FCC RADIO TEST REPORT

FCC ID	:	**ZAT-1312PSIP-1**
Equipment	:	**CC1312PSIP**
Brand Name	:	**Texas Instruments**
Model Name	:	**CC1312PSIP SimpleLink™ Sub-1-GHz Wireless System-in-Package**
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 Apr. 13, 2023 and testing was performed from Apr. 21, 2023 to Jun. 13, 2023. We, Sporton International Inc. Wensan 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 test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

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History of this test report

Report No.	Version	Description	Issued Date
FR341305	01	Initial issue of report	Jun. 28, 2023

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 Spurious Emission	Pass	0.10 dB under the limit at 3651.000 MHz
3.9	15.207	AC Conducted Emission	Pass	4.38 dB under the limit at 0.159 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Danny Lee
Report Producer: Ming Chen

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature
General Specs Sub-1GHz Function (Data Rate / Modulation: 50 kbps, 2-GFSK, 25 kHz Deviation)

Antenna Information				
	Brand	**Antenna Type**	**Model**	**915MHz Gain**
1	TI	Integrated PCB antenna	LP-EM-CC1312PSIP antenna	+2.69 dBi
2	Kaadas	Flexi PCB antenna	K1	-5.82 dBi
3	Leederson	Integrated PCB antenna	L1	-4.51 dBi
4	Leederson	Integrated PCB antenna	L2	-1.83 dBi
5	Leederson	Stanced antenna	L3	-9.48 dBi
6	Leederson	Stanced antenna	L4	+0.37 dBi
7	Leederson	Integrated PCB antenna	L5	-1.74 dBi
8	Pulse	External whip antenna	W5017	+0.90 dBi
9	Johanson Technology	Chip antenna	0900AT43A0070	-0.50 dBi
10	Johanson Technology	Chip antenna	0915AT43A0026	+1.0 dBi
11	Pulse	Wire antenna	W3113	+0.80 dBi

Remark:

1. The EUT uses the Integrated PCB antenna from Texas Instruments (Antenna #1)
2. The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

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 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	**Sporton Site No.**
	CO05-HY (TAF Code: 1190)
Remark	The AC Conducted Emission test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory.

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

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	TH05-HY, 03CH11-HY

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

FCC designation No.: TW1190 and TW3786

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 15.247 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.
3. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	912.75	21	915.35	41	917.95
	2	912.88	22	915.48	42	918.08
	3	913.01	23	915.61	43	918.21
	4	913.14	24	915.74	44	918.34
	5	913.27	25	915.87	45	918.47
	6	913.40	26	916.00	46	918.60
	7	913.53	27	916.13	47	918.73
	8	913.66	28	916.26	48	918.86
	9	913.79	29	916.39	49	918.99
	10	913.92	30	916.52	50	919.12
	11	914.05	31	916.65	-	-
	12	914.18	32	916.78	-	-
	13	914.31	33	916.91	-	-
	14	914.44	34	917.04	-	-
	15	914.57	35	917.17	-	-
	16	914.70	36	917.30	-	-
	17	914.83	37	917.43	-	-
	18	914.96	38	917.56	-	-
	19	915.09	39	917.69	-	-
	20	915.22	40	917.82	-	-

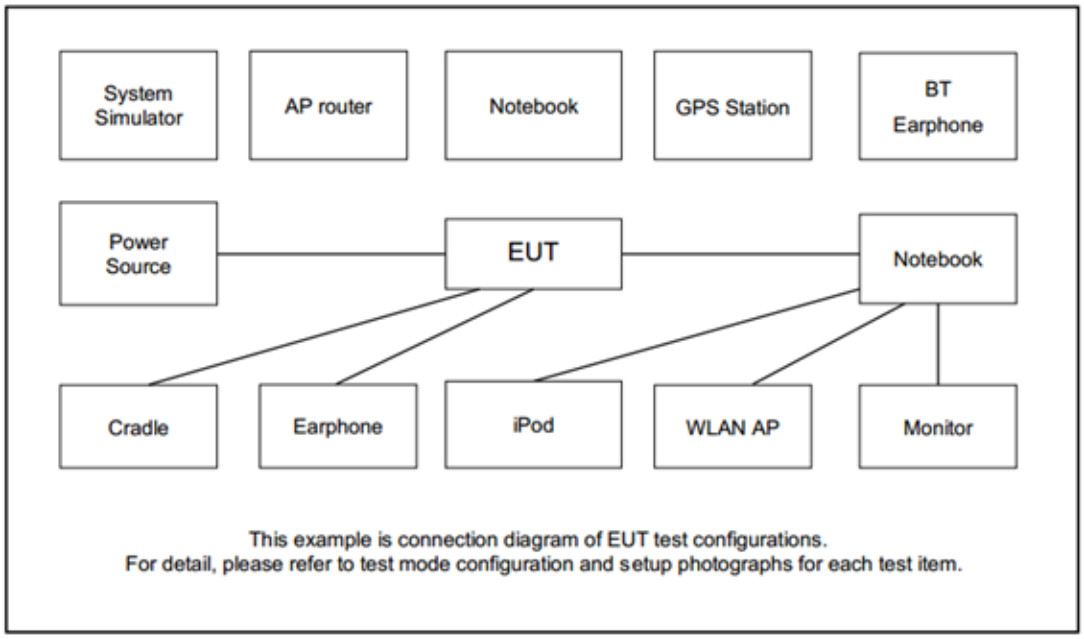
2.2 Test Mode

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 measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported 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_912.75 MHz Mode 2: CH50 Tx _919.12 MHz
Radiated Test Cases	Mode 1: CH01 Tx_912.75 MHz Mode 2: CH50 Tx _919.12 MHz
AC Conducted Emission	Mode 1: Sub-1GHz TX + USB Cable(Charging from Notebook)

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	ASUS	RT-AC66U	MSQ-RTAC66U	Unshielded, 3.0 m	Unshielded, 1.8 m
2.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A
3.	Notebook	DELL	Latitude 3420	FCC DoC	Shielded, 0.3 m	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Fixture 1	Texas Instruments	LP-XDS110	N/A	N/A	N/A
5.	Fieture 2	Texas Instruments	LP-EM-CC1312PSIP	N/A	N/A	N/A
6.	Notebook	Lenovo	Ideapad Gaming 3 15IHU6	FCC DoC	Shielded, 0.3 m	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

The RF test items, utility “SmartRF Studio 7” 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 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

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedure

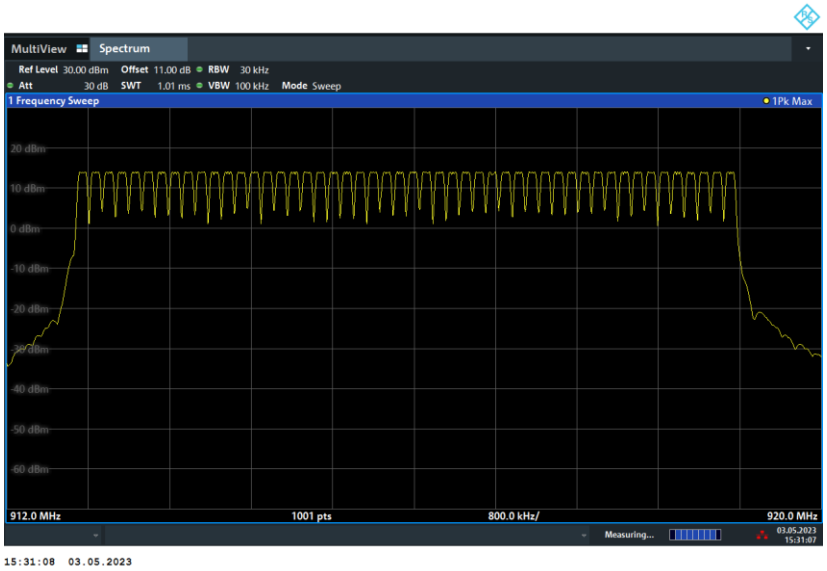
1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW = 30 kHz; 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 - 50



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.

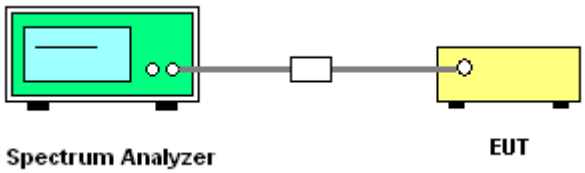
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in 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.

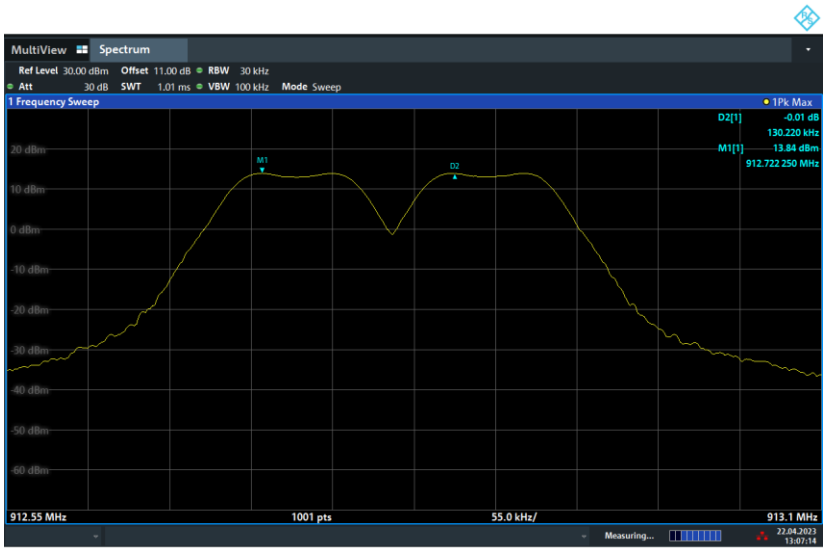
3.2.4 Test Setup



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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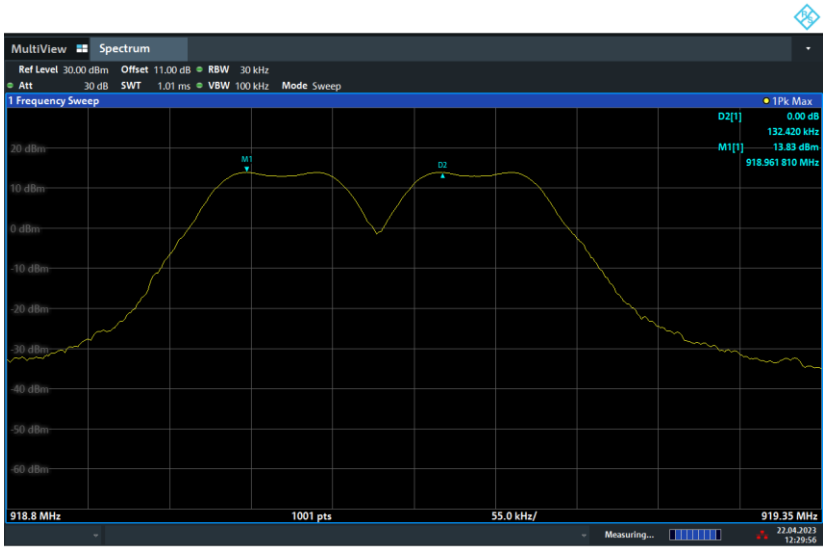
Channel Separation Plot on Channel 49-50



12:29:57 22.04.2023

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.

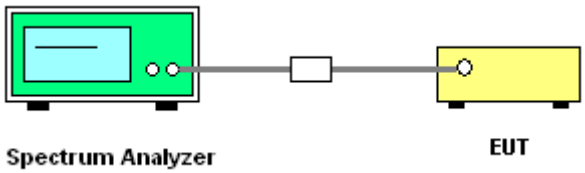
3.3.2 Measuring Instruments

Please refer to the measuring equipment list in 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 = 100 kHz; 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.

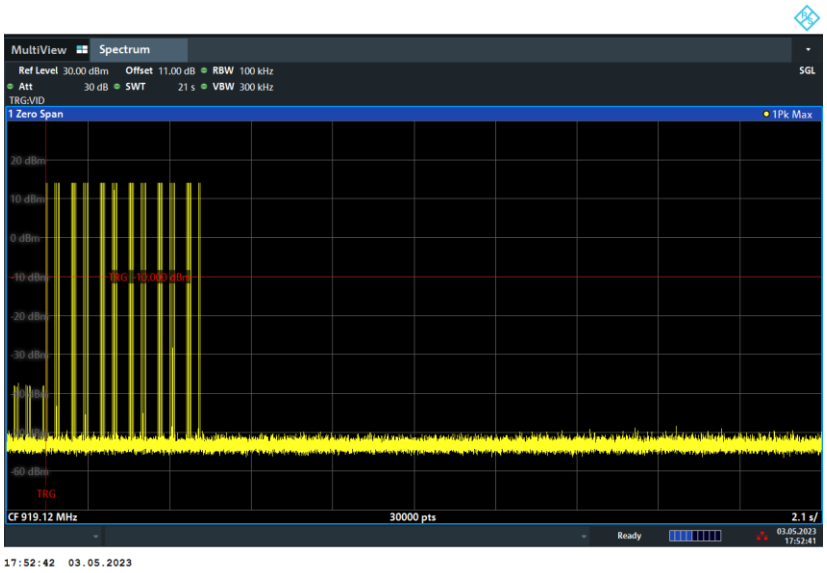
3.3.4 Test Setup



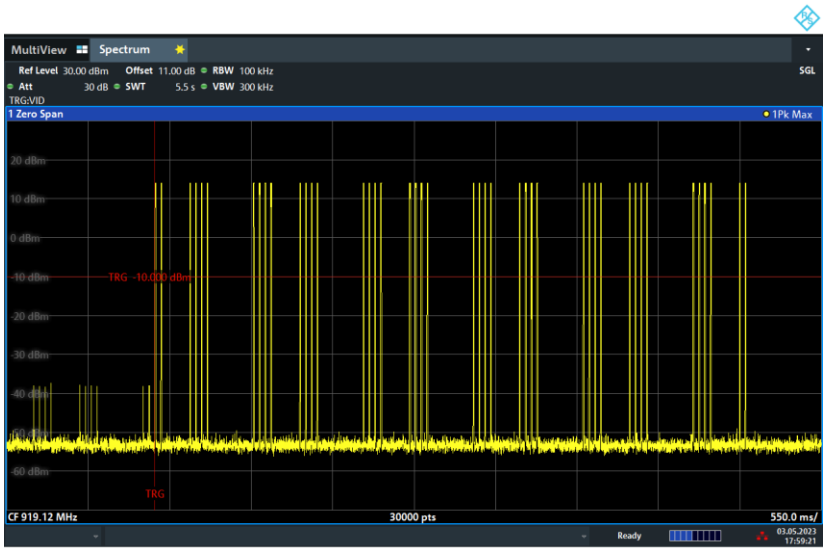
3.3.5 Test Result of Dwell Time

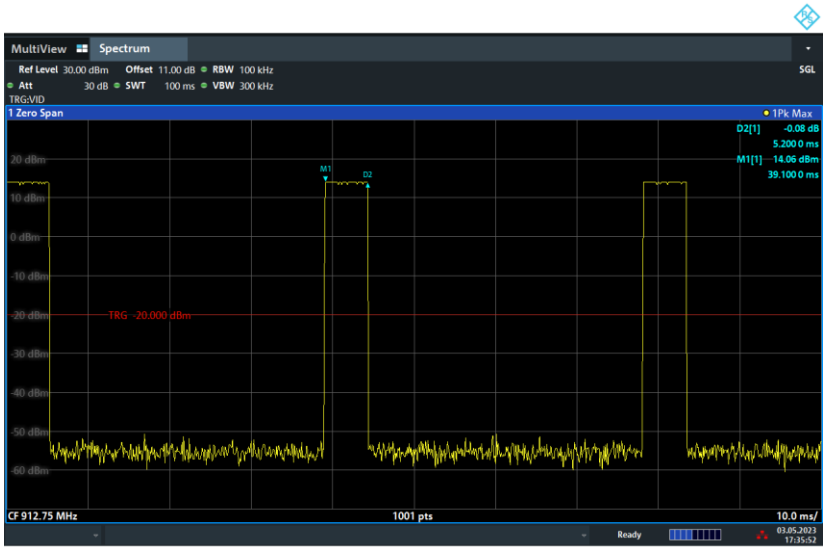
Please refer to Appendix A.

Package Transfer Time Plot



Package Transfer Time Plot





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

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedures

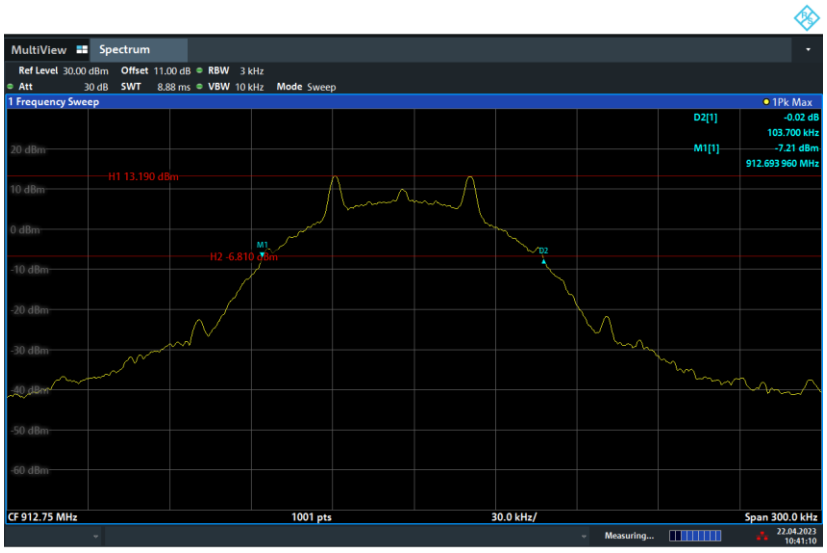
1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4.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



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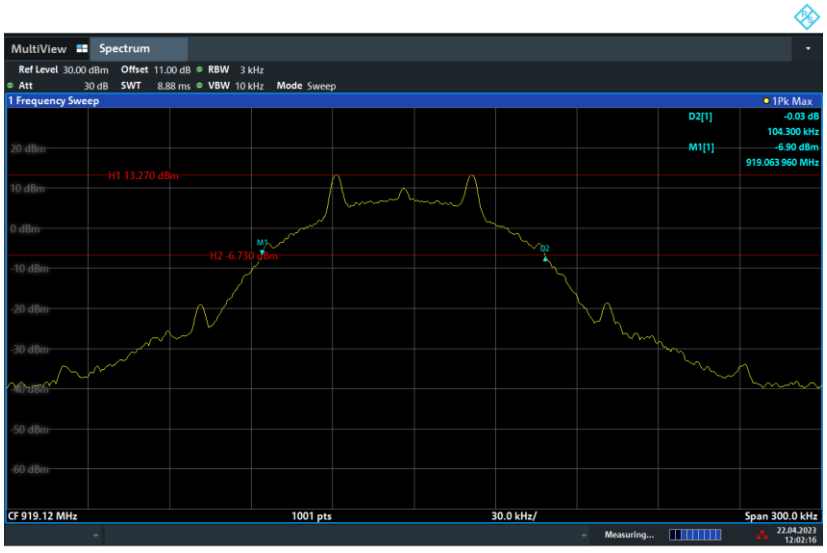
20 dB Bandwidth Plot on Channel 50



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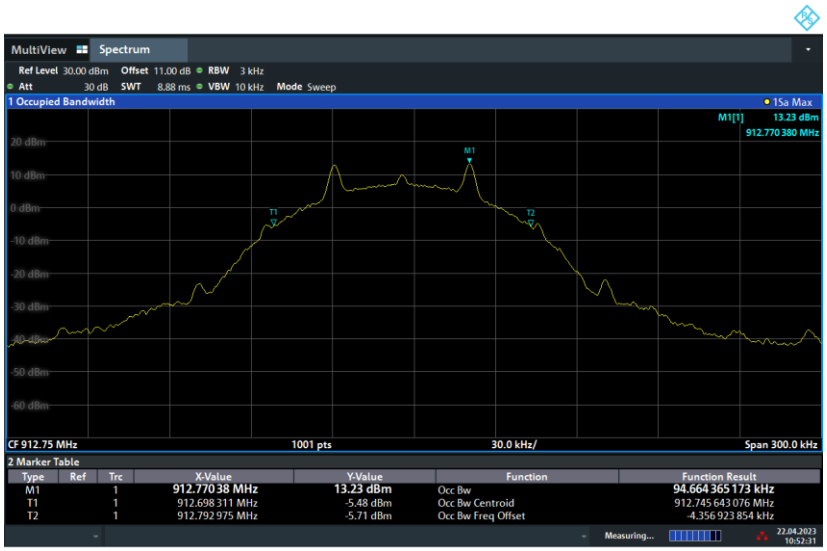
3.4.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

99% Occupied Bandwidth Plot on Channel 01



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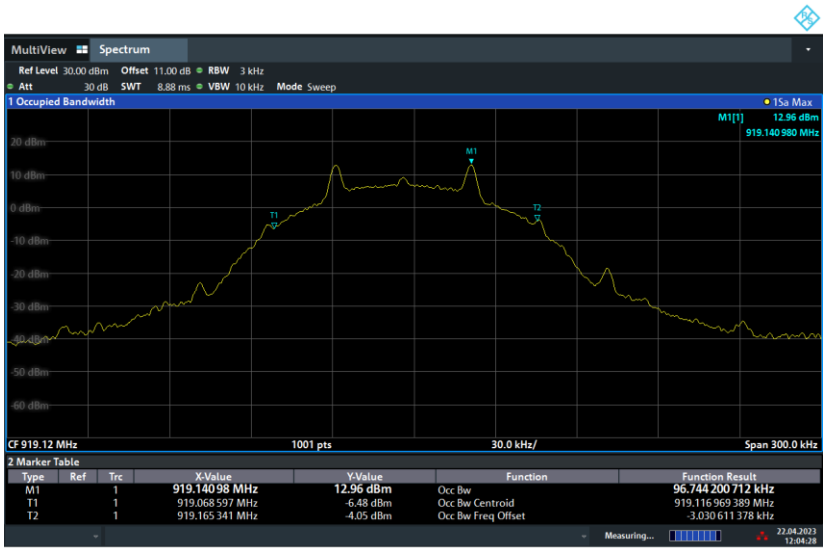
99% Occupied Bandwidth Plot on Channel 50



12:04:28 22.04.2023

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.

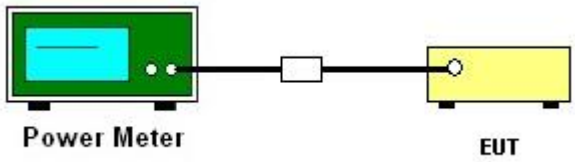
3.5.2 Measuring Instruments

Please refer to the measuring equipment list in 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.

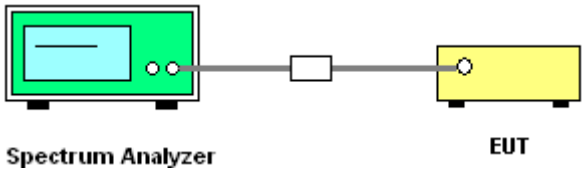
3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.6.3 Test Procedures

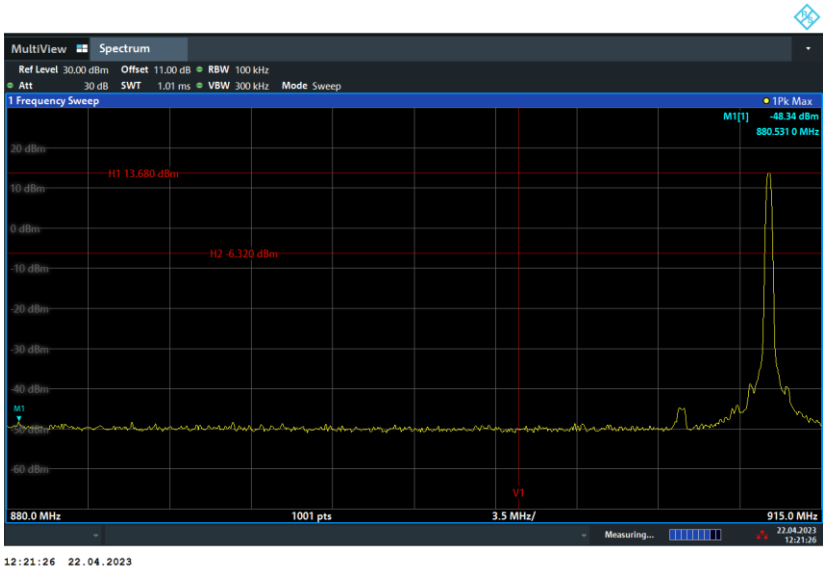
1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. 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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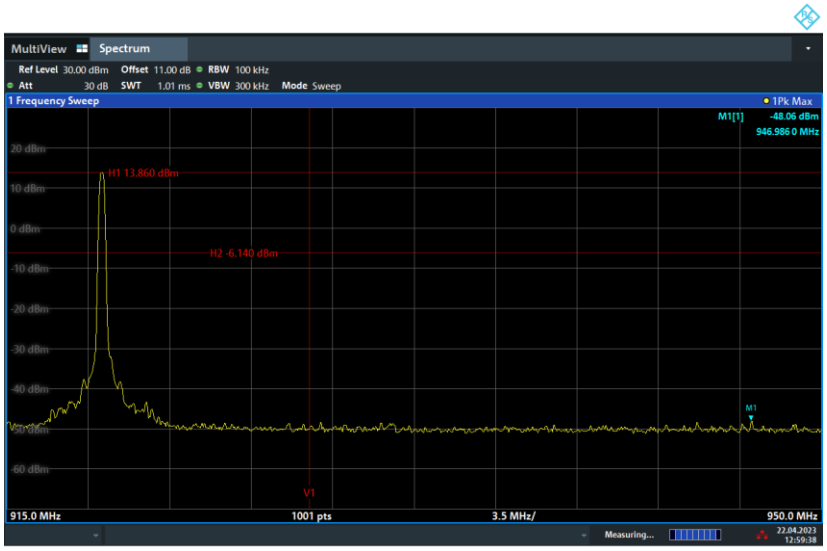
High Band Edge Plot on Channel 50



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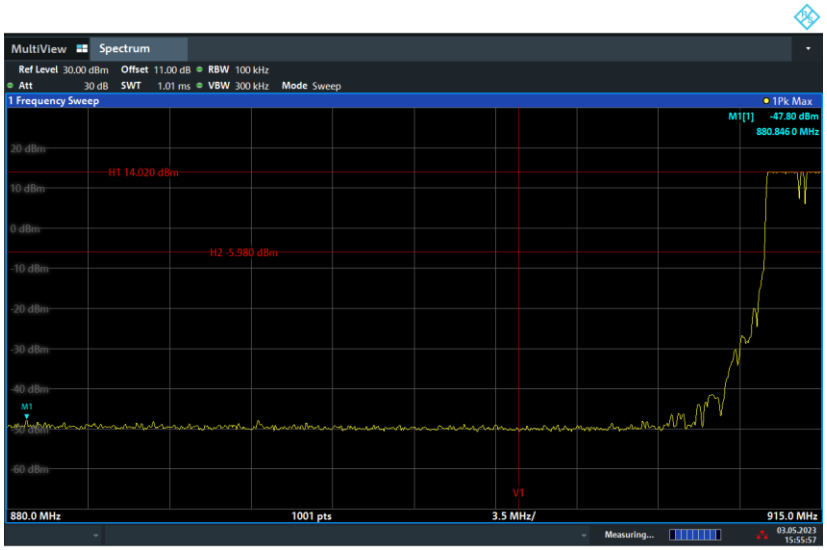
3.6.6 Test Result of Conducted Hopping Mode Band Edges

Hopping Mode Low Band Edge Plot



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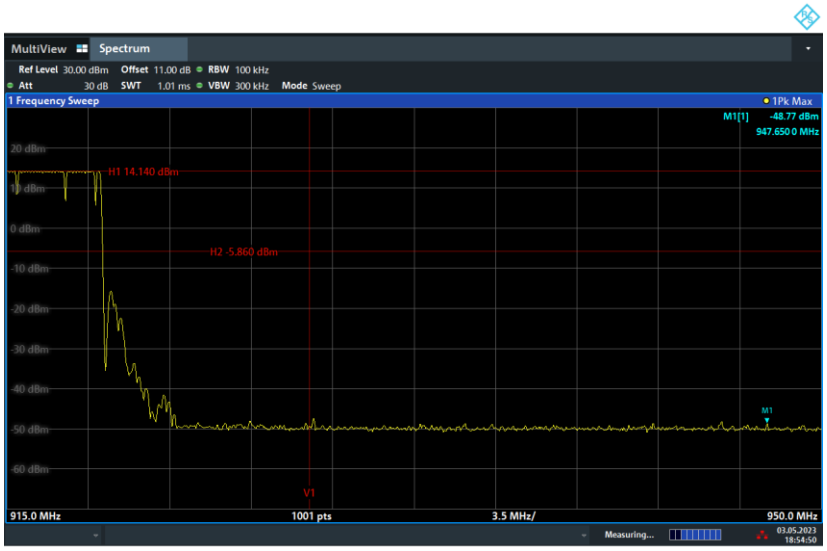
Hopping Mode High Band Edge Plot



18:54:50 03.05.2023

3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Conducted Spurious Emission

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.

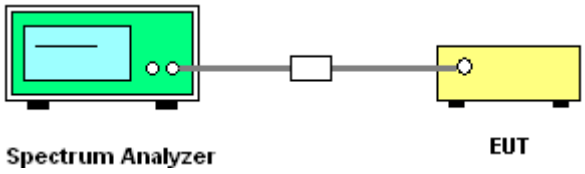
3.7.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.7.3 Test Procedure

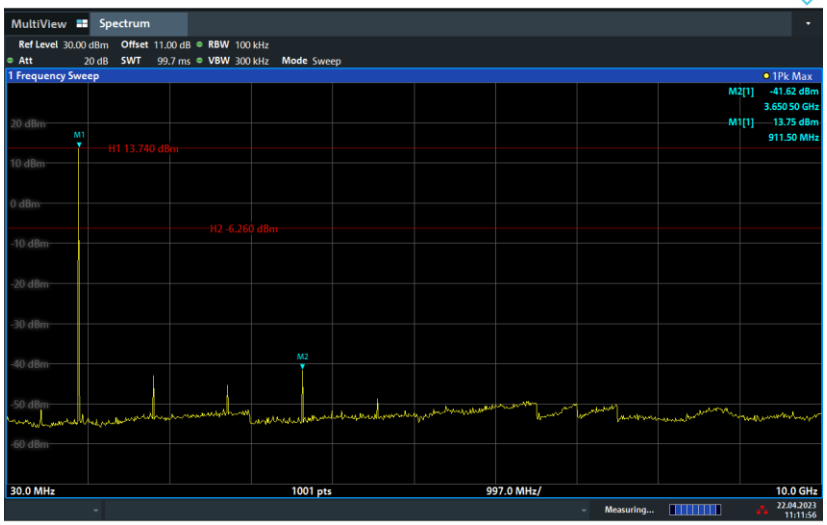
1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurious 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



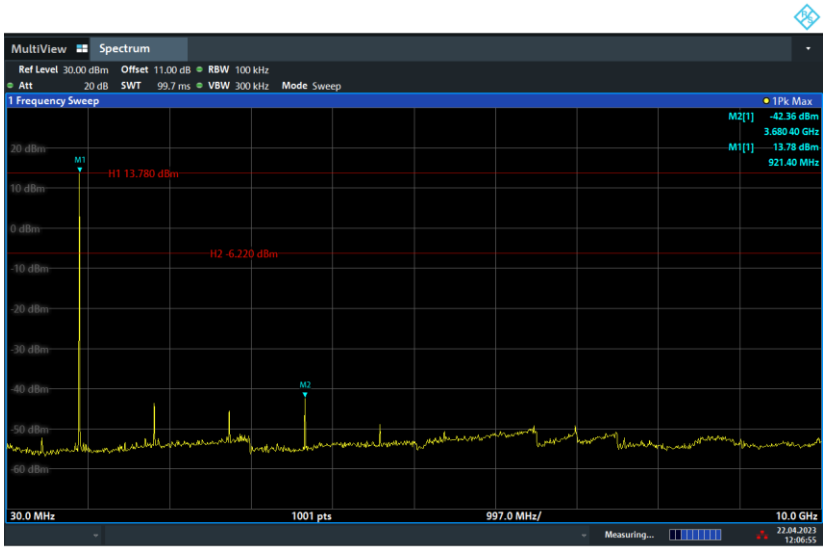
3.7.5 Test Result of Conducted Spurious Emission

CSE Plot on Channel 01



11:11:56 22.04.2023

CSE Plot on Channel 50



12:06:56 22.04.2023

3.8 Radiated Spurious Emission Measurement

3.8.1 Limit of Radiated 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

Please refer to the measuring equipment list in this test report.

3.8.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.12.2 Antenna-port conducted measurements.
2. Measure the conducted output power (in dBm) using the peak detector.
3. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP.
4. Add the appropriate maximum ground reflection factor to the EIRP (6 dB for frequencies ≤ 30 MHz; 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and 0 dB for frequencies > 1000 MHz).
5. Convert the resultant EIRP to an equivalent electric field strength using the following relationship:

   E = EIRP − 20 log d + 104.8,

   where

   E is the electric field strength in dBμV/m

   EIRP is the equivalent isotropically radiated power in dBm

   d is the specified measurement distance in 3m
6. Compare the resultant electric field strength level with the applicable regulatory limit.
7. Corrected Reading for conducted spurious emission: Antenna Factor + Cable Loss + Read Level = Level
8. Perform the cabinet radiated spurious emission test.
9. The EUT is 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.
10. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
11. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
12. Corrected Reading for cabinet radiated spurious emission: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
13. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-“.
14. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-“.

15. 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 ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;

(3) Set RBW = 1 MHz, VBW = 3 MHz for f ≥ 1 GHz for peak measurement.

(4) For RMS average measurement when 60 ms max TX_on time duty cycling mode: 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 N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

RMS Average Emission Level = Average Emission Level (reduced VBW) + 20*log (Duty cycle)

The maximum on time is 60 ms in the 100 ms period please refer to manufacture's Operational Description.

The RMS average levels are calculated from the average level (reduced VBW) corrected with duty cycle correction factor (-4.44 dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

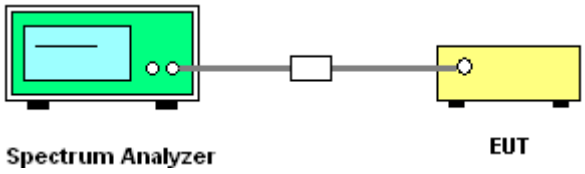
(5) For average measurement when no duty cycling mode:

• VBW = 10 Hz, when duty cycle is no less than 98 percent.

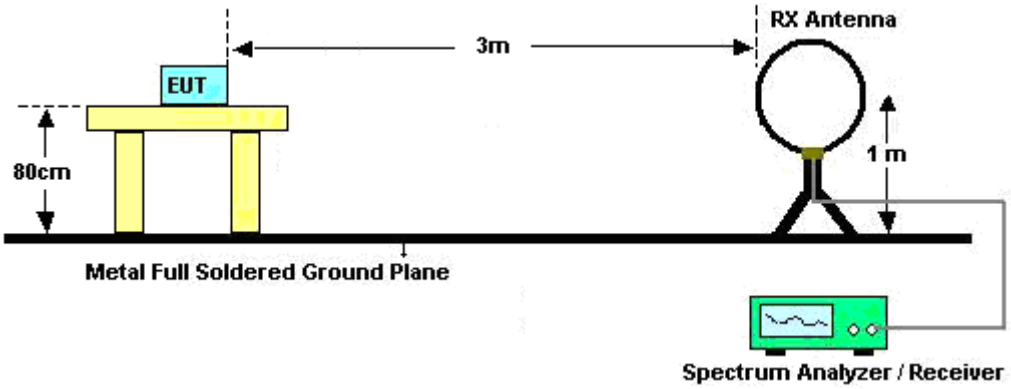
• VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.8.4 Test Setup

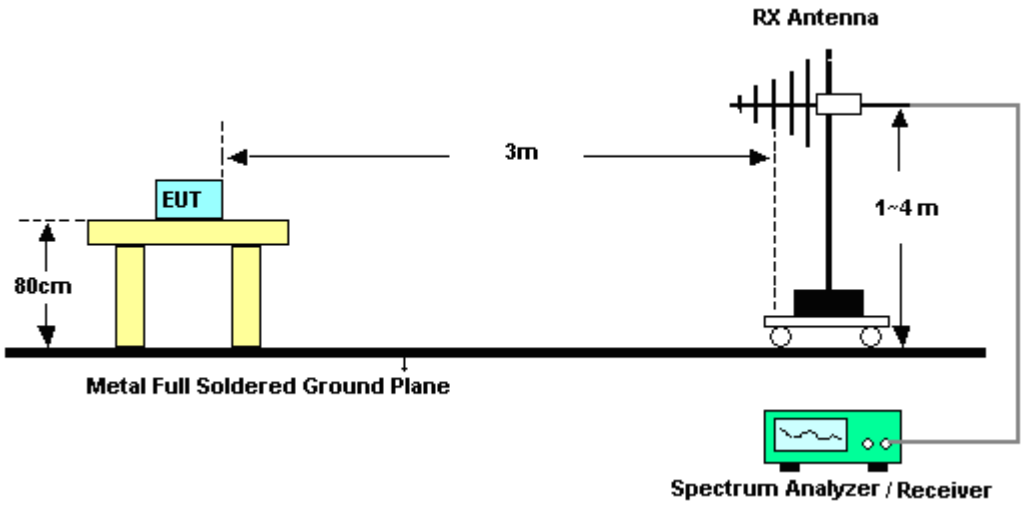
For antenna-port conducted measurement setup:



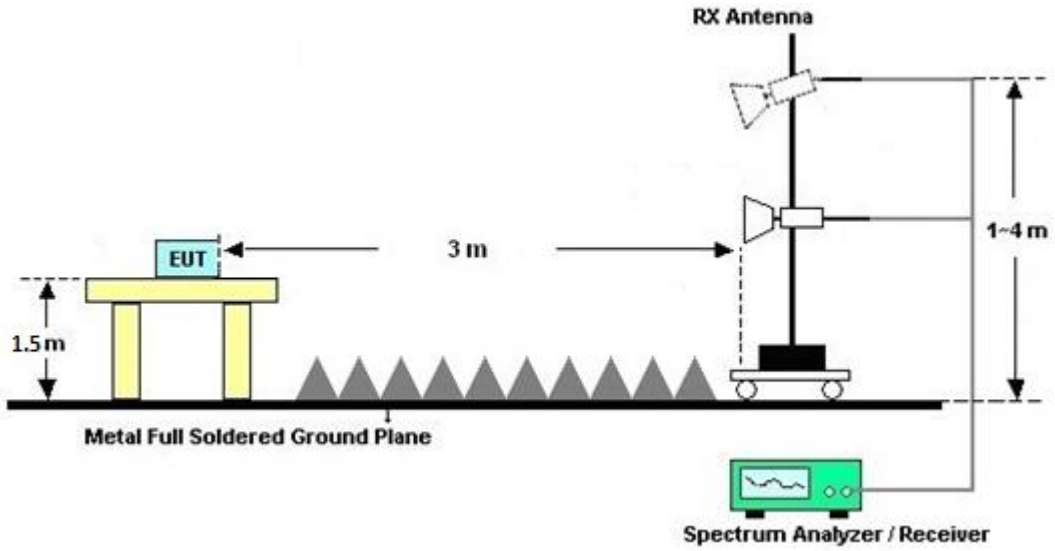
For radiated emissions below 30MHz



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 Conduced Spurious Emission in the Restricted Band (30 MHz ~ 10th Harmonic)

Please refer to Appendix C and D.

Test Result of Cabinet Radiated Spurious Emission in the Restricted Band (30 MHz ~ 10th Harmonic)

Please refer to Appendix E and F.

3.8.7 Duty Cycle

Please refer to Appendix G.

3.9 AC Conducted Emission Measurement

3.9.1 Limit of AC Conducted Emission

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

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

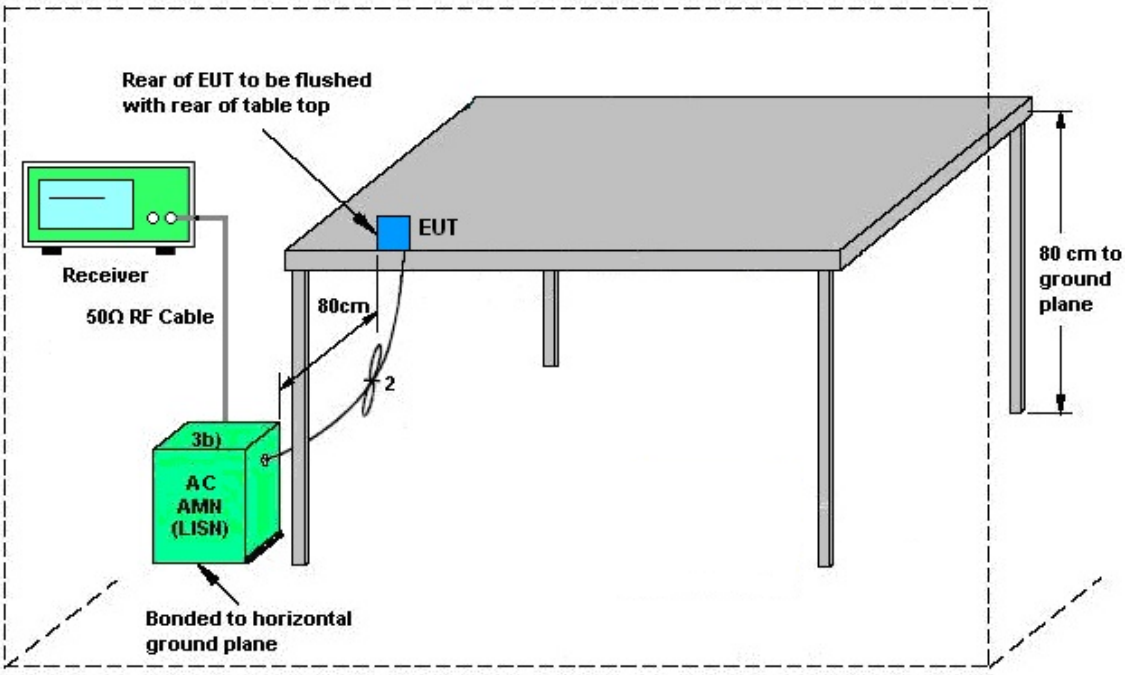
3.9.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.9.3 Test Procedures

16. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
17. Connect EUT to the power mains through a line impedance stabilization network (LISN).
18. All the support units are connecting to the other LISN.
19. The LISN provides 50 ohm coupling impedance for the measuring instrument.
20. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
21. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
22. The frequency range from 150 kHz to 30 MHz is scanned.
23. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.9.4 Test Setup



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

3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B

3.10 Antenna Requirements

3.10.1 Standard Applicable

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.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	Rohde & Schwarz	FSV3044	101104	10Hz~44GHz	Feb. 21, 2023	Mar. 22, 2023~ Jun. 08, 2023	Feb. 20, 2024	Conducted (TH05-HY)
Power Meter	Anritsu	ML2495A	0932001	N/A	Sep. 26, 2022	Mar. 22, 2023~ Jun. 08, 2023	Sep. 25, 2023	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	846202	300MHz~40GHz	Sep. 26, 2022	Mar. 22, 2023~ Jun. 08, 2023	Sep. 25, 2023	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Apr. 21, 2023	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Dec. 01, 2022	Apr. 21, 2023	Nov. 30, 2023	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 01, 2022	Apr. 21, 2023	Nov. 30, 2023	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 17, 2022	Apr. 21, 2023	Nov. 16, 2023	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32	N/A	N/A	N/A	Apr. 21, 2023	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	00691	N/A	Aug. 01, 2022	Apr. 21, 2023	Jul. 31, 2023	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 29, 2022	Apr. 21, 2023	Dec. 28, 2023	Conduction (CO05-HY)
Spectrum Analyzer	ROHDE & SCHWARZ	FSV40	101565	10Hz~40GHz	Dec. 26, 2022	May 03, 2023~ Jun. 13, 2023	Dec. 25, 2023	CSE (TH05-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30MHz~18GHz	Feb. 08, 2023	May 03, 2023~ Jun. 13, 2023	Feb. 07, 2024	CSE (TH05-HY)
Filter	Wainwright	WHKX12-900-10 00-15000-60SS	SN12	1GHz High Pass Filter	Sep. 12, 2022	May 03, 2023~ Jun. 13, 2023	Sep. 11, 2023	CSE (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Apr. 26, 2023~ Apr. 27, 2023	Sep. 19, 2023	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D & N-6-06	35414 & AT-N0602	30MHz~1GHz	Oct. 08, 2022	Apr. 26, 2023~ Apr. 27, 2023	Oct. 07, 2023	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-01620	1GHz~18GHz	Aug. 24, 2022	Apr. 26, 2023~ Apr. 27, 2023	Aug. 23, 2023	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Dec. 09, 2022	Apr. 26, 2023~ Apr. 27, 2023	Dec. 08, 2023	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 09, 2022	Apr. 26, 2023~ Apr. 27, 2023	Nov. 08, 2023	Radiation (03CH11-HY)
Preamplifier	Jet-Power	JPA0118-55-303	17100018000 55007	1GHz~18GHz	Jun. 15, 2022	Apr. 26, 2023~ Apr. 27, 2023	Jun. 14, 2023	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 07, 2022	Apr. 26, 2023~ Apr. 27, 2023	Oct. 06, 2023	Radiation (03CH11-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20MHz~8.4GHz	Oct. 18, 2022	Apr. 26, 2023~ Apr. 27, 2023	Oct. 17, 2023	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Apr. 26, 2023~ Apr. 27, 2023	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Apr. 26, 2023~ Apr. 27, 2023	N/A	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001053	N/A	N/A	Apr. 26, 2023~ Apr. 27, 2023	N/A	Radiation (03CH11-HY)

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz~40GHz	Mar. 07, 2023	Apr. 26, 2023~ Apr. 27, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	801595/2	30MHz~40GHz	Mar. 07, 2023	Apr. 26, 2023~ Apr. 27, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	803951/2	9K~30M	Mar. 07, 2023	Apr. 26, 2023~ Apr. 27, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	803951/2	30M~40G	Mar. 07, 2023	Apr. 26, 2023~ Apr. 27, 2023	Mar. 06, 2024	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000-1530-8000-40SS	SN11	1.53G Low Pass	Sep. 12, 2022	Apr. 26, 2023~ Apr. 27, 2023	Sep. 11, 2023	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-900-1000-15000-60SS	SN12	1GHz High Pass Filter	Sep. 12, 2022	Apr. 26, 2023~ Apr. 27, 2023	Sep. 11, 2023	Radiation (03CH11-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.5 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.3 dB

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.4 dB

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.8 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.3 dB

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Tommy Lee	Temperature:	21~25	°C
Test Date:	2023/4/22~2023/6/8	Relative Humidity:	50-56	%

<60 ms max Tx_on time duty cycling, 14 dBm and antenna gain 2.69 dBi>

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth

Operation Band	NTX	CH.	Freq. (MHz)	99% Bandwidth (kHz)	20dB BW (kHz)	20dB BW Limit (kHz)	Pass/Fail
902-928 MHz	1	1	912.75	94.664	103.700	< 500	Pass
902-928 MHz	1	50	919.12	96.744	104.300	< 500	Pass

TEST RESULTS DATA
Hopping Channel Separation

Operation Band	NTX	CH.	Hopping Channel Separation (kHz)	Hopping Channel Separation Limit (kHz)	Pass/Fail
902-928 MHz	1	1~2	132.420	> 103.700	Pass
902-928 MHz	1	49~50	130.220	> 104.300	Pass

TEST RESULTS DATA
Dwell Time

Operation Band	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Hopping	44.00	5.20	0.23	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
902-928 MHz	1	1	912.75	13.67	30.00	2.69	16.36	36.00	Pass
902-928 MHz	1	50	919.12	**13.68**	30.00	2.69	16.37	36.00	Pass

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	912.75	13.63	0.00
902-928 MHz	1	50	919.12	**13.64**	0.00

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
50	≧ 50	Pass

<No duty cycling, 12 dBm and antenna gain 2.69 dBi>

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
902-928 MHz	1	1	912.75	**10.17**	30.00	2.69	12.86	36.00	Pass
902-928 MHz	1	50	919.12	10.12	30.00	2.69	12.81	36.00	Pass

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	912.75	**10.09**	0.00
902-928 MHz	1	50	919.12	10.04	0.00

<No duty cycling, 12.5 dBm and antenna gain 2 dBi>

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
902-928 MHz	1	1	912.75	**11.54**	30.00	2.00	13.54	36.00	Pass
902-928 MHz	1	50	919.12	11.52	30.00	2.00	13.52	36.00	Pass

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	912.75	**11.49**	0.00
902-928 MHz	1	50	919.12	11.46	0.00

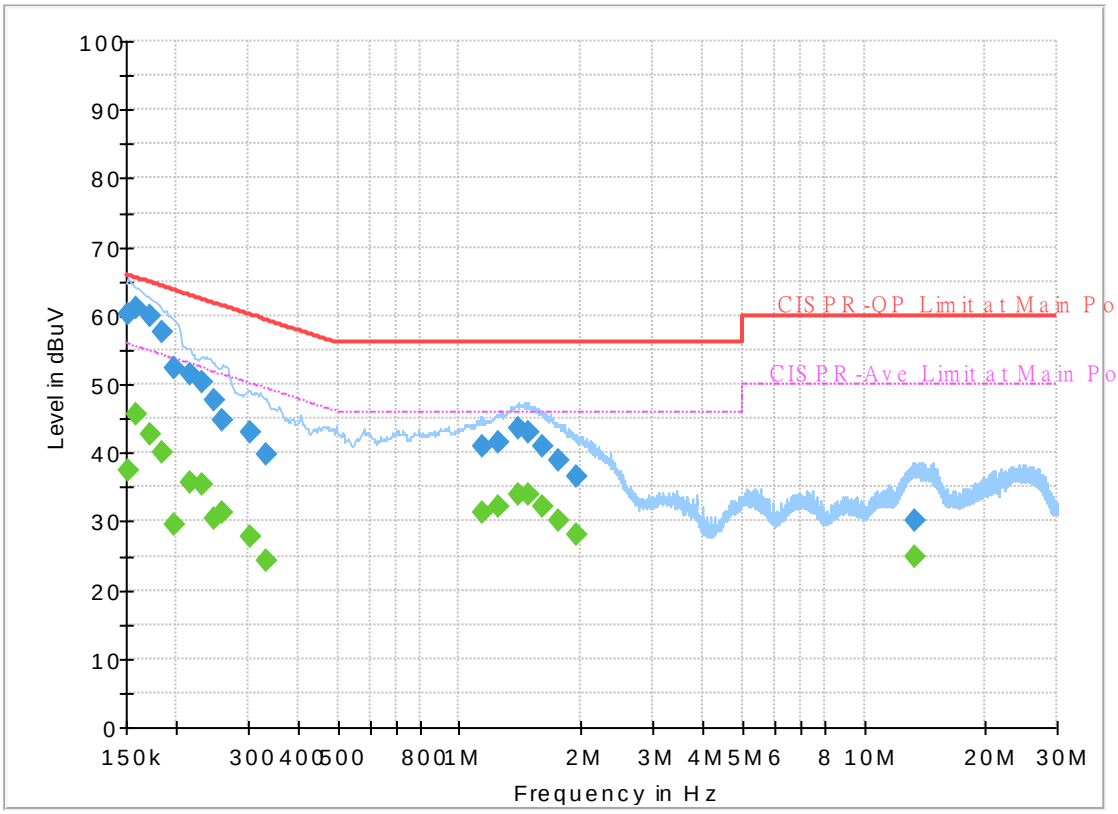
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Calvin Wang	**Temperature :**	23~26℃
		Relative Humidity :	45~55%

EUT Information

Report NO :	341305
Test Mode :	Mode 1
Test Voltage :	Power From System
Phase :	Line

Full Spectrum



Final_Result

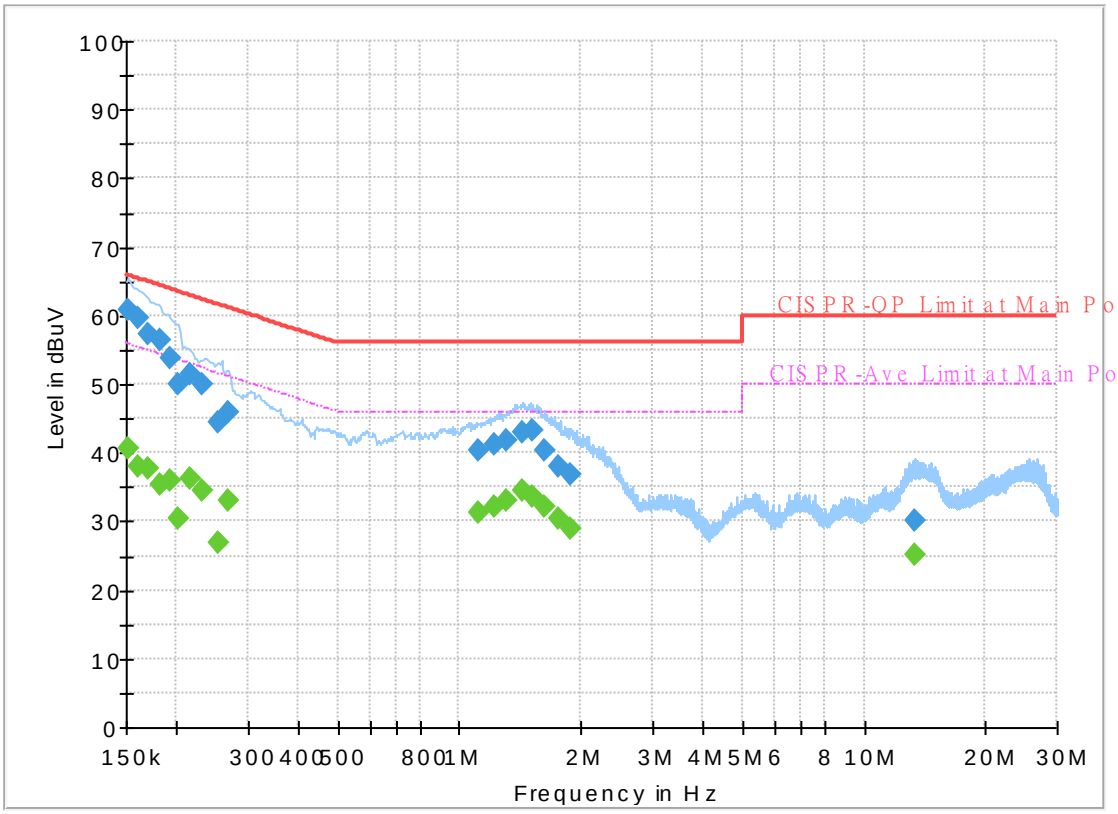
Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	37.52	55.88	18.36	L1	OFF	19.8
0.152250	60.16	---	65.88	5.72	L1	OFF	19.8
0.159000	---	45.48	55.52	10.04	L1	OFF	19.8
0.159000	61.14	---	65.52	4.38	L1	OFF	19.8
0.172500	---	42.66	54.84	12.18	L1	OFF	19.8
0.172500	59.90	---	64.84	4.94	L1	OFF	19.8
0.183750	---	40.09	54.31	14.22	L1	OFF	19.8
0.183750	57.74	---	64.31	6.57	L1	OFF	19.8
0.197250	---	29.64	53.73	24.09	L1	OFF	19.8
0.197250	52.41	---	63.73	11.32	L1	OFF	19.8
0.215250	---	35.71	53.00	17.29	L1	OFF	19.8
0.215250	51.41	---	63.00	11.59	L1	OFF	19.8
0.231000	---	35.47	52.41	16.94	L1	OFF	19.8
0.231000	50.20	---	62.41	12.21	L1	OFF	19.8
0.246750	---	30.51	51.87	21.36	L1	OFF	19.8
0.246750	47.72	---	61.87	14.15	L1	OFF	19.8
0.260250	---	31.36	51.42	20.06	L1	OFF	19.8
0.260250	44.85	---	61.42	16.57	L1	OFF	19.8
0.305250	---	27.70	50.10	22.40	L1	OFF	19.8
0.305250	42.98	---	60.10	17.12	L1	OFF	19.8
0.334500	---	24.22	49.34	25.12	L1	OFF	19.8

0.334500	39.73	---	59.34	19.61	L1	OFF	19.8
1.144500	---	31.43	46.00	14.57	L1	OFF	19.8
1.144500	40.81	---	56.00	15.19	L1	OFF	19.8
1.252500	---	32.27	46.00	13.73	L1	OFF	19.8
1.252500	41.59	---	56.00	14.41	L1	OFF	19.8
1.394250	---	34.06	46.00	11.94	L1	OFF	19.8
1.394250	43.43	---	56.00	12.57	L1	OFF	19.8
1.482000	---	33.96	46.00	12.04	L1	OFF	19.8
1.482000	42.96	---	56.00	13.04	L1	OFF	19.8
1.608000	---	32.14	46.00	13.86	L1	OFF	19.8
1.608000	41.02	---	56.00	14.98	L1	OFF	19.8
1.761000	---	30.14	46.00	15.86	L1	OFF	19.8
1.761000	38.98	---	56.00	17.02	L1	OFF	19.8
1.947750	---	28.13	46.00	17.87	L1	OFF	19.8
1.947750	36.46	---	56.00	19.54	L1	OFF	19.8
13.301250	---	24.85	50.00	25.15	L1	OFF	20.0
13.301250	30.11	---	60.00	29.89	L1	OFF	20.0

EUT Information

Report NO :	341305
Test Mode :	Mode 1
Test Voltage :	Power From System
Phase :	Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.152250	---	40.54	55.88	15.34	N	OFF	19.8
0.152250	60.85	---	65.88	5.03	N	OFF	19.8
0.161250	---	37.97	55.40	17.43	N	OFF	19.8
0.161250	59.64	---	65.40	5.76	N	OFF	19.8
0.170250	---	37.67	54.95	17.28	N	OFF	19.8
0.170250	57.37	---	64.95	7.58	N	OFF	19.8
0.181500	---	35.49	54.42	18.93	N	OFF	19.8
0.181500	56.30	---	64.42	8.12	N	OFF	19.8
0.192750	---	35.97	53.92	17.95	N	OFF	19.8
0.192750	53.77	---	63.92	10.15	N	OFF	19.8
0.201750	---	30.55	53.54	22.99	N	OFF	19.8
0.201750	49.96	---	63.54	13.58	N	OFF	19.8
0.215250	---	36.22	53.00	16.78	N	OFF	19.8
0.215250	51.47	---	63.00	11.53	N	OFF	19.8
0.231000	---	34.50	52.41	17.91	N	OFF	19.8
0.231000	50.01	---	62.41	12.40	N	OFF	19.8
0.253500	---	27.03	51.64	24.61	N	OFF	19.8
0.253500	44.41	---	61.64	17.23	N	OFF	19.8
0.269250	---	32.98	51.14	18.16	N	OFF	19.8
0.269250	45.78	---	61.14	15.36	N	OFF	19.8
1.110750	---	31.17	46.00	14.83	N	OFF	19.8

1.110750	40.50	---	56.00	15.50	N	OFF	19.8
1.214250	---	32.24	46.00	13.76	N	OFF	19.8
1.214250	41.33	---	56.00	14.67	N	OFF	19.8
1.304250	---	33.09	46.00	12.91	N	OFF	19.8
1.304250	41.94	---	56.00	14.06	N	OFF	19.8
1.428000	---	34.46	46.00	11.54	N	OFF	19.8
1.428000	43.02	---	56.00	12.98	N	OFF	19.8
1.509000	---	33.75	46.00	12.25	N	OFF	19.8
1.509000	43.14	---	56.00	12.86	N	OFF	19.8
1.621500	---	32.30	46.00	13.70	N	OFF	19.8
1.621500	40.45	---	56.00	15.55	N	OFF	19.8
1.756500	---	30.31	46.00	15.69	N	OFF	19.8
1.756500	38.00	---	56.00	18.00	N	OFF	19.8
1.882500	---	28.96	46.00	17.04	N	OFF	19.8
1.882500	36.81	---	56.00	19.19	N	OFF	19.8
13.400250	---	25.11	50.00	24.89	N	OFF	20.1
13.400250	30.17	---	60.00	29.83	N	OFF	20.1

Appendix C. Conducted Spurious Emission

Test Engineer :	Kai Liao	**Temperature :**	20.1~24.5°C
		Relative Humidity :	54.3~66.1%

<60 ms max Tx_on time duty cycling, 14 dBm and antenna gain 2.69 dBi>

902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

Mode	Note	Frequency (MHz)	Level (dBm)	Over Limit (dB)	Limit Line (dBm)	Read Level (dBm)	Antenna Factor (dBi)	Path Loss (dB)	MIMO Factor (dB)	Grounding Factor (dB)	Peak QP. (P/Q)
CH 01 912.75 MHz		32.97	-69.03	-13.83	-55.2	-76.57	2.69	0.15	0	4.7	P
		187.14	-71.12	-19.42	-51.7	-78.8	2.69	0.29	0	4.7	P
		248.16	-70.1	-20.9	-49.2	-77.84	2.69	0.35	0	4.7	P
		456.1	-50.37	-1.17	-49.2	-58.28	2.69	0.52	0	4.7	P
		720.7	-60.43	-11.23	-49.2	-68.51	2.69	0.69	0	4.7	P
		770.4	-56.84	-7.64	-49.2	-65.01	2.69	0.78	0	4.7	P
		864.9	-56.46	-7.26	-49.2	-64.66	2.69	0.81	0	4.7	P
	*	912.75	17.87	-	-	9.59	2.69	0.89	0	4.7	P
		960.8	-53.76	-12.56	-41.2	-62.09	2.69	0.94	0	4.7	P
CH 50 919.12 MHz		32.7	-69.76	-14.56	-55.2	-77.3	2.69	0.15	0	4.7	P
		204.15	-69.94	-18.24	-51.7	-77.7	2.69	0.37	0	4.7	P
		282.72	-69.97	-20.77	-49.2	-77.77	2.69	0.41	0	4.7	P
		459.6	-50.43	-1.23	-49.2	-58.33	2.69	0.51	0	4.7	P
		775.3	-55.64	-6.44	-49.2	-63.81	2.69	0.78	0	4.7	P
		871.2	-52.13	-2.93	-49.2	-60.33	2.69	0.81	0	4.7	P
		906.9	-50.77	-1.57	-49.2	-59.05	2.69	0.89	0	4.7	P
	*	919.12	21.18	-	-	12.85	2.69	0.94	0	4.7	P
		955.2	-56.51	-7.31	-49.2	-64.82	2.69	0.92	0	4.7	P
		967.1	-51.74	-10.54	-41.2	-60.07	2.69	0.94	0	4.7	P
Remark	1. No other spurious found. 2. All results are PASS against limit line.										

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	MIMO	Grounding	Peak
				Limit	Line	Level	Gain	Loss	Factor	Factor	Avg.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/A)
CH 01 912.75 MHz		1369	-53.34	-32.14	-21.2	-57.33	2.69	1.3	0	0	P
		1825.5	-41.45	-20.25	-21.2	-45.19	2.69	1.05	0	0	P
		2738.25	-47.92	-26.72	-21.2	-51.67	2.69	1.06	0	0	P
		3651	-32.64	-11.44	-21.2	-36.49	2.69	1.16	0	0	P
		3651	-41.78	-0.58	-41.2	-45.6300	2.69	1.16	0	0	A
		4564	-48.27	-27.07	-21.2	-52.19	2.69	1.23	0	0	P
		7309	-63.95	-42.75	-21.2	-68.32	2.69	1.68	0	0	P
		8218	-63.09	-41.89	-21.2	-67.39	2.69	1.61	0	0	P
		9127	-63.65	-42.45	-21.2	-68.19	2.69	1.85	0	0	P
CH 50 919.12 MHz		1063	-58.2	-37	-21.2	-62.46	2.69	1.57	0	0	P
		1378	-54.5	-33.3	-21.2	-58.49	2.69	1.3	0	0	P
		1838.24	-49.03	-27.83	-21.2	-52.76	2.69	1.04	0	0	P
		2757.36	-42.43	-21.23	-21.2	-46.21	2.69	1.09	0	0	P
		3676.48	-37.7	-16.5	-21.2	-41.56	2.69	1.17	0	0	P
		3676.48	-45.91	-4.71	-41.2	-49.77	2.69	1.17	0	0	A
		4600	-44.79	-23.59	-21.2	-48.68	2.69	1.2	0	0	P
		5518	-59.67	-38.47	-21.2	-63.82	2.69	1.46	0	0	P
		6436	-50.56	-29.36	-21.2	-54.52	2.69	1.27	0	0	P
		8272	-60.43	-39.23	-21.2	-64.76	2.69	1.64	0	0	P
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.										

<No duty cycling, 12 dBm and antenna gain 2.69 dBi>

902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

Mode	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	MIMO Factor	Grounding Factor	Peak QP.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/Q)
CH 01 912.75 MHz		32.97	-69.03	-13.83	-55.2	-76.57	2.69	0.15	0	4.7	P
		187.14	-71.12	-19.42	-51.7	-78.8	2.69	0.29	0	4.7	P
		248.16	-70.1	-20.9	-49.2	-77.84	2.69	0.35	0	4.7	P
		456.1	-50.37	-1.17	-49.2	-58.28	2.69	0.52	0	4.7	P
		720.7	-60.43	-11.23	-49.2	-68.51	2.69	0.69	0	4.7	P
		770.4	-56.84	-7.64	-49.2	-65.01	2.69	0.78	0	4.7	P
		864.9	-56.46	-7.26	-49.2	-64.66	2.69	0.81	0	4.7	P
	*	912.75	17.87	-	-	9.59	2.69	0.89	0	4.7	P
		960.8	-53.76	-12.56	-41.2	-62.09	2.69	0.94	0	4.7	P
Remark	1. No other spurious found. 2. All results are PASS against limit line.										

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	MIMO	Grounding	Peak
				Limit	Line	Level	Gain	Loss	Factor	Factor	Avg.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/A)
CH 01 912.75 MHz		1369	-57.02	-35.82	-21.2	-61.01	2.69	1.3	0	0	P
		2738.25	-53.55	-32.35	-21.2	-57.3	2.69	1.06	0	0	P
		3651	-39.82	-18.62	-21.2	-43.67	2.69	1.16	0	0	P
		3651	-44.62	-3.42	-41.2	-48.47	2.69	1.16	0	0	A
		4564	-53.27	-32.07	-21.2	-57.19	2.69	1.23	0	0	P
		7309	-60.76	-39.56	-21.2	-65.13	2.69	1.68	0	0	P
		8218	-69.85	-48.65	-21.2	-74.15	2.69	1.61	0	0	P
		9127	-68.5	-47.3	-21.2	-73.04	2.69	1.85	0	0	P
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.										

<No duty cycling, 12.5 dBm and antenna gain 2 dBi>

902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

Mode	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	MIMO Factor	Grounding Factor	Peak QP.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/Q)
CH 01 912.75 MHz		33.24	-69.57	-14.37	-55.2	-76.42	33.24	-69.57	0	4.7	P
		210.36	-69.85	-18.15	-51.7	-76.92	210.36	-69.85	0	4.7	P
		287.04	-68.42	-19.22	-49.2	-75.53	287.04	-68.42	0	4.7	P
		456.1	-50.47	-1.27	-49.2	-57.69	456.1	-50.47	0	4.7	P
		720.7	-62.19	-12.99	-49.2	-69.58	720.7	-62.19	0	4.7	P
		770.4	-57.36	-8.16	-49.2	-64.84	770.4	-57.36	0	4.7	P
		864.9	-56.8	-7.6	-49.2	-64.31	864.9	-56.8	0	4.7	P
	*	912.75	17.68	-	-	10.09	912.75	17.68	0	4.7	P
		960.8	-55.38	-14.18	-41.2	-63.02	960.8	-55.38	0	4.7	P
Remark	1. No other spurious found. 2. All results are PASS against limit line.										

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz)

Mode	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	MIMO	Grounding	Peak
				Limit	Line	Level	Gain	Loss	Factor	Factor	Avg.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/A)
CH 01 912.75 MHz		1369	-56.34	-35.14	-21.2	-59.64	2	1.3	0	0	P
		2738.25	-52.23	-31.03	-21.2	-55.29	2	1.06	0	0	P
		3651	-36.48	-15.28	-21.2	-39.64	2	1.16	0	0	P
		3651	-41.3	-0.1	-41.2	-44.46	2	1.16	0	0	A
		4564	-53.8	-32.6	-21.2	-57.03	2	1.23	0	0	P
		7309	-64.16	-42.96	-21.2	-67.84	2	1.68	0	0	P
		8218	-70.15	-48.95	-21.2	-73.76	2	1.61	0	0	P
		9127	-68.07	-46.87	-21.2	-71.92	2	1.85	0	0	P

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.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

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

	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	MIMO	Grounding	Peak
				Limit	Line	Level	Factor	Loss	Factor	Factor	Avg.
		(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dBi)	(dB)	(dB)	(dB)	(P/A)
CH 01 912.75 MHz		1825.5	-38.76	-17.56	-21.2	-42.5	2.69	1.05	0	0	P
		1825.5	-42.33	-1.13	-41.2	-46.07	2.69	1.05	0	0	A

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBm) =

Antenna Factor(dBi) + Path Loss(dB) + Read Level(dBm)

3. Over Limit(dB) = Level(dBm) – Limit Line(dBm)

For Peak Limit @ 1825.5 MHz:

1. Level(dBm)

= Antenna Factor(dBi) + Path Loss(dB) + Read Level(dBm)

= 2.69(dBi) + 1.05(dB) – 42.5(dBm)

= -38.76 (dBm)

2. Over Limit(dB)

= Level(dBm) – Limit Line(dBm)

= -38.76(dBm) +21.2(dBm)

= -17.56(dB)

For Average Limit @ 1825.5MHz:

1. Level(dBm)

= Antenna Factor(dBi) + Path Loss(dB) + Read Level(dBm)

= 2.69(dBi) + 1.05(dB) – 46.07(dBm)

= -42.33 (dBm)

2. Over Limit(dB)

= Level(dBm) – Limit Line(dBm)

= -42.33(dBm) + 41.2(dBm)

= -1.13(dB)

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

Appendix D. Conducted Spurious Emission Plots

Test Engineer :	Kai Liao	**Temperature :**	20.1~24.5°C
		Relative Humidity :	54.3~66.1%

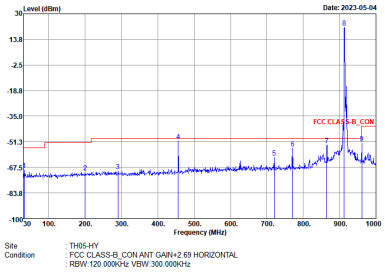
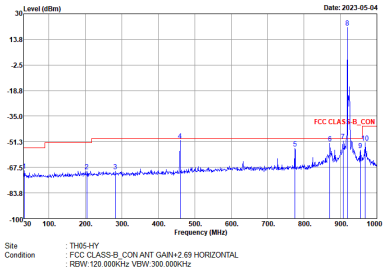
Note symbol

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

<60 ms max Tx_on time duty cycling, 14 dBm and antenna gain 2.69 dBi>

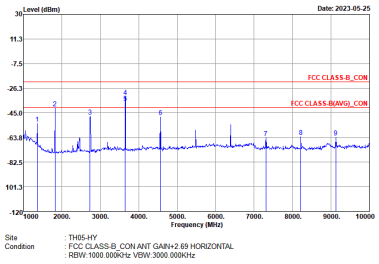
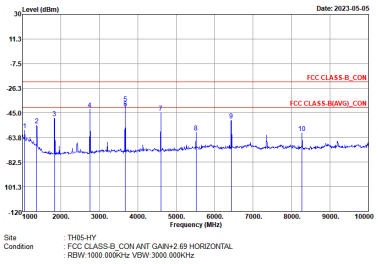
902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	CH50 919.12 MHz
Peak/ QP		

902 MHz ~ 928 MHz

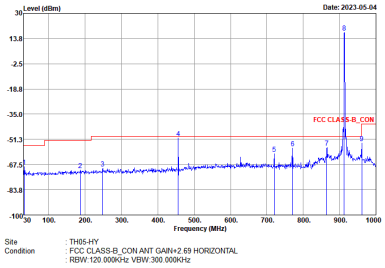
(1 GHz ~ 10 GHz)

	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	CH50 919.12 MHz
Peak Avg.		

<No duty cycling, 12 dBm and antenna gain 2.69 dBi>

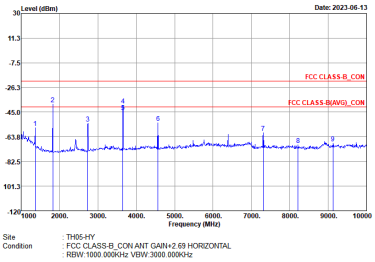
902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	
Peak/ QP		

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz)

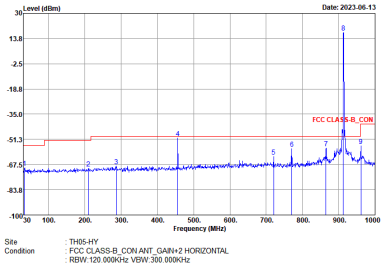
	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	
Peak Avg.		

Remark: The unwanted signal of 2nd Harmonic in plot falls within the non-restricted band and meet the requirements of 15.247 (d).

<No duty cycling, 12.5 dBm and antenna gain 2 dBi>

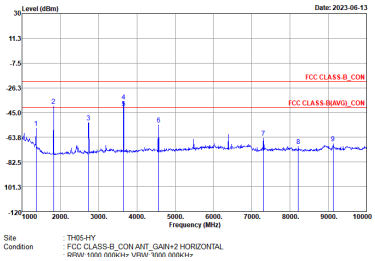
902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz)

	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	
Peak/ QP		

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz)

	902 MHz ~ 928 MHz	
	CH01 912.75 MHz	
Peak Avg.		

Remark: The unwanted signal of 2nd Harmonic in plot falls within the non-restricted band and meet the requirements of 15.247 (d).

Appendix E. Cabinet Radiated Spurious Emission

Test Engineer :	Yuan Lee and Fu Chen	**Temperature :**	20~22.4°C
		Relative Humidity :	57~68.6%

<14 dBm>

902 MHz ~ 928 MHz

(30 MHz ~ 1 GHz @ 3m)

Mode	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path 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)
		108.3	30.39	-13.11	43.5	44.3	16.57	1.66	32.14	-	-	P	H
		192	31.9	-11.6	43.5	47.3	14.53	2.14	32.07	-	-	P	H
		289.47	30.11	-15.89	46	40.64	18.89	2.59	32.01	-	-	P	H
		313.3	29.64	-16.36	46	39.68	19.27	2.69	32	-	-	P	H
		719.3	31.31	-14.69	46	32.61	26.62	4.09	32.01	-	-	P	H
	*	912.75	67.27	-	-	65.33	28.61	4.46	31.13	100	44	P	H
		958.7	34	-12	46	29.4	30.62	4.69	30.71	-	-	P	H
													H
CH01													H
912.75MHz		57.81	33.75	-6.25	40	53.04	11.7	1.25	32.24	-	-	P	V
		120.45	29.96	-13.54	43.5	43.04	17.28	1.8	32.16	-	-	P	V
		193.08	29.59	-13.91	43.5	44.95	14.56	2.15	32.07	-	-	P	V
		633.9	28.98	-17.02	46	31.06	26.08	3.85	32.01	-	-	P	V
		861.4	32.61	-13.39	46	31	28.74	4.39	31.52	-	-	P	V
	*	912.75	56.81	-	-	54.87	28.61	4.46	31.13	100	303	P	V
		932.8	33.61	-12.39	46	30.72	29.28	4.56	30.95	-	-	P	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. Non restricted band limit is radio frequency level down 20dB

Mode	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		96.42	28.89	-14.61	43.5	44.05	15.41	1.56	32.13	-	-	P	H
		159.06	29.28	-14.22	43.5	43.05	16.29	2.03	32.09	-	-	P	H
		289.2	29.64	-16.36	46	40.17	18.89	2.59	32.01	-	-	P	H
		312.6	29.06	-16.94	46	39.11	19.26	2.69	32	-	-	P	H
		877.5	31.52	-14.48	46	29.97	28.56	4.39	31.4	-	-	P	H
	*	919.12	67.15	-	-	65.03	28.7	4.49	31.07	100	45	P	H
		951	33.63	-12.37	46	29.53	30.23	4.66	30.79	-	-	P	H
CH50												P	H
919.12MHz		36.21	33.55	-6.45	40	43.66	21.13	0.96	32.2	-	-	P	V
		53.49	30.04	-9.96	40	48.5	12.58	1.21	32.25	-	-	P	V
		122.07	28.81	-14.69	43.5	41.84	17.33	1.8	32.16	-	-	P	V
		564.6	26.94	-19.06	46	29.55	25.75	3.64	32	-	-	P	V
		739.6	30.09	-15.91	46	30.32	27.5	4.15	31.88	-	-	P	V
	*	919.12	56.34	-	-	54.22	28.7	4.49	31.07	100	302	P	V
		939.8	33.64	-12.36	46	30.33	29.59	4.61	30.89	-	-	P	V
												P	V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.
3. Non restricted band limit is radio frequency level down 20db

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz @ 3m)

Mode	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		2738.25	36.63	-37.37	74	59.75	28.48	8.76	60.36	-	-	P	H
		3651	38.18	-35.82	74	56.92	29.8	10.27	58.81	-	-	P	H
													H
													H
													H
													H
													H
CH01													H
912.75MHz		2738.25	36.9	-37.1	74	60.02	28.48	8.76	60.36	-	-	P	V
		3651	37.76	-36.24	74	56.5	29.8	10.27	58.81	-	-	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. Non restricted band limit is radio frequency level down 20db												

Mode	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		2757.36	36.84	-37.16	74	59.89	28.51	8.78	60.34	-	-	P	H
		3676.48	39.06	-34.94	74	57.7	29.85	10.26	58.75	-	-	P	H
													H
													H
													H
													H
													H
CH50													H
919.12MHz		2757.36	37.42	-36.58	74	60.47	28.51	8.78	60.34	-	-	P	V
		3676.48	39.8	-34.2	74	58.44	29.85	10.26	58.75	-	-	P	V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.
3. Non restricted band limit is radio frequency level down 20db

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.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

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

Mode	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
					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)
CH 01 2402MHz		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Margin(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

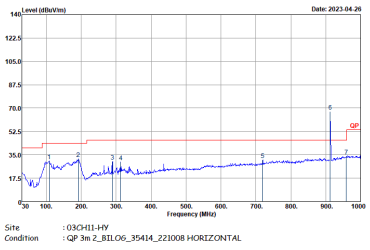
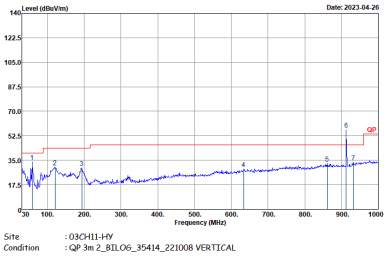
Both peak and average measured complies with the limit line, so test result is "PASS".

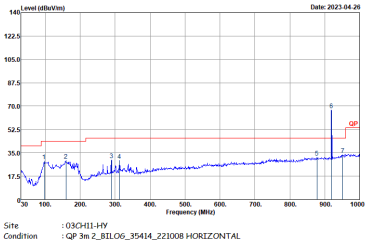
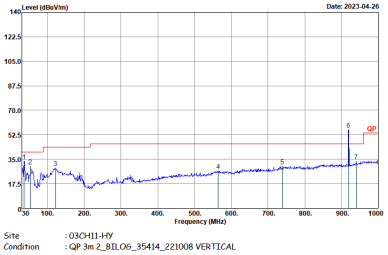
Appendix F. Cabinet Radiated Spurious Emission Plots

<14 dBm>

902 MHz ~ 928 MHz

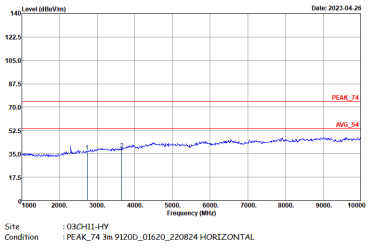
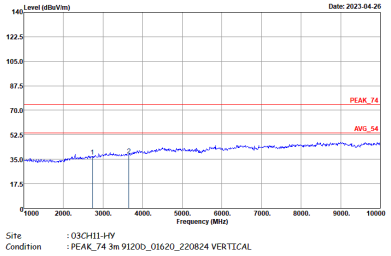
(30 MHz ~ 1 GHz @ 3m)

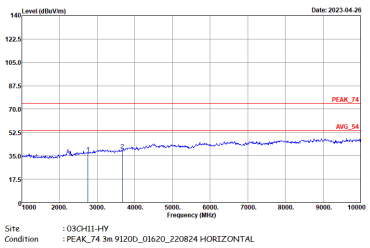
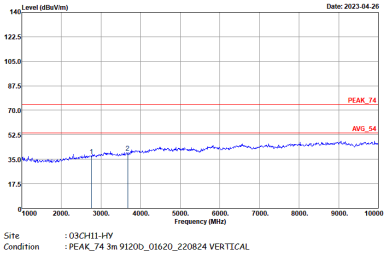
	CH01 912.75 MHz	
	Horizontal	**Vertical**
Peak / QP		

	CH50 919.12 MHz	
	Horizontal	Vertical
Peak / QP		

902 MHz ~ 928 MHz

(1 GHz ~ 10 GHz @ 3m)

	CH01 912.75 MHz	
	Horizontal	Vertical
Peak Avg.		

	CH50 919.12 MHz	
	Horizontal	Vertical
Peak Avg.		

Appendix E. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
Sub 1 GHz	100.00	-	-	10Hz

Sub 1 GHz