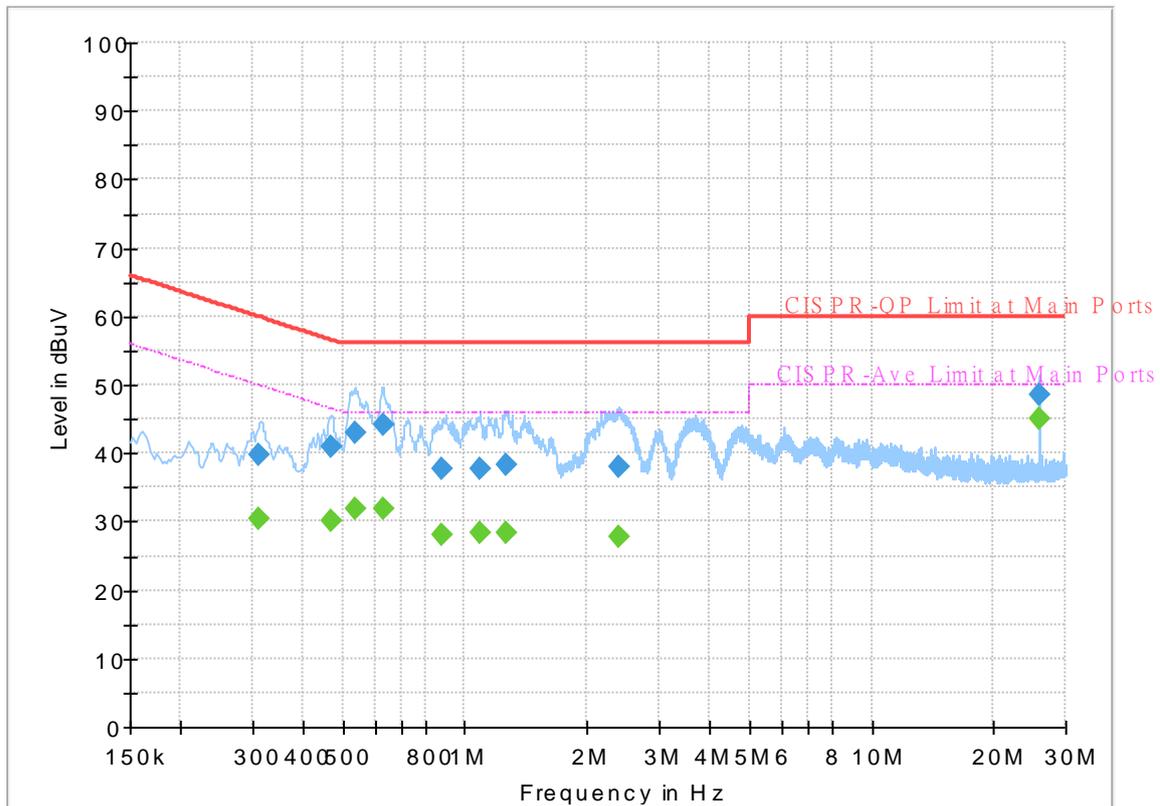
## Final\_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.316500	---	29.32	49.80	20.48	L1	OFF	19.4
0.316500	37.84	---	59.80	21.96	L1	OFF	19.4
0.469500	---	29.22	46.52	17.30	L1	OFF	19.4
0.469500	40.09	---	56.52	16.43	L1	OFF	19.4
0.532500	---	31.29	46.00	14.71	L1	OFF	19.4
0.532500	42.57	---	56.00	13.43	L1	OFF	19.4
0.624750	---	31.24	46.00	14.76	L1	OFF	19.4
0.624750	43.78	---	56.00	12.22	L1	OFF	19.4
1.261500	---	28.29	46.00	17.71	L1	OFF	19.5
1.261500	38.32	---	56.00	17.68	L1	OFF	19.5
2.386500	---	27.96	46.00	18.04	L1	OFF	19.5
2.386500	38.51	---	56.00	17.49	L1	OFF	19.5
3.707250	---	27.26	46.00	18.74	L1	OFF	19.6
3.707250	35.78	---	56.00	20.22	L1	OFF	19.6
26.000250	---	44.75	50.00	5.25	L1	OFF	20.3
26.000250	48.24	---	60.00	11.76	L1	OFF	20.3

## EUT Information

Report NO : 9O2401  
 Test Mode : Mode 4  
 Test Voltage : 120Vac/60Hz  
 Phase : Neutral

Full Spectrum



## Final\_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.312000	---	30.51	49.92	19.41	N	OFF	19.5
0.312000	39.86	---	59.92	20.06	N	OFF	19.5
0.469500	---	30.25	46.52	16.27	N	OFF	19.5
0.469500	40.96	---	56.52	15.56	N	OFF	19.5
0.534750	---	31.91	46.00	14.09	N	OFF	19.5
0.534750	42.88	---	56.00	13.12	N	OFF	19.5
0.627000	---	31.76	46.00	14.24	N	OFF	19.5
0.627000	44.17	---	56.00	11.83	N	OFF	19.5
0.879000	---	27.93	46.00	18.07	N	OFF	19.5
0.879000	37.77	---	56.00	18.23	N	OFF	19.5
1.088250	---	28.27	46.00	17.73	N	OFF	19.5
1.088250	37.58	---	56.00	18.42	N	OFF	19.5
1.257000	---	28.35	46.00	17.65	N	OFF	19.5
1.257000	38.32	---	56.00	17.68	N	OFF	19.5
2.395500	---	27.81	46.00	18.19	N	OFF	19.6
2.395500	38.15	---	56.00	17.85	N	OFF	19.6
26.000250	---	45.03	50.00	4.97	N	OFF	20.5
26.000250	48.46	---	60.00	11.54	N	OFF	20.5



### Appendix C. Radiated Spurious Emission

Test Engineer :	Jack Cheng , Lance Chiang ,CR Liao	Temperature :	21.2~26.5°C
		Relative Humidity :	50.3~64.8%

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	Limit	Level	Factor	Loss	Factor	Pos	Pos	Avg.		
					Line	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
BT CH00 2402MHz		2356.2	45.28	-28.72	74	44.25	27.59	6.56	33.12	132	293	P	H	
		2356.2	20.49	-33.51	54	-	-	-	-	-	-	A	H	
	*	2402	102.59	-	-	101.65	27.5	6.61	33.17	132	293	P	H	
	*	2402	77.8	-	-	-	-	-	-	-	-	A	H	
													H	
														H
			2340.03	45.53	-28.47	74	44.43	27.66	6.54	33.1	358	277	P	V
			2340.03	20.74	-33.26	54	-	-	-	-	-	-	A	V
	*		2402	100.1	-	-	99.16	27.5	6.61	33.17	358	277	P	V
	*		2402	75.31	-	-	-	-	-	-	-	-	A	V
													V	
													V	
BT CH 39 2441MHz		2381.96	45.86	-28.14	74	44.88	27.54	6.59	33.15	121	292	P	H	
		2381.96	21.07	-32.93	54	-	-	-	-	-	-	A	H	
	*	2441	102.96	-	-	102.12	27.42	6.64	33.22	121	292	P	H	
	*	2441	78.17	-	-	-	-	-	-	-	-	A	H	
			2495.45	45.06	-28.94	74	44.34	27.31	6.69	33.28	121	292	P	H
			2495.45	20.27	-33.73	54	-	-	-	-	-	-	A	H
			2362.92	45.27	-28.73	74	44.26	27.57	6.57	33.13	345	273	P	V
			2362.92	20.48	-33.52	54	-	-	-	-	-	-	A	V
	*		2441	100.55	-	-	99.71	27.42	6.64	33.22	345	273	P	V
	*		2441	75.76	-	-	-	-	-	-	-	-	A	V
			2486.56	44.9	-29.1	74	44.16	27.33	6.68	33.27	345	273	P	V
			2486.56	20.11	-33.89	54	-	-	-	-	-	-	A	V



<b>BT CH 78 2480MHz</b>	*	2480	102.67	-	-	101.92	27.34	6.68	33.27	118	291	P	H
	*	2480	77.88	-	-	-	-	-	-	-	-	A	H
		2483.88	45.31	-28.69	74	44.57	27.33	6.68	33.27	118	291	P	H
		2483.88	20.52	-33.48	54	-	-	-	-	-	-	A	H
													H
													H
	*	2480	101.01	-	-	100.26	27.34	6.68	33.27	334	272	P	V
	*	2480	76.22	-	-	-	-	-	-	-	-	A	V
		2485.12	44.96	-29.04	74	44.22	27.33	6.68	33.27	334	272	P	V
		2485.12	20.17	-33.83	54	-	-	-	-	-	-	A	V
													V
													V
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz  
BT (Harmonic @ 3m)

BT	Note	Frequency ( MHz )	Level ( dBμV/m )	Over Limit ( dB )	Limit Line ( dBμV/m )	Read Level ( dBμV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )
BT CH 00 2402MHz		4804	43.33	-30.67	74	59.75	31.1	10.07	57.59	100	0	P	H
		4804	18.54	-35.46	54	-	-	-	-	-	-	A	H
													H
													H
		4804	45.09	-28.91	74	61.51	31.1	10.07	57.59	100	0	P	V
		4804	20.3	-33.7	54	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		4882	40.65	-33.35	74	56.91	31.1	10.08	57.44	100	0	P	H
		4882	15.86	-38.14	54	-	-	-	-	-	-	A	H
		7323	44.67	-29.33	74	52.9	36.55	12.51	57.29	100	0	P	H
		7323	19.88	-34.12	54	-	-	-	-	-	-	A	H
		4882	40.82	-33.18	74	57.08	31.1	10.08	57.44	100	0	P	V
		4882	16.03	-37.97	54	-	-	-	-	-	-	A	V
		7323	44.22	-29.78	74	52.45	36.55	12.51	57.29	100	0	P	V
		7323	19.43	-34.57	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4960	43.3	-30.7	74	59.18	31.32	10.08	57.28	100	0	P	H
		4960	18.51	-35.49	54	-	-	-	-	-	-	A	H
		7440	43.78	-30.22	74	52.22	36.38	12.61	57.43	100	0	P	H
		7440	18.99	-35.01	54	-	-	-	-	-	-	A	H
		4960	43.79	-30.21	74	59.67	31.32	10.08	57.28	100	0	P	V
		4960	19	-35	54	-	-	-	-	-	-	A	V
		7440	43.62	-30.38	74	52.06	36.38	12.61	57.43	100	0	P	V
		7440	18.83	-35.17	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BT LF		30	24.87	-15.13	40	30.04	24.17	0.84	30.18	-	-	P	H	
		152.22	19.61	-23.89	43.5	31.17	17.08	1.73	30.37	-	-	P	H	
		267.65	26.55	-19.45	46	35.23	19.3	2.22	30.2	-	-	P	H	
		567.38	29.44	-16.56	46	29.88	25.74	3.5	29.68	-	-	P	H	
		732.28	35.79	-10.21	46	33.66	27.59	3.99	29.45	100	0	P	H	
		993.21	36.31	-17.69	54	29.87	30.5	4.81	28.87	-	-	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
			30	32.09	-7.91	40	37.26	24.17	0.84	30.18	100	0	P	V
			167.74	24.16	-19.34	43.5	36.85	15.85	1.82	30.36	-	-	P	V
			256.98	23.2	-22.8	46	32	19.28	2.14	30.22	-	-	P	V
			698.33	32.05	-13.95	46	31.11	26.59	3.87	29.52	-	-	P	V
			870.02	34.97	-11.03	46	30.55	29.19	4.41	29.18	-	-	P	V
			967.99	36.31	-17.69	54	29.72	30.81	4.72	28.94	-	-	P	V
														V
													V	
													V	
													V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.													



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



A calculation example for radiated spurious emission is shown as below:

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
		( MHz )	( dBμV/m )	( dB )	Limit Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
					( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
BT		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 00		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2402MHz													

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

**Both peak and average measured complies with the limit line, so test result is “PASS”.**



## Appendix D. Radiated Spurious Emission Plots

Test Engineer :	Jack Cheng , Lance Chiang ,CR Liao	Temperature :	21.2~26.5°C
		Relative Humidity :	50.3~64.8%

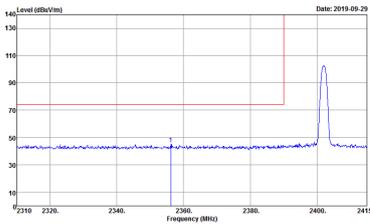
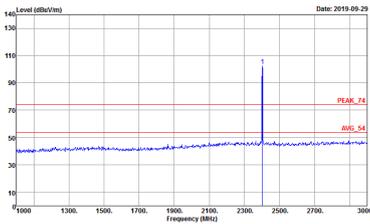
**Note symbol**

-L	Low channel location
-R	High channel location

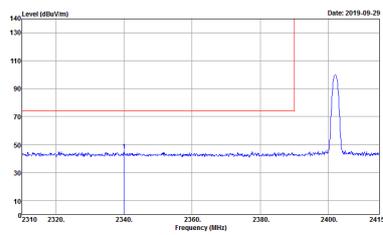
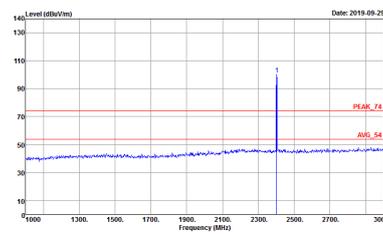


2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH00 2402MHz		
Horizontal		Fundamental
Peak	 <p>Site : 03CH2-HY  Condition : PEAK_85_74 3m HORN_91200_1328 HORIZONTAL  : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 982030</p>	 <p>Site : 03CH2-HY  Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL  : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto  Detector : Peak  Project : 982030</p>

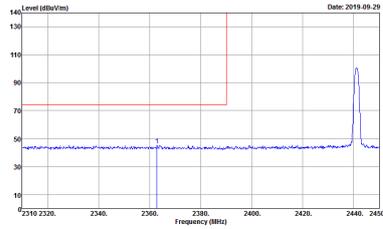
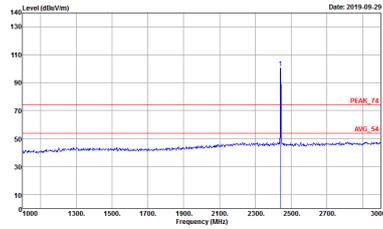
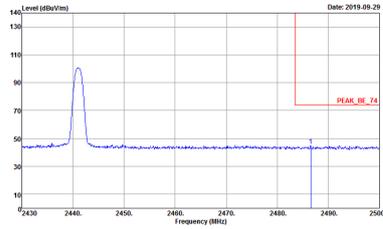


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH00 2402MHz	
	Vertical	Fundamental
<b>Peak</b>	 <p>Site : 03CH2-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 982030</p>	 <p>Site : 03CH2-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 982030</p>

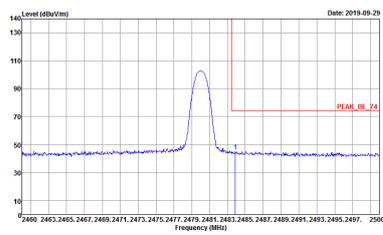
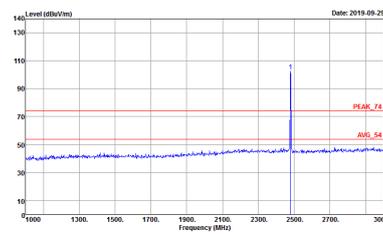


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH39 2441MHz	
	Horizontal	Fundamental
<p><b>Peak</b></p>	<p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL            Detector : Peak            Project : 982030</p>	<p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL            Detector : Peak            Project : 982030</p>
<p><b>Peak</b></p>	<p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL            Detector : Peak            Project : 982030</p>	<p>Left blank</p>

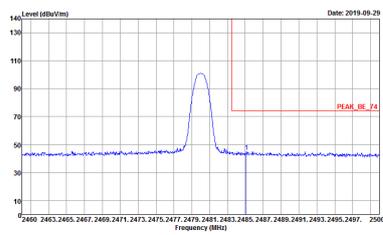
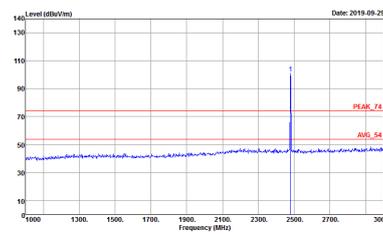


BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
BT CH39 2441MHz		
Vertical		Fundamental
Peak	 <p>Date: 2019-09-29</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 982030</p>	 <p>Date: 2019-09-29</p> <p>Site : 03CH12-HY            Condition : PEAK_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 982030</p>
Peak	 <p>Date: 2019-09-29</p> <p>Site : 03CH12-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 982030</p>	Left blank



BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Horizontal	Fundamental
<b>Peak</b>	 <p>Site : 03CH2-HY Condition : PEAK_BE_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 982030</p>	 <p>Site : 03CH2-HY Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 982030</p>



BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	BT CH78 2480MHz	
	Vertical	Fundamental
<p><b>Peak</b></p>	 <p>Site : 03CH2-HY            Condition : PEAK_BE_74 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 982030</p>	 <p>Site : 03CH2-HY            Condition : PEAK_F4 3m HORN_91200_1328 VERTICAL            Detector : Peak            Project : 982030</p>

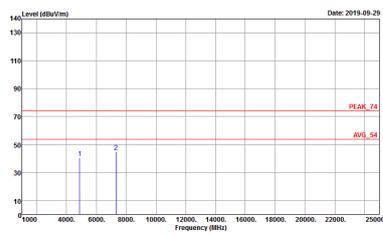
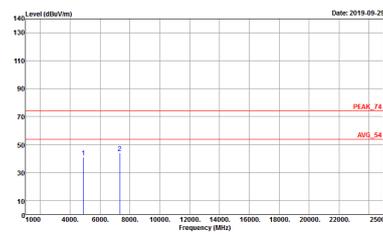


2.4GHz 2400~2483.5MHz

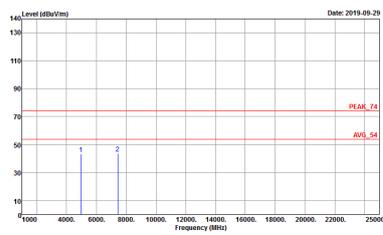
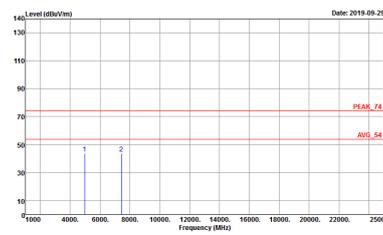
BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH00 2402MHz	
	Horizontal	Vertical
<b>Peak</b> <b>Avg.</b>	<p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 982030</p>	<p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 982030</p>



BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH39 2441MHz	
	Horizontal	Vertical
<p><b>Peak</b> <b>Avg.</b></p>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 982030</p>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 982030</p>

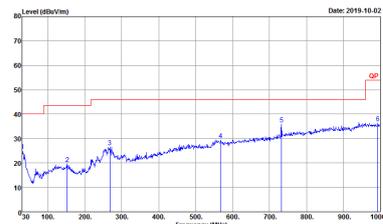
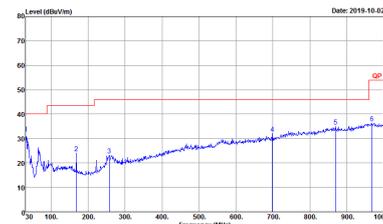


BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	BT CH78 2480MHz	
	Horizontal	Vertical
<p><b>Peak</b> <b>Avg.</b></p>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 HORIZONTAL Detector : Peak Project : 982030</p>	 <p>Site : 03CH12-HY Condition : PEAK_74 3m HORN_91200_1328 VERTICAL Detector : Peak Project : 982030</p>



Emission below 1GHz

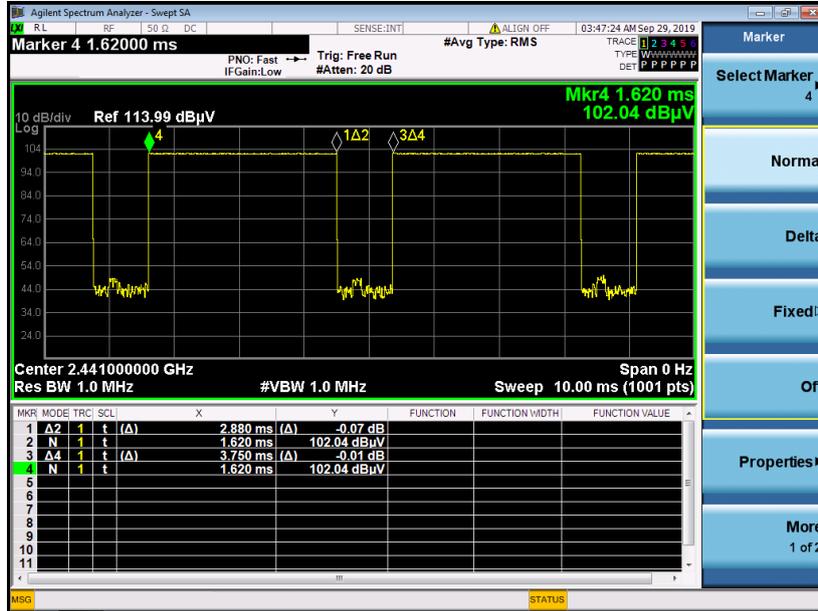
2.4GHz BT (LF)

BT	2.4GHz 2400~2483.5MHz	
BT LF		
Horizontal		Vertical
QP / Peak	 <p>Site : 03CH12-HY Condition : QP 3m BIL06_6111D_37059 HORIZONTAL Detector : Peak Project : 982030</p>	 <p>Site : 03CH12-HY Condition : QP 3m BIL06_6111D_37059 VERTICAL Detector : Peak Project : 982030</p>

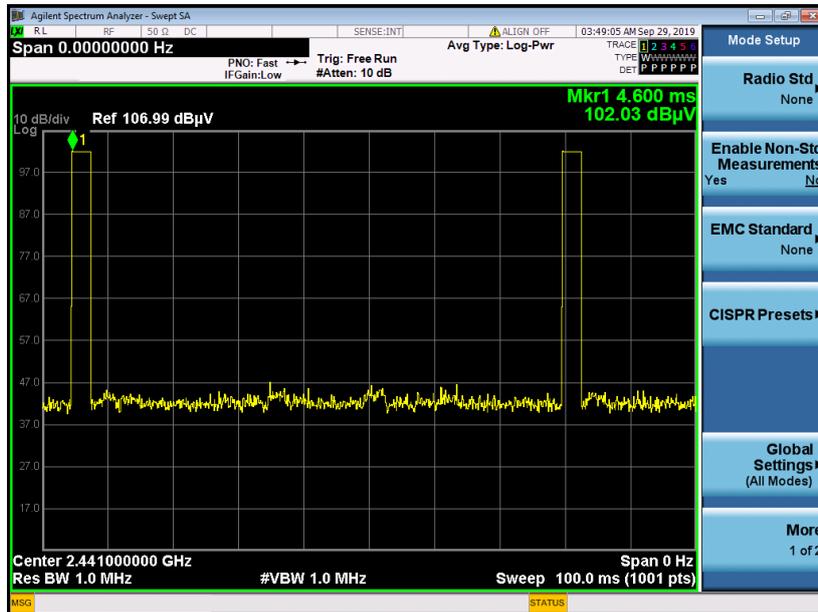


# Appendix E. Duty Cycle Plots

### DH5 on time (One Pulse) Plot on Channel 39



### on time (Count Pulses) Plot on Channel 39



**Note:**

1. Worst case Duty cycle = on time/100 milliseconds =  $2 * 2.88 / 100 = 5.76 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -24.79 \text{ dB}$
3. DH5 has the highest duty cycle worst case and is reported.



**Duty Cycle Correction Factor Consideration for AFH mode:**

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

$$2.88 \text{ ms} \times 20 \text{ channels} = 57.6 \text{ ms}$$

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period.  $[100\text{ms} / 57.6\text{ms}] = 2$  hops

Thus, the maximum possible ON time:

$$2.88 \text{ ms} \times 2 = 5.76 \text{ ms}$$

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.76 \text{ ms}/100\text{ms}) = -24.79 \text{ dB}$$