FCC RADIO TEST REPORT

FCC ID	:	**WR92221123114**
Equipment	:	**thermostat**
Brand Name	:	**ecobee**
Model Name	:	**ECB402**
Applicant	:	**ecobee Inc.** **207 Queens Quay West, Suite 600, Toronto, ON, Canada**
Manufacturer	:	**ecobee Inc.** **207 Queens Quay West, Suite 600, Toronto, ON, Canada**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Jan. 17, 2019 and testing was started from Feb. 15, 2019 and completed on Apr. 11, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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

Jones Tsai

Approved by: Jones Tsai

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR911708D	01	Initial issue of report	Apr. 25, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(1)	Number of Channels	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	Pass	-
3.3	15.247(f)	Dwell Time of Each Channel	Pass	-
3.4	15.247(a)(1)	20dB Bandwidth	Pass	-
3.4	2.1049	99% Occupied Bandwidth	Reporting Only	-
3.5	15.247(b)(2) &15.247(b)(3)	Output Power	Pass	-
3.6	15.247(f)	Power Spectral Density	Pass	-
3.7	15.247(d)	Conducted Band Edges	Pass	-
3.8	15.247(d)	Conducted Spurious Emission	Pass	-
3.9	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 3.11 dB at 951.500 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.10	15.203 & 15.247(b)	Antenna Requirement	Pass	-
Remark: Not required means after assessing, test items are not necessary to carry out.				

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Maggie Chiang

1 General Description

1.1 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac, and Proprietary Sensor

Product Specification subjective to this standard	
Antenna Type	WLAN: Ceramic Chip Antenna Bluetooth: FPC Antenna Proprietary Sensor: IFA Meander Printed PCB Type Antenna

1.2 Modification of EUT

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

1.3 Testing Location

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	**Sporton Site No.**
	TH05-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., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH13-HY

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

FCC Designation No.: TW1190 and TW0007

1.4 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 v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- 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)
920.00-927.35 MHz	0	920.00	27	924.05
	1	920.15	28	924.20
	2	920.30	29	924.35
	3	920.45	30	924.50
	4	920.60	31	924.65
	5	920.75	32	924.80
	6	920.90	33	924.95
	7	921.05	34	925.10
	8	921.20	35	925.25
	9	921.35	36	925.40
	10	921.50	37	925.55
	11	921.65	38	925.70
	12	921.80	39	925.85
	13	921.95	40	926.00
	14	922.10	41	926.15
	15	922.25	42	926.30
	16	922.40	43	926.45
	17	922.55	44	926.60
	18	922.70	45	927.75
	19	922.85	46	926.90
	20	923.00	47	927.05
	21	923.15	48	927.20
	22	923.30	49	927.35
	23	923.45		
	24	923.60		
	25	923.75		
	26	923.90		

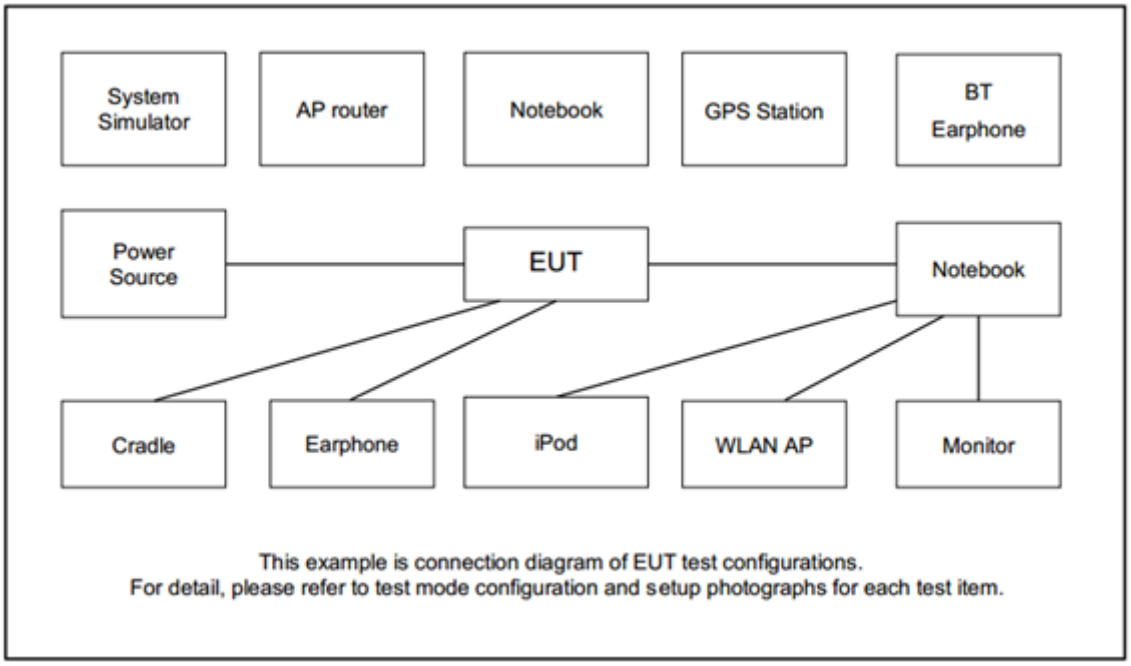
2.2 Test Mode

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, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.

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

Summary table of Test Cases	
Test Item	**SUB-GIG**
Conducted Test Cases	Mode 1: Sub-gig Tx CH00_920.00 MHz Mode 2: Sub-gig Tx CH49_927.35 MHz
Radiated Test Cases	Mode 1: Sub-gig Tx CH00_920.00 MHz Mode 2: Sub-gig Tx CH49_927.35 MHz

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	Adapter	Jameco	ADU240050	FCC DoC	N/A	AC I/P: Unshielded, 6 m

2.5 EUT Operation Test Setup

The RF test items, utility “Putty” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor 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 and attenuator factor.
Offset = RF cable loss + attenuator factor.
Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

Frequency hopping systems in the 920.00-927.35 MHz band shall use at least 25 channels.

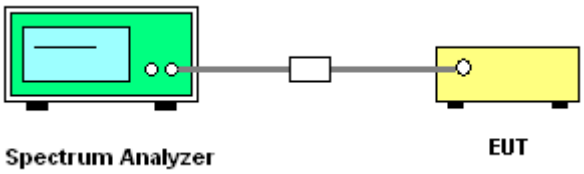
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedure

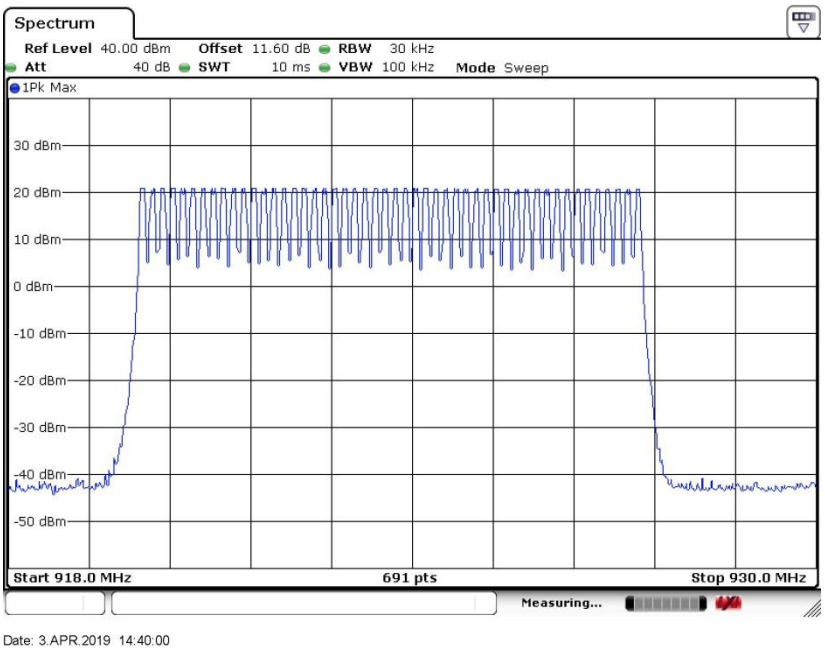
1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW = 30kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup



3.1.5 Test Result of Number of Hopping Frequency

Number of Hopping Channel Plot on Channel 00 - 49



3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 920.00-927.35 MHz band may have hopping channel carrier frequencies that are 20 dB bandwidth of the hopping channel, whichever is greater.

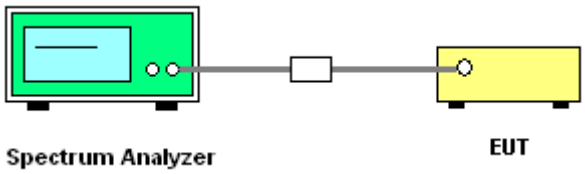
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

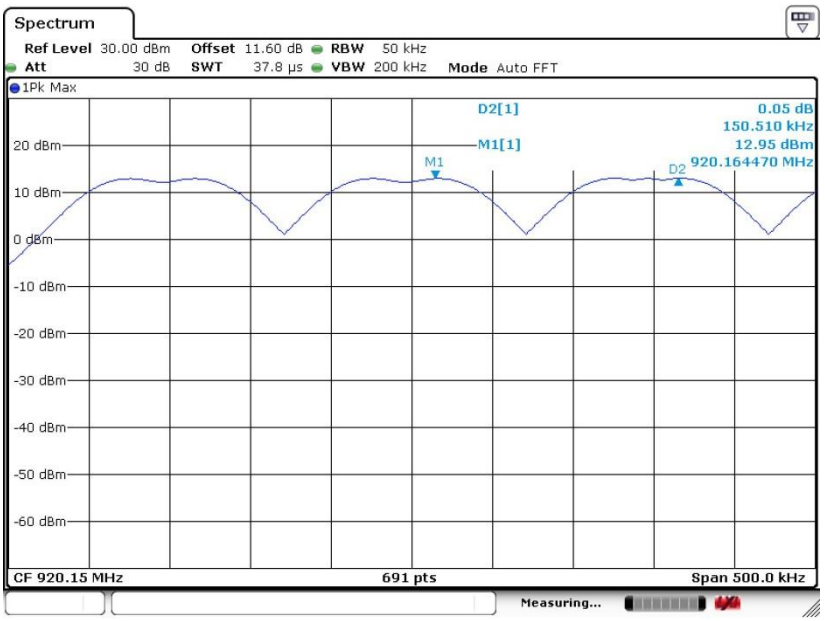
1. The testing follows ANSI C63.10-2013 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels;
   RBW = 50kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Hopping Channel Separation

Channel Separation Plot



3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

§ 15.247(f): For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

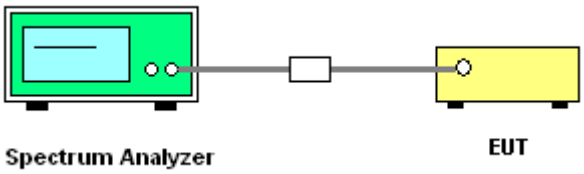
3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.4.
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. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 100kHz; VBW ≥ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

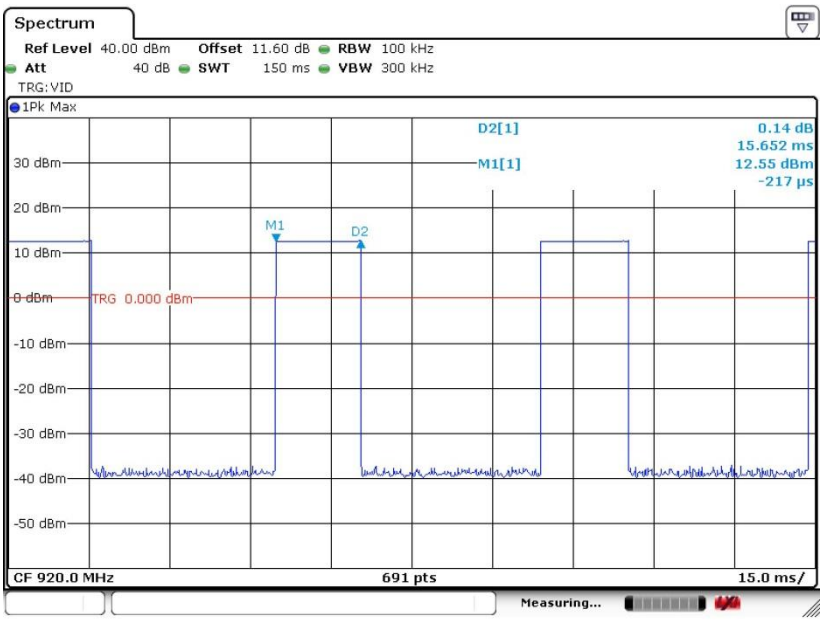
3.3.4 Test Setup



3.3.5 Test Result of Dwell Time

Package Transfer Time Plot

2 Hopping Frequencies



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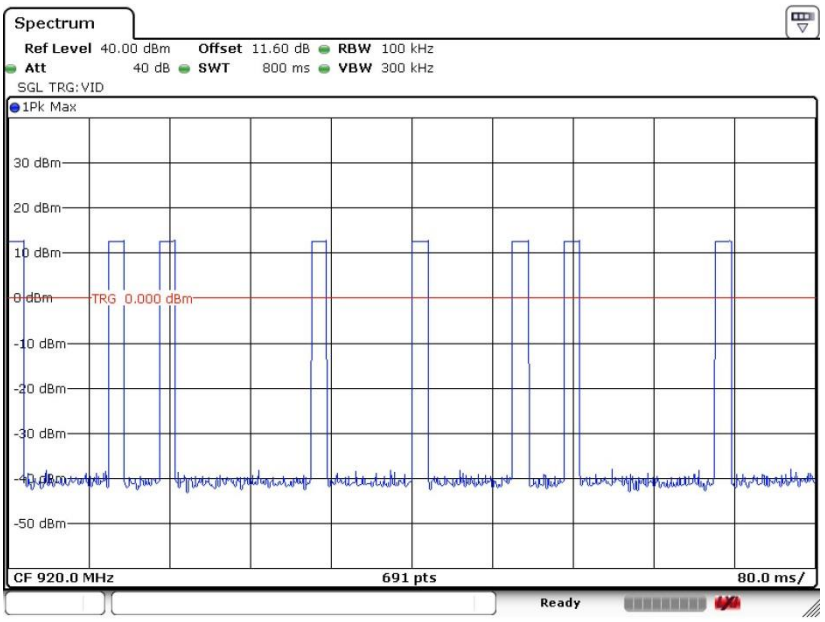

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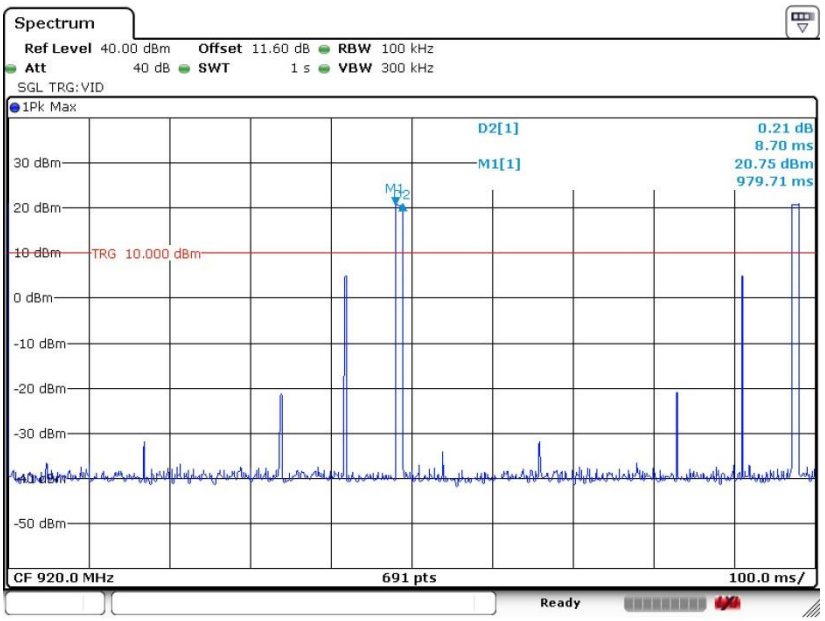
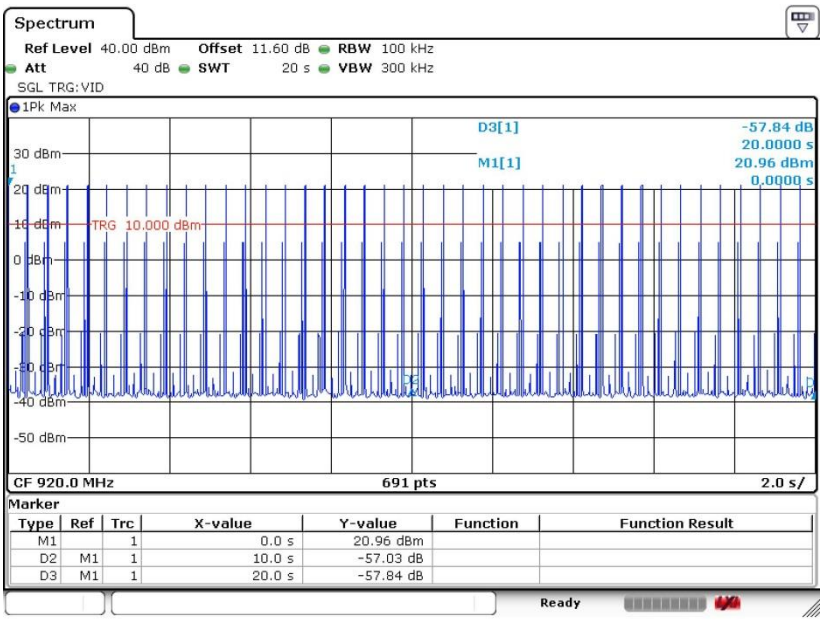
Remark: Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

Package Transfer Time Plot

50 Hopping Frequencies



Date: 3.APR.2019 11:51:01



Date: 3.APR.2019 15:20:15

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedures

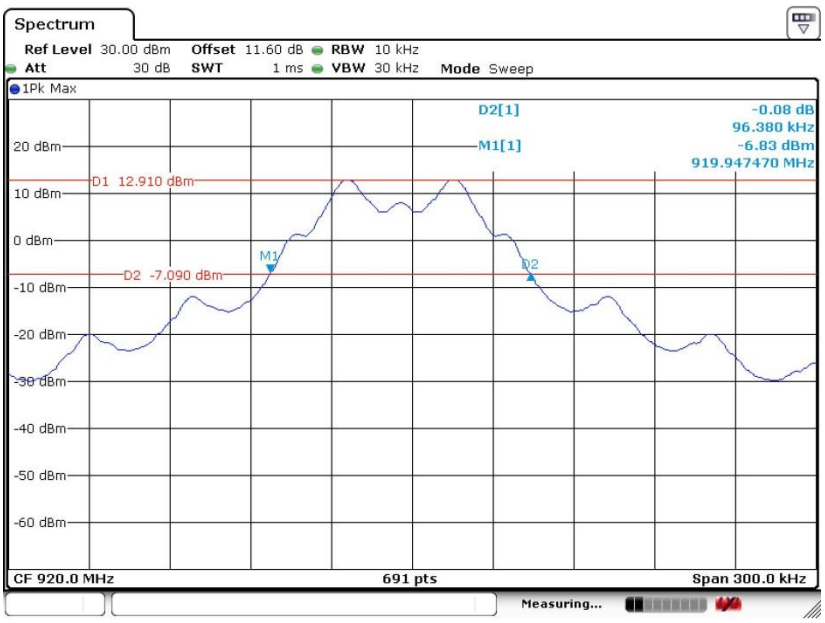
1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
   Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;
   RBW ≥ 1% of the 20 dB bandwidth; VBW ≥ RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.
   Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;
   RBW ≥ 1-5% of the 99% bandwidth; VBW ≥ 3 * RBW; Sweep = auto; Detector function = peak;
   Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup

3.4.5 Test Result of 20dB Bandwidth

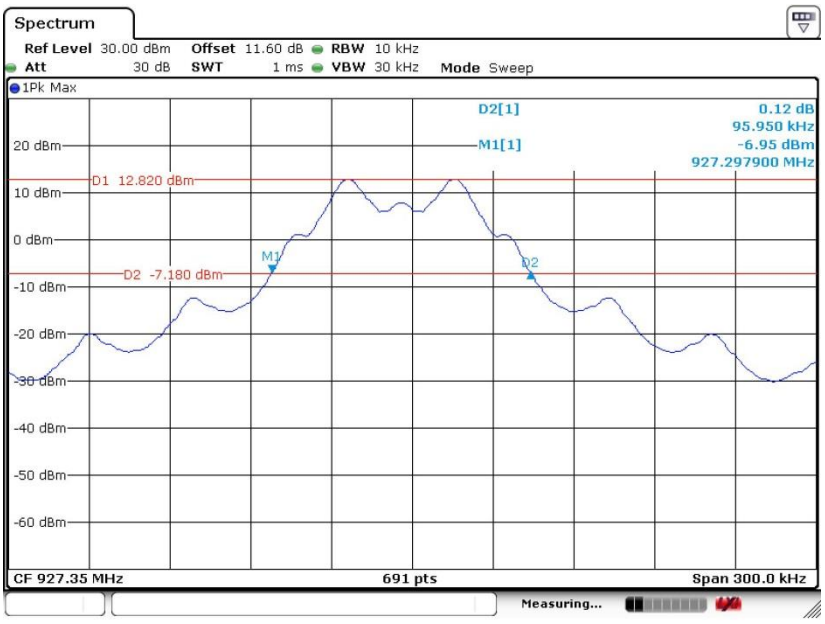
Please refer to Appendix A.

20 dB Bandwidth Plot on Channel 00



Date: 11.APR.2019 14:34:52

20 dB Bandwidth Plot on Channel 49

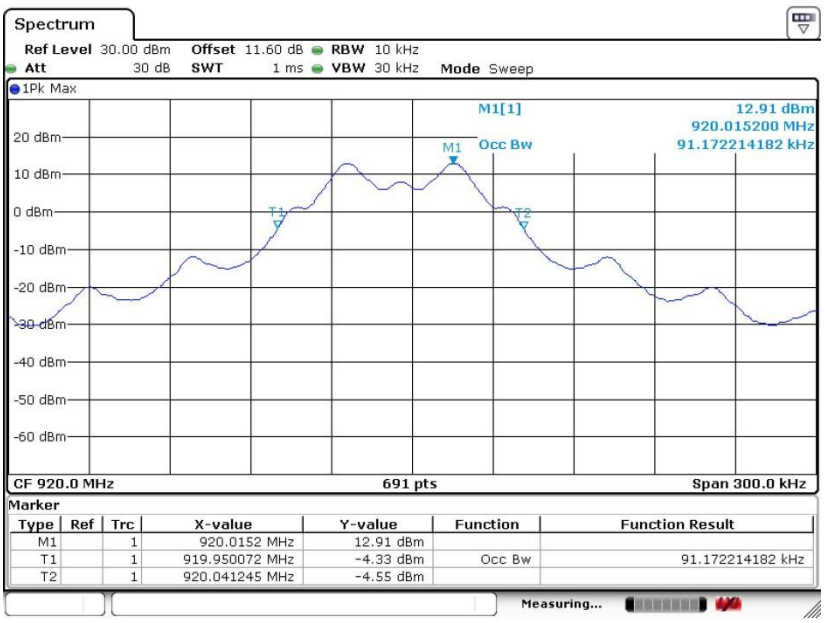


Date: 11.APR.2019 14:58:59

3.4.6 Test Result of 99% Occupied Bandwidth

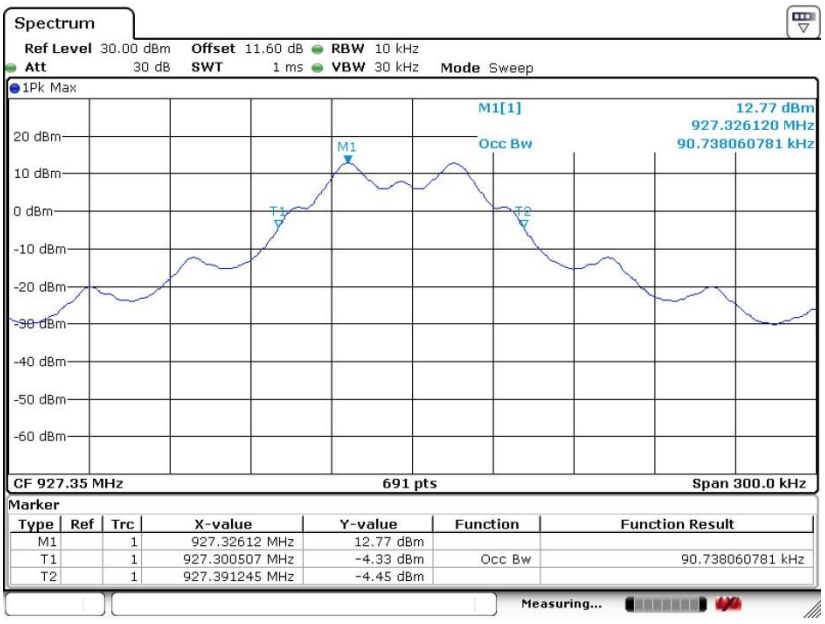
Please refer to Appendix A.

99% Occupied Bandwidth Plot on Channel 00



Date: 11.APR.2019 14:44:30

99% Occupied Bandwidth Plot on Channel 49



Date: 11.APR.2019 15:03:21

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

3.5 Output Power Measurement

3.5.1 Limit of Output Power

Section 15.247(b) (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

Section 15.247(b) (3) For systems using digital modulation in the 902-928 MHz, the limit for peak output power is 1 watt.

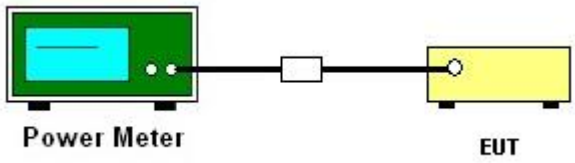
3.5.2 Measuring Instruments

See list of measuring equipment of this test report.

3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter 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 with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Output Power

Please refer to Appendix A.

3.6 Power Spectral Density Measurement

3.6.1 Limit of Power Spectral Density

The peak power spectral density which due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

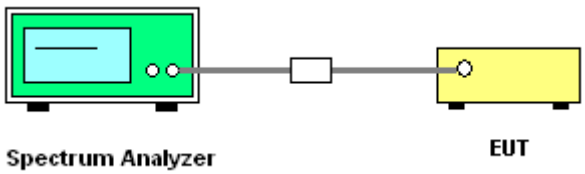
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

3.6.3 Test Procedures

1. The testing follows the ANSI C63.10-2013 Section 11.10.3 AVGPSD-1 Method PKPSD.
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 = power averaging (rms), Sweep time = auto couple, Trace mode = over a minimum of 100 traces. Use the peak marker function to determine the maximum amplitude level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.6.4 Test Setup

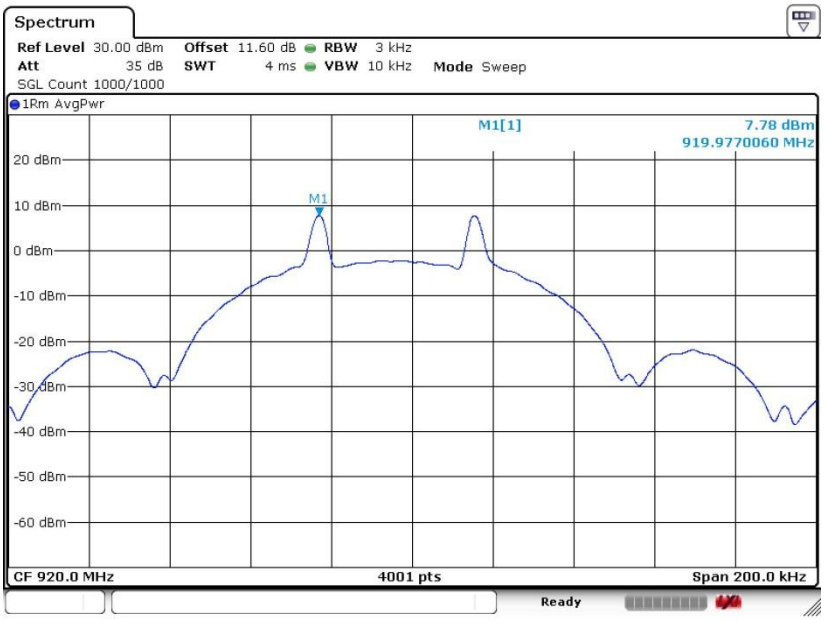


3.6.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.6.6 Test Result of Power Spectral Density Plots

PSD Plot on Channel 00



Date: 2.APR.2019 11:03:55

PSD Plot on Channel 49

Date: 2.APR.2019 11:07:19

3.7 Conducted Band Edges Measurement

3.7.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

3.7.2 Measuring Instruments

See list of measuring equipment of this test report.

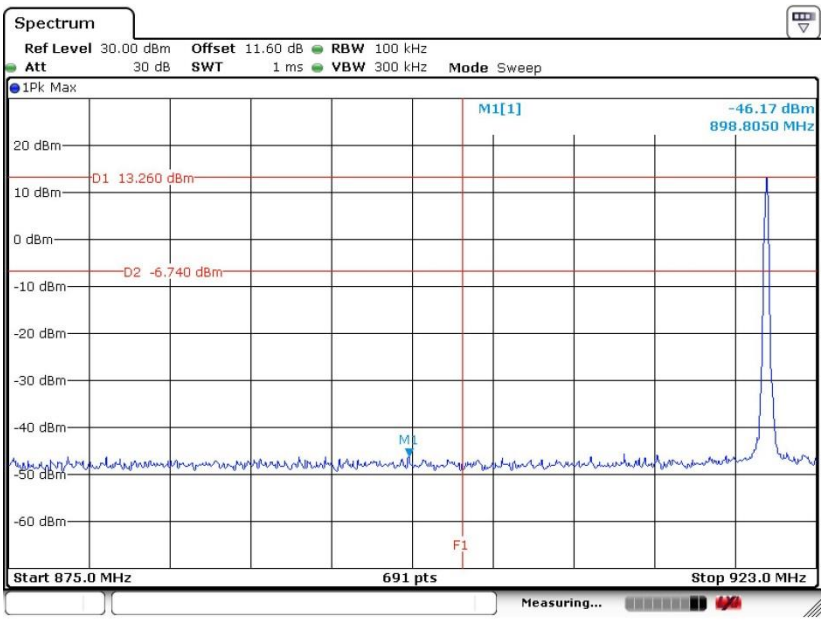
3.7.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

3.7.4 Test Setup

3.7.5 Test Result of Conducted Band Edges

Low Band Edge Plot on Channel 00



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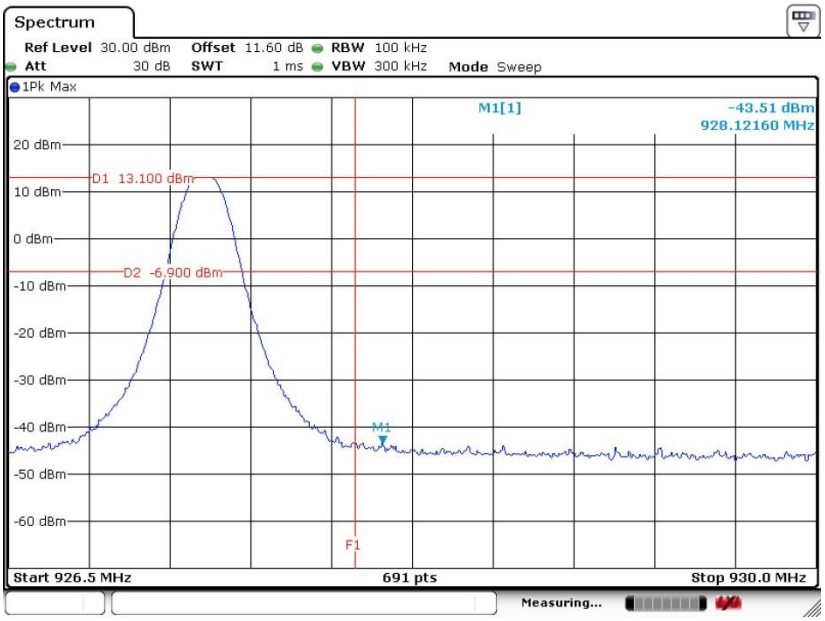
High Band Edge Plot on Channel 49



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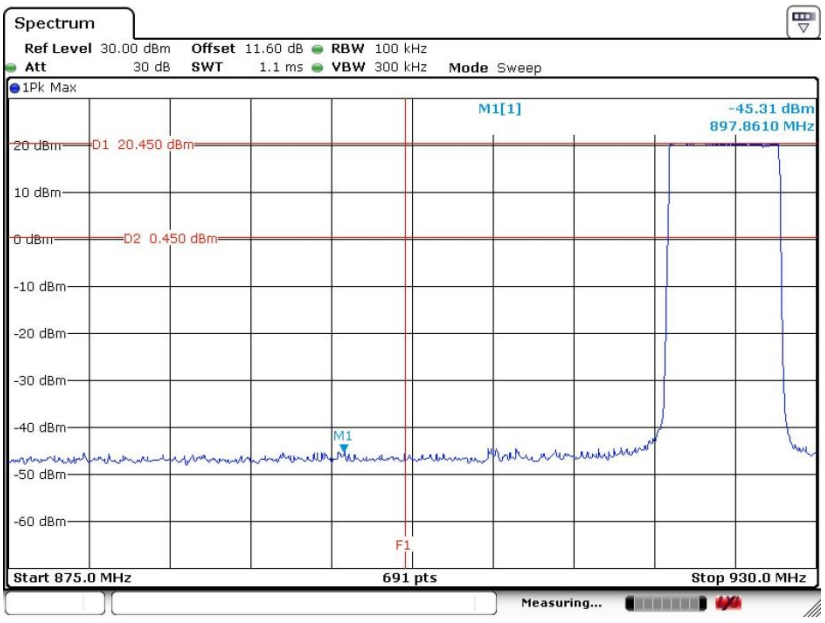
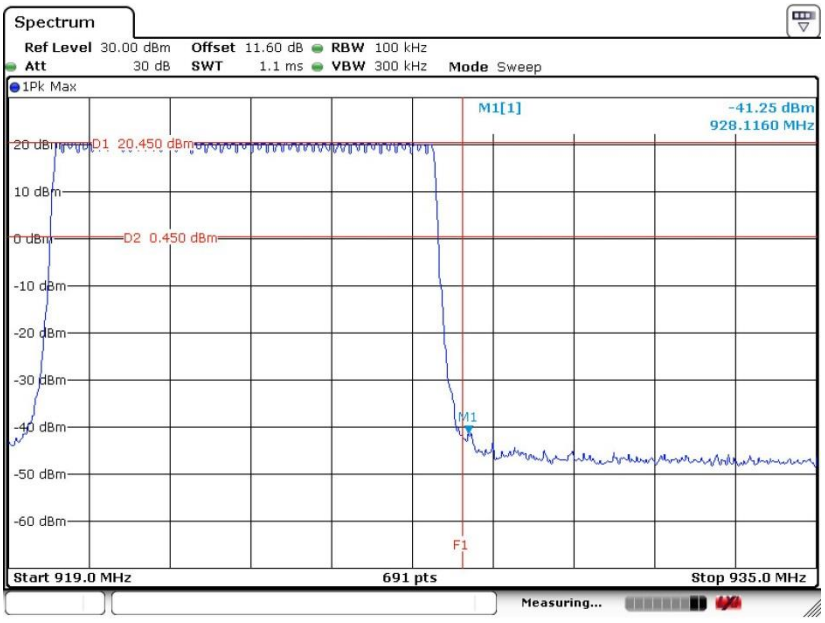
3.7.6 Test Result of Conducted Hopping Mode Band Edges

Hopping Mode Low Band Edge Plot



Date: 11.APR.2019 13:28:16

Hopping Mode High Band Edge Plot



Date: 11.APR.2019 13:34:11

3.8 Conducted Spurious Emission Measurement

3.8.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

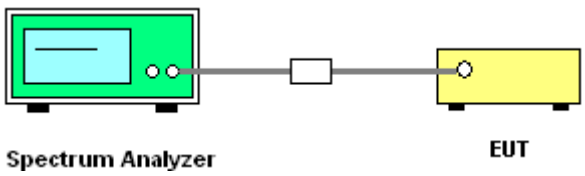
3.8.2 Measuring Instruments

See list of measuring equipment of this test report.

3.8.3 Test Procedure

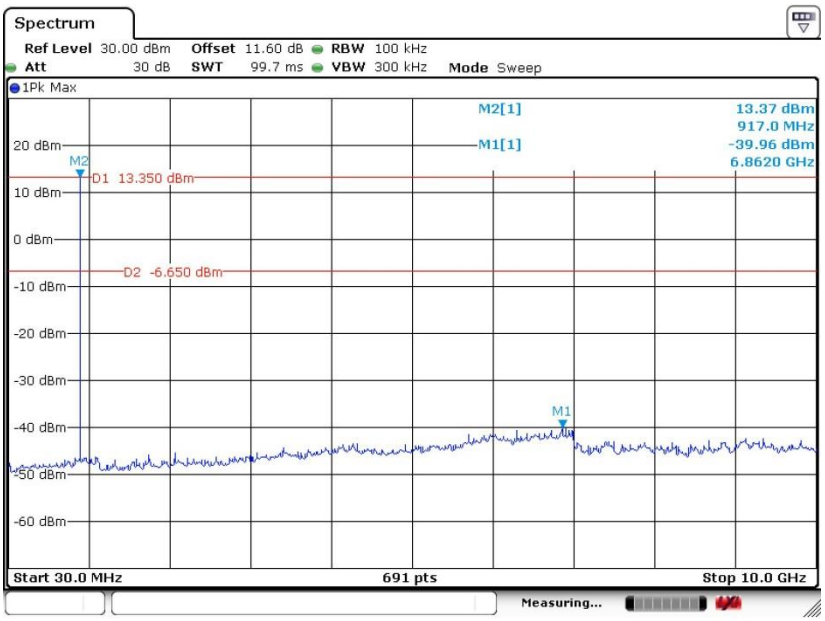
1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
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.

3.8.4 Test Setup



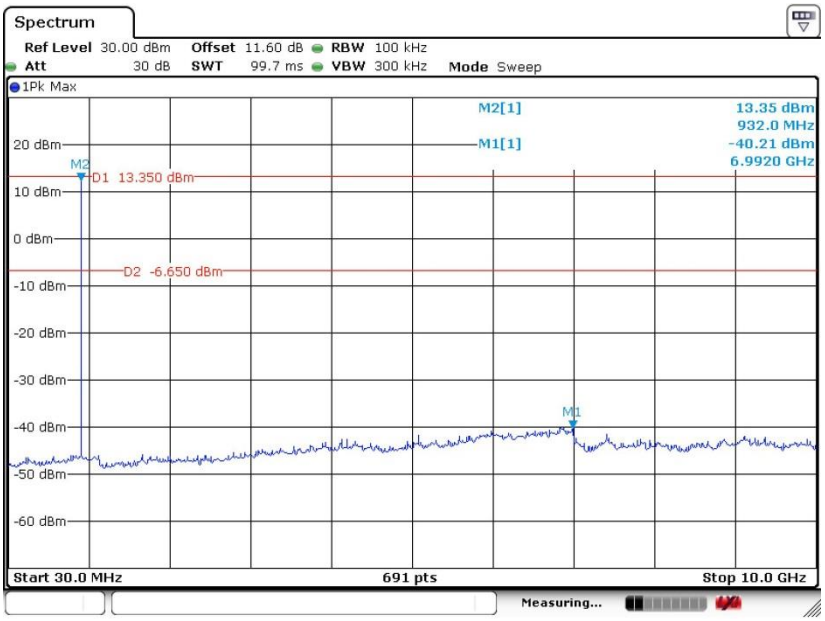
3.8.5 Test Result of Conducted Spurious Emission

CSE Plot on Ch 00 between 30MHz ~ 10 GHz



Date: 2.APR.2019 22:30:39

CSE Plot on Ch 49 between 30MHz ~ 10 GHz



Date: 2.APR.2019 19:16:41

3.9 Radiated Band Edges and Spurious Emission Measurement

3.9.1 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

3.9.2 Measuring Instruments

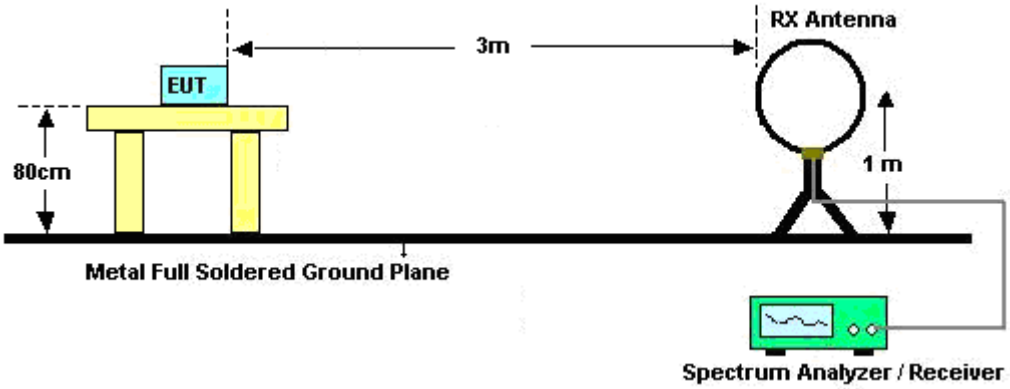
See list of measuring equipment of this test report.

3.9.3 Test Procedures

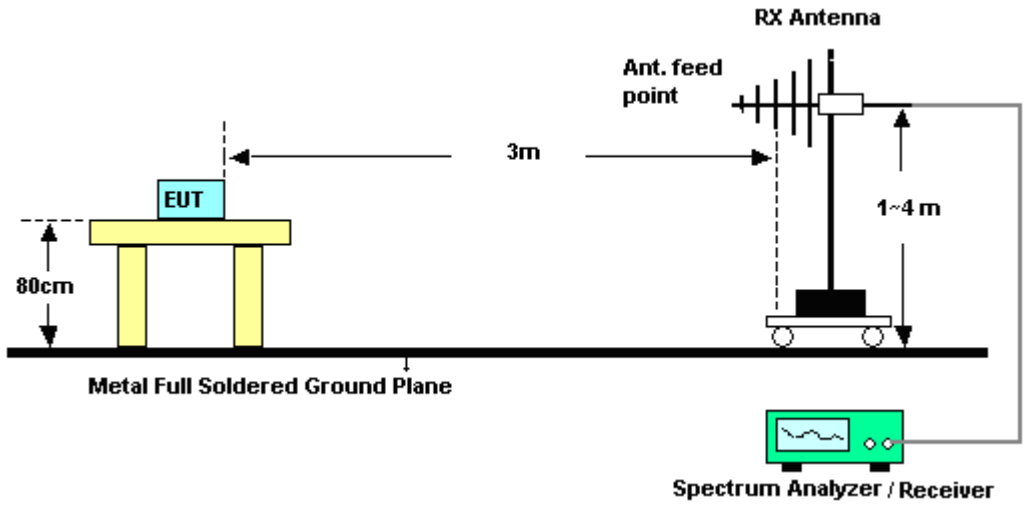
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 GHz, RBW=1MHz for f>1GHz ; VBW ≥ 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 = N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln
   Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

3.9.4 Test Setup

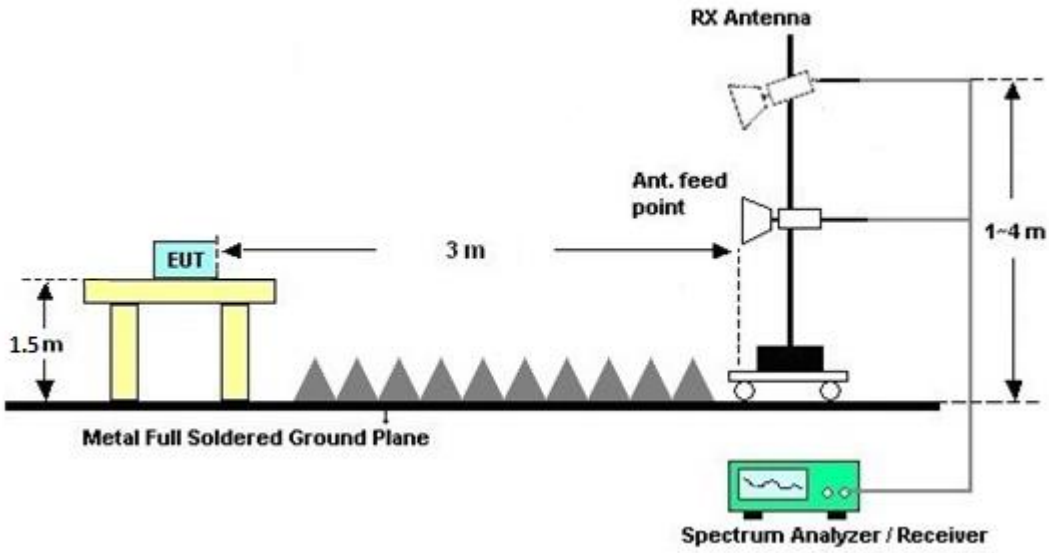
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.9.5 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.

3.9.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.9.7 Duty Cycle

Please refer to Appendix D.

3.9.8 Test Result of Radiated Spurious Emission

Please refer to Appendix B and C.

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 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	Anritsu	ML2495A	1218006	N/A	Oct. 08, 2018	Mar. 21, 2019~ Apr. 11, 2019	Oct. 07, 2019	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1207363	300MHz~40GHz	Oct. 08, 2018	Mar. 21, 2019~ Apr. 11, 2019	Oct. 07, 2019	Conducted (TH05-HY)
Power Sensor	DARE	RPR3006W	16I00054SNO 12	10MHz~6GHz	Dec. 27, 2018	Mar. 21, 2019~ Apr. 11, 2019	Dec. 26, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101397	10Hz~40GHz	Nov. 13, 2018	Mar. 21, 2019~ Apr. 11, 2019	Nov. 12, 2019	Conducted (TH05-HY)
RF Cable	Burgeon	ETF-058	EC1300484	N/A	Apr. 17, 2018	Mar. 21, 2019~ Apr. 11, 2019	Apr. 16, 2019	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jan. 07, 2019	Feb. 15, 2019~ Mar. 29, 2019	Jan. 06, 2020	Radiation (03CH13-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1241	1GHz ~ 18GHz	Jun. 29, 2018	Feb. 15, 2019~ Mar. 29, 2019	Jun. 28, 2019	Radiation (03CH13-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	37059&01	30MHz~1GHz	Oct. 13, 2018	Feb. 15, 2019~ Mar. 29, 2019	Oct. 12, 2019	Radiation (03CH13-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Dec. 05, 2018	Feb. 15, 2019~ Mar. 29, 2019	Dec. 04, 2019	Radiation (03CH13-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 14, 2018	Feb. 15, 2019~ Mar. 29, 2019	Nov. 13, 2020	Radiation (03CH13-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	1GHz~18GHz	May 21, 2018	Feb. 15, 2019~ Mar. 29, 2019	May 20, 2019	Radiation (03CH13-HY)
Amplifier	Sonoma-Instrument	310 N	187282	9KHz~1GHz	Dec. 18, 2018	Feb. 15, 2019~ Mar. 29, 2019	Dec. 17, 2019	Radiation (03CH13-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 16, 2018	Feb. 15, 2019~ Mar. 29, 2019	Jul. 15, 2019	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0030/126E	30M-18G	Feb. 13, 2019	Feb. 15, 2019~ Mar. 29, 2019	Feb. 12, 2020	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	804793/4	30M-18G	Feb. 13, 2019	Feb. 15, 2019~ Mar. 29, 2019	Feb. 12, 2020	Radiation (03CH13-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24961/4	30M-18G	Feb. 13, 2019	Feb. 15, 2019~ Mar. 29, 2019	Feb. 12, 2020	Radiation (03CH13-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Apr. 17, 2018	Feb. 15, 2019~ Mar. 29, 2019	Apr. 16, 2019	Radiation (03CH13-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Feb. 15, 2019~ Mar. 29, 2019	N/A	Radiation (03CH13-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Feb. 15, 2019~ Mar. 29, 2019	N/A	Radiation (03CH13-HY)
Software	AUDIX	E3 6.2009-8-24c	RK-001124	N/A	N/A	Feb. 15, 2019~ Mar. 29, 2019	N/A	Radiation (03CH13-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20Hz ~ 8.4GHz	Nov. 01, 2018	Feb. 15, 2019~ Mar. 29, 2019	Oct. 31, 2019	Radiation (03CH13-HY)
Filter	Wainwright	WHKX12-1080 -1200-15000-6 0ST	SN3	1.2 GHz Highpass	Jul. 15, 2018	Feb. 15, 2019~ Mar. 29, 2019	Jul. 14, 2019	Radiation (03CH13-HY)
Filter	Wainwright	WHKX12-1080 -1200-15000-6 0ST	SN3	1.2G Low Pass	Jul. 05, 2018	Feb. 15, 2019~ Mar. 29, 2019	Jul. 04, 2019	Radiation (03CH13-HY)

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.9**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.4**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.3**

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Tommy Lee	Temperature:	21~25	°C
Test Date:	2019/3/21~2019/4/11	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)
Sub-gig	1	0	920.00	0.091	0.055
Sub-gig	1	49	927.35	0.091	0.055

TEST RESULTS DATA
Average Power Table

Mod.	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
FH	1	0	920.00	19.96	30.00	1.50	21.46	36.00	Pass
FH	1	49	927.35	19.96	30.00	1.50	21.46	36.00	Pass
Hybrid	1	0	920.00	13.21	30.00	1.50	14.71	36.00	Pass
Hybrid	1	49	927.35	13.12	30.00	1.50	14.62	36.00	Pass

TEST RESULTS DATA
Peak Power Density

Mod.	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail	Pass/Fail
Sub-gig	1	0	920.00	7.78	1.50	8.00	Pass	Pass
Sub-gig	1	49	927.35	7.71	1.50	8.00	Pass	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

Appendix B. Radiated Spurious Emission

Test Engineer :	Alex Jheng, Fu Chen, and Wilson Wu	Temperature :	24.5~25.3°C
		Relative Humidity :	50~55%

902~928MHz

(1GHz ~ 10GHz @ 3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
3		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
920MHz		1840	41.17	-32.83	74	68.85	25.97	3.98	57.63	100	0	P	H
		2760	45	-29	74	69.51	28.09	4.76	57.36	100	0	P	H
		3680	40.1	-33.9	74	63.54	29.14	5.74	58.32	100	0	P	H
		4600	37.81	-36.19	74	58.76	30.81	6.24	58	100	0	P	H
		5520	41.28	-32.72	74	58.05	31.92	7.18	55.87	100	0	P	H
		1840	40.87	-33.13	74	68.55	25.97	3.98	57.63	100	0	P	V
		2760	44.05	-29.95	74	68.56	28.09	4.76	57.36	100	0	P	V
		3680	41.13	-32.87	74	64.57	29.14	5.74	58.32	100	0	P	V
		4600	37.07	-36.93	74	58.02	30.81	6.24	58	100	0	P	V
		5520	38.8	-35.2	74	55.57	31.92	7.18	55.87	100	0	P	V
927.35MHz		1854.7	37.36	-36.64	74	65.01	25.99	3.98	57.62	100	0	P	H
		2782.05	43.81	-30.19	74	68.29	28.12	4.78	57.38	100	0	P	H
		3709.4	41.59	-32.41	74	65.04	29.17	5.73	58.35	100	0	P	H
		4636.75	39.43	-34.57	74	60.25	30.88	6.23	57.93	100	0	P	H
		5564.1	40.31	-33.69	74	57.1	31.97	7.05	55.81	100	0	P	H
		1854.7	36.83	-37.17	74	64.48	25.99	3.98	57.62	100	0	P	V
		2782.05	43.24	-30.76	74	67.72	28.12	4.78	57.38	100	0	P	V
		3709.4	42.44	-31.56	74	65.89	29.17	5.73	58.35	100	0	P	V
		4636.75	37.64	-36.36	74	58.46	30.88	6.23	57.93	100	0	P	V
		5564.1	38	-36	74	54.79	31.97	7.05	55.81	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

902~928MHz

(30MHz ~ 1GH @3m)

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
3		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
920MHz		30	33.2	-6.8	40	31.04	24.17	0.45	32.29	-	-	P	H
		490.75	35.31	-10.69	46	31.96	23.79	1.75	32.17	-	-	P	H
		570.29	37.35	-8.65	46	32.01	25.61	1.95	32.22	-	-	P	H
		662.44	39.8	-6.2	46	33.5	26.35	2.1	32.15	-	-	P	H
		824.43	42.25	-3.75	46	33.25	28.38	2.37	31.77	100	0	P	H
	*	920	112.91	-	-	102.29	29.37	2.44	31.24	-	-	P	H
		960.23	43.87	-10.13	54	31.38	30.87	2.46	30.9	-	-	P	H
													H
													H
		31.94	34.49	-5.51	40	33.18	23.32	0.45	32.29	-	-	P	V
		559.62	37.11	-8.89	46	31.37	26.02	1.93	32.21	-	-	P	V
		651.77	38.63	-7.37	46	32.44	26.26	2.09	32.16	-	-	P	V
		824.43	42.21	-3.79	46	33.21	28.38	2.37	31.77	-	-	P	V
		852.56	42.55	-3.45	46	32.55	29.13	2.46	31.64	-	-	P	V
	*	920	105.06	-	-	94.44	29.37	2.44	31.24	-	-	P	V
		951.5	42.89	-3.11	46	30.76	30.58	2.45	30.97	100	0	P	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.

	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
3		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
927.35MHz		30.97	32.02	-7.98	40	30.29	23.74	0.45	32.29	-	-	P	H
		484.93	35.15	-10.85	46	31.91	23.69	1.74	32.17	-	-	P	H
		557.68	37	-9	46	31.45	25.83	1.93	32.21	-	-	P	H
		695.42	39.24	-6.76	46	32.64	26.58	2.13	32.1	-	-	P	H
		763.32	41.31	-4.69	46	33.05	28	2.21	31.96	-	-	P	H
		845.77	42.59	-3.41	46	32.78	29	2.44	31.67	100	0	P	H
	*	927.35	113.15	-	-	102.15	29.67	2.45	31.18	-	-	P	H
													H
													H
		31.94	33.53	-6.47	40	32.22	23.32	0.45	32.29	-	-	P	V
		615.88	37.75	-8.25	46	32.04	25.89	2.04	32.22	-	-	P	V
		778.84	40.65	-5.35	46	32.2	28.14	2.24	31.93	-	-	P	V
		829.28	41.02	-4.98	46	31.81	28.54	2.39	31.75	-	-	P	V
		897.18	42.4	-3.6	46	32.33	29.01	2.44	31.42	100	0	P	V
	*	927.35	106.22	-	-	95.22	29.67	2.45	31.18	-	-	P	V
		983.51	44.08	-9.92	54	31.58	30.65	2.5	30.7	-	-	P	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.

Note symbol

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

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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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 C. Radiated Spurious Emission Plots

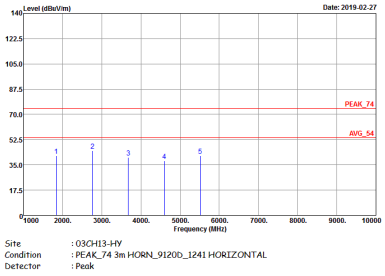
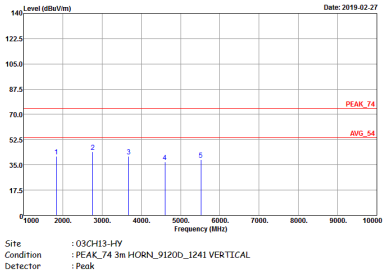
Test Engineer :	Alex Jheng, Fu Chen, and Wilson Wu	**Temperature :**	24.5~25.3°C
		Relative Humidity :	50~55%

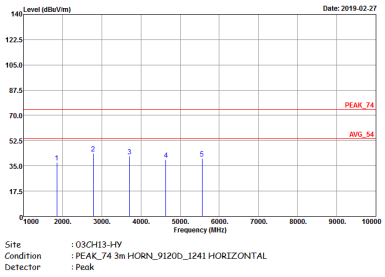
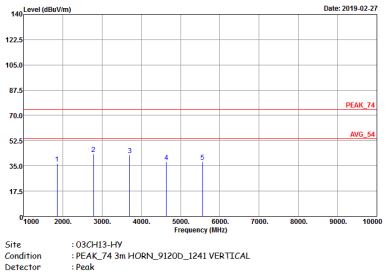
Note symbol

-L	**Low channel location**
-R	**High channel location**

902~928MHz

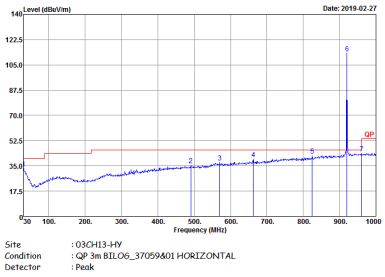
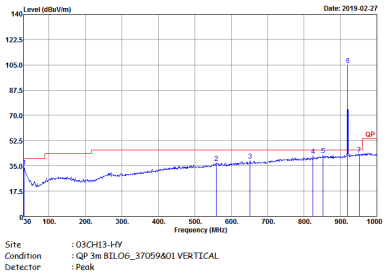
(1GHz ~ 10GHz @ 3m)

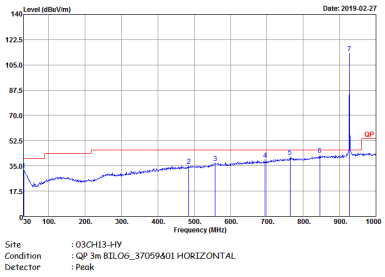
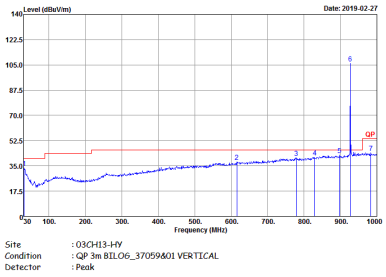
ANT	**920MHz**	
3	**Horizontal**	**Vertical**
Peak **Avg.**		

ANT	927.35MHz	
3	Horizontal	Vertical
Peak Avg.		

902~928MHz

(30MHz ~ 1GHz @ 3m)

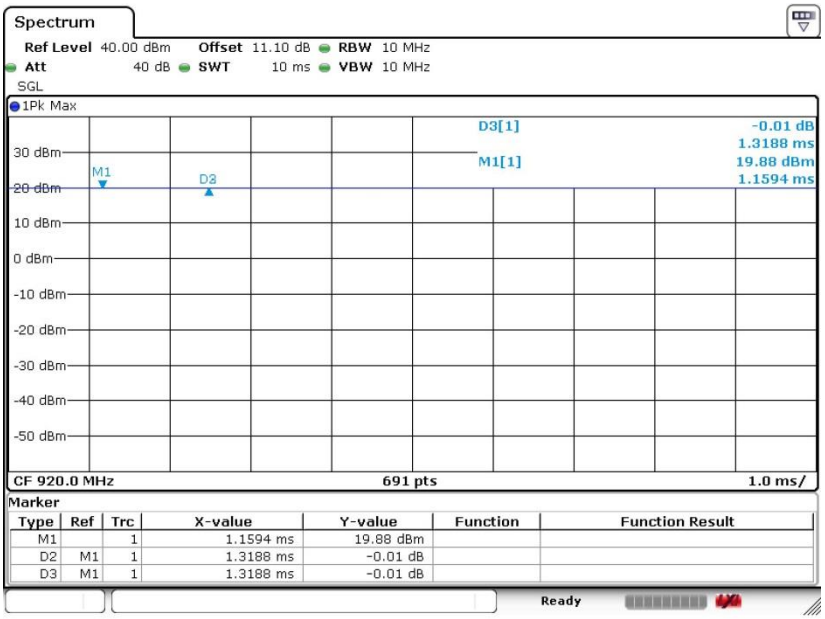
ANT	920MHz	
3	Horizontal	Vertical
QP / Peak		

ANT	927.35MHz	
3	Horizontal	Vertical
QP / Peak		

Appendix D. Single Frequency Mode of Duty Cycle

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
Sub-gig	100	1318.8	0.76	10Hz	0.00

Sub-gig



————THE END————