FCC RADIO TEST REPORT

FCC ID	:	**Z64-LPSTKCC1352R**
Equipment	:	**CC1352R LaunchPad SensorTag Kit**
Brand Name	:	**Texas Instruments Incorporated**
Model Name	:	**LPSTK-CC1352R**
Marketing Name	:	**SimpleLink™ multiprotocol CC1352R wireless MCU LaunchPad™ SensorTag development kit**
Applicant	:	**Texas Instruments Incorported 12500 TI BLVD., Dallas Texas, 75243**
Manufacturer	:	**Texas Instruments Incorported 12500 TI BLVD., Dallas Texas, 75243**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Sep. 10, 2019 and testing was started from Sep. 27, 2019 and completed on Oct. 15, 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.

Louis Wu

Approved by: Louis Wu

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

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FR991024B	01	Initial issue of report	Oct. 30, 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(a)(1)	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)	Peak Output Power	Pass	-
3.6	15.247(d)	Conducted Band Edges	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	Pass	-
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	Under limit 0.90 dB at 832.000 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.9	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: Dara Chiu

1 General Description

1.1 Product Feature of Equipment Under Test

Bluetooth Low Energy, and Sub-1GHz

Product Specification subjective to this standard	
Antenna Type	Bluetooth Low Energy: PCB Trace Antenna Sub-1GHz: Whip 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. EMC & Wireless Communications Laboratory	
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	03CH07-HY

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

FCC designation No.: TW1190

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 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)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.2	28	907.6	55	913.0	82	918.4	109	923.8
	2	902.4	29	907.8	56	913.2	83	918.6	110	924.0
	3	902.6	30	908.0	57	913.4	84	918.8	111	924.2
	4	902.8	31	908.2	58	913.6	85	919.0	112	924.4
	5	903.0	32	908.4	59	913.8	86	919.2	113	924.6
	6	903.2	33	908.6	60	914.0	87	919.4	114	924.8
	7	903.4	34	908.8	61	914.2	88	919.6	115	925.0
	8	903.6	35	909.0	62	914.4	89	919.8	116	925.2
	9	903.8	36	909.2	63	914.6	90	920.0	117	925.4
	10	904.0	37	909.4	64	914.8	91	920.2	118	925.6
	11	904.2	38	909.6	65	915.0	92	920.4	119	925.8
	12	904.4	39	909.8	66	915.2	93	920.6	120	926.0
	13	904.6	40	910.0	67	915.4	94	920.8	121	926.2
	14	904.8	41	910.2	68	915.6	95	921.0	122	926.4
	15	905.0	42	910.4	69	915.8	96	921.2	123	926.6
	16	905.2	43	910.6	70	916.0	97	921.4	124	926.8
	17	905.4	44	910.8	71	916.2	98	921.6	125	927.0
	18	905.6	45	911.0	72	916.4	99	921.8	126	927.2
	19	905.8	46	911.2	73	916.6	100	922.0	127	927.4
	20	906.0	47	911.4	74	916.8	101	922.2	128	927.6
	21	906.2	48	911.6	75	917.0	102	922.4	129	927.8
	22	906.4	49	911.8	76	917.2	103	922.6	-	-
	23	906.6	50	912.0	77	917.4	104	922.8	-	-
	24	906.8	51	912.2	78	917.6	105	923.0	-	-
	25	907.0	52	912.4	79	917.8	106	923.2	-	-
	26	907.2	53	912.6	80	918.0	107	923.4	-	-
	27	907.4	54	912.8	81	918.2	108	923.6	-	-

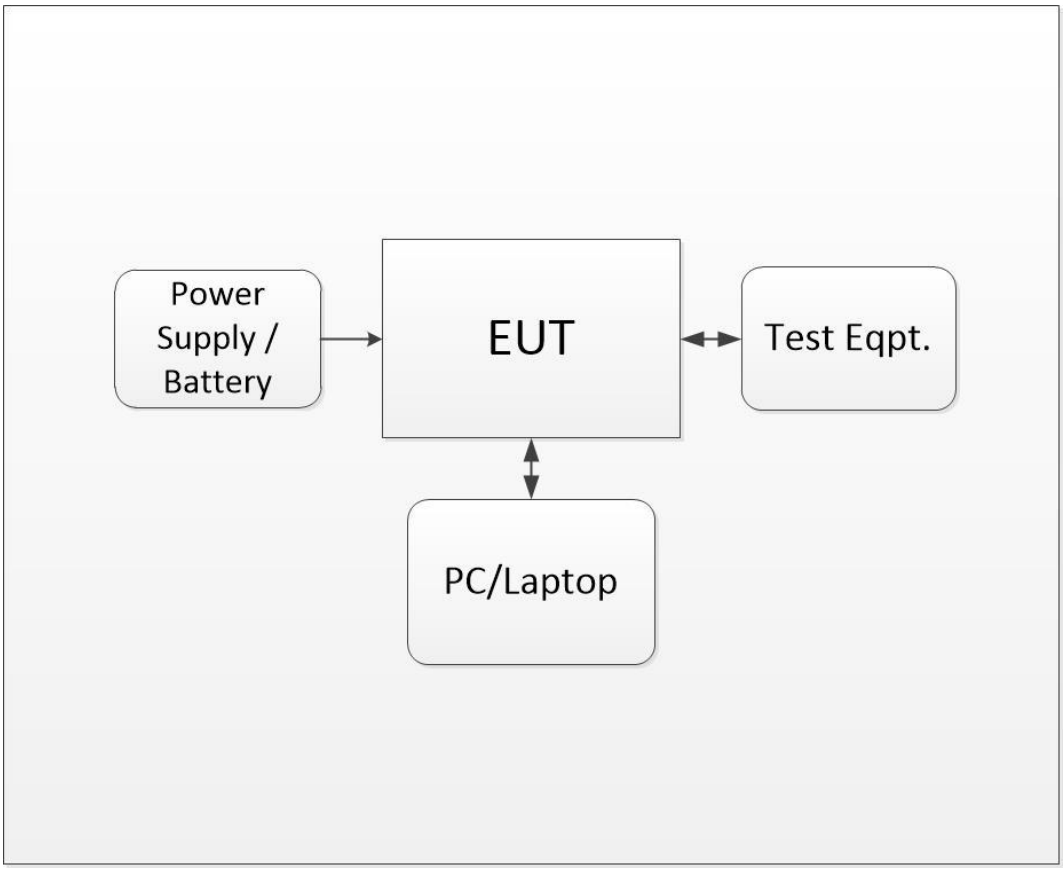
2.2 Test Mode

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: 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 (X 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-1GHz**
Conducted Test Cases	Mode 1: CH01 Tx_902.20 MHz Mode 2: CH65 Tx _915.00 MHz Mode 3: CH129 Tx _927.80 MHz
Radiated Test Cases	Mode 1: CH01 Tx_902.20 MHz Mode 2: CH65 Tx _915.00 MHz Mode 3: CH129 Tx _927.80 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.	Battery	TOSHIBA	R03 SIZE AAA 1.5V	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “SmartRF Studio 7 Tool” 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.

Maximum TX power Setting of +11 dBm from SmartRF Studio 7 is used in all the tests.

Data Rate / Modulation: 50KBPS, 2-GFSK, 25KHz Deviation is used in all the tests.

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 0.8 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 0.8 + 10 = 10.8 (dB)

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

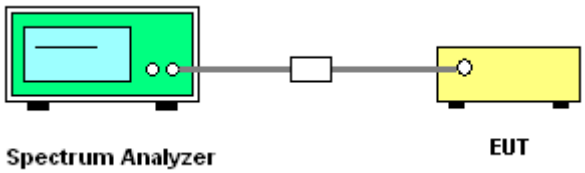
3.1.2 Measuring Instruments

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 = 100kHz; 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.

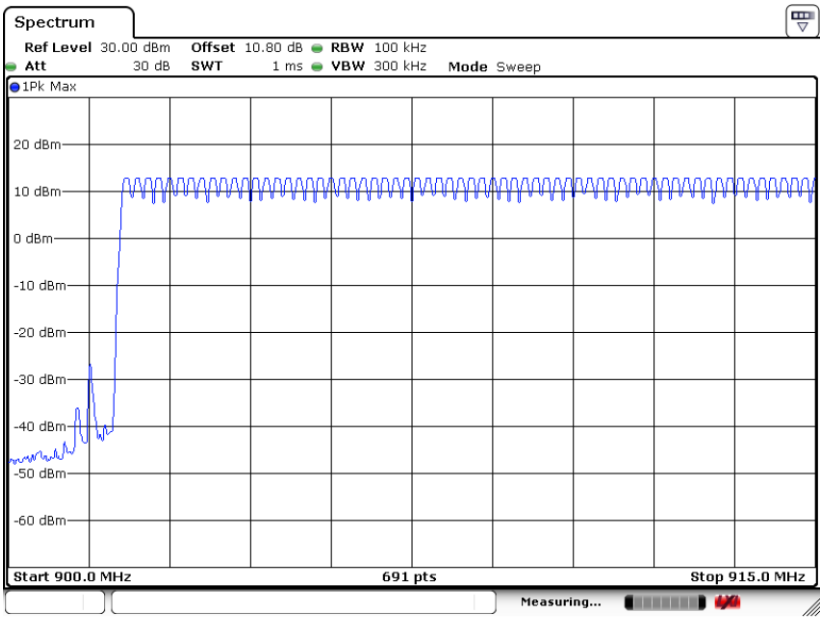
3.1.4 Test Setup

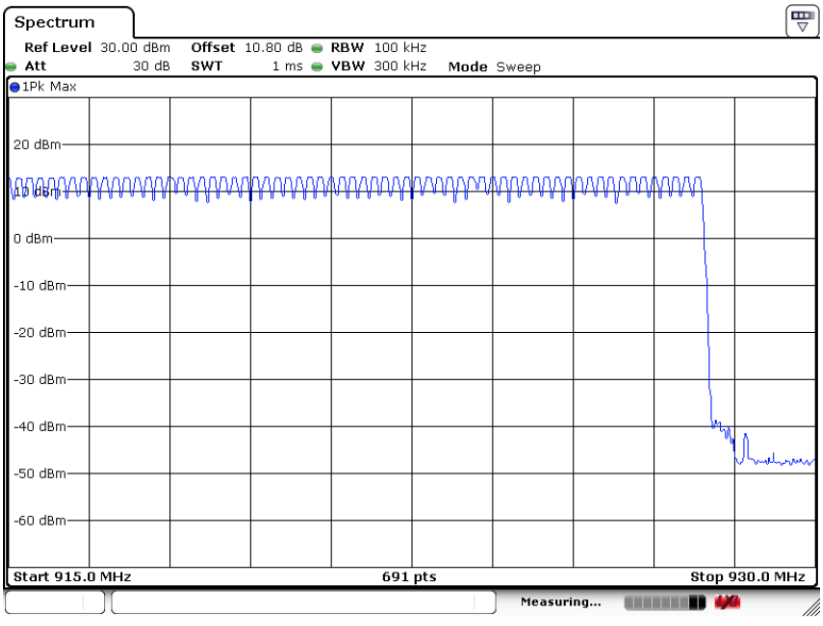


3.1.5 Test Result of Number of Hopping Frequency

Please refer to Appendix A.

Number of Hopping Channel Plot on Channel 01 - 129





3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 902 – 928 MHz band 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.

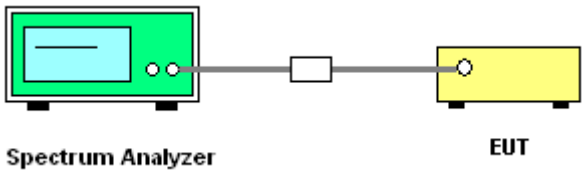
3.2.2 Measuring Instruments

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 = 30kHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

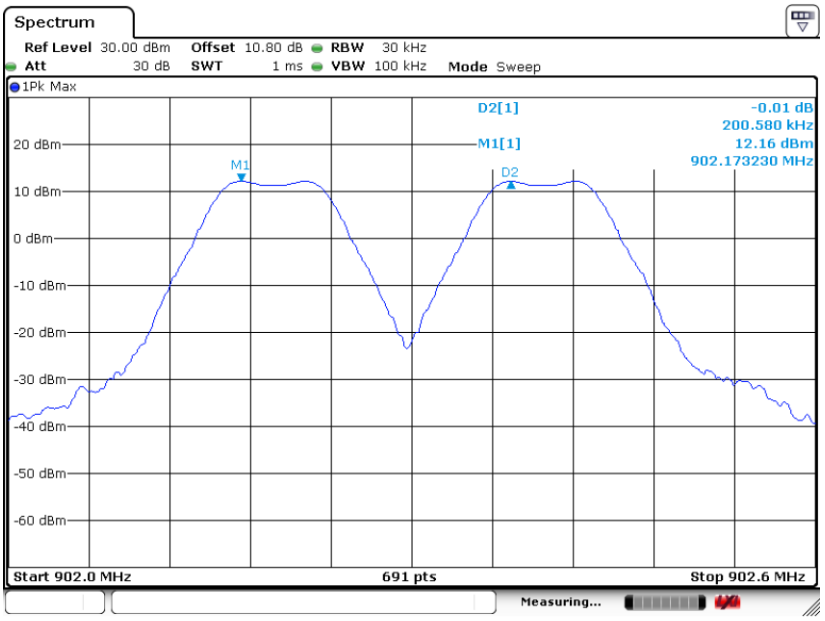
3.2.4 Test Setup



3.2.5 Test Result of Hopping Channel Separation

Please refer to Appendix A.

Channel Separation Plot on Channel 01 - 02



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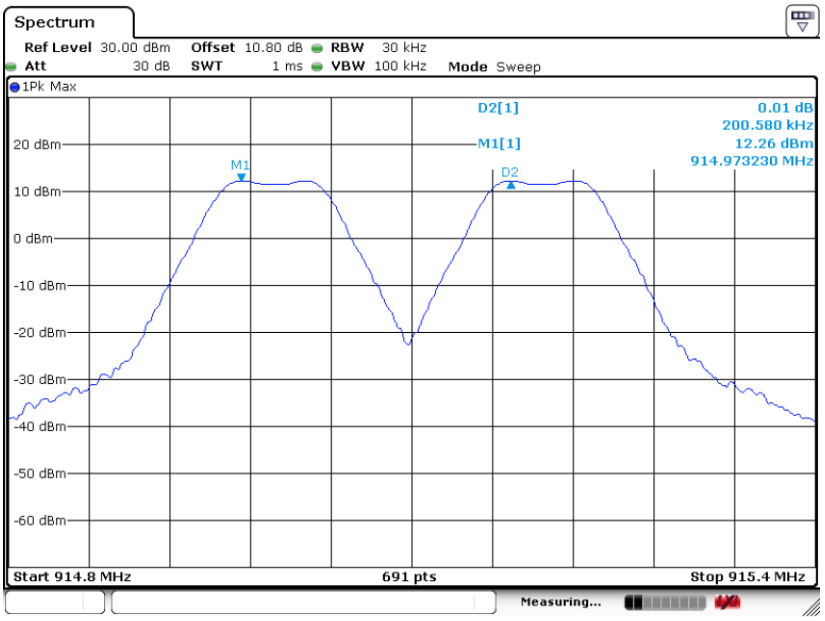
Channel Separation Plot on Channel 65 - 66



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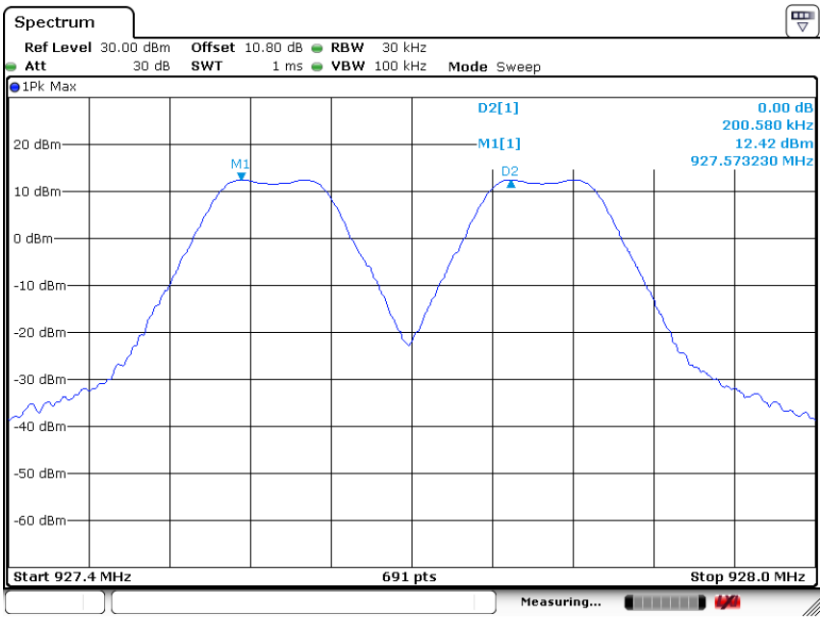
Channel Separation Plot on Channel 128 - 129



3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 20 seconds multiplied by the number of hopping channels employed.

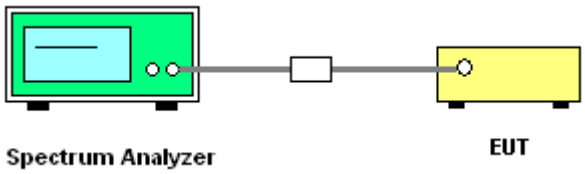
3.3.2 Measuring Instruments

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 = 1 MHz; 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.

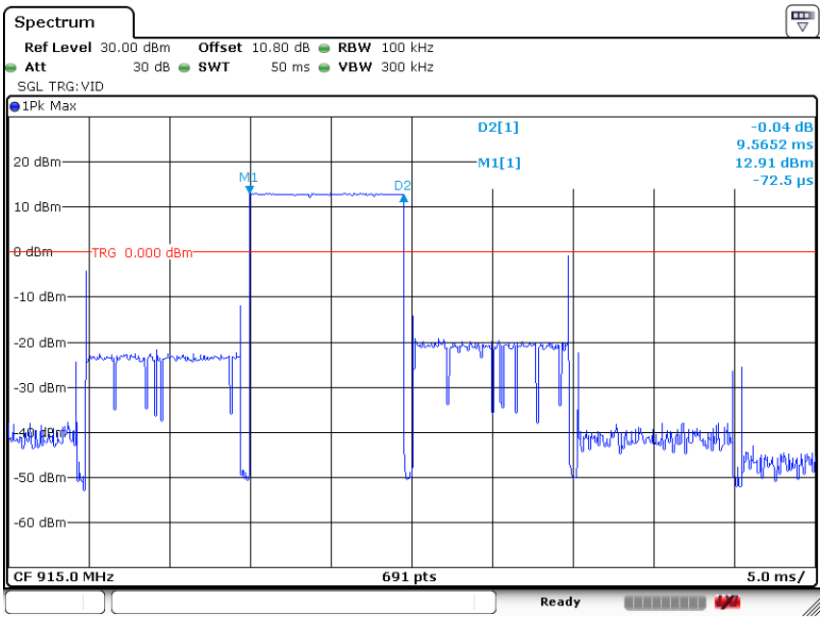
3.3.4 Test Setup



3.3.5 Test Result of Dwell Time

Please refer to Appendix A.

Package Transfer Time Plot



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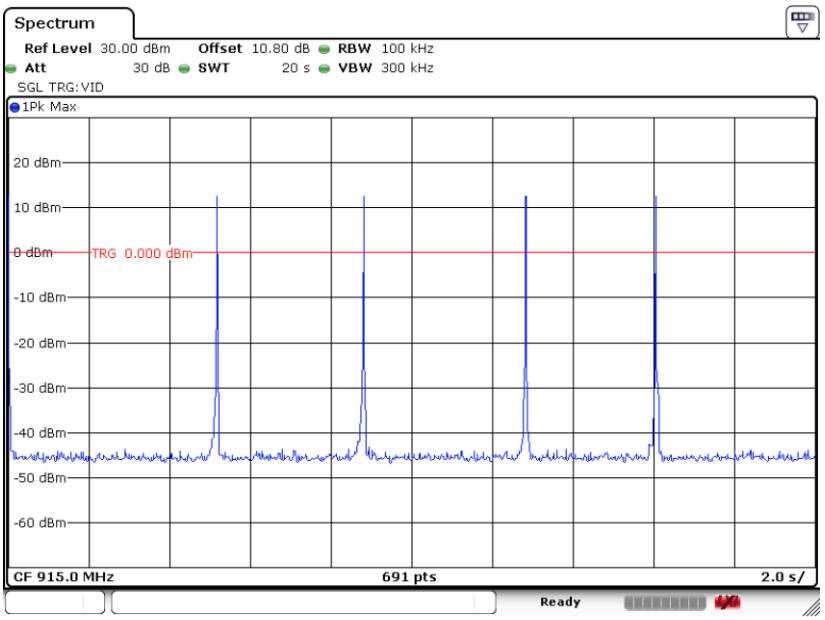


Date: 3.OCT.2019 16:35:25

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

99% Bandwidth is reporting only.

3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

3.4.3 Test Procedures

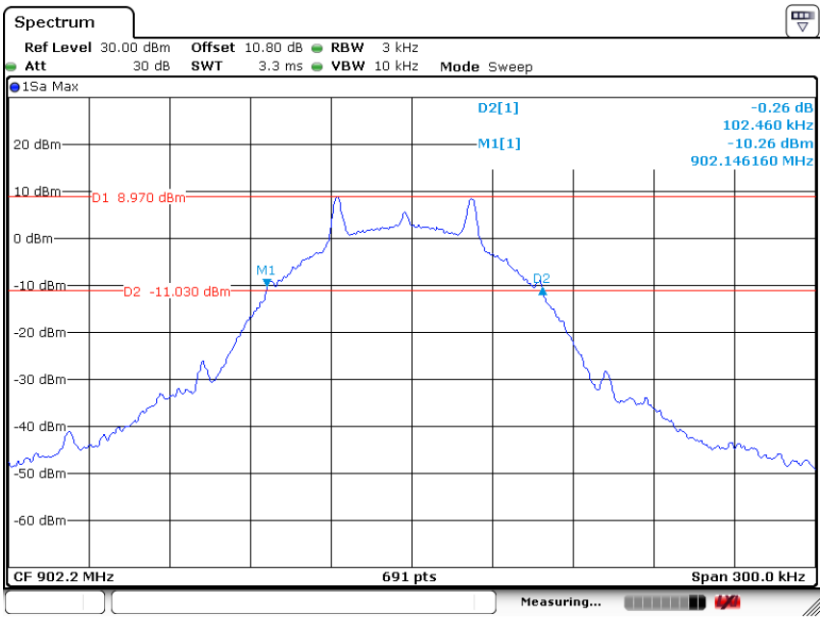
1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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

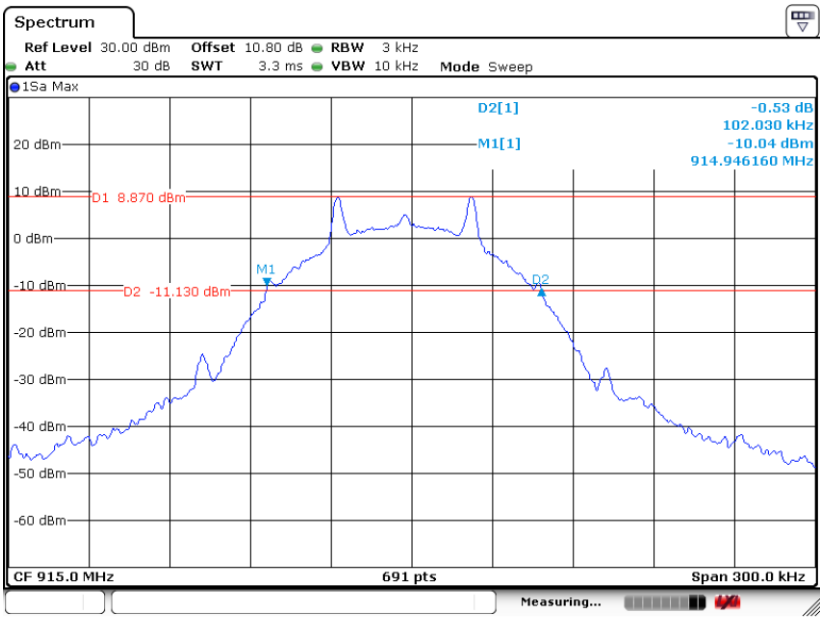
Please refer to Appendix A.

20 dB Bandwidth Plot on Channel 01



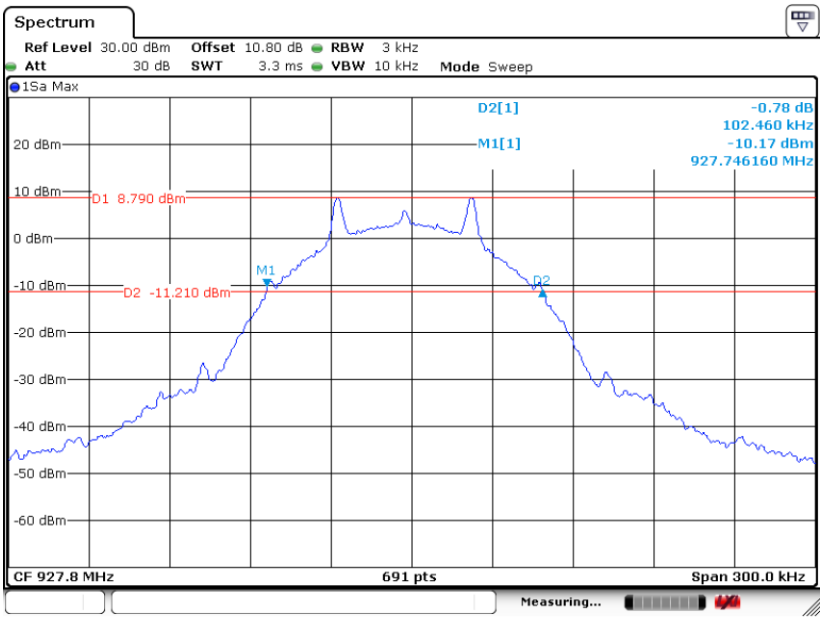
Date: 3.OCT.2019 16:07:49

20 dB Bandwidth Plot on Channel 65



Date: 3.OCT.2019 16:09:54

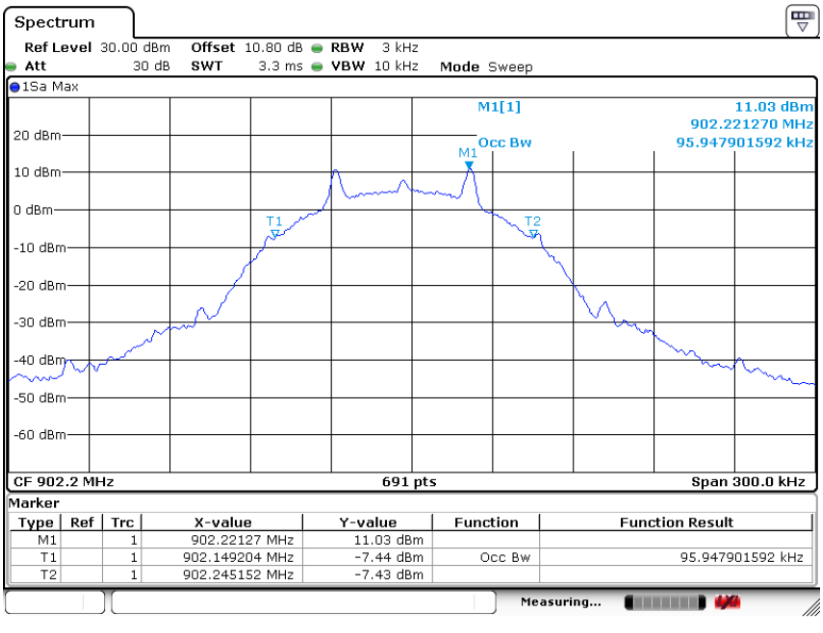
20 dB Bandwidth Plot on Channel 129



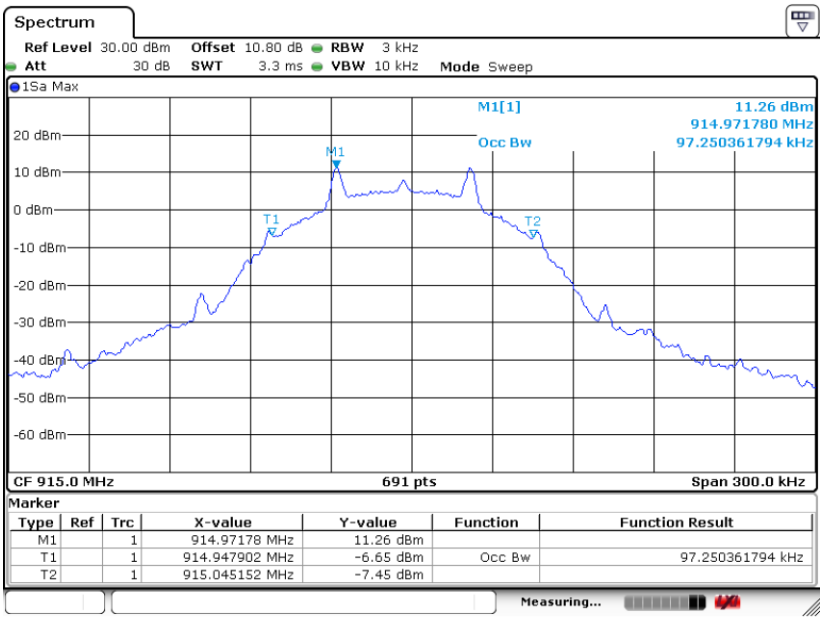
3.4.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

99% Occupied Bandwidth Plot on Channel 01



99% Occupied Bandwidth Plot on Channel 65



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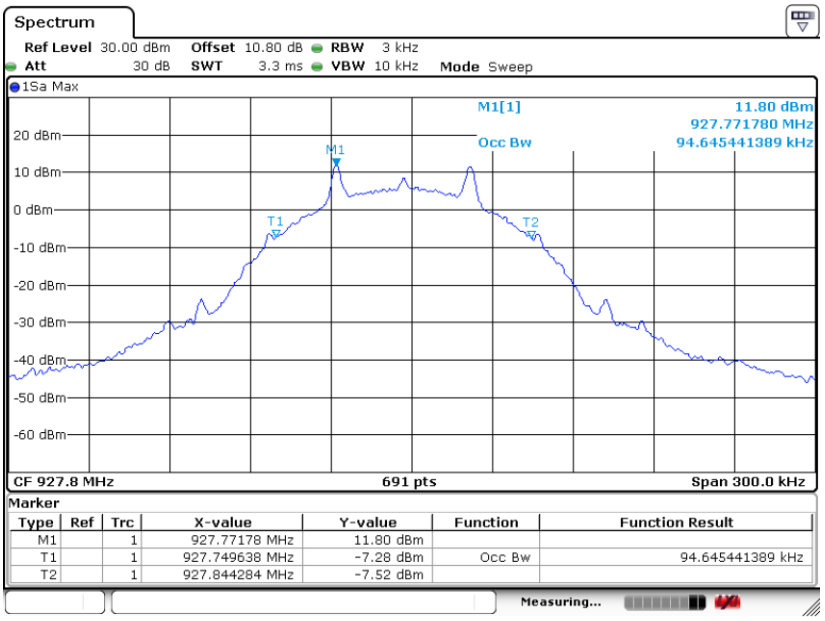
99% Occupied Bandwidth Plot on Channel 129



Date: 2.OCT.2019 15:25:46

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

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

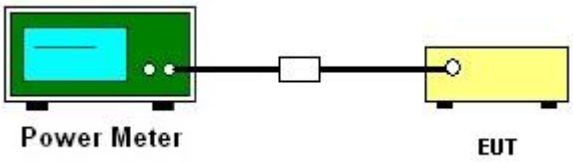
3.5.2 Measuring Instruments

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 Peak Output Power

Please refer to Appendix A.

3.5.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.6 Conducted Band Edges Measurement

3.6.1 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.

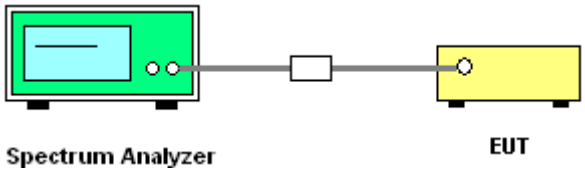
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

3.6.3 Test Procedures

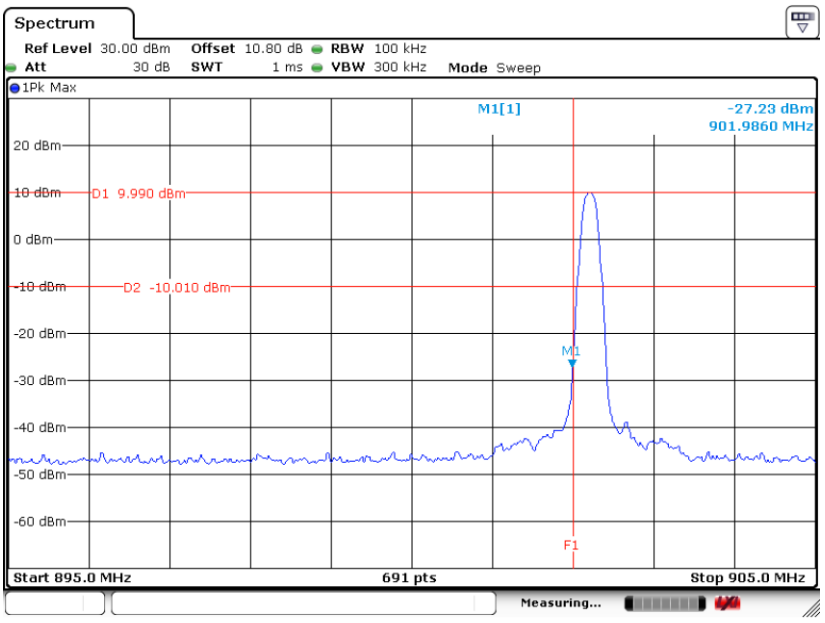
1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. 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.

3.6.4 Test Setup



3.6.5 Test Result of Conducted Band Edges

Low Band Edge Plot on Channel 01



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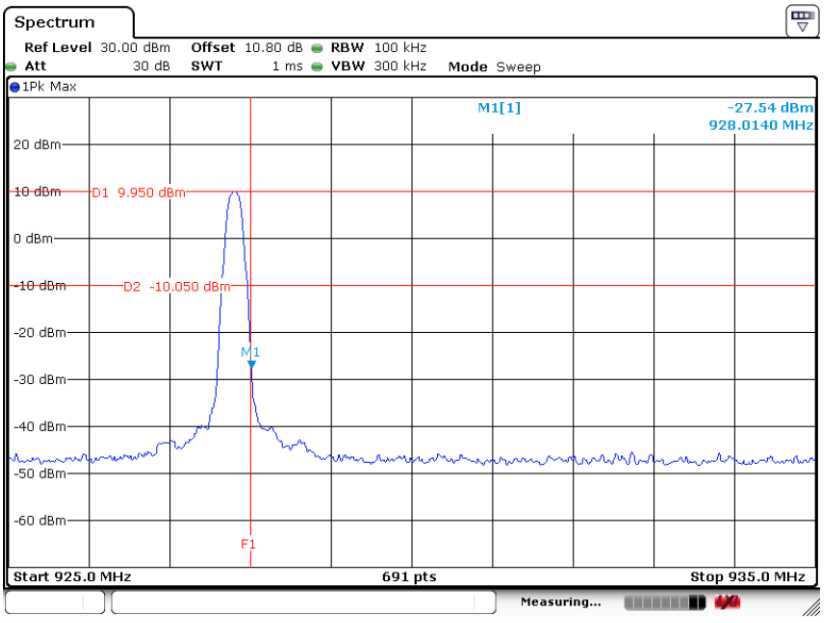
High Band Edge Plot on Channel 129



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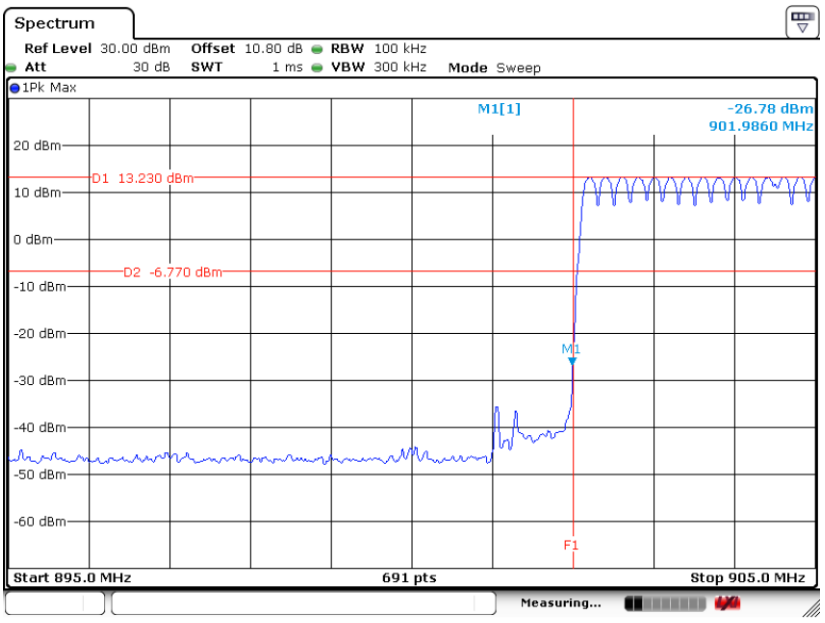
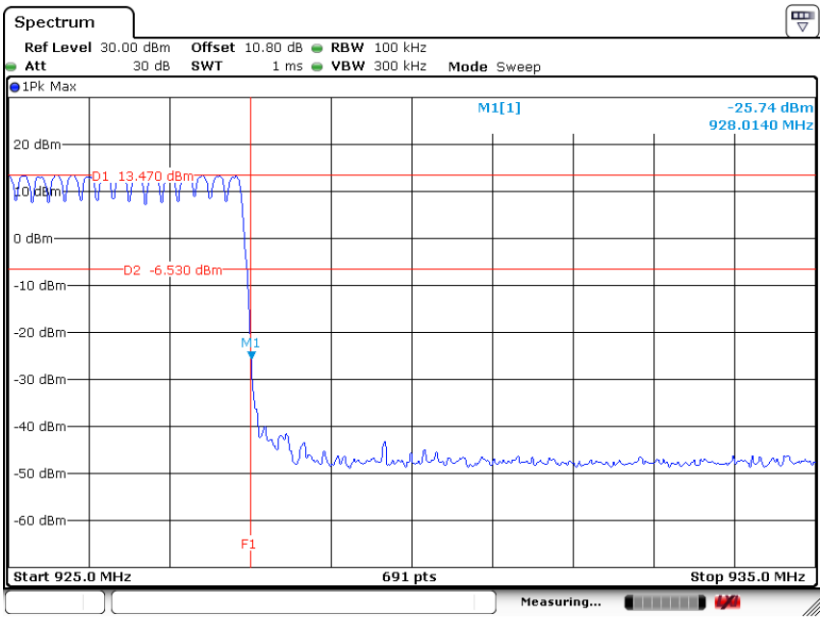
3.6.6 Test Result of Conducted Hopping Mode Band Edges

Hopping Mode Low Band Edge Plot



Hopping Mode High Band Edge Plot



3.7 Conducted Spurious Emission Measurement

3.7.1 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.

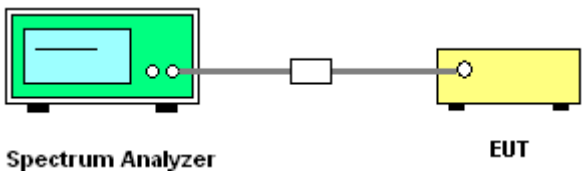
3.7.2 Measuring Instruments

See list of measuring equipment of this test report.

3.7.3 Test Procedure

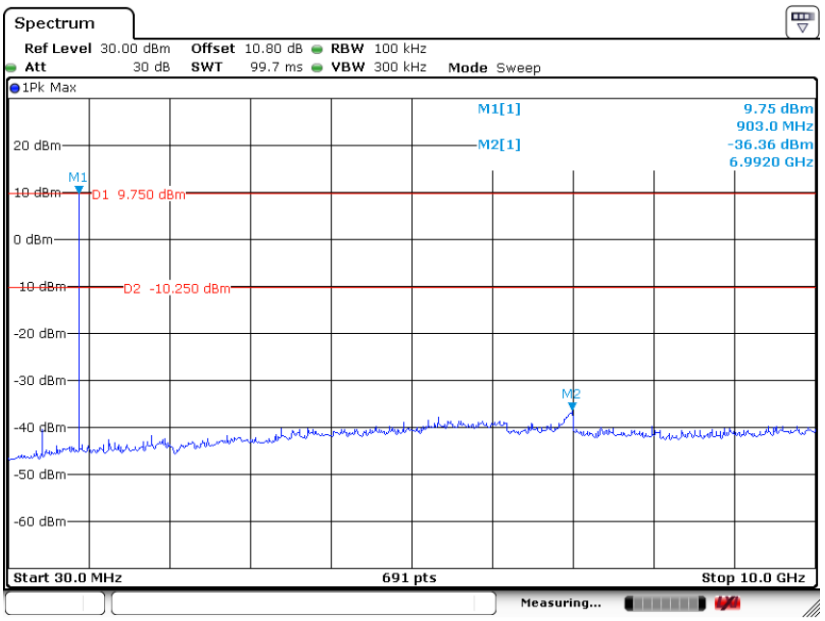
1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 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.

3.7.4 Test Setup



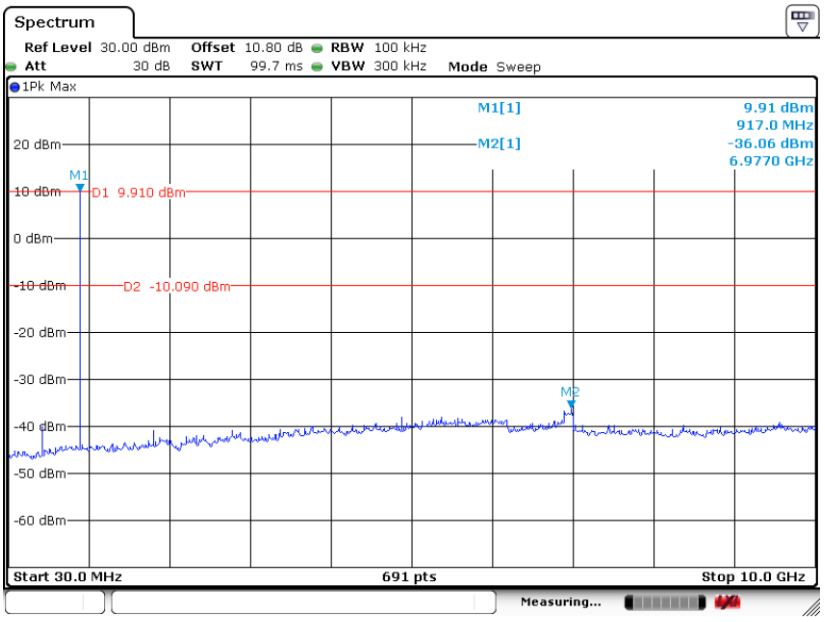
3.7.5 Test Result of Conducted Spurious Emission

CSE Plot on Ch 01 between 30MHz ~10 GHz



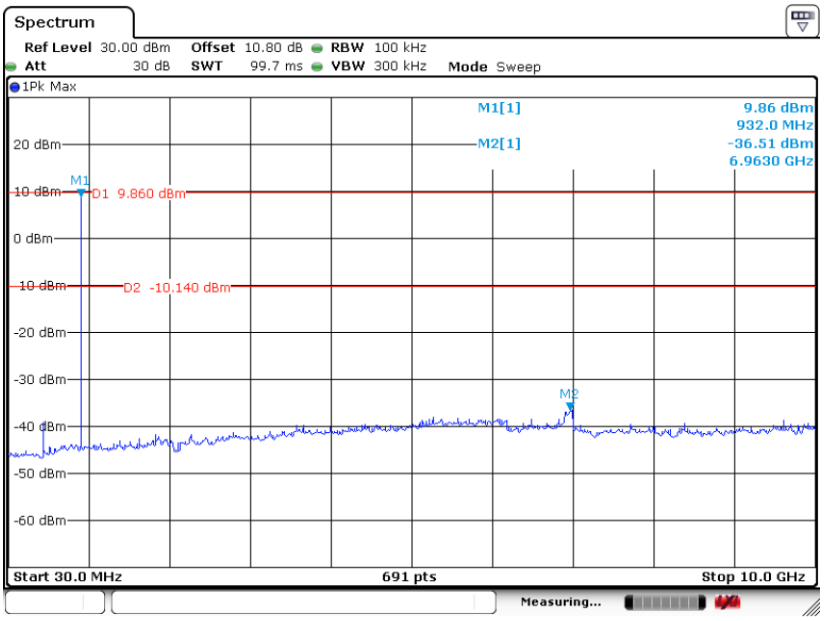
Date: 3.OCT.2019 13:38:07

CSE Plot on Ch 65 between 30MHz ~ 10 GHz



Date: 3.OCT.2019 13:41:58

CSE Plot on Ch 129 between 30MHz ~ 10 GHz



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

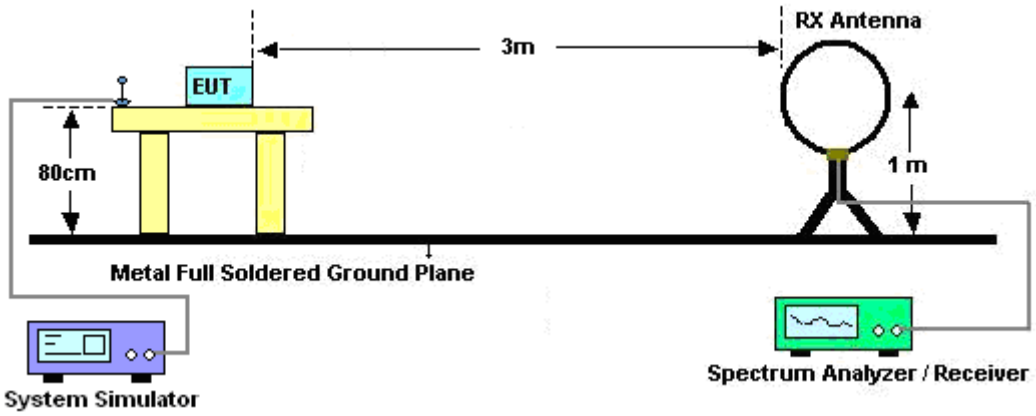
See list of measuring equipment of this test report.

3.8.3 Test Procedures

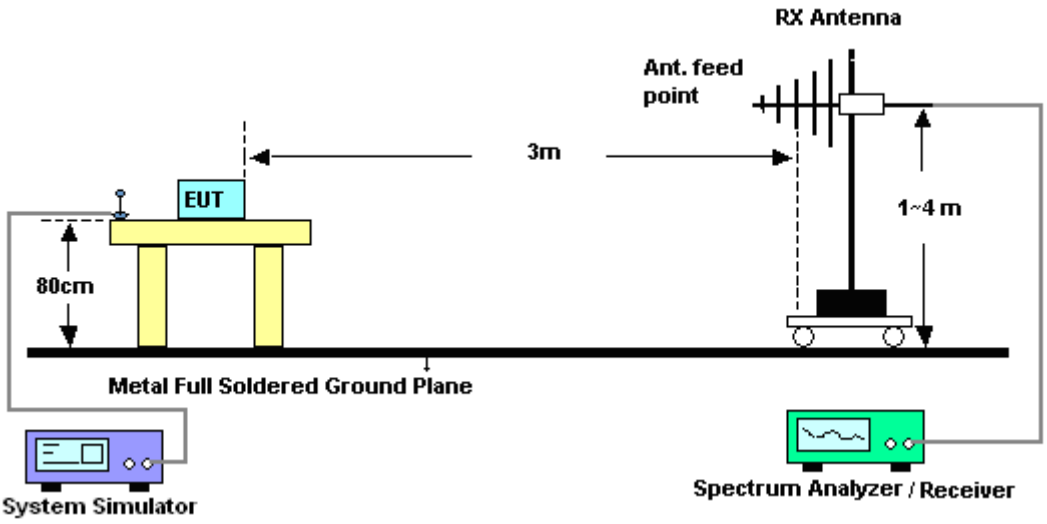
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 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 = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   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(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.

3.8.4 Test Setup

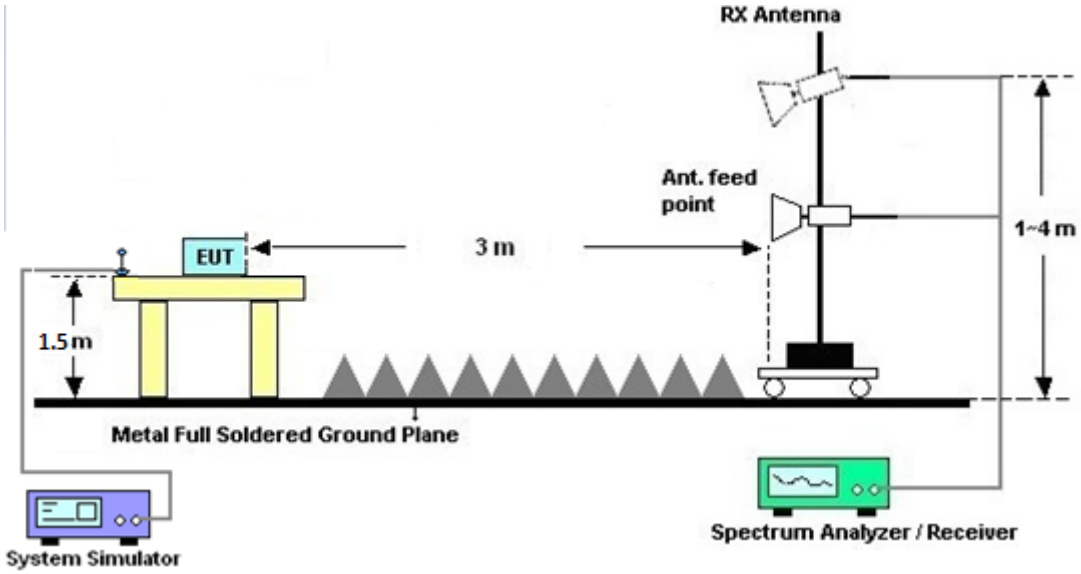
For radiated emissions below 30MHz



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 B and C.

3.8.7 Duty Cycle

Please refer to Appendix D.

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

Please refer to Appendix B and C.

3.9 Antenna Requirements

3.9.1 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.

3.9.2 Antenna Anti-Replacement Construction

Supplied with Whip Antenna.

Manufacturer Name : ShenZhen VLG Wireless Technology Co,. Ltd.

Model name: LSD7RF-MINI1352

3.9.3 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	Anritsu	ML2495A	1218006	N/A	Oct. 08, 2018	Sep. 27, 2019~ Oct. 07, 2019	Oct. 07, 2019	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	1207363	300MHz~40GHz	Oct. 08, 2018	Sep. 27, 2019~ Oct. 07, 2019	Oct. 07, 2019	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz~30GHz	Jan. 21, 2019	Sep. 27, 2019~ Oct. 07, 2019	Jan. 20, 2020	Conducted (TH05-HY)
Programmable Power Supply	GW Instek	PSS-2005	GEO821767	N/A	Oct. 16, 2018	Sep. 27, 2019~ Oct. 07, 2019	Oct. 15, 2019	Conducted (TH05-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC1208382	N/A	Mar. 27, 2019	Sep. 27, 2019~ Oct. 07, 2019	Mar. 26, 2020	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 11, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Jan. 10, 2020	Radiation (03CH07-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	35419 & 03	30MHz~1GHz	Apr. 30, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Apr. 29, 2020	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 02, 2018	Oct. 09, 2019 ~ Oct. 15, 2019	Dec. 03, 2019	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	May 20, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	May 19, 2020	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz~18GHz	Apr. 24, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Apr. 23, 2020	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz~26.5GHz	Jan. 23, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Jan. 22, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971/4, MY28655/4	9kHz~30MHz	Feb. 26, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	30MHz~1GHz	Feb. 26, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655/4, MY24971/4, MY15682/4	1GHz~18GHz	Feb. 26, 2019	Oct. 09, 2019 ~ Oct. 15, 2019	Feb. 25, 2020	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	80504004656 H	N/A	N/A	Oct. 09, 2019 ~ Oct. 15, 2019	N/A	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Oct. 09, 2019 ~ Oct. 15, 2019	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Oct. 09, 2019 ~ Oct. 15, 2019	N/A	Radiation (03CH07-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))	**5.7 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.5 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.2 dB**

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Tommy Lee	Temperature:	21~25	°C
Test Date:	2019/9/27~2019/10/07	Relative Humidity:	51~54	%

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth and Hopping Channel Separation

Operation Band	NTX	CH.	Freq. (MHz)	99% Bandwidth (kHz)	20dB BW (kHz)	20dB BW Limit (kHz)	Hopping Channel Separation Measurement (kHz)	Hopping Channel Separation Measurement Limit (kHz)	Pass/Fail
902-928 MHz	1	1	902.2	95.948	102.460	500	200.580	102.460	Pass
902-928 MHz	1	65	915.0	97.250	102.030	500	200.580	102.030	Pass
902-928 MHz	1	129	927.8	94.645	102.460	500	200.580	102.460	Pass

TEST RESULTS DATA
Dwell Time

Operation Band	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Nomal	129	4	9.57	0.04	0.40	Pass

TEST RESULTS DATA
Peak Power Table

Operation Band	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail	TX Power Setting
902-928 MHz	1	1	902.2	9.46	30.00	-1.90	7.56	36.00	Pass	+11 dBm
902-928 MHz	1	65	915.0	9.48	30.00	-1.90	7.58	36.00	Pass	+11 dBm
902-928 MHz	1	129	927.8	**9.52**	30.00	-1.90	7.62	36.00	Pass	+11 dBm

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Operation Band	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Duty Factor (dB)
902-928 MHz	1	1	902.2	9.40	0.00
902-928 MHz	1	65	915.0	9.42	0.00
902-928 MHz	1	129	927.8	**9.46**	0.00

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
129	> 50	Pass

Appendix B. Radiated Spurious Emission

Test Engineer :	Nick Yu and Stan Hsieh	Temperature :	24~26°C
		Relative Humidity :	58~60%

902 MHz~928 MHz

(30MHz ~ 1GHz @ 3m)

Mode	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH01 902.2MHz		30	30.83	-9.17	40	35.02	24.6	1.19	29.98	-	-	P	H
		46.2	24.94	-15.06	40	37.85	15.89	1.19	29.99	-	-	P	H
		67.26	20.85	-19.15	40	37.26	12.03	1.55	29.99	-	-	P	H
		806.1	40.43	-5.57	46	37.45	27.91	4.33	29.26	100	123	Q	H
		854.4	37.35	-8.65	46	33.08	28.88	4.48	29.09	-	-	P	H
	*	902.2	107.43	-	-	102.91	28.76	4.68	28.92	-	-	P	H
		950.3	40.35	-5.65	46	33.78	30.39	4.74	28.56	100	112	Q	H
													H
													H
		30	32.6	-7.4	40	36.79	24.6	1.19	29.98	100	0	P	V
		45.66	20.34	-19.66	40	32.84	16.3	1.19	29.99	-	-	P	V
		59.97	17.26	-22.74	40	34.17	11.89	1.19	29.99	-	-	P	V
		806.1	36.47	-9.53	46	33.49	27.91	4.33	29.26	-	-	P	V
		871.9	32.28	-13.72	46	27.73	28.95	4.63	29.03	-	-	P	V
	*	902.2	94.67	-	-	90.15	28.76	4.68	28.92	-	-	P	V
		950.3	34.28	-11.72	46	27.71	30.39	4.74	28.56	-	-	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

902 MHz~928 MHz

(1GHz ~ 10GHz @ 3m)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH01 902.2MHz		2706.6	48.2	-25.8	74	66.82	32.6	8.16	59.38	100	0	P	H
		3608.8	39.25	-34.75	74	56.6	32.9	9.43	59.68	100	0	P	H
		4511	51.24	-22.76	74	66.56	33.87	10.47	59.66	100	294	P	H
		4511	48.35	-5.65	54	63.67	33.87	10.47	59.66	100	294	A	H
		5413.2	43.23	-30.77	74	54.28	34.63	11.53	57.21	100	0	P	H
		8119.8	45.88	-28.12	74	53.65	35.73	14.24	57.74	100	0	P	H
		9022	45.5	-28.5	74	53.24	36.03	15.2	58.97	100	0	P	H
													H
													H
		2706.6	45.53	-28.47	74	64.15	32.6	8.16	59.38	100	0	P	V
		3608.8	38.7	-35.3	74	56.05	32.9	9.43	59.68	100	0	P	V
		4511	45.55	-28.45	74	60.87	33.87	10.47	59.66	100	0	P	V
		5413.2	43.76	-30.24	74	54.81	34.63	11.53	57.21	100	0	P	V
		8119.8	45.21	-28.79	74	52.98	35.73	14.24	57.74	100	0	P	V
		9022	45.47	-28.53	74	53.21	36.03	15.2	58.97	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

902 MHz ~928 MHz

(30MHz ~ 1GHz @ 3m)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		30	30.9	-9.1	40	35.09	24.6	1.19	29.98	-	-	P	H
		46.47	25.16	-14.84	40	38.07	15.89	1.19	29.99	-	-	P	H
		61.32	20.17	-19.83	40	36.73	11.88	1.55	29.99	-	-	P	H
		818.7	43.1	-2.9	46	40.19	27.79	4.33	29.21	100	120	Q	H
		867	39.75	-6.25	46	35.18	28.98	4.63	29.04	-	-	P	H
		911.1	40.78	-5.22	46	35.99	28.96	4.68	28.85	100	109	Q	H
	*	915	106.41	-	-	101.51	29.04	4.68	28.82	-	-	P	H
													H
CH65													H
915.0MHz		30	32.23	-7.77	40	36.42	24.6	1.19	29.98	100	0	P	V
		35.94	21.67	-18.33	40	28.95	21.51	1.19	29.98	-	-	P	V
		47.28	19.91	-20.09	40	33.23	15.48	1.19	29.99	-	-	P	V
		818.7	37.59	-8.41	46	34.68	27.79	4.33	29.21	-	-	P	V
		867	34.07	-11.93	46	29.5	28.98	4.63	29.04	-	-	P	V
	*	915	93.71	-	-	88.81	29.04	4.68	28.82	-	-	P	V
		951	35.11	-10.89	46	28.53	30.39	4.74	28.55	-	-	P	V
													V
													V

Remark

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

902 MHz ~928 MHz

(1GHz ~ 10GHz @ 3m)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH65 915.0MHz		2745	46.66	-27.34	74	65.32	32.5	8.22	59.38	100	0	P	H
		3660	41.08	-32.92	74	58.4	32.9	9.48	59.7	100	0	P	H
		4575	51.56	-22.44	74	66.61	34	10.51	59.56	104	278	P	H
		4575	48.89	-5.11	54	63.94	34	10.51	59.56	104	278	A	H
		7320	43.12	-30.88	74	52.3	35.63	13.5	58.31	100	0	P	H
		8235	46.11	-27.89	74	53.88	35.8	14.35	57.92	100	0	P	H
		9150	46.28	-27.72	74	53.97	36.1	15.35	59.14	100	0	P	H
													H
													H
		2745	41.29	-32.71	74	59.95	32.5	8.22	59.38	100	0	P	V
		3660	39.72	-34.28	74	57.04	32.9	9.48	59.7	100	0	P	V
		4575	45.44	-28.56	74	60.49	34	10.51	59.56	100	0	P	V
		7320	42.48	-31.52	74	51.66	35.63	13.5	58.31	100	0	P	V
		8235	45.61	-28.39	74	53.38	35.8	14.35	57.92	100	0	P	V
		9150	47.51	-26.49	74	55.2	36.1	15.35	59.14	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

902 MHz ~928 MHz

(30MHz ~ 1GHz @ 3m)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH129 927.8MHz		30	31.32	-8.68	40	35.51	24.6	1.19	29.98	-	-	P	H
		46.74	25.24	-14.76	40	38.15	15.89	1.19	29.99	-	-	P	H
		59.43	20.09	-19.91	40	36.92	11.97	1.19	29.99	-	-	P	H
		832	45.1	-0.9	46	41.56	28.23	4.48	29.17	100	106	Q	H
		879.6	40.81	-5.19	46	36.28	28.9	4.63	29	100	109	Q	H
		923.7	39.67	-6.33	46	34.48	29.27	4.68	28.76	100	122	Q	H
	*	927.8	106.29	-	-	100.91	29.43	4.68	28.73	-	-	P	H
													H
													H
		30	32.77	-7.23	40	36.96	24.6	1.19	29.98	100	0	P	V
		47.01	20.41	-19.59	40	33.73	15.48	1.19	29.99	-	-	P	V
		60.24	16.95	-23.05	40	33.5	11.89	1.55	29.99	-	-	P	V
		463.8	32.69	-13.31	46	35.87	23.21	3.41	29.8	-	-	P	V
		783	34.57	-11.43	46	31.59	27.98	4.33	29.33	-	-	P	V
		832	38.47	-7.53	46	34.93	28.23	4.48	29.17	-	-	P	V
	*	927.8	94.66	-	-	89.28	29.43	4.68	28.73	-	-	P	V
													V
													V

Remark

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

902 MHz ~928 MHz

(1GHz ~ 10GHz @ 3m)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH129 927.8MHz		2783.4	47.11	-26.89	74	65.78	32.43	8.28	59.38	100	0	P	H
		3711.2	38.87	-35.13	74	56.01	33	9.58	59.72	100	0	P	H
		4639	51.65	-22.35	74	66.38	34.07	10.62	59.42	114	275	P	H
		4639	48.87	-5.13	54	63.6	34.07	10.62	59.42	114	275	A	H
		7422.4	42.73	-31.27	74	51.98	35.5	13.62	58.37	100	0	P	H
		8350.2	44.52	-29.48	74	52.51	35.6	14.49	58.08	100	0	P	H
													H
													H
		2783.4	40.05	-33.95	74	58.72	32.43	8.28	59.38	100	0	P	V
		3711.2	38.69	-35.31	74	55.83	33	9.58	59.72	100	0	P	V
		4639	47.22	-26.78	74	61.95	34.07	10.62	59.42	100	0	P	V
		7422.4	42.45	-31.55	74	51.7	35.5	13.62	58.37	100	0	P	V
		8350.2	44.47	-29.53	74	52.46	35.6	14.49	58.08	100	0	P	V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average 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:

Mode	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
CH 01		4511	51.24	-22.76	74	66.56	33.87	10.47	59.66	100	294	P	H
902.2 MHz		4511	48.35	-5.65	54	63.67	33.87	10.47	59.66	100	294	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 @ 4511MHz:

1. Level(dBμV/m)

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

= 33.87(dB/m) + 10.47(dB) + 66.56(dBμV) – 59.66 (dB)

= 51.24 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 51.24(dBμV/m) – 74(dBμV/m)

= -22.76(dB)

For Average Limit @ 4511MHz:

1. Level(dBμV/m)

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

= 33.87dB/m) + 10.47(dB) + 63.67(dBμV) – 59.66 (dB)

= 48.35 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 48.35(dBμV/m) – 54(dBμV/m)

= -5.65(dB)

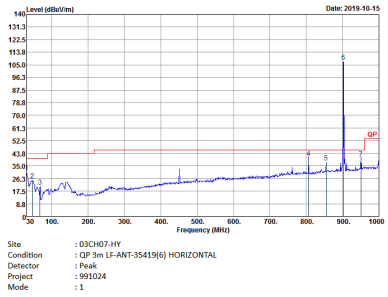
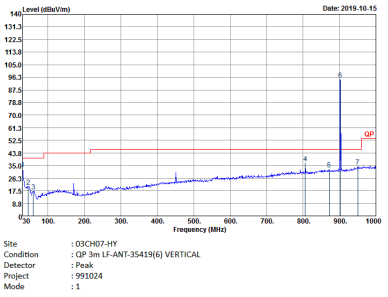
Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix C. Radiated Spurious Emission Plots

Test Engineer :	Nick Yu and Stan Hsieh	Temperature :	24~26°C
		Relative Humidity :	58~60%

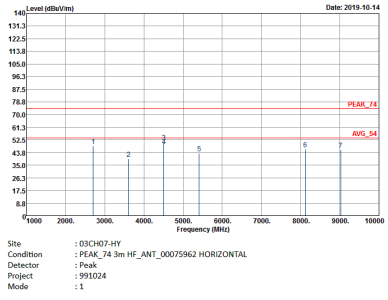
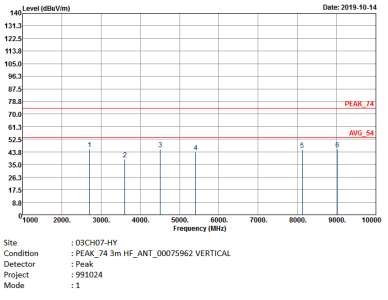
902 MHz ~ 928 MHz

(30MHz ~ 1GHz @ 3m)

	CH01 902.2 MHz	
	Horizontal	Vertical
Peak / QP		

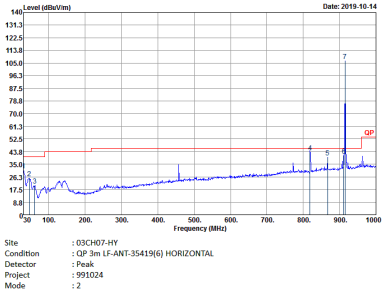
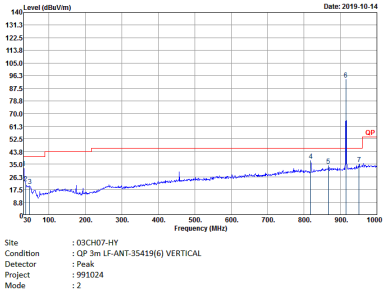
902 MHz ~ 928 MHz

(1GHz ~ 10GHz @ 3m)

	CH01 902.2 MHz	
	Horizontal	Vertical
Peak Avg.		

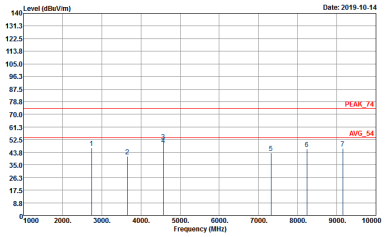
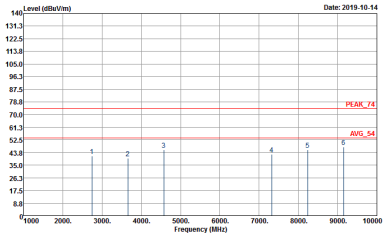
902 MHz ~ 928 MHz

(30MHz ~ 1GHz @ 3m)

	CH65 915.0 MHz	
	Horizontal	Vertical
Peak / QP		

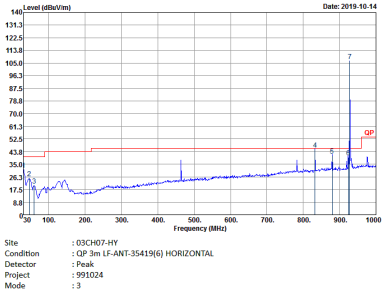
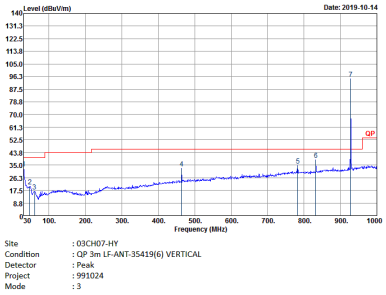
902 MHz ~ 928 MHz

(1GHz ~ 10GHz @ 3m)

	CH65 915.0 MHz	
	Horizontal	Vertical
Peak Avg.		

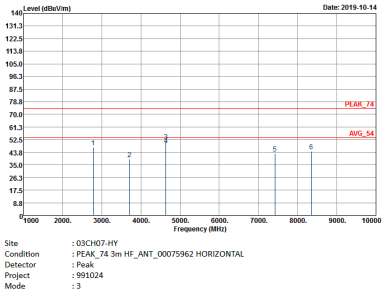
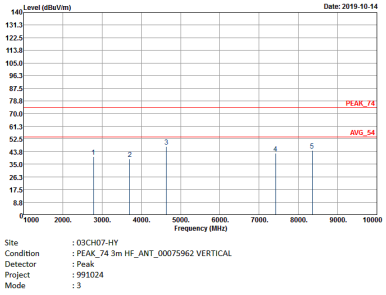
902 MHz ~ 928 MHz

(30MHz ~ 1GHz @ 3m)

	CH129 927.8 MHz	
	Horizontal	Vertical
Peak / QP		

902 MHz ~ 928 MHz

(1GHz ~ 10GHz @ 3m)

	CH129 927.8 MHz	
	Horizontal	Vertical
Peak Avg.		

Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting	Duty Factor(dB)
902-928 MHz	100	-	-	10Hz	0.00