



FCC RF Test Report

APPLICANT : Ubiquiti Networks, Inc.
EQUIPMENT : UniFi LED
BRAND NAME : UBIQUITI
MODEL NAME : ULED-AT
FCC ID : SWX-ULEDAT
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The product was received on Nov. 07, 2017 and testing was completed on Dec. 07, 2017. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Anderson Chiu / Manager

Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.



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SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)(3)	Maximum Output Power	$\leq 30\text{dBm}$	Pass	-
3.3	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 0.82 dB at 30.81 MHz
3.6	15.207	AC Power Conducted Emission	15.207(a)	Pass	Under limit 2.6 dB at 0.494 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Ubiquiti Networks, Inc.
685 Third Avenue, 27th Floor New York, New York 10017 USA

1.2 Manufacturer

Ubiquiti Networks, Inc.
685 Third Avenue, 27th Floor New York, New York 10017 USA

1.3 Product Feature of Equipment Under Test

Bluetooth v4.0

Product Specification subjective to this standard	
Antenna Type	Internal antenna
Antenna Gain	3.5dBi

1.4 Modification of EUT

No modifications are made to the EUT during all test items.



1.5 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.	
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978	
Test Site No.	Sporton Site No.	
	CO05-HY	

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	SPORTON INTERNATIONAL INC.	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
	03CH15-HY	TH06-HY

Note: The test site complies with ANSI C63.4 2014 requirement.



1.6 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
- ♦ ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	0	2402	21	2444
	1	2404	22	2446
	2	2406	23	2448
	3	2408	24	2450
	4	2410	25	2452
	5	2412	26	2454
	6	2414	27	2456
	7	2416	28	2458
	8	2418	29	2460
	9	2420	30	2462
	10	2422	31	2464
	11	2424	32	2466
	12	2426	33	2468
	13	2428	34	2470
	14	2430	35	2472
	15	2432	36	2474
	16	2434	37	2476
	17	2436	38	2478
	18	2438	39	2480
	19	2440	-	-
20	2442	-	-	



2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the worst cases (X plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

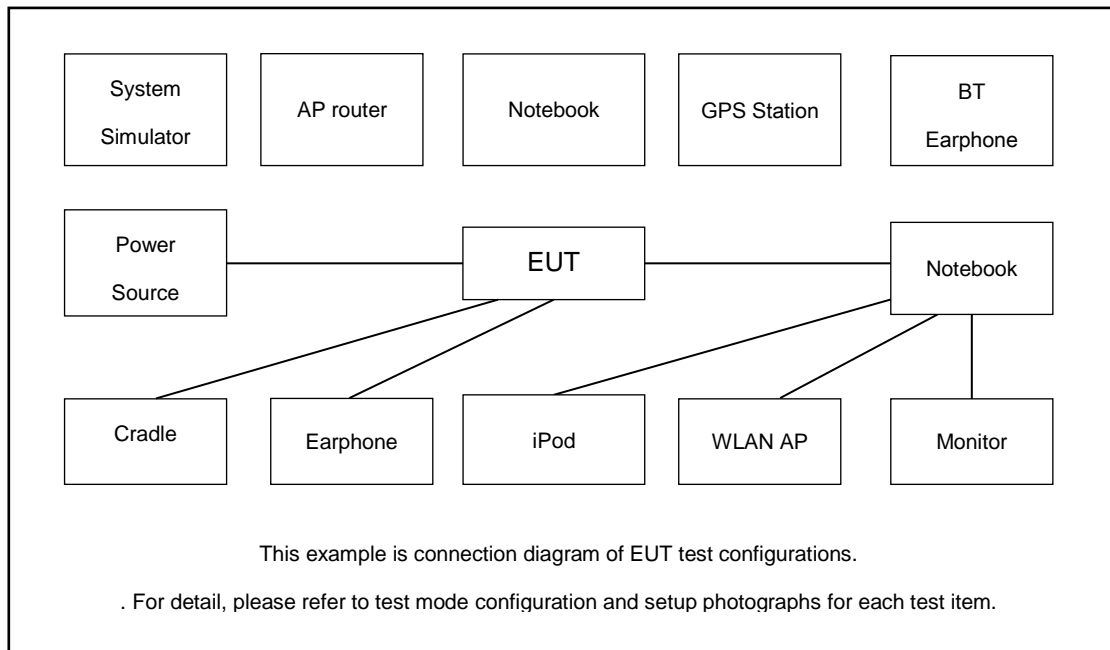
The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – LE / GFSK
Conducted TCs	Mode 1: Bluetooth Tx CH00_1Mbps Mode 2: Bluetooth Tx CH19_1Mbps Mode 3: Bluetooth Tx CH39_1Mbps
Radiated TCs	Mode 1: Bluetooth Tx CH00_1Mbps Mode 2: Bluetooth Tx CH19_1Mbps Mode 3: Bluetooth Tx CH39_1Mbps
AC Conducted Emission	Mode 1: Bluetooth Tx CH39 + Switch

2.3 Test Condition

Applicable To	Environmental Conditions	Input Power	Tested by
Radiated Emission	22-25 deg. C, 52-55 % RH	120 Vac, 60 Hz	Will Chen
AC Conduction	21-22 deg. C, 54-55 % RH	120 Vac, 60 Hz	Blue Lan
RF Conducted	23-25 deg. C, 53-55 % RH	120 Vac, 60 Hz	Howard Kao

2.4 Connection Diagram of Test System





2.5 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Switch/POE	UBIQUITI	US-8-150W	FCC DoC	N/A	non-shielded, 1.8m, with core

2.6 EUT Operation Test Setup

The RF test items, programmed RF utility, “Putty” installed in the notebook make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.

2.7 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss.

Offset = RF cable loss .

Following shows an offset computation example with cable loss 4.2 dB.

$$\begin{aligned} \text{Offset}(dB) &= \text{RF cable loss}(dB). \\ &= 4.2 \text{ (dB)} \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

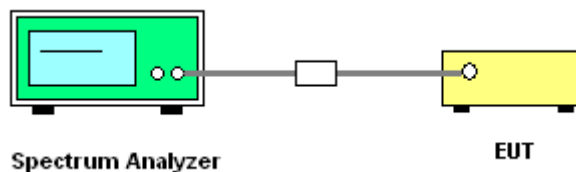
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30kHz and set the Video bandwidth (VBW) = 100kHz.
6. Measure and record the results in the test report.

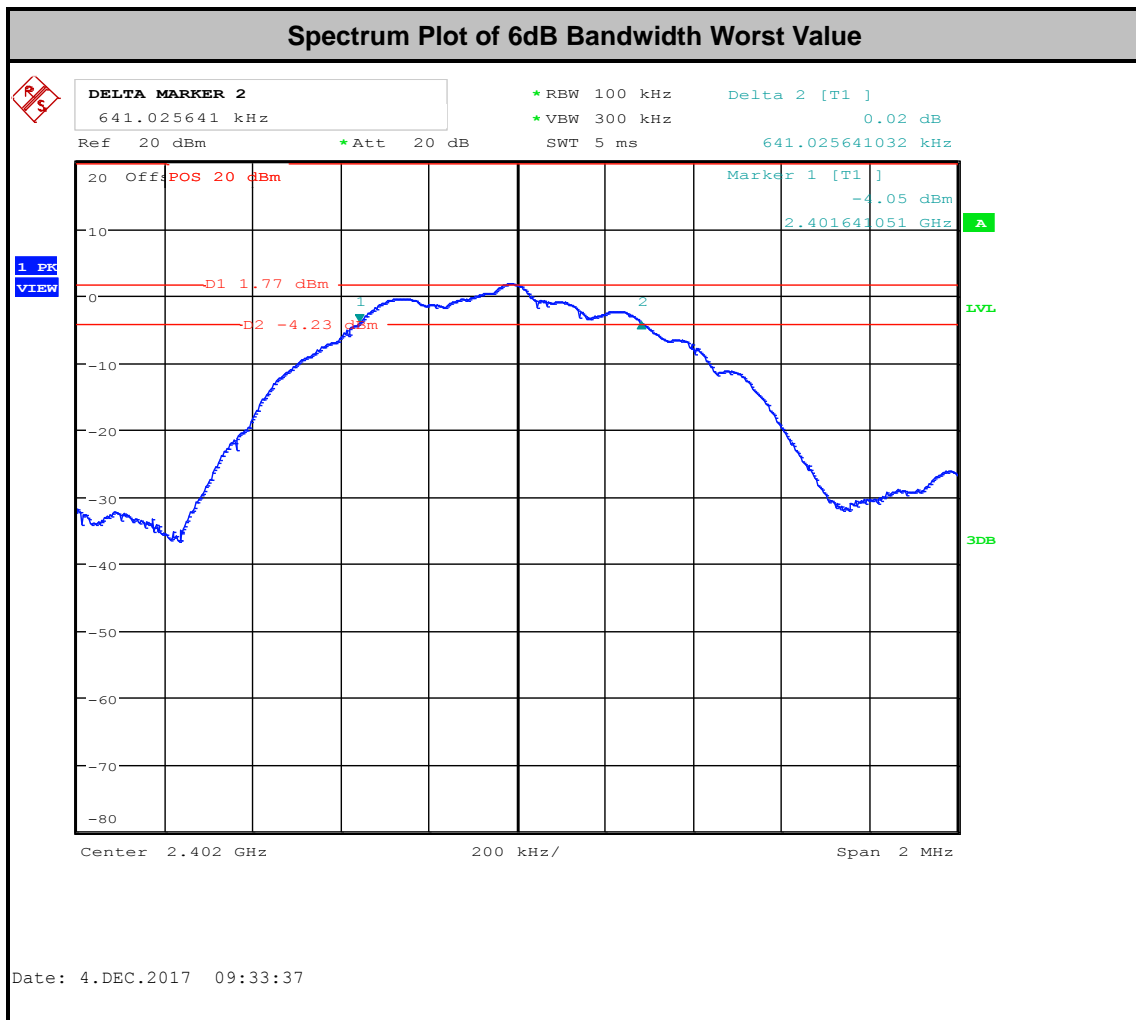
3.1.4 Test Setup

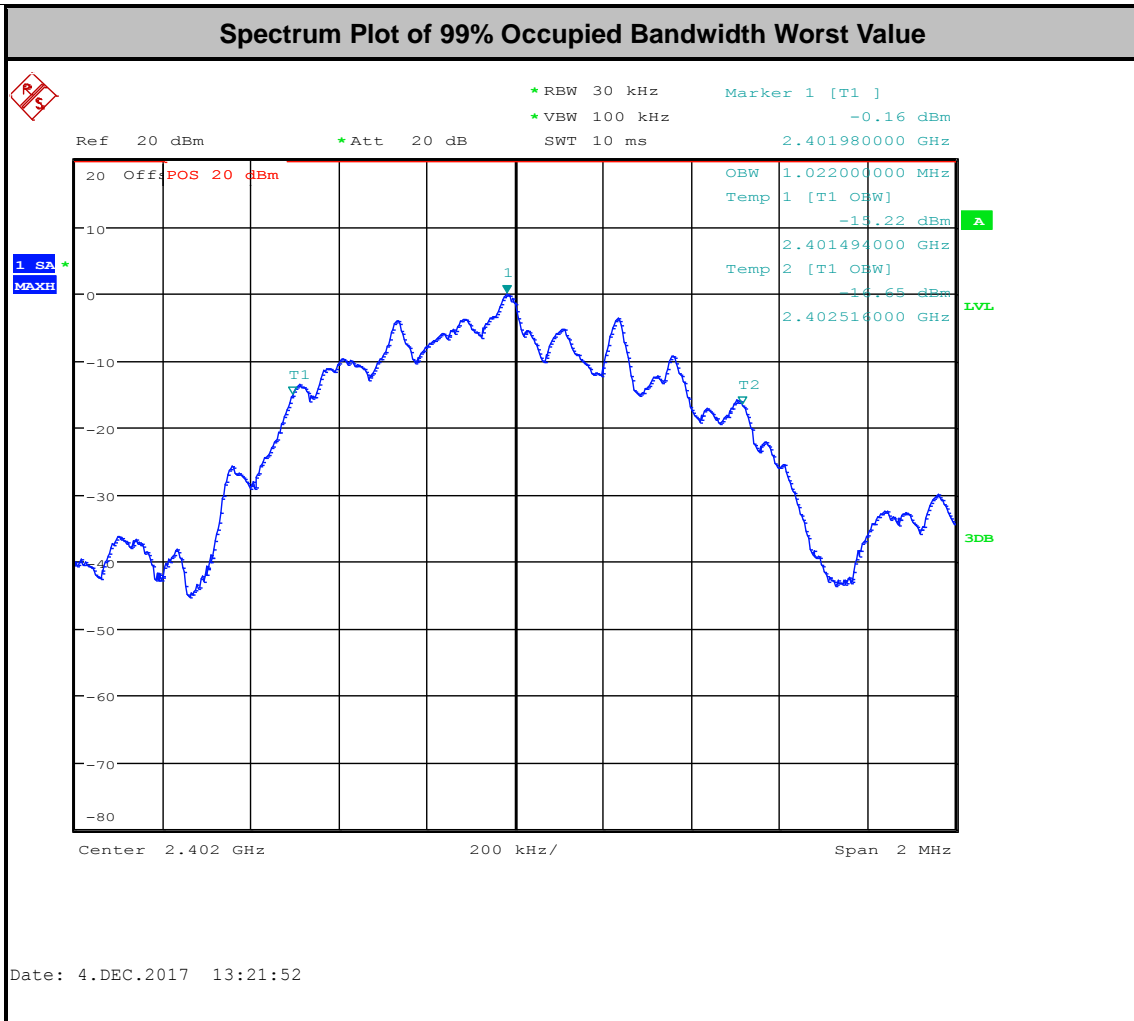




3.1.5 Test Result

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
BLE	1Mbps	1	0	2402	1.02	0.641	0.50	Pass
BLE	1Mbps	1	19	2440	1.02	0.643	0.50	Pass
BLE	1Mbps	1	39	2480	1.02	0.676	0.50	Pass





Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Maximum Output Power Measurement

3.2.1 Limit of Maximum Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

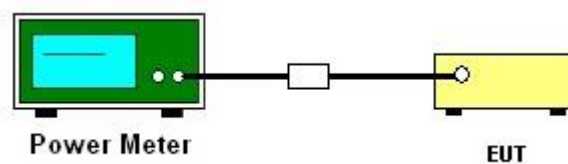
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v04 section 9.1.2 PKPM1 Peak power meter method.
2. The RF output of EUT was connected to the power sensor by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup





3.2.5 Test Result

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
BLE	1Mbps	1	0	2402	2.17	30.00	3.50	5.67	36.00	Pass
BLE	1Mbps	1	19	2440	4.41	30.00	3.50	7.91	36.00	Pass
BLE	1Mbps	1	39	2480	5.19	30.00	3.50	8.69	36.00	Pass

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

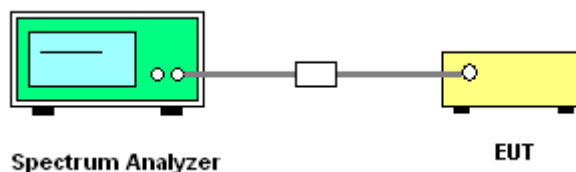
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.

3.3.4 Test Setup



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

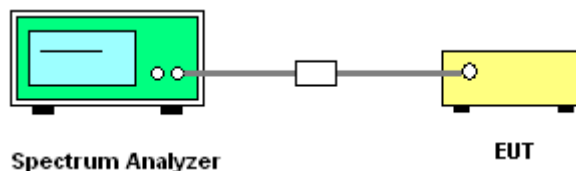
3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

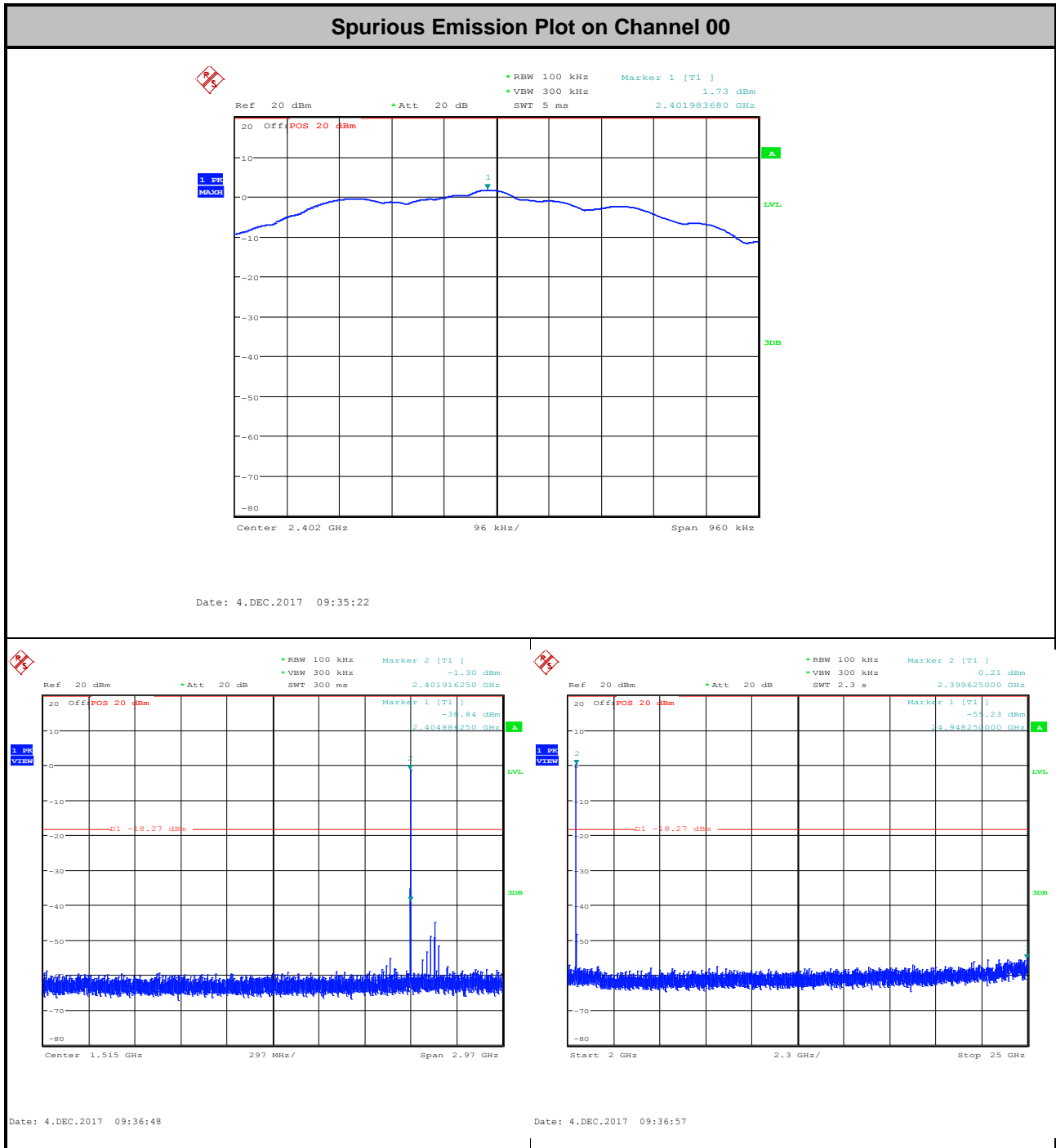
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



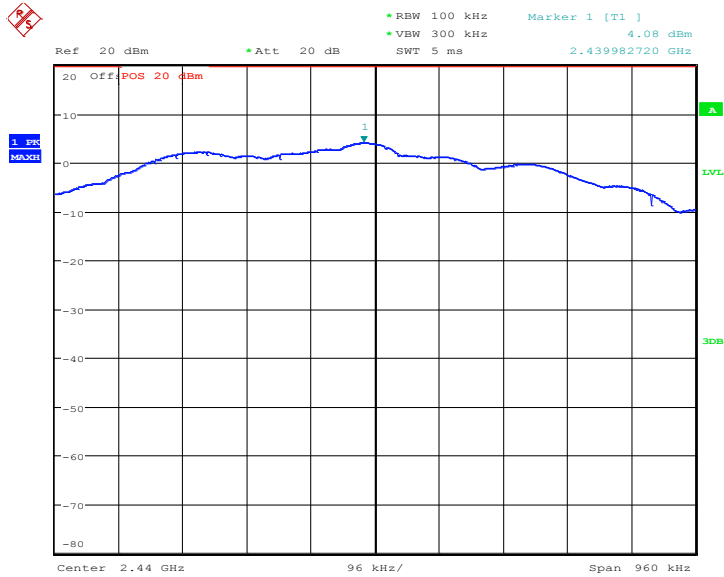


3.4.5 Test Result

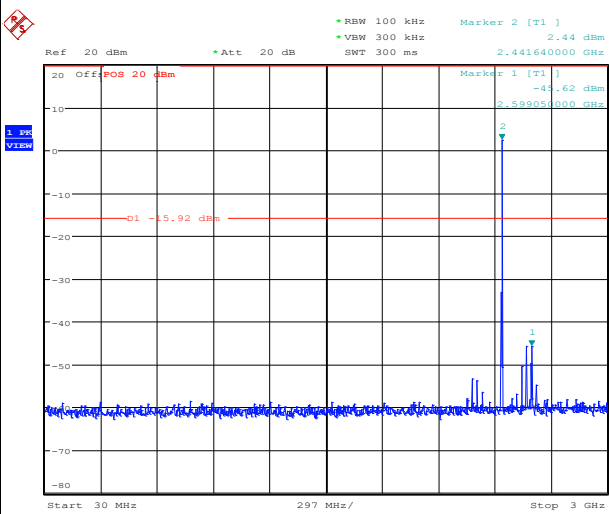




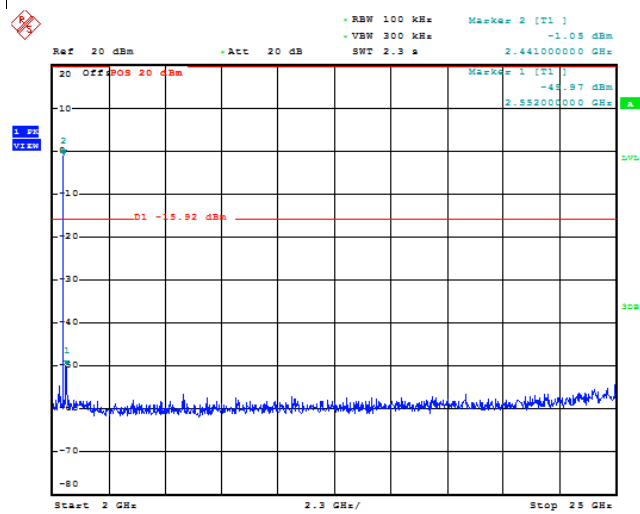
Spurious Emission Plot on Channel 19



Date: 4.DEC.2017 09:07:56



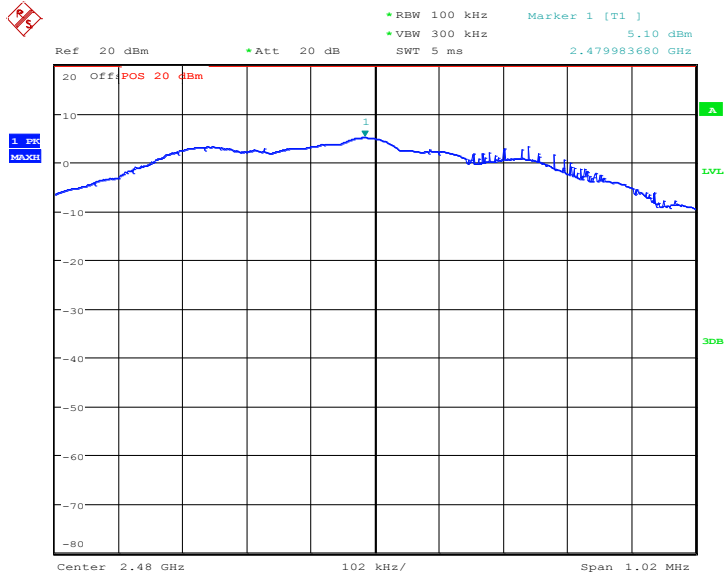
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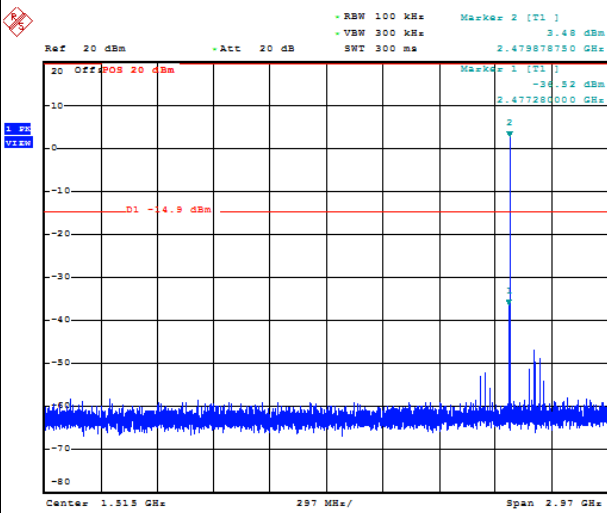
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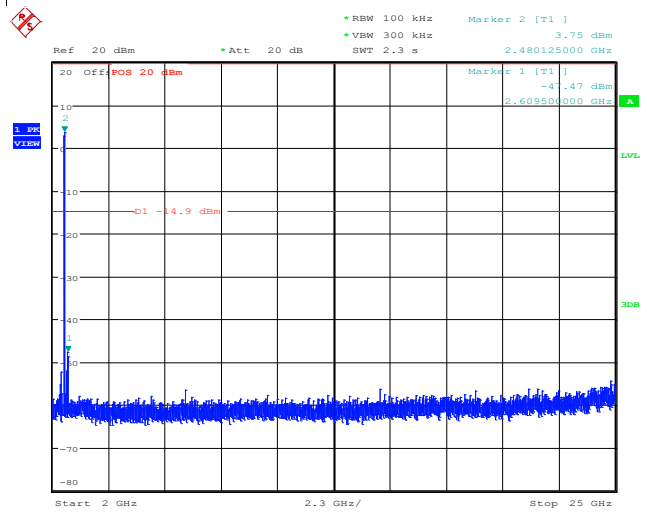
Spurious Emission Plot on Channel 39



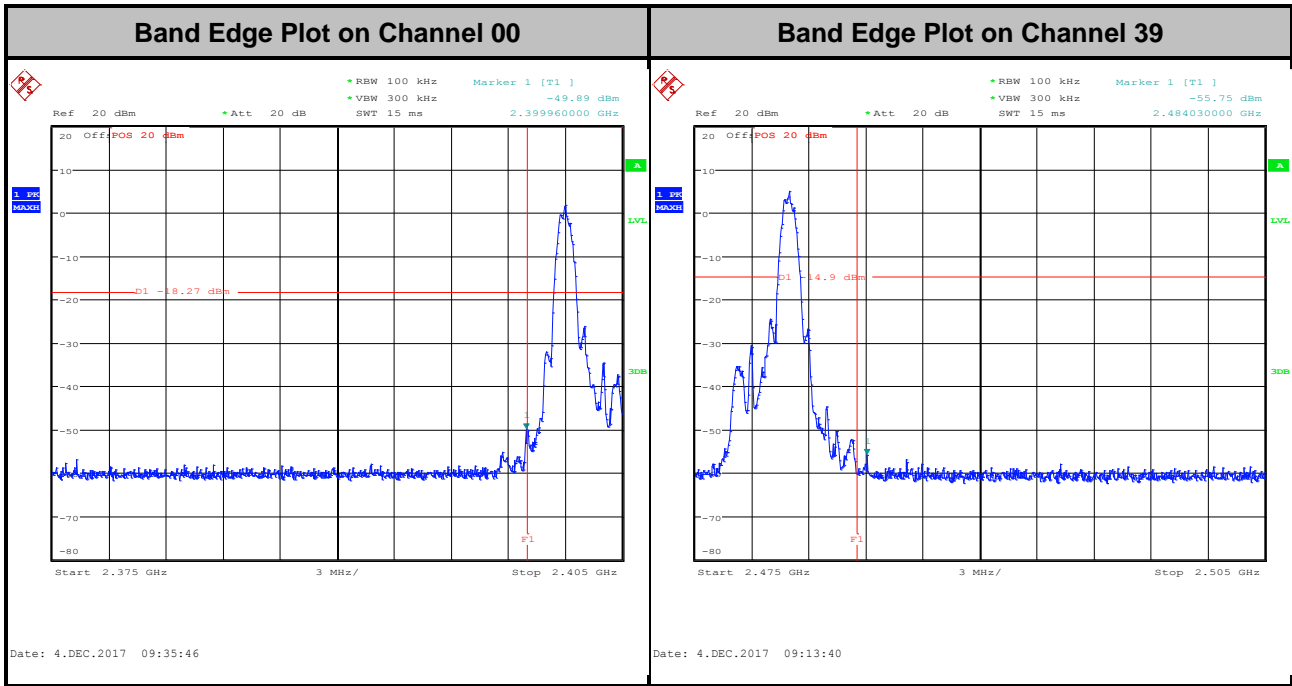
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3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. 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

3.5.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

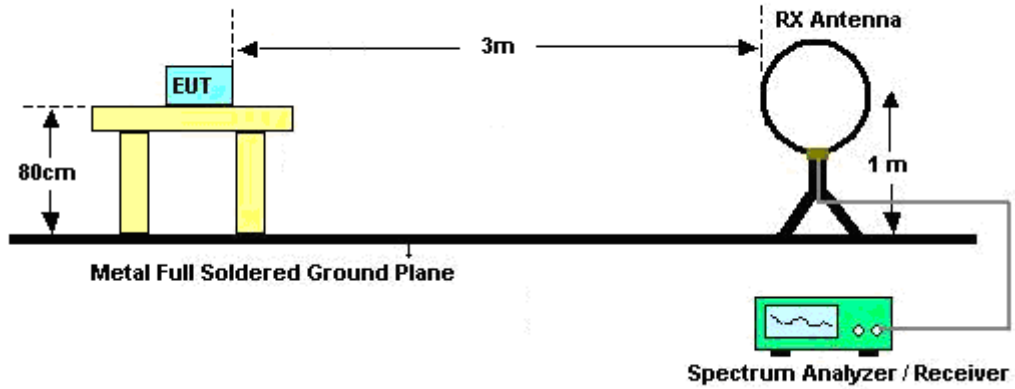


3.5.3 Test Procedures

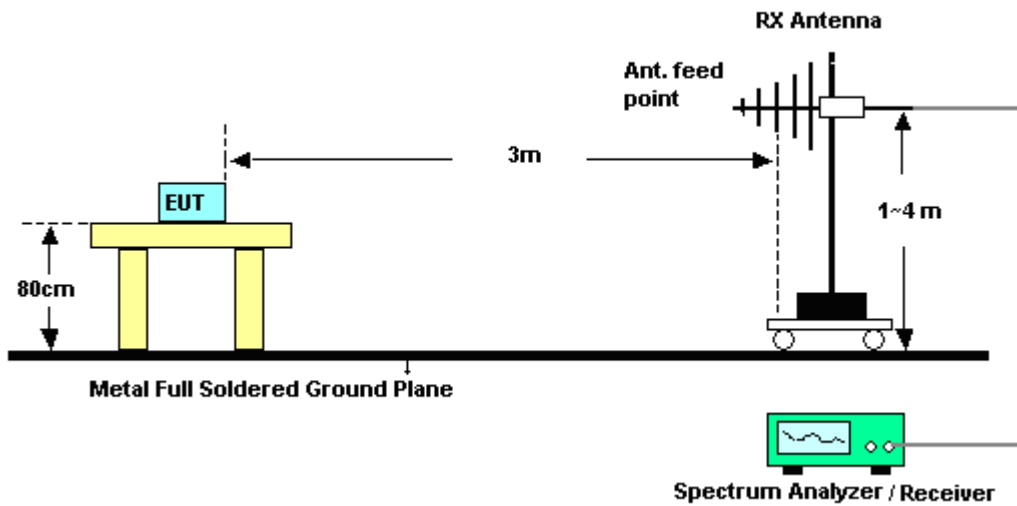
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. 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.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

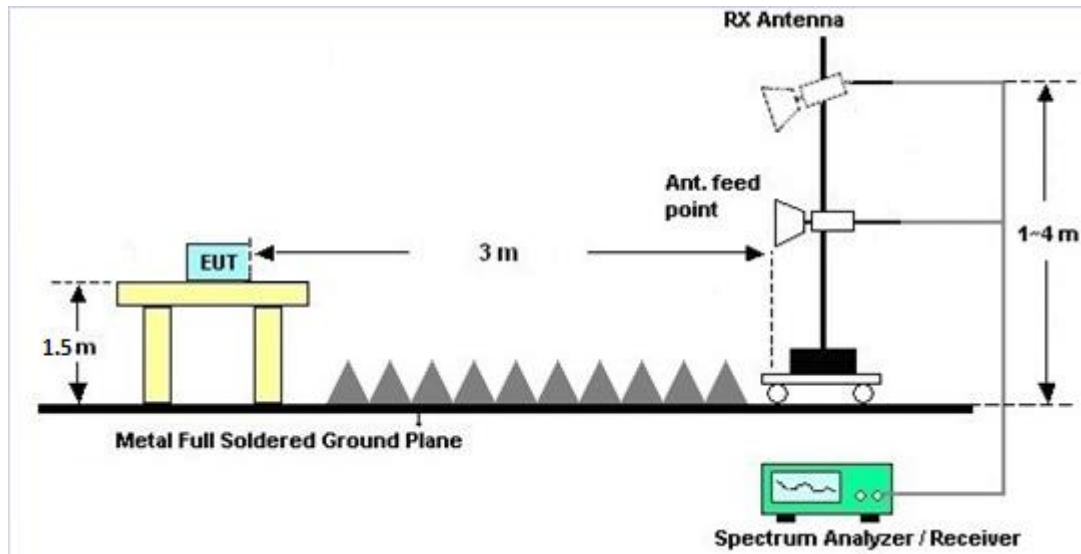
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 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.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A

3.5.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A

3.5.8 Duty Cycle

Please refer to Appendix B



3.5.9 Test Result

ABOVE 1 GHz DATA :

EUT Test Condition			
Channel	Channel 0	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2358.41	42.35	-31.65	74	42.08	27.21	3.94	30.88	385	4	Peak
2376.26	31.97	-22.03	54	31.61	27.26	3.96	30.86	385	4	Average
2402	96.61			96.13	27.36	3.97	30.85	385	4	Peak
2402	95.43			95	27.31	3.97	30.85	385	4	Average
4804	46.94	-27.06	74	40.08	31.32	5.68	30.14	100	0	Peak
4804	45.6	-8.4	54	38.74	31.32	5.68	30.14	100	0	Average

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2350.85	42.93	-31.07	74	42.72	27.17	3.92	30.88	317	320	Peak
2360.72	35.76	-18.24	54	35.49	27.21	3.94	30.88	317	320	Average
2402	102.18			101.7	27.36	3.97	30.85	317	320	Peak
2402	100.95			100.52	27.31	3.97	30.85	317	320	Average
4804	51.99	-22.01	74	45.13	31.32	5.68	30.14	366	323	Peak
4804	50.59	-3.41	54	43.73	31.32	5.68	30.14	366	323	Average

Remarks:

1. The other emission levels were very low against the limit.
2. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Over Limit = Emission level – Limit value
3. 2402 MHz: Fundamental frequency.



EUT Test Condition			
Channel	Channel 19	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2335.9	35.67	-18.33	54	35.48	27.17	3.91	30.89	397	96	Average
2336.04	43.51	-30.49	74	43.32	27.17	3.91	30.89	397	96	Peak
2440	96.56			95.93	27.46	4	30.83	397	96	Peak
2440	95.38			94.76	27.46	4	30.84	397	96	Average
2487.54	42.86	-31.14	74	42.04	27.6	4.04	30.82	397	96	Peak
2494.12	32.51	-21.49	54	31.68	27.6	4.04	30.81	397	96	Average
4880	47.05	-26.95	74	39.99	31.46	5.72	30.12	100	0	Peak
4880	45.56	-8.44	54	38.5	31.46	5.72	30.12	100	0	Average



Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2335.9	42.77	-11.23	54	42.58	27.17	3.91	30.89	317	322	Average
2336.18	47.33	-26.67	74	47.14	27.17	3.91	30.89	317	322	Peak
2440	101.65			101.03	27.46	4	30.84	317	322	Peak
2440	100.41			99.79	27.46	4	30.84	317	322	Average
2484.67	43.04	-30.96	74	42.27	27.55	4.04	30.82	317	322	Peak
2491.95	33.93	-20.07	54	33.1	27.6	4.04	30.81	317	322	Average
4880	51.51	-22.49	74	44.45	31.46	5.72	30.12	363	319	Peak
4880	50.01	-3.99	54	42.95	31.46	5.72	30.12	363	319	Average
7320	54.55	-19.45	74	42.6	36.12	7.06	31.23	280	258	Peak
7320	50.93	-3.07	54	38.98	36.12	7.06	31.23	280	258	Average

Remarks:

1. The other emission levels were very low against the limit.
2. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Over Limit = Emission level – Limit value
3. 2440 MHz: Fundamental frequency.



EUT Test Condition			
Channel	Channel 39	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	98.99			98.23	27.55	4.03	30.82	381	11	Peak
2480	97.91			97.15	27.55	4.03	30.82	381	11	Average
2483.52	49.45	-24.55	74	48.68	27.55	4.04	30.82	381	11	Peak
2483.52	40.06	-13.94	54	39.29	27.55	4.04	30.82	381	11	Average
4960	49.26	-24.74	74	41.96	31.63	5.76	30.09	100	15	Peak
4960	47.87	-6.13	54	40.57	31.63	5.76	30.09	100	15	Average

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	102.43			101.67	27.55	4.03	30.82	355	343	Peak
2480	101.22			100.46	27.55	4.03	30.82	355	343	Average
2483.52	53.23	-20.77	74	52.46	27.55	4.04	30.82	355	343	Peak
2483.52	42.36	-11.64	54	41.59	27.55	4.04	30.82	355	343	Average
4960	54.02	-19.98	74	46.72	31.63	5.76	30.09	100	180	Peak
4960	52.18	-1.82	54	44.88	31.63	5.76	30.09	100	180	Average
7440	55.01	-18.99	74	42.81	36.39	7.1	31.29	275	297	Peak
7440	50.12	-3.88	54	37.92	36.39	7.1	31.29	275	297	Average

Remarks:

1. The other emission levels were very low against the limit.
2. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Over Limit = Emission level – Limit value
3. 2480 MHz: Fundamental frequency.



30 MHz ~ 1 GHz WORST-CASE DATA: :

EUT Test Condition			
Channel	Channel 39	Frequency Range :	30 MHz ~ 1 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Quasi-peak (QP)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
76.98	34.81	-5.19	40	53.8	12.86	0.74	32.59	-	-	Peak
101.82	35.41	-8.09	43.5	50.97	16.25	0.79	32.6	-	-	Peak
204.15	39.74	-3.76	43.5	56.01	15.07	1.16	32.5	100	247	QP
374.9	38.72	-7.28	46	48.65	21.12	1.51	32.56	-	-	Peak
588.4	38.76	-7.24	46	43.7	25.8	1.91	32.65	-	-	Peak
663.3	32.22	-13.78	46	36.28	26.51	2.02	32.59	-	-	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Over Limit (dB)	Limit (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
30.81	39.18	-0.82	40	47.07	24.24	0.46	32.59	100	0	QP
40.8	34.17	-5.83	40	47.09	19.07	0.59	32.58	100	189	QP
51.06	36.72	-3.28	40	54.78	13.92	0.59	32.57	100	195	QP
56.73	36.53	-3.47	40	56.21	12.3	0.59	32.57	100	200	QP
374.9	39.16	-6.84	46	49.09	21.12	1.51	32.56	-	-	Peak
589.8	42.73	-3.27	46	47.66	25.81	1.91	32.65	-	-	Peak

Remarks:

- The other emission levels were very low against the limit.
- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Over Limit = Emission level – Limit value



3.6 AC Power Conducted Emission Measurement

3.6.1 Limit of AC Power 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 μ 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.

For terminal test result, the testing follows FCC KDB 174176.

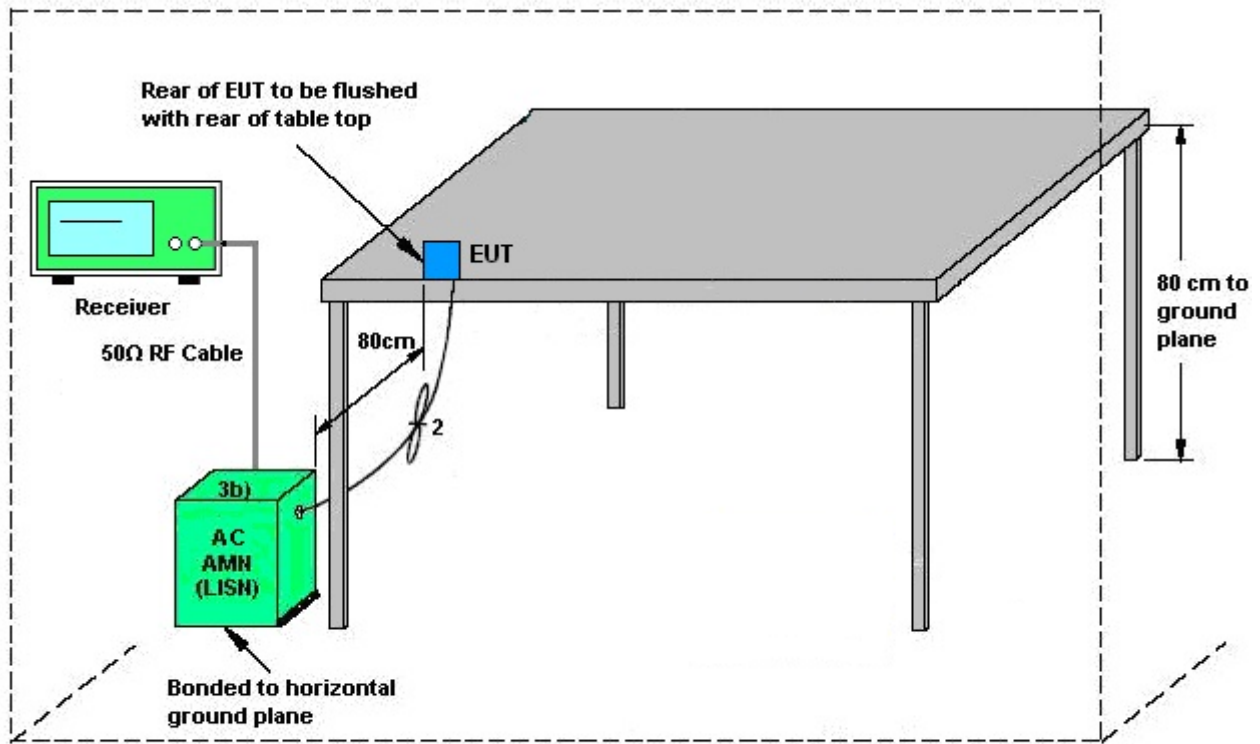
3.6.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.6.3 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.

3.6.4 Test Setup



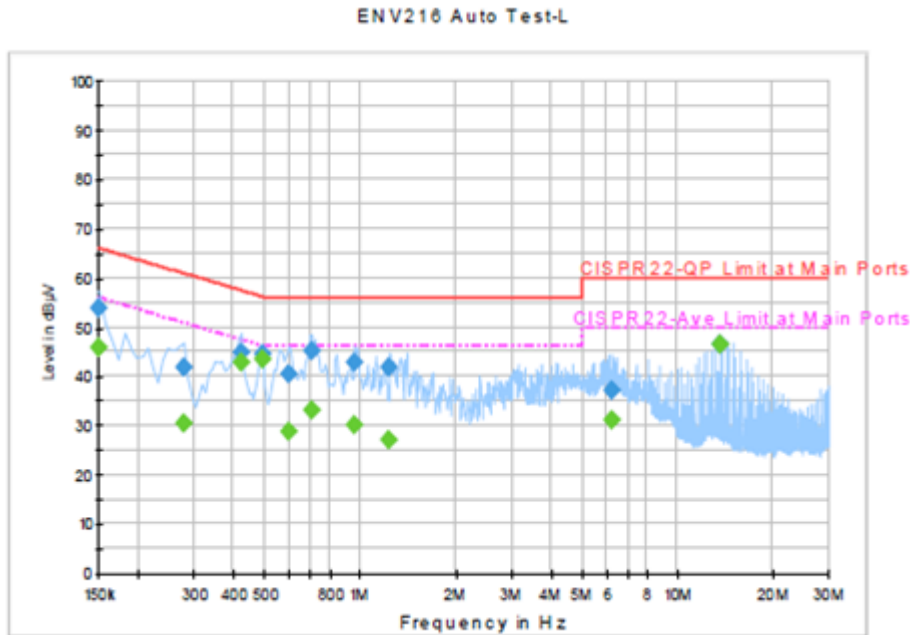
AMN = Artificial mains network (LISH)
 AE = Associated equipment
 EUT = Equipment under test
 ISN = Impedance stabilization network



3.6.5 Test Result

CONDUCTED WORST-CASE DATA

Test Engineer :	Blue Lan	Phase :	Line (L)	Temperature :	21~22°C
		Date :	2017.11.21	Relative Humidity :	54~55%
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.				



Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	53.8	Off	L1	19.6	12.2	66.0
0.278000	41.7	Off	L1	19.5	19.2	60.9
0.422000	44.9	Off	L1	19.5	12.5	57.4
0.494000	44.6	Off	L1	19.5	11.5	56.1
0.598000	40.3	Off	L1	19.5	15.7	56.0
0.702000	45.0	Off	L1	19.5	11.0	56.0
0.966000	42.7	Off	L1	19.5	13.3	56.0
1.238000	41.8	Off	L1	19.5	14.2	56.0
6.206000	37.2	Off	L1	19.6	22.8	60.0
13.614000	46.4	Off	L1	19.7	13.6	60.0

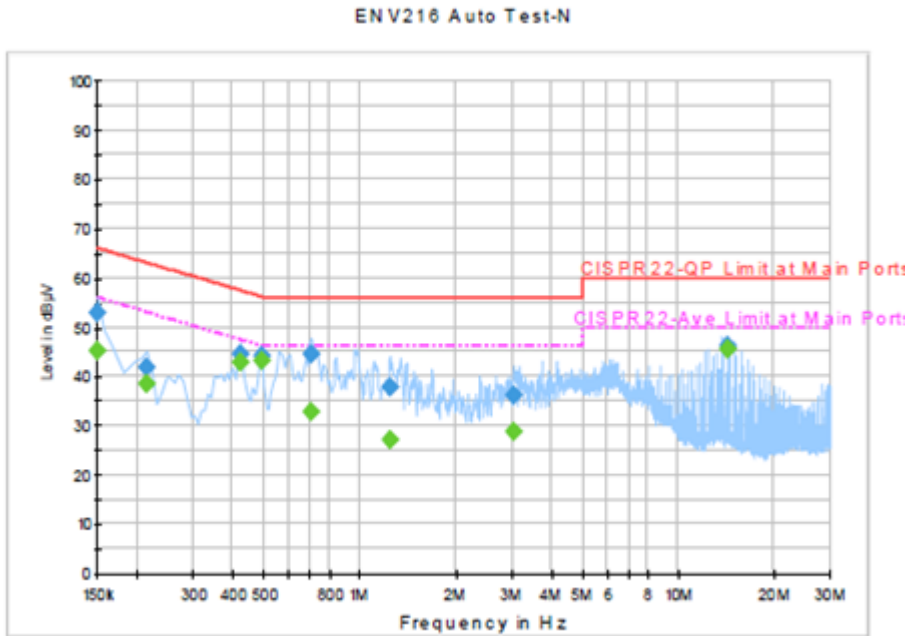


Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	46.0	Off	L1	19.6	10.0	56.0
0.278000	30.5	Off	L1	19.5	20.4	50.9
0.422000	42.8	Off	L1	19.5	4.6	47.4
0.494000	43.5	Off	L1	19.5	2.6	46.1
0.598000	28.6	Off	L1	19.5	17.4	46.0
0.702000	33.1	Off	L1	19.5	12.9	46.0
0.966000	30.1	Off	L1	19.5	15.9	46.0
1.238000	27.2	Off	L1	19.5	18.8	46.0
6.206000	31.0	Off	L1	19.6	19.0	50.0
13.614000	46.5	Off	L1	19.7	3.5	50.0



Test Engineer :	Blue Lan	Phase :	Neutral (N)	Temperature :	21~22°C
		Date :	2017.11.21	Relative Humidity :	54~55%
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.				



Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	52.9	Off	N	19.5	13.1	66.0
0.214000	41.6	Off	N	19.5	21.4	63.0
0.422000	44.3	Off	N	19.5	13.1	57.4
0.494000	44.3	Off	N	19.5	11.8	56.1
0.702000	44.6	Off	N	19.5	11.4	56.0
1.246000	37.8	Off	N	19.5	18.2	56.0
3.038000	36.0	Off	N	19.5	20.0	56.0
14.334000	46.2	Off	N	19.8	13.8	60.0



Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	45.2	Off	N	19.5	10.8	56.0
0.214000	38.3	Off	N	19.5	14.7	53.0
0.422000	42.7	Off	N	19.5	4.7	47.4
0.494000	43.0	Off	N	19.5	3.1	46.1
0.702000	32.8	Off	N	19.5	13.2	46.0
1.246000	27.1	Off	N	19.5	18.9	46.0
3.038000	28.7	Off	N	19.5	17.3	46.0
14.334000	45.5	Off	N	19.8	4.5	50.0



3.7 Antenna Requirements

3.7.1 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.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 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.	Calibration Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Conduction
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	Sep. 20, 2017	Sep. 19, 2018	Conduction
Hygrometer	Testo	608-H1	34913912	Mar. 20, 2017	Mar. 19, 2018	Conduction
LISN	Rohde & Schwarz	ENV216	100080	Nov. 29, 2016	Nov. 28, 2017	Conduction
LF Cable	HUBER + SUHNER	RG-214/U	LF01	Jan. 05, 2017	Jan. 04, 2018	Conduction
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100851	Jan. 05, 2017	Jan. 04, 2018	Conduction
Bilog Antenna	TESEQ	CBL6111D&00800N1D01N-06	41912&05	Jan. 07, 2017	Jan. 06, 2018	Radiation
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1620	Oct. 03, 2017	Oct. 02, 2018	Radiation
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	Nov. 24, 2017	Nov. 23, 2019	Radiation
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170576	Apr. 27, 2017	Apr. 26, 2018	Radiation
Preamplifier	Keysight	83017A	MY53270195	Aug. 21, 2017	Aug. 20, 2018	Radiation
Amplifier	SONOMA	310N	187311	Oct. 19, 2017	Oct. 18, 2018	Radiation
Amplifier	MITEQ	TTA1840-35-HG	1871923	Jul. 18, 2017	Jul. 17, 2018	Radiation
Antenna Mast	ChainTek	MBS-520-1	N/A	N/A	N/A	Radiation



Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Due Date	Remark
Turn Table	ChainTek	T-200-S-1	N/A	N/A	N/A	Radiation
Spectrum Analyzer	Rohde & Schwarz	FSQ	200578	Mar. 22, 2017	Mar. 21, 2018	Radiation
EMI Test Receiver	Agilent Technologies	N9038A(MXE)	MY53290045	Jan. 19, 2017	Jan. 18, 2018	Radiation
RF signal cable	HUBER+SUH NNER	SUCOFLEX 104	MY11681/4PE	Mar. 16, 2017	Mar. 15, 2018	Radiation
RF signal cable	HUBER+SUH NNER	SUCOFLEX 104	MY36980/4	Mar. 17, 2017	Mar. 16, 2018	Radiation
Software	Audix	E3 6.2009-8-24	N/A	N/A	N/A	Radiation
Spectrum Analyzer	Rohde & Schwarz	FSQ	200578	Mar. 22, 2017	Mar. 21, 2018	Conducted
Power Sensor	Keysight	U2021XA	MY54060013	Feb. 15, 2017	Feb. 14, 2018	Conducted
Power Sensor	Keysight	U2021XA	MY54070013	Feb. 15, 2017	Feb. 14, 2018	Conducted



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.70
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.14
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.48
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.12
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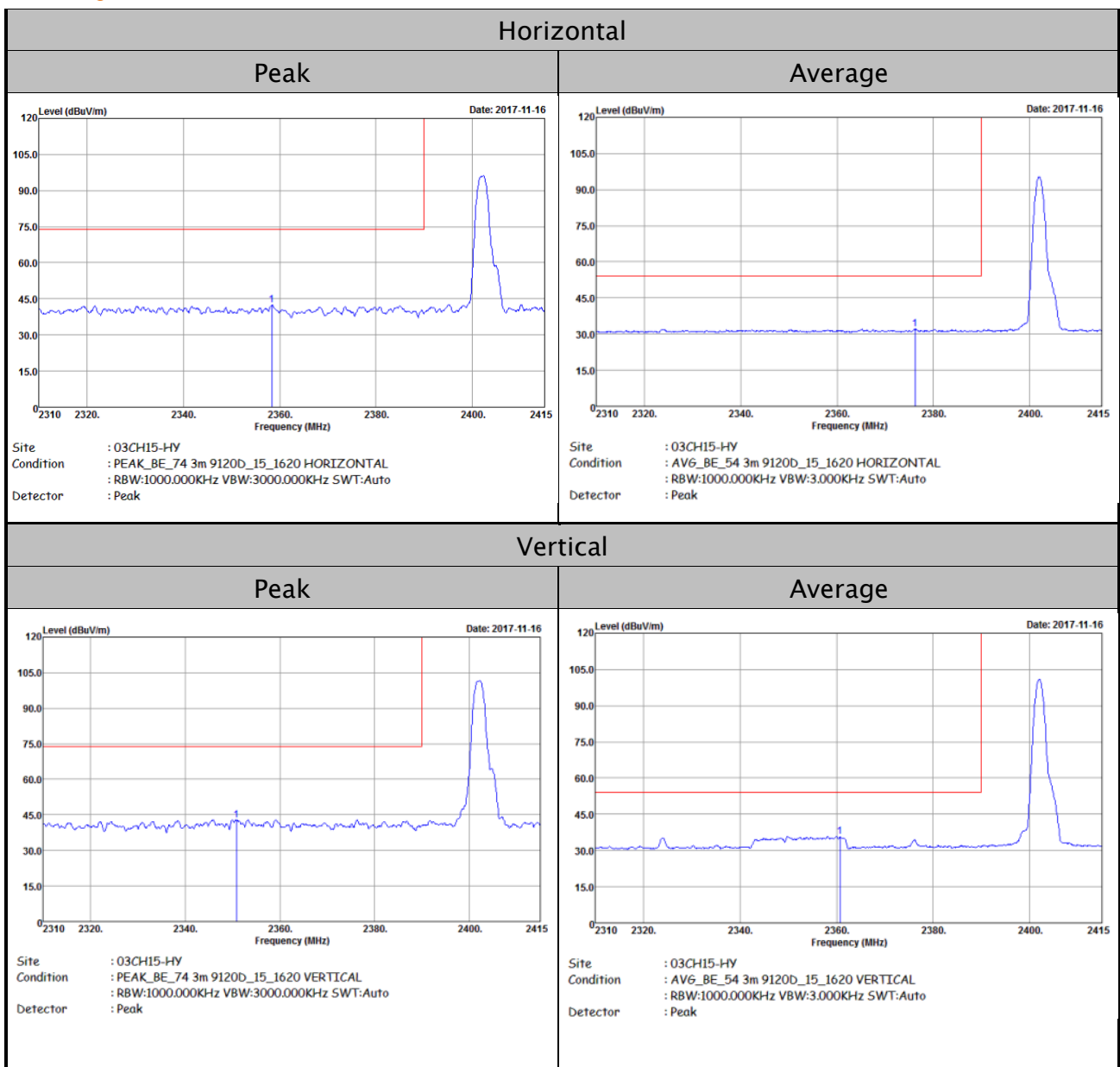


Appendix A. Radiated Spurious Emission

ABOVE 1 GHz DATA :

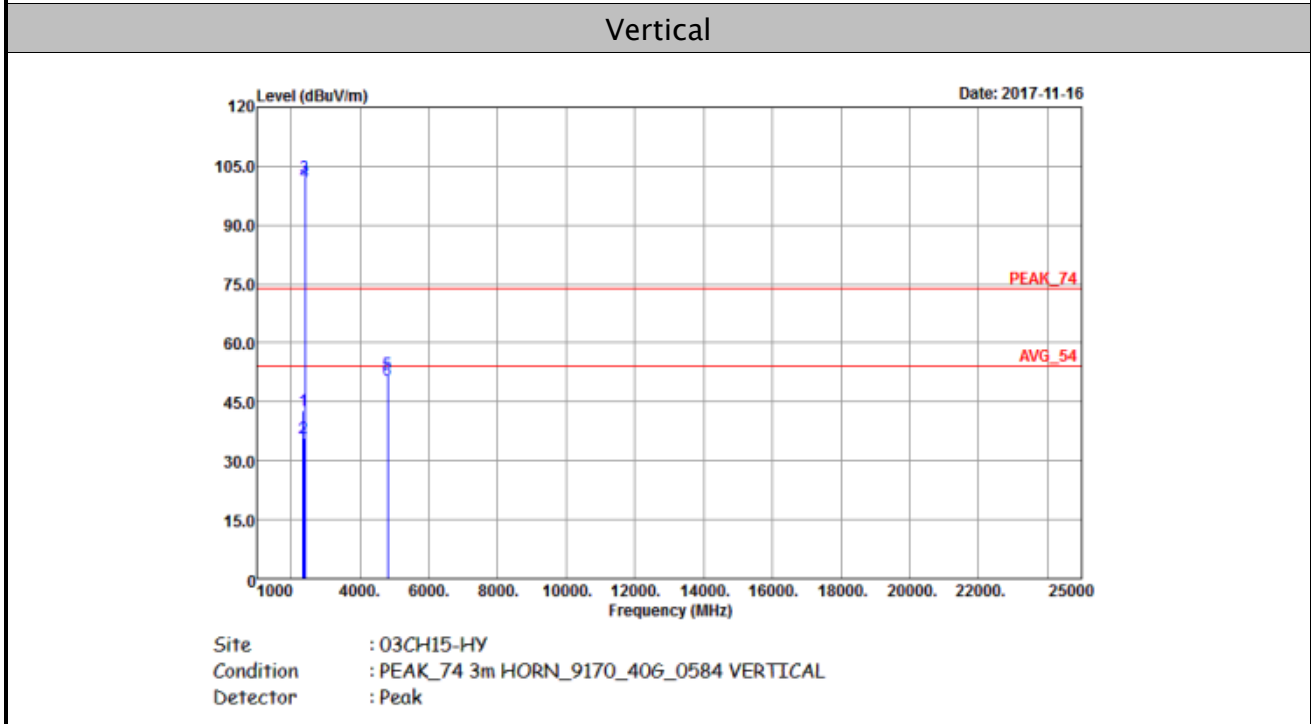
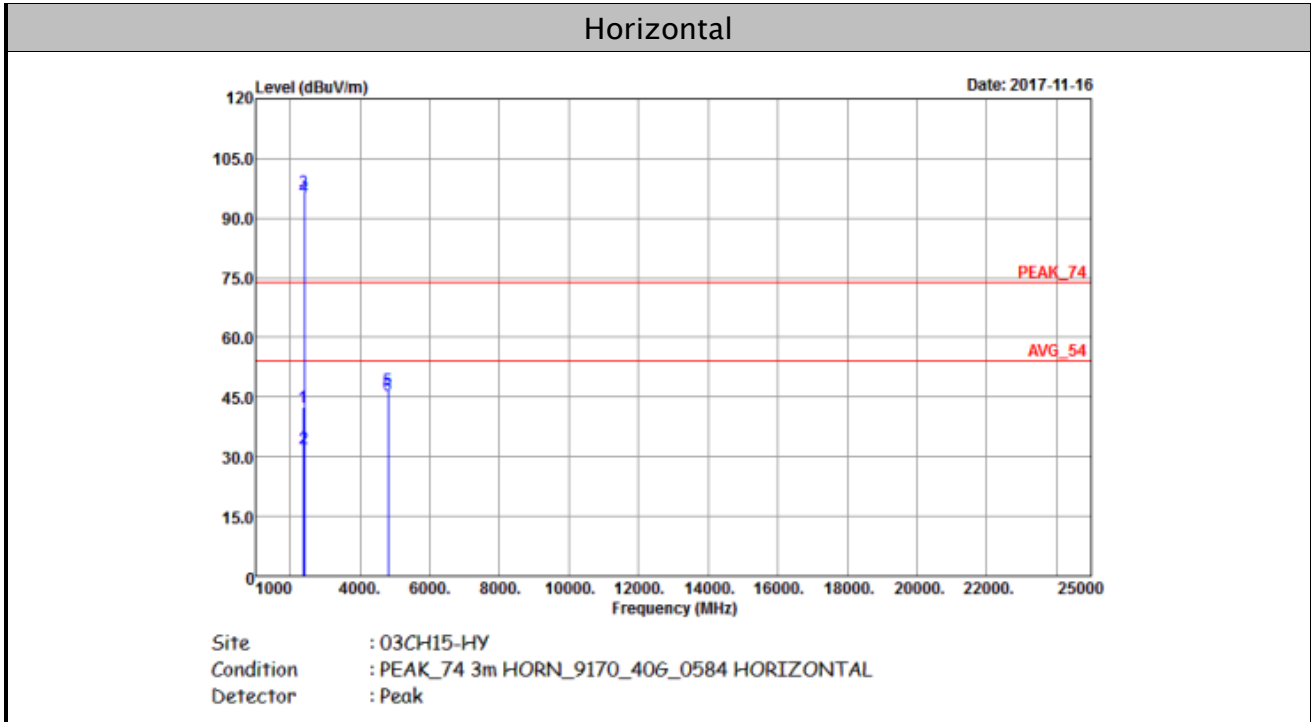
EUT Test Condition			
Channel	Channel 0	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

Band Edge





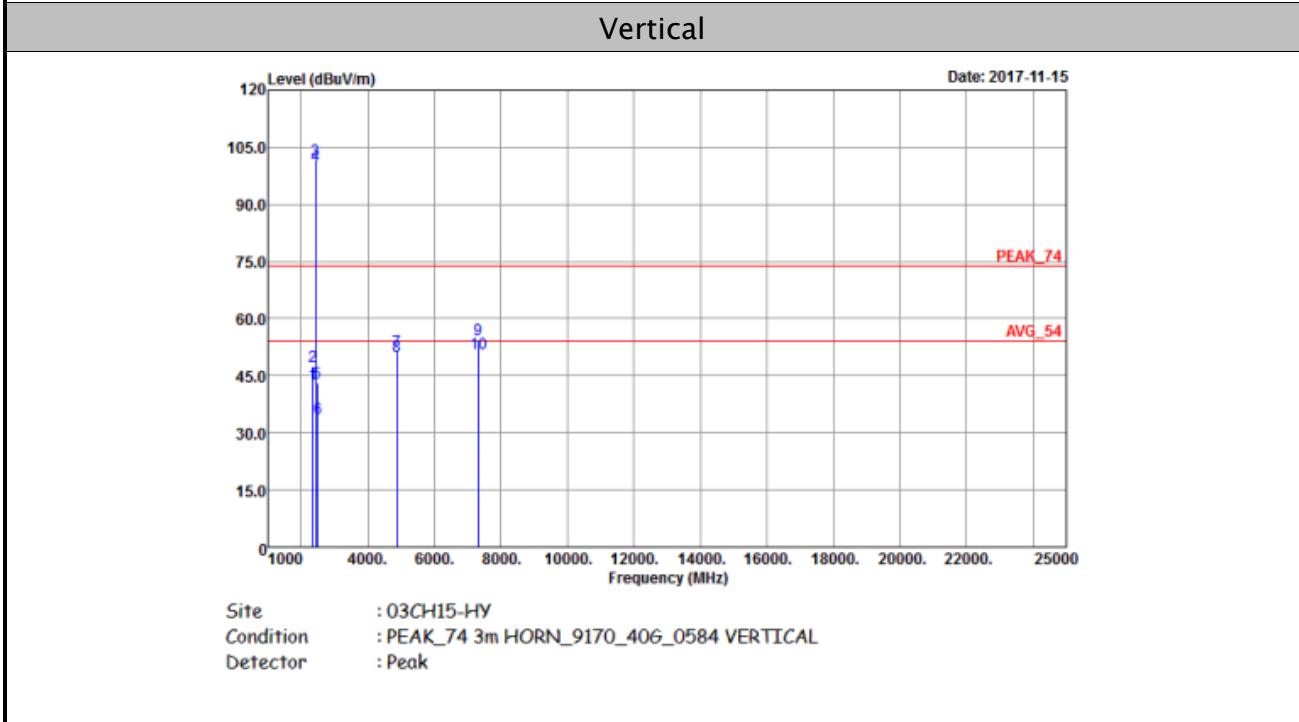
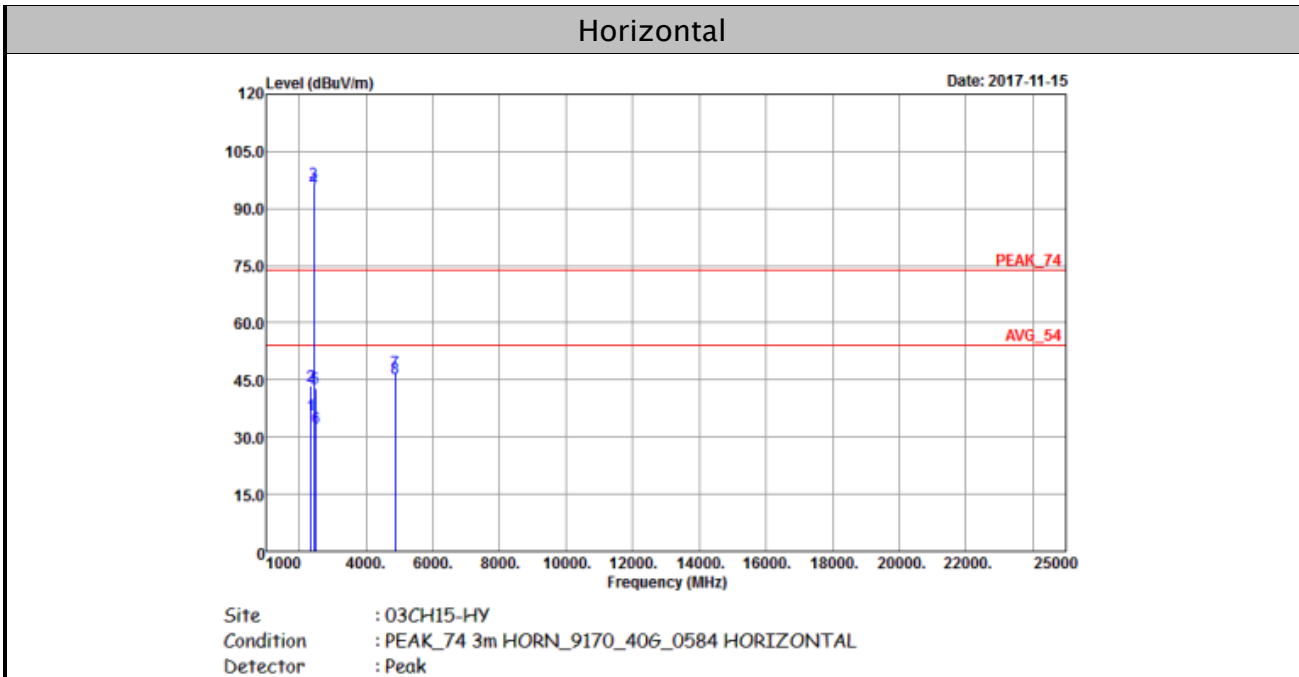
Spurious Emission



EUT Test Condition			
Channel	Channel 19	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen



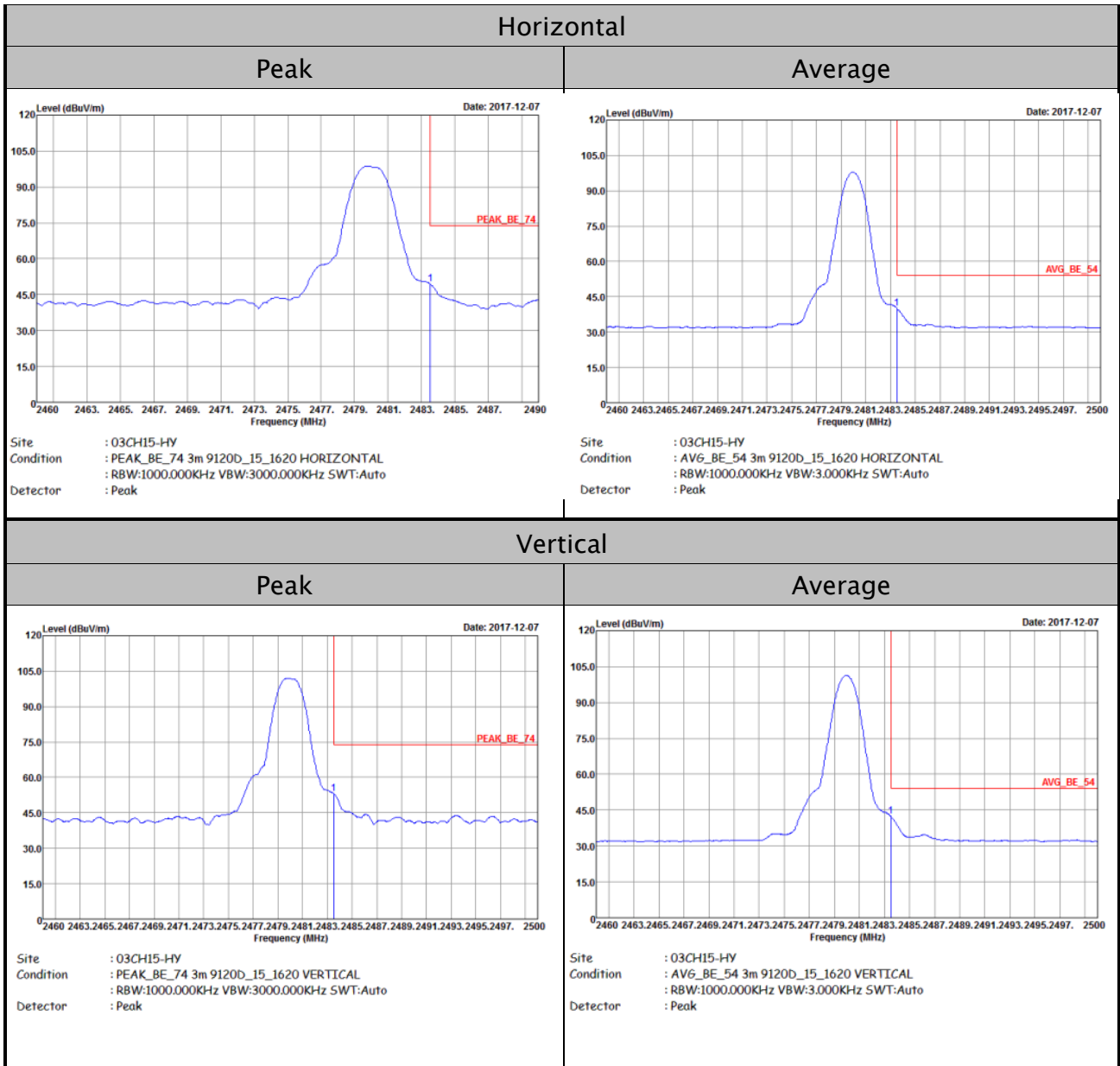
Spurious Emission



EUT Test Condition			
Channel	Channel 39	Frequency Range :	1 GHz ~ 25 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Average (AV)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen



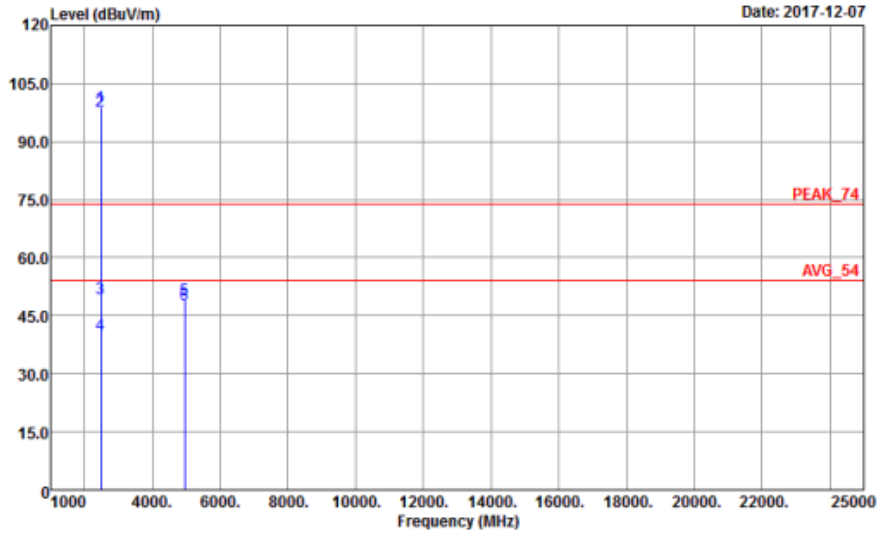
Band Edge





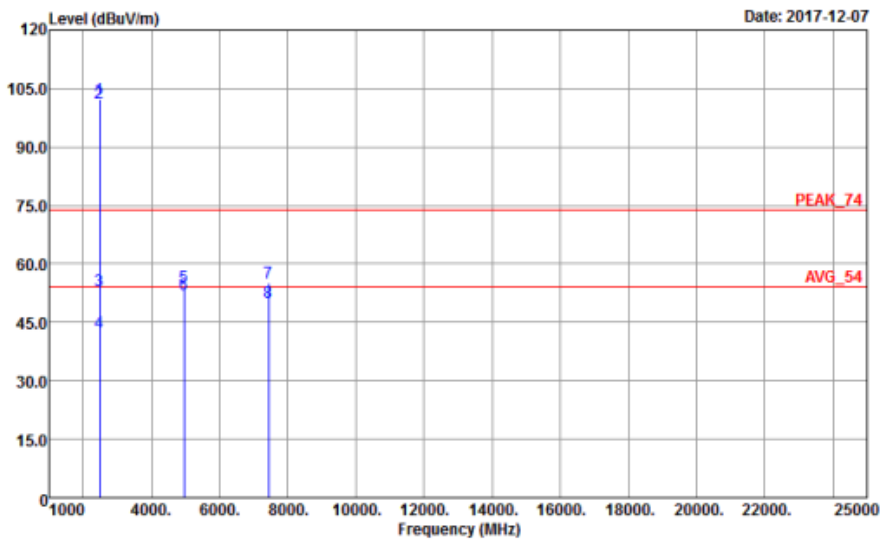
Spurious Emission

Horizontal



Site : 03CH15-HY
Condition : PEAK_74 3m HORN_9170_406_0584 HORIZONTAL
Detector : Peak

Vertical



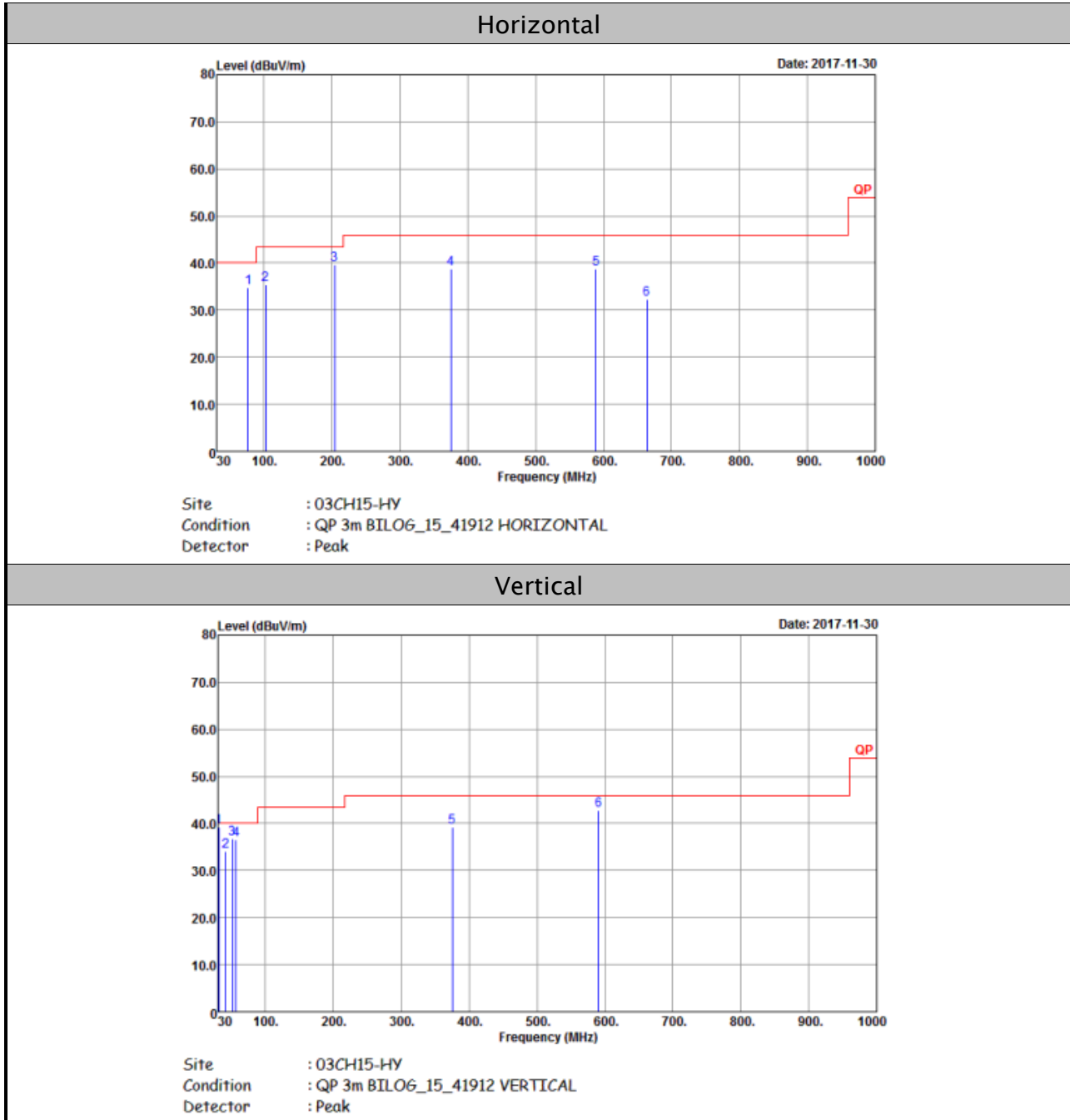
Site : 03CH15-HY
Condition : PEAK_74 3m HORN_9170_406_0584 VERTICAL
Detector : Peak



30 MHz ~ 1 GHz WORST-CASE DATA:

EUT Test Condition			
Channel	Channel 39	Frequency Range :	30 MHz ~ 1 GHz
Temperature :	22~25°C	Detector Function :	Peak (PK)
Relative Humidity :	52~55%		Quasi-peak (QP)
Input Power :	120 Vac, 60 Hz	Test Engineer :	Will Chen

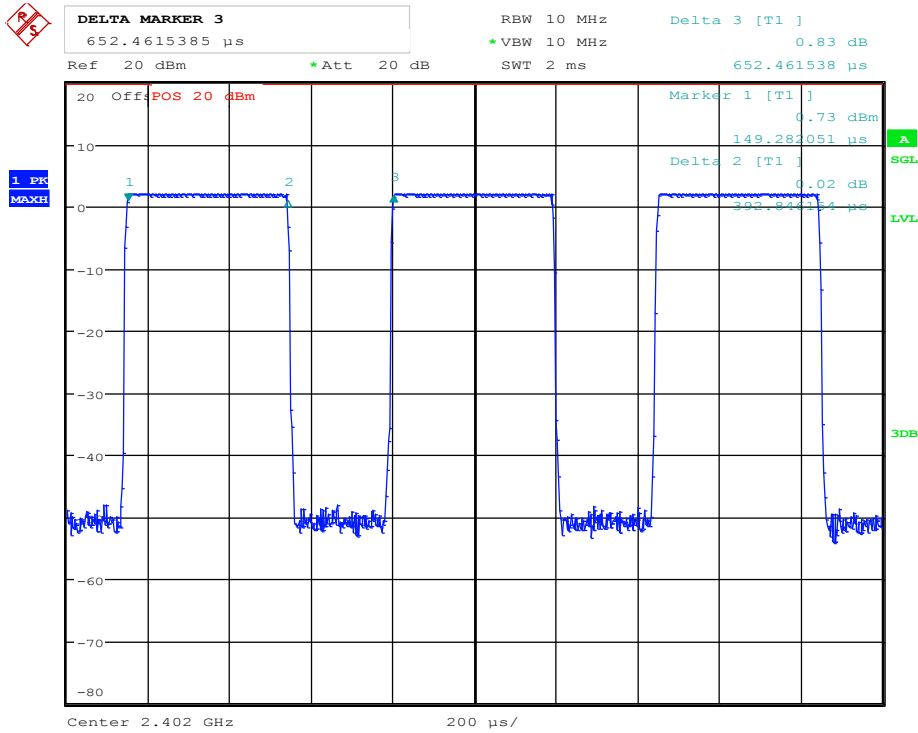
Spurious Emission





Appendix B. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Bluetooth-LE	60.21	392.846	2.55	3kHz



Date: 4.DEC.2017 09:32:01