FCC RADIO TEST REPORT

FCC ID	:	**2A2SECAG-0100**
Equipment	:	**Communication Appliance**
Brand Name	:	**CASWELL**
Model Name	:	**CAG-0100xxxxxxxxx, CAP-0100xxxxxxxxx (x can be 0-9, A-Z, a-z, "-" or blank)**
Marketing Name	:	**Coordinator**
Applicant	:	**CASWELL, INC.** **8 F, No. 242, Bo-Ai St., Shu-Lin Dist., New Taipei City 23845, Taiwan**
Manufacturer	:	**CASWELL, INC.** **8 F, No. 242, Bo-Ai St., Shu-Lin Dist., New Taipei City 23845, Taiwan**
Standard	:	**FCC Part 15 Subpart C §15.247**

The product was received on Jun. 17, 2021 and testing was started from Aug. 12, 2021 and completed on Sep. 02, 2021. 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 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 333, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR161721	01	Initial issue of report	Nov. 03, 2021

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	Under limit 3.37 dB at 2782.800 MHz
3.6	15.207	AC Conducted Emission	Pass	Under limit 10.36 dB at 0.501MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

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: Keven Cheng

Report Producer: Celery Wei

1 General Description

1.1 Product Feature of Equipment Under Test

UHF RFID

Product Specification subjective to this standard	
Sample 1	CAG-0100-8102
Sample 2	CAP-0100-8101
Antenna Type	UHF RFID: PCB Antenna
Antenna Gain	3.06 dBi

Remark:

1. Please refer to PED for the sample differences between the two models.
2. The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations 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.**		
	TH02-HY	CO05-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 Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. 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

Frequency Band	Freq. (MHz)				
902-928 MHz	902.4	907.8	913.2	918.6	924
	902.6	908	913.4	918.8	924.2
	902.8	908.2	913.6	919	924.4
	903	908.4	913.8	919.2	924.6
	903.2	908.6	914	919.4	924.8
	903.4	908.8	914.2	919.6	925
	903.6	909	914.4	919.8	925.2
	903.8	909.2	914.6	920	925.4
	904	909.4	914.8	920.2	925.6
	904.2	909.6	915	920.4	925.8
	904.4	909.8	915.2	920.6	926
	904.6	910	915.4	920.8	926.2
	904.8	910.2	915.6	921	926.4
	905	910.4	915.8	921.2	926.6
	905.2	910.6	916	921.4	926.8
	905.4	910.8	916.2	921.6	927
	905.6	911	916.4	921.8	927.2
	905.8	911.2	916.6	922	927.4
	906	911.4	916.8	922.2	927.6
	906.2	911.6	917	922.4	
	906.4	911.8	917.2	922.6	
	906.6	912	917.4	922.8	
	906.8	912.2	917.6	923	
	907	912.4	917.8	923.2	
	907.2	912.6	918	923.4	
	907.4	912.8	918.2	923.6	
	907.6	913	918.4	923.8	

2.2 Test Mode

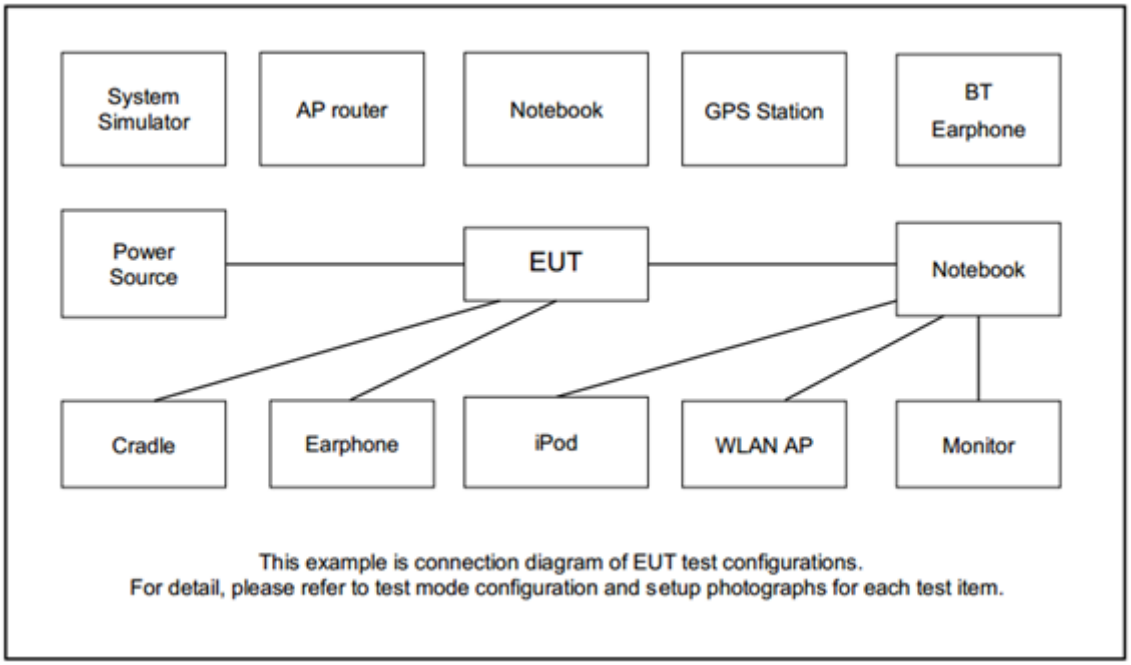
a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental 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 find Y plane as worst plane.

b. AC power line Conducted Emission was tested under maximum output power.

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

Summary table of Test Cases	
Test Item	**UHF RFID**
Conducted Test Cases	Mode 1: UHF RFID Tx _902.40 MHz Mode 2: UHF RFID Tx _915.00 MHz Mode 3: UHF RFID Tx _927.60 MHz
Radiated Test Cases	Mode 1: UHF RFID Tx _902.40 MHz Mode 2: UHF RFID Tx _915.00 MHz Mode 3: UHF RFID Tx _927.60 MHz
AC Conducted Emission	Mode 1: RFID Tx + LAN Link + USB Cable (Charging from AC Adapter)
Remark: All the tests were performed with Sample 1.	

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.	Notebook	Dell	Latitude 3400	FCC DoC	N/A	AC I/P：Unshielded, 1.2m DC O/P：Shielded, 1.8m
2.	Adapter	DVE	DSA-5PFM-05 FUS 050100	FCC DoC	N/A	N/A
3.	Notebook	Dell	E3340	FCC DoC	N/A	AC I/P：Unshielded, 1.2m DC O/P：Shielded, 1.8m
4.	POE switch	N/A	N/A	N/A	N/A	N/A
5.	USB Cable	CABLING MANUFACTURING INC.	M-3105	N/A	D-shielded, 201 cm	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “Coordinator Control 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.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

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

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

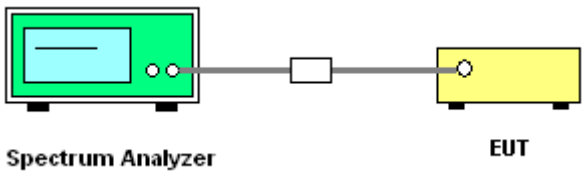
3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

3.1.3 Test Procedures

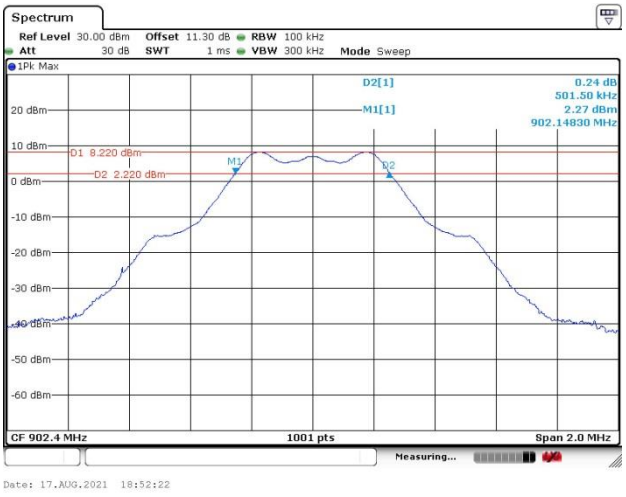
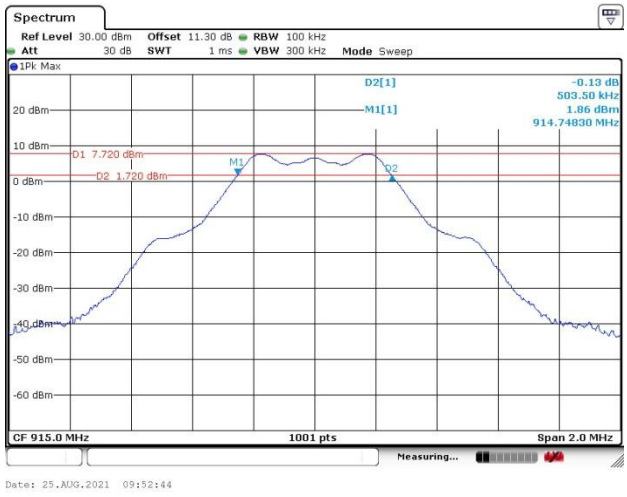
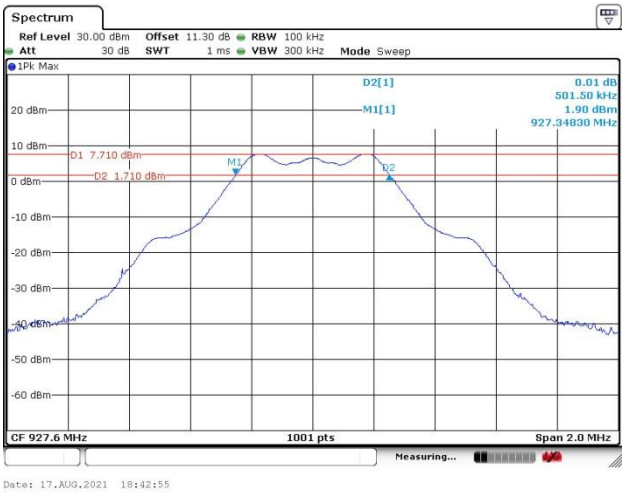
1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
6. Measure and record the results in the test report.

3.1.4 Test Setup



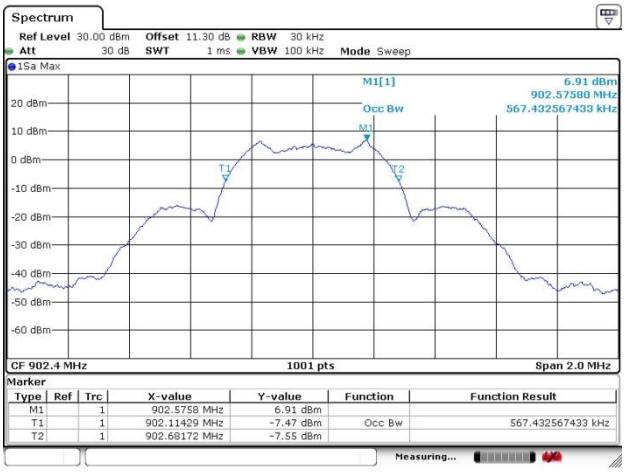
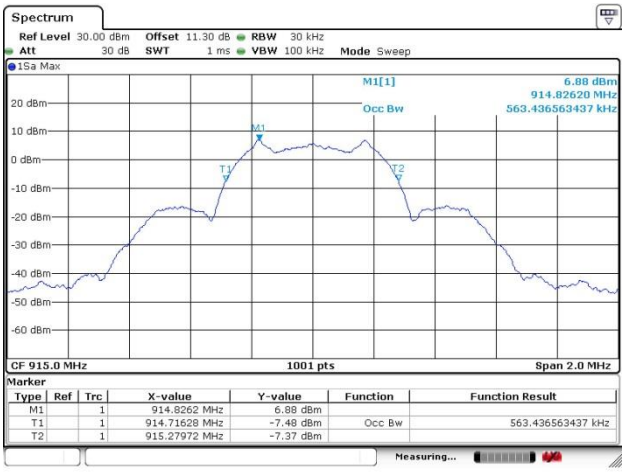
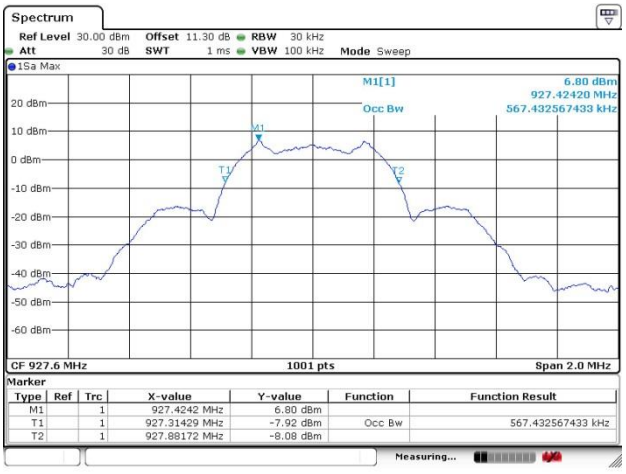
3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

6 dB Bandwidth Plot on 902.4 MHz	6 dB Bandwidth Plot on 915.0 MHz
	
6 dB Bandwidth Plot on 927.6 MHz	**N/A**
	

3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

99% Bandwidth Plot on 902.4 MHz	99% Occupied Bandwidth Plot on 915.0 MHz
	
99% Occupied Bandwidth Plot on 927.6 MHz	**N/A**
	

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

3.2 Output Power Measurement

3.2.1 Limit of Output Power

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

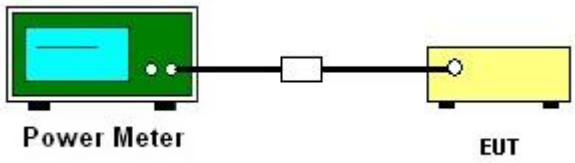
3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

3.2.3 Test Procedures

1. For Peak Power, the testing follows ANSI C63.10 Section 11.9.1.3 PKPM1.
2. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
3. The RF output of EUT was connected to the power meter by RF cable and attenuator.
4. The path loss was compensated to the results for each measurement.
5. Set the maximum power setting and enable the EUT to transmit continuously.
6. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

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

3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

3.3.3 Test Procedures

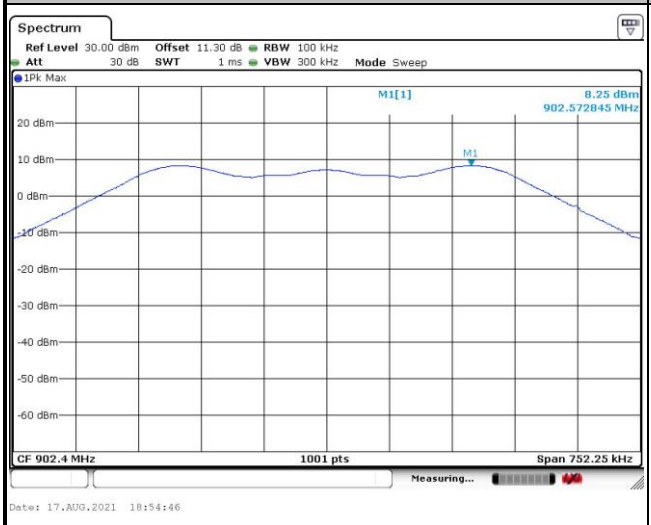
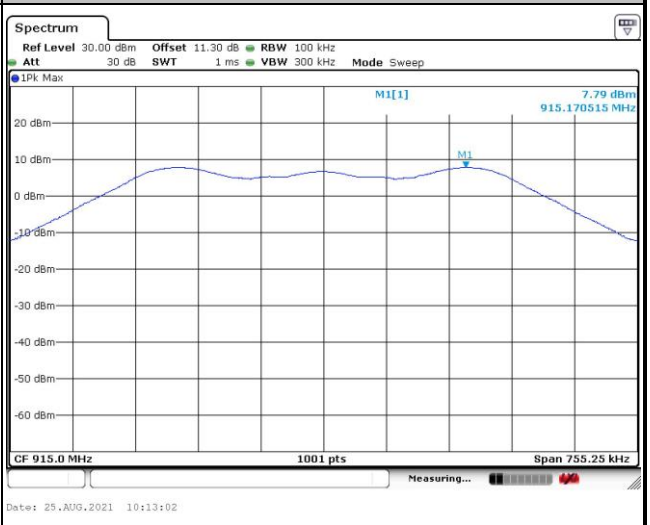
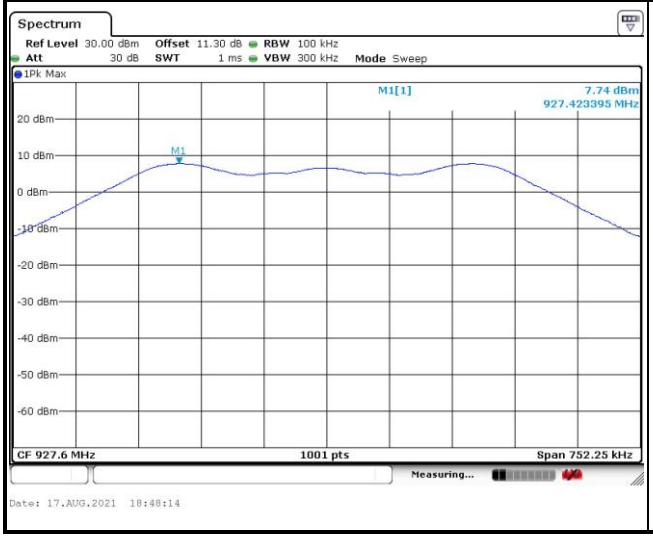
1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz. In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100 kHz is a reference level and is used as 20 dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup

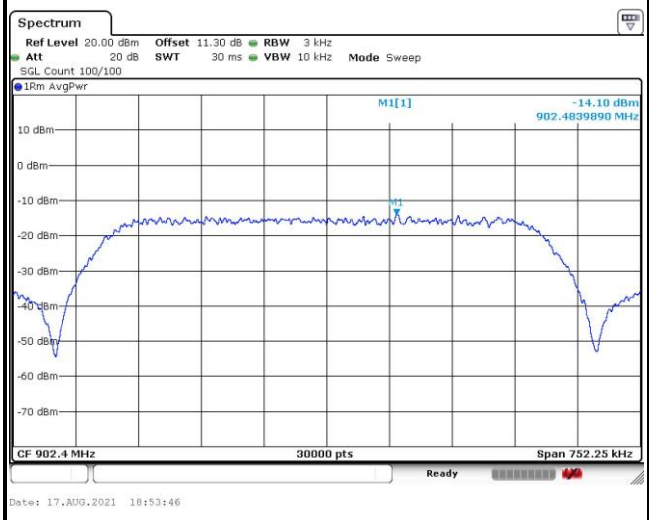
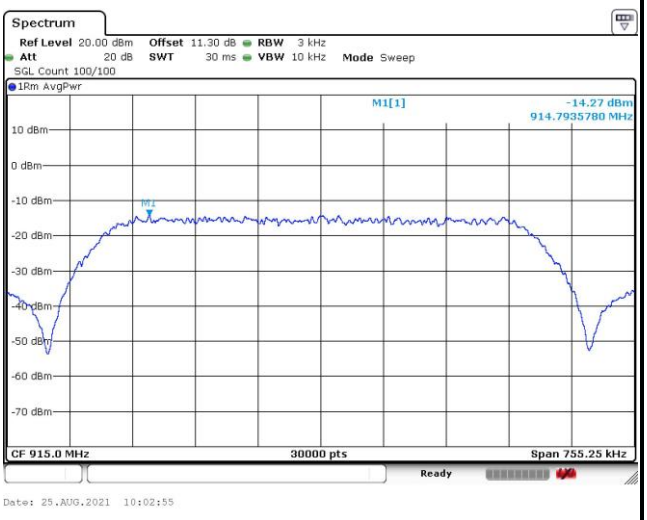
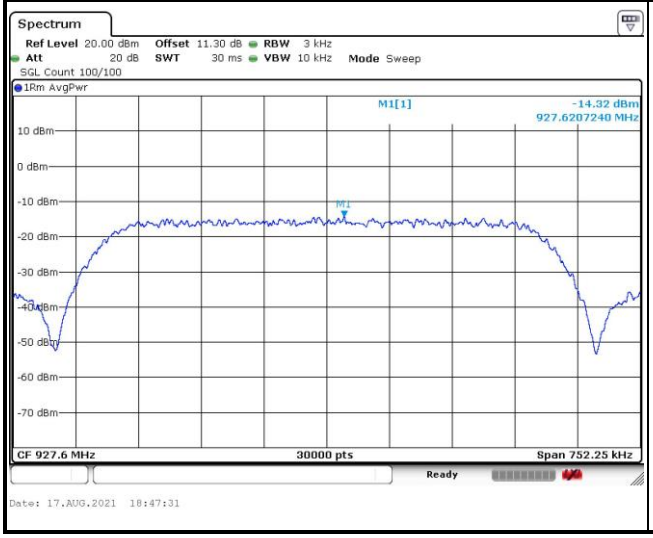
3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.3.6 Test Result of Power Spectral Density Plots (100kHz)

PSD 100kHz Plot on 902.4 MHz	PSD 100kHz Plot on 915.0 MHz
	
PSD 100kHz Plot on 927.6 MHz	**N/A**
	

3.3.7 Test Result of Power Spectral Density Plots (3kHz)

PSD 3kHz Plot on 902.4 MHz	PSD 3kHz Plot on 915.0 MHz
	
PSD 3kHz Plot on 927.6 MHz	**N/A**
	

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

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

3.4.2 Measuring Instruments

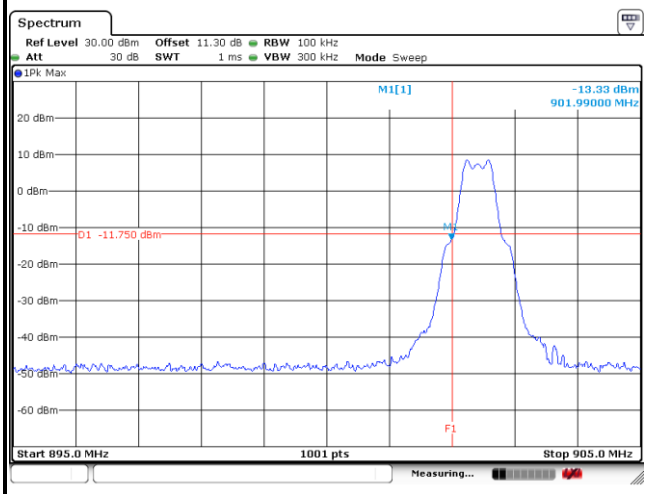
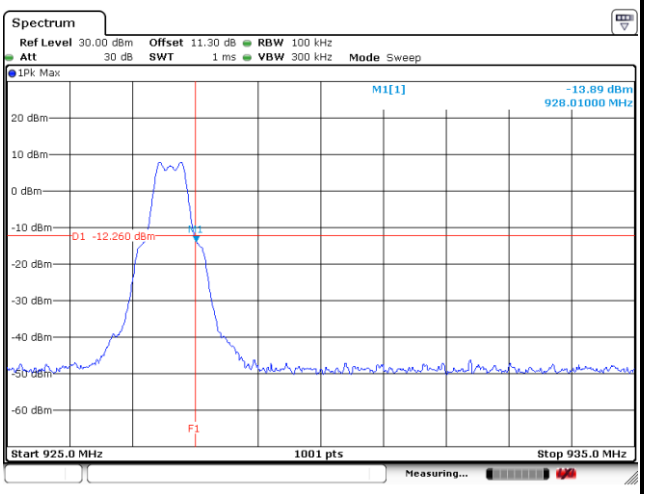
See list of measuring equipment of this test report.

3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
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 the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

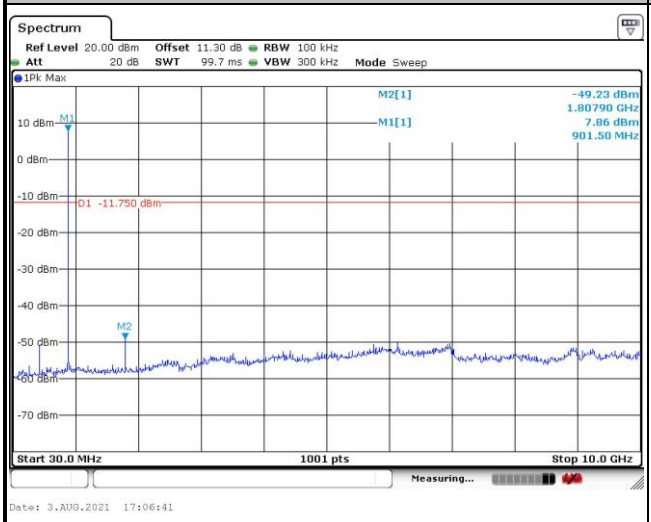
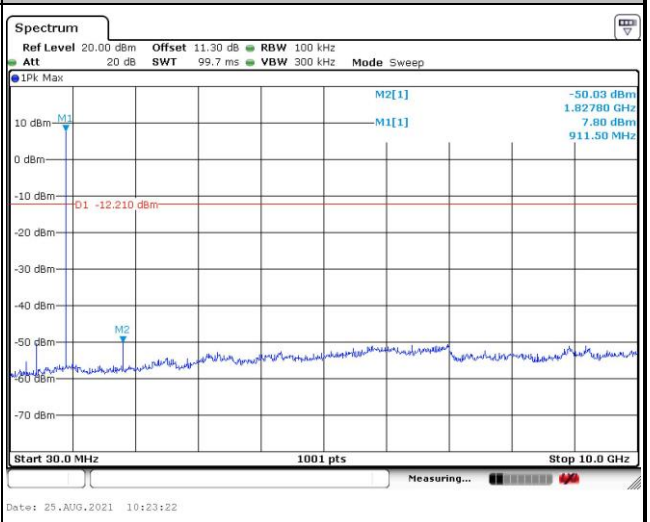
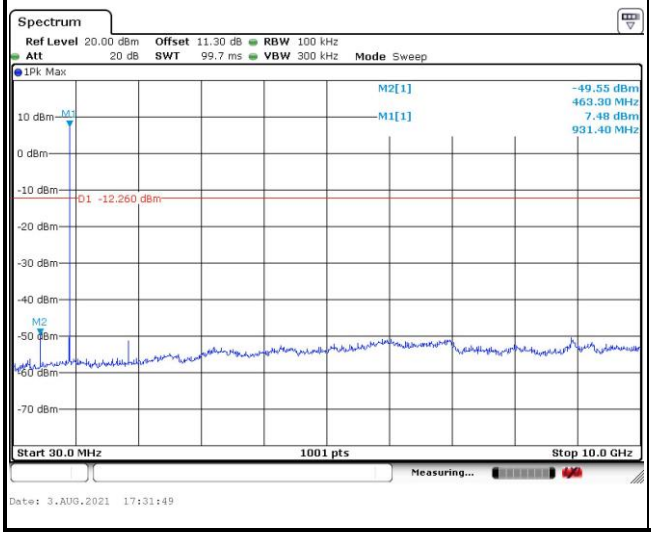
3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges Plots

Low Band Edge Plot on 902.4 MHz	High Band Edge Plot on 927.6 MHz
	

3.4.6 Test Result of Conducted Spurious Emission Plots

<1Mbps>

Conducted Spurious Emission Plot on 902.4 MHz	Conducted Spurious Emission Plot on 915.0 MHz
	
Conducted Spurious Emission Plot on 927.6 MHz	**N/A**
	

3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

See list of measuring equipment of this test report.

3.5.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1GHz was performed by adjusting the antenna tower from 1m to 4m and by rotating the turn table from 0degree to 360 degree to find the peak maximum hold reading.
   When there is no suspected emission found, or the peak measurement instead of QP measurement as alternative complies with the QP limit, the test position is marked as "-".

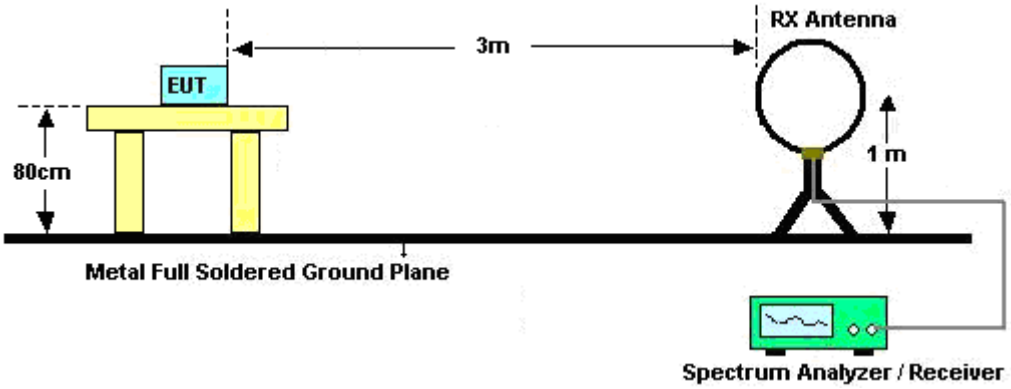
7. Radiated testing above 1GHz was performed by adjusting the antenna tower from 1m to 4m and by rotating the turn table from 0degree to 360 degree to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found or the peak emission level complies with the average limit and no further average measurement (*) is required, the test position is marked as "-".

   * The ANSI C63.10, Section 6.6.4.3, NOTE 1— where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

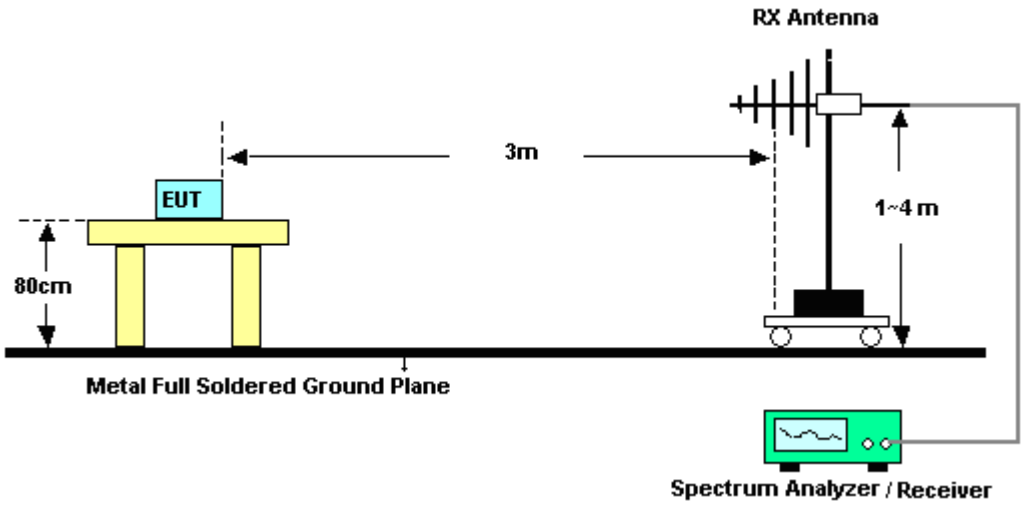
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW = 100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW = 3 MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - 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.

3.5.4 Test Setup

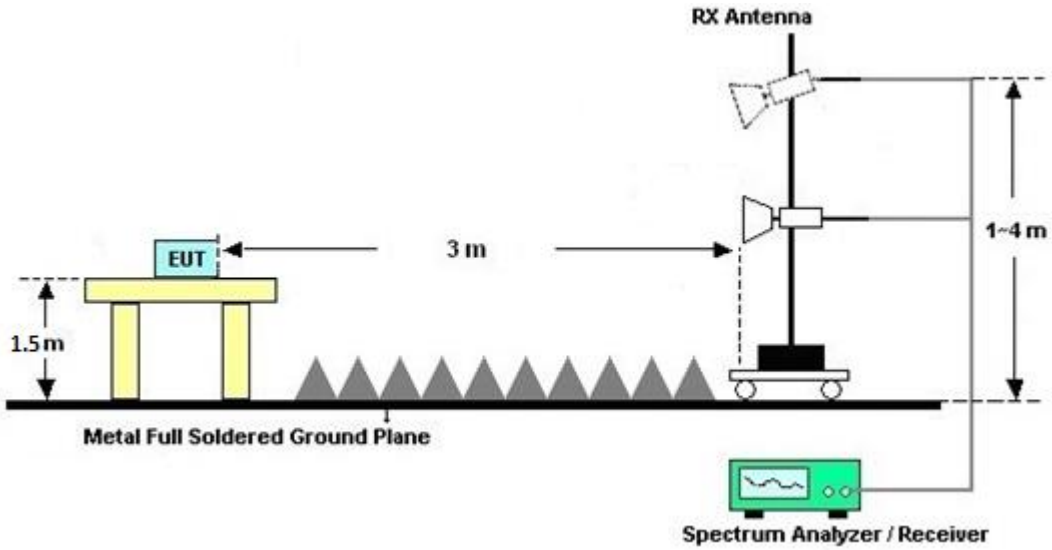
For radiated test below 30MHz



For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



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

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

There is adequate comparison measurement 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.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.5.7 Duty Cycle

Please refer to Appendix E.

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

Please refer to Appendix C and D.

3.6 AC Conducted Emission Measurement

3.6.1 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.

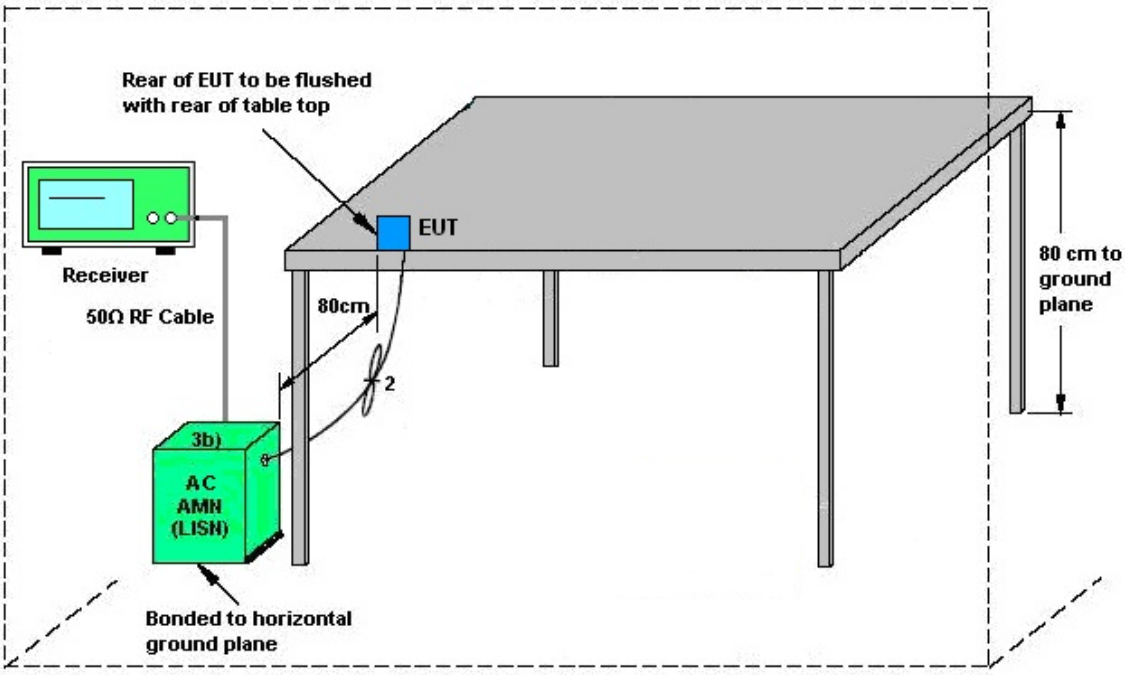
3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

3.6.3 Test Procedures

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

3.6.4 Test Setup



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

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 Standard Applicable

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

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

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

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	35419 & 03	30MHz~1GHz	Apr. 28, 2021	Aug. 13, 2021~ Sep. 02, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Dec. 01, 2020	Aug. 13, 2021~ Sep. 02, 2021	Nov. 30, 2021	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 04, 2021	Aug. 13, 2021~ Sep. 02, 2021	Jan. 03, 2022	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	1GHz~18GHz	Apr. 22, 2021	Aug. 13, 2021~ Sep. 02, 2021	Apr. 21, 2022	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	May 18, 2021	Aug. 13, 2021~ Sep. 02, 2021	May 17, 2022	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9030A	MY52350276	3Hz~44GHz	Jul. 22, 2021	Aug. 13, 2021~ Sep. 02, 2021	Jul. 21, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY15682-4	30MHz to 18GHz	Feb. 24, 2021	Aug. 13, 2021~ Sep. 02, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY24971-4	9kHz to 18GHz	Feb. 24, 2021	Aug. 13, 2021~ Sep. 02, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY28655-4	9kHz to 18GHz	Feb. 24, 2021	Aug. 13, 2021~ Sep. 02, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2858/2,80 1606/2	18GHz~40GHz	Feb. 24, 2021	Aug. 13, 2021~ Sep. 02, 2021	Feb. 23, 2022	Radiation (03CH07-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126	532078/126E	30MHz~18GHz	Sep. 18, 2020	Aug. 13, 2021~ Sep. 02, 2021	Sep. 17, 2021	Radiation (03CH07-HY)
Controller	EMEC	EM1000	N/A	Control Ant Mast	Apr. 28, 2021	Aug. 13, 2021~ Sep. 02, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Controller	MF	MF-7802	N/A	Control Turn table	N/A	Aug. 13, 2021~ Sep. 02, 2021	N/A	Radiation (03CH07-HY)
Antenna Mast	EMEC	AM-BS-4500E	N/A	Boresight mast 1M~4M	Apr. 28, 2021	Aug. 13, 2021~ Sep. 02, 2021	Apr. 27, 2022	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Aug. 13, 2021~ Sep. 02, 2021	N/A	Radiation (03CH07-HY)
Software	Audix	E3 6.2009-8-24	N/A	N/A	N/A	Aug. 13, 2021~ Sep. 02, 2021	N/A	Radiation (03CH07-HY)
USB Data Logger	TECPEL	TR-32	HE17XB2495	N/A	Mar. 09, 2021	Aug. 13, 2021~ Sep. 02, 2021	Mar. 08, 2022	Radiation (03CH07-HY)
EMI Test Receiver	Agilent	N9038A(MXE)	MY53290053	20Hz~26.5GHz	May 24, 2021	Aug. 13, 2021~ Sep. 02, 2021	May 23, 2022	Radiation (03CH07-HY)

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	TR-32	HE17XB2468	N/A	Mar. 09, 2021	Aug. 12, 2021~ Aug. 25, 2021	Mar. 08, 2022	Conducted (TH02-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101397	10Hz ~ 40GHz	Nov. 27, 2020	Aug. 12, 2021~ Aug. 25, 2021	Nov. 26, 2021	Conducted (TH02-HY)
Power Meter	Anritsu	ML2495A	1218006	N/A	Oct. 18, 2020	Aug. 12, 2021~ Aug. 25, 2021	Oct. 17, 2021	Conducted (TH02-HY)
Power Sensor	Anritsu	MA2411B	1207363	300MHz~40GHz	Oct. 18, 2020	Aug. 12, 2021~ Aug. 25, 2021	Oct. 17, 2021	Conducted (TH02-HY)
Switch Box & RF Cable	Burgeon	ETF058	EC1300484	N/A	Nov. 19, 2020	Aug. 12, 2021~ Aug. 25, 2021	Nov. 18, 2021	Conducted (TH02-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Aug. 17, 2021	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102388	9kHz~3.6GHz	Nov. 30, 2020	Aug. 17, 2021	Nov. 29, 2021	Conduction (CO05-HY)
Hygrometer	Testo	608-H1	34913912	N/A	Nov. 18, 2020	Aug. 17, 2021	Nov. 17, 2021	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Nov. 16, 2020	Aug. 17, 2021	Nov. 15, 2021	Conduction (CO05-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Aug. 17, 2021	N/A	Conduction (CO05-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-FN	00691	N/A	Jul. 28, 2021	Aug. 17, 2021	Jul. 27, 2022	Conduction (CO05-HY)
LISN Cable	MVE	RG-400	260260	N/A	Dec. 31, 2020	Aug. 17, 2021	Dec. 30, 2021	Conduction (CO05-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.3 dB**

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

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

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.1 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.7 dB**

Appendix A. Test Result of Conducted Test Items

Test Enginee	Tommy Lee	Temperature:	24.4~24.9	°C
Test Date:	2021/8/12~2021/8/25	Relative Humidity:	47.1~49.6	%

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	NTX	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
RFID	1	902.4	0.567	0.502	0.50	Pass
RFID	1	915	0.563	0.504	0.50	Pass
RFID	1	927.6	0.567	0.502	0.50	Pass

TEST RESULTS DATA
Peak Power Table

Mod.	NTX	Freq. (MHz)	Paek Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
RFID	1	902.4	7.90	30.00	3.06	10.96	36.00	Pass
RFID	1	915	7.76	30.00	3.06	10.82	36.00	Pass
RFID	1	927.6	7.44	30.00	3.06	10.50	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Reporting Only)

Mod.	NTX	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)
RFID	1	902.4	0.12	7.79
RFID	1	915	0.12	7.64
RFID	1	927.6	0.12	7.32

TEST RESULTS DATA
Average Power Density

Mod.	NTX	Freq. (MHz)	Peak PSD (dBm /100kHz)	Average PSD (dBm /3kHz)	DG (dBi)	Average PSD Limit (dBm /3kHz)	Pass/Fail
RFID	1	902.4	8.25	-14.10	3.06	8.00	Pass
RFID	1	915	7.79	-14.27	3.06	8.00	Pass
RFID	1	927.6	7.74	-14.32	3.06	8.00	Pass

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

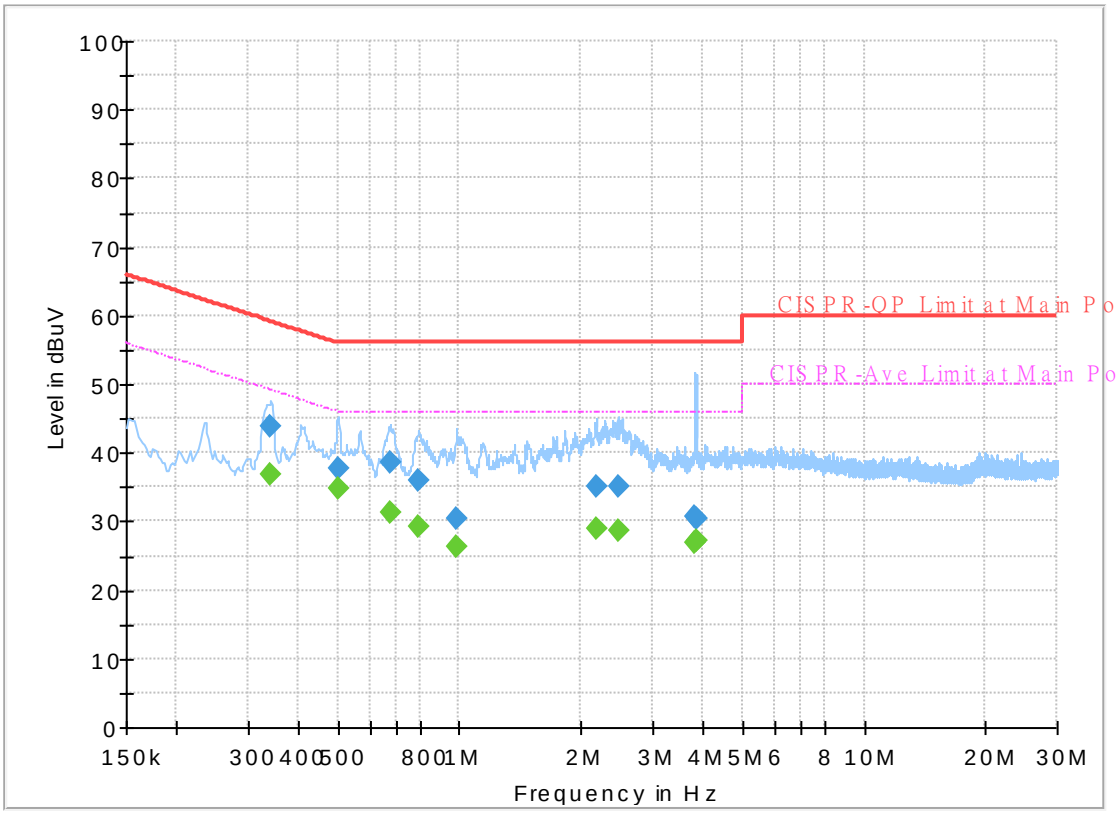
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Tom Lee	**Temperature :**	23~26℃
		Relative Humidity :	40~50%

EUT Information

Report NO :	161721
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Line

Full Spectrum



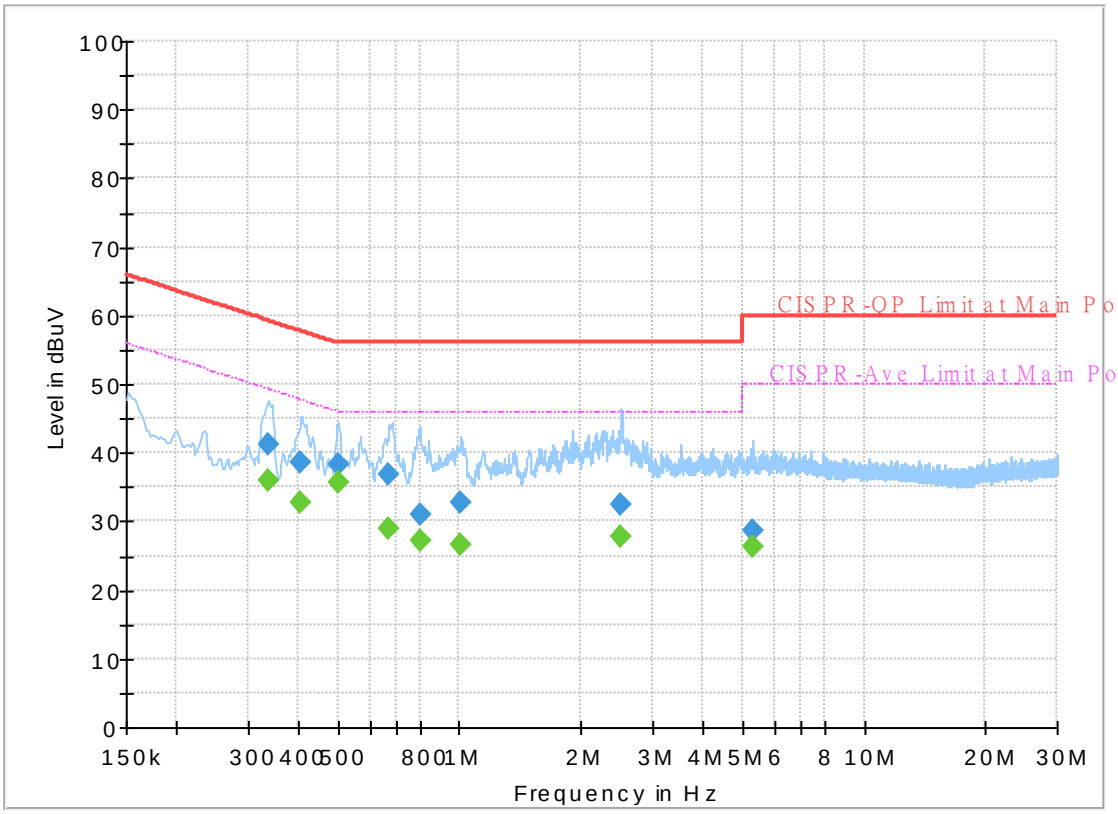
Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.341250	---	36.75	49.17	12.42	L1	OFF	19.7
0.341250	43.73	---	59.17	15.44	L1	OFF	19.7
0.501000	---	34.84	46.00	11.16	L1	OFF	19.8
0.501000	37.78	---	56.00	18.22	L1	OFF	19.8
0.676500	---	31.34	46.00	14.66	L1	OFF	20.0
0.676500	38.70	---	56.00	17.30	L1	OFF	20.0
0.791250	---	29.25	46.00	16.75	L1	OFF	20.0
0.791250	35.98	---	56.00	20.02	L1	OFF	20.0
0.982500	---	26.44	46.00	19.56	L1	OFF	20.2
0.982500	30.41	---	56.00	25.59	L1	OFF	20.2
2.172750	---	28.89	46.00	17.11	L1	OFF	20.1
2.172750	35.15	---	56.00	20.85	L1	OFF	20.1
2.460750	---	28.57	46.00	17.43	L1	OFF	20.1
2.460750	34.99	---	56.00	21.01	L1	OFF	20.1
3.806250	---	26.93	46.00	19.07	L1	OFF	20.0
3.806250	30.58	---	56.00	25.42	L1	OFF	20.0
3.844500	---	27.16	46.00	18.84	L1	OFF	20.0
3.844500	30.43	---	56.00	25.57	L1	OFF	20.0

EUT Information

Report NO :	161721
Test Mode :	Mode 1
Test Voltage :	120Vac/60Hz
Phase :	Neutral

Full Spectrum



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.336750	---	35.90	49.28	13.38	N	OFF	19.7
0.336750	41.16	---	59.28	18.12	N	OFF	19.7
0.406500	---	32.62	47.72	15.10	N	OFF	19.7
0.406500	38.47	---	57.72	19.25	N	OFF	19.7
0.501000	---	35.64	46.00	10.36	N	OFF	19.8
0.501000	38.39	---	56.00	17.61	N	OFF	19.8
0.669750	---	29.03	46.00	16.97	N	OFF	20.0
0.669750	36.84	---	56.00	19.16	N	OFF	20.0
0.798000	---	27.23	46.00	18.77	N	OFF	20.1
0.798000	31.09	---	56.00	24.91	N	OFF	20.1
1.005000	---	26.65	46.00	19.35	N	OFF	20.2
1.005000	32.85	---	56.00	23.15	N	OFF	20.2
2.514750	---	27.91	46.00	18.09	N	OFF	20.1
2.514750	32.41	---	56.00	23.59	N	OFF	20.1
5.289000	---	26.36	50.00	23.64	N	OFF	20.0
5.289000	28.58	---	60.00	31.42	N	OFF	20.0

Appendix C. Radiated Spurious Emission

Test Engineer :	Jesse Wang and Stan Hsieh	Temperature :	21.6~24.2°C
		Relative Humidity :	53.6~62.1%

RFID 902~928MHz

RFID (Band Edge @ 3m)

RFID	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		41.34	28.11	-11.89	40	38.22	18.75	1.16	30.02	100	0	QP	H
		59.7	30.41	-9.59	40	47.28	11.78	1.36	30.01	-	-	P	H
		141.78	35.56	-7.94	43.5	46.28	17.24	2.02	29.98	-	-	P	H
		451.2	31.71	-14.29	46	35.16	23.08	3.39	29.92	-	-	P	H
		684.3	28.1	-17.9	46	27.59	26.18	4.12	29.79	-	-	P	H
	*	902.4	101.58	-	-	97.2	28.61	4.67	28.9	-	-	P	H
		981.8	33.84	-20.16	54	26.91	30.51	5	28.58	-	-	P	H
													H
													H
													H
RFID 902.4MHz		41.34	31.14	-8.86	40	41.25	18.75	1.16	30.02	100	0	QP	V
		59.7	28.77	-11.23	40	45.64	11.78	1.36	30.01	100	0	QP	V
		80.22	33.06	-6.94	40	48.17	13.36	1.53	30	-	-	P	V
		451.2	35.08	-10.92	46	38.53	23.08	3.39	29.92	-	-	P	V
		682.9	28.82	-17.18	46	28.33	26.18	4.11	29.8	-	-	P	V
	*	902.4	107.86	-	-	103.48	28.61	4.67	28.9	-	-	P	V
		963.6	35.87	-18.13	54	28.74	30.87	4.92	28.66	-	-	P	V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

RFID	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
RFID 915MHz		30	31.3	-8.7	40	35.86	24.57	0.9	30.03	-	-	P	H
		61.59	32.5	-7.5	40	49.35	11.78	1.38	30.01	-	-	P	H
		144.21	36.06	-7.44	43.5	46.7	17.31	2.03	29.98	-	-	P	H
		457.5	30.46	-15.54	46	33.72	23.24	3.41	29.91	-	-	P	H
		605.2	27.51	-18.49	46	28.37	25.18	3.87	29.91	-	-	P	H
	*	915	102.79	-	-	98.05	28.87	4.72	28.85	-	-	P	H
		962.2	34.3	-19.7	54	27.19	30.85	4.92	28.66	-	-	P	H
													H
													H
													H
		41.07	31.59	-8.41	40	41.55	18.91	1.15	30.02	100	0	QP	V
		61.59	23.54	-16.46	40	40.39	11.78	1.38	30.01	100	0	QP	V
		80.22	33.89	-6.11	40	49	13.36	1.53	30	-	-	P	V
		457.5	31.37	-14.63	46	34.63	23.24	3.41	29.91	-	-	P	V
		658.4	27.97	-18.03	46	27.73	26.03	4.04	29.83	-	-	P	V
	*	915	107.34	-	-	102.6	28.87	4.72	28.85	-	-	P	V
		974.1	37.82	-16.18	54	30.64	30.82	4.97	28.61	-	-	P	V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

RFID	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
RFID 927.6MHz		30.27	31.85	-8.15	40	36.6	24.37	0.91	30.03	-	-	P	H
		41.34	28.56	-11.44	40	38.67	18.75	1.16	30.02	100	0	QP	H
		59.7	30.14	-9.86	40	47.01	11.78	1.36	30.01	-	-	P	H
		463.8	28.99	-17.01	46	32.09	23.37	3.43	29.9	-	-	P	H
		697.6	28.8	-17.2	46	28.29	26.13	4.15	29.77	-	-	P	H
	*	927.6	101.62	-	-	96.52	29.12	4.78	28.8	-	-	P	H
		966.4	34.38	-19.62	54	27.19	30.89	4.94	28.64	-	-	P	H
													H
													H
													H
		41.34	32.25	-7.75	40	42.36	18.75	1.16	30.02	100	0	QP	V
		59.7	28.78	-11.22	40	45.65	11.78	1.36	30.01	100	0	QP	V
		80.22	33.93	-6.07	40	49.04	13.36	1.53	30	-	-	P	V
		463.8	34.68	-11.32	46	37.78	23.37	3.43	29.9	-	-	P	V
		648.6	27.65	-18.35	46	27.42	26.06	4.02	29.85	-	-	P	V
	*	927.6	105.99	-	-	100.89	29.12	4.78	28.8	-	-	P	V
		970.6	35.61	-18.39	54	28.38	30.91	4.95	28.63	-	-	P	V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

RFID (Harmonic @ 3m)

RFID	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
RFID 902.4MHz		2707.2	47.52	-26.48	74	65.25	32.7	8.6	59.36	-	-	P	H
		3609.6	42.64	-31.36	74	59.16	33.07	10.11	60.23	-	-	P	H
		4512	43.64	-30.36	74	56.38	33.77	11.09	58.34	-	-	P	H
		5414.4	40.89	-33.11	74	51.3	34.6	11.99	57.64	-	-	P	H
		8121.6	41.1	-32.9	74	47.22	35.9	15.05	57.8	-	-	P	H
		9024	42.07	-31.93	74	48.3	36.1	15.67	58.82	-	-	P	H
		2707.2	52.75	-21.25	74	70.48	32.7	8.6	59.36	201	0	P	V
		2707.2	49.57	-4.43	54	67.3	32.7	8.6	59.36	201	0	A	V
		3609.6	44.43	-29.57	74	60.95	33.07	10.11	60.23	-	-	P	V
		4512	42.88	-31.12	74	55.62	33.77	11.09	58.34	-	-	P	V
		5414.4	39.21	-34.79	74	49.62	34.6	11.99	57.64	-	-	P	V
		8121.6	42.48	-31.52	74	48.6	35.9	15.05	57.8	-	-	P	V
		9024	42.27	-31.73	74	48.5	36.1	15.67	58.82	-	-	P	V
RFID 915MHz		2745	48.52	-25.48	74	66.37	32.5	8.68	59.36	-	-	P	H
		3660	41.08	-32.92	74	57.52	33.2	10.09	60.27	-	-	P	H
		4575	44.79	-29.21	74	57.13	33.93	11.12	58.26	-	-	P	H
		7320	43.35	-30.65	74	50.87	35.6	13.91	57.92	-	-	P	H
		8235	42.94	-31.06	74	49.03	35.8	15.16	57.84	-	-	P	H
		9150	42.76	-31.24	74	49.22	36.2	15.76	59.11	-	-	P	H
		2745	53.28	-20.72	74	71.13	32.5	8.68	59.36	201	355	P	V
		2745	49.9	-4.1	54	67.75	32.5	8.68	59.36	201	355	A	V
		3660	44.27	-29.73	74	60.71	33.2	10.09	60.27	-	-	P	V
		4575	44.58	-29.42	74	56.92	33.93	11.12	58.26	-	-	P	V
		7320	42.33	-31.67	74	49.85	35.6	13.91	57.92	-	-	P	V
		8235	42.21	-31.79	74	48.3	35.8	15.16	57.84	-	-	P	V
		9150	43.14	-30.86	74	49.6	36.2	15.76	59.11	-	-	P	V

RFID 927.6MHz		2782.8	48.85	-25.15	74	66.63	32.5	8.75	59.37	-	-	P	H
		3710.4	40.8	-33.2	74	57.38	33.1	10.07	60.31	-	-	P	H
		4638	42.59	-31.41	74	54.57	34.07	11.23	58.19	-	-	P	H
		7420.8	40.3	-33.7	74	47.8	35.6	14.07	58.02	-	-	P	H
		8348.4	41.89	-32.11	74	48.3	35.8	14.75	57.88	-	-	P	H
		2782.8	53.85	-20.15	74	71.63	32.5	8.75	59.37	201	355	P	V
		2782.8	50.63	-3.37	54	68.41	32.5	8.75	59.37	201	355	A	V
		3710.4	43.32	-30.68	74	59.9	33.1	10.07	60.31	-	-	P	V
		4638	43.15	-30.85	74	55.13	34.07	11.23	58.19	-	-	P	V
		7420.8	39.9	-34.1	74	47.4	35.6	14.07	58.02	-	-	P	V
		8348.4	41.26	-32.74	74	47.67	35.8	14.75	57.88	-	-	P	V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

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:

BLE	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	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)
BLE CH 00 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. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

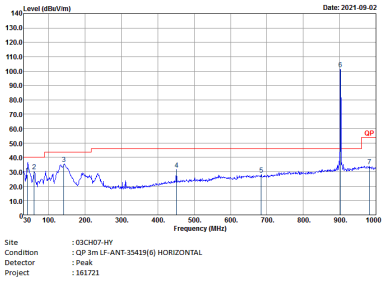
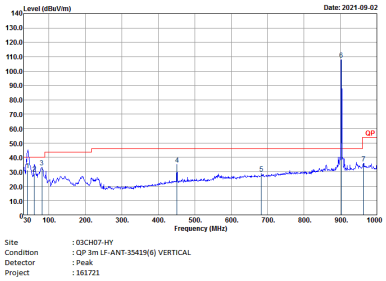
Both peak and average measured complies with the limit line, so test result is “PASS”.

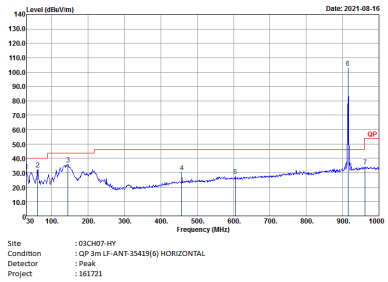
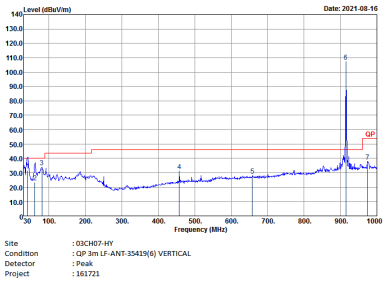
Appendix D. Radiated Spurious Emission Plots

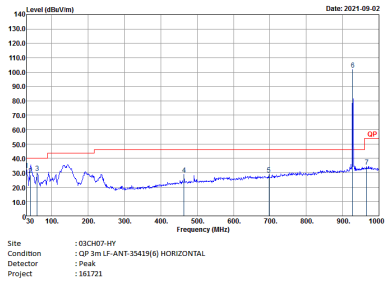
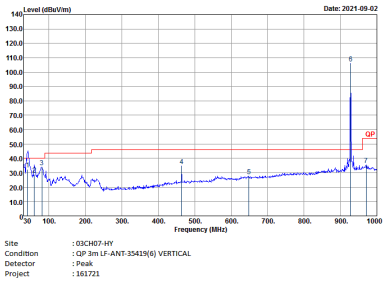
Test Engineer :	Jesse Wang and Stan Hsieh	Temperature :	21.6~24.2°C
		Relative Humidity :	53.6~62.1%

RFID 902~928MHz

RFID (Band Edge @ 3m)

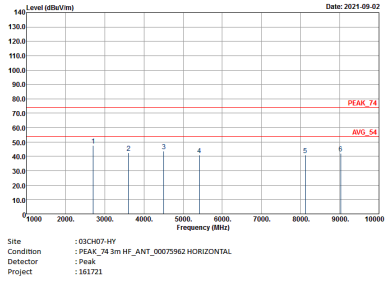
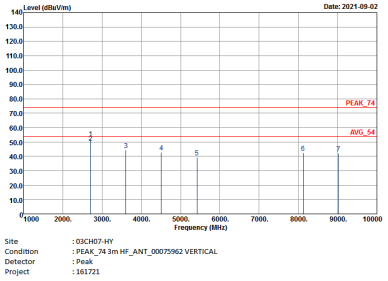
RFID	RFID 902~928MHz	
	RFID 902.4MHz	
	Horizontal	Vertical
QP / Peak		

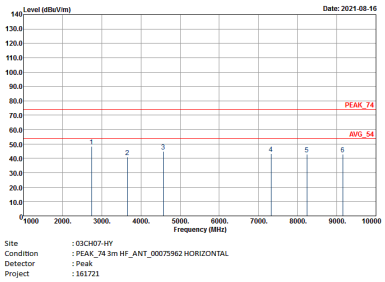
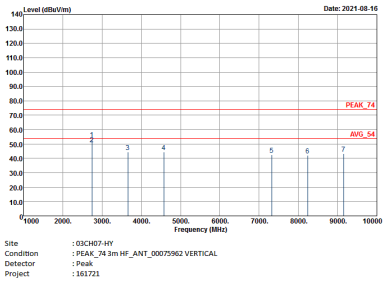
RFID	RFID 902~928MHz	
	RFID 915MHz	
	Horizontal	Vertical
QP / Peak		

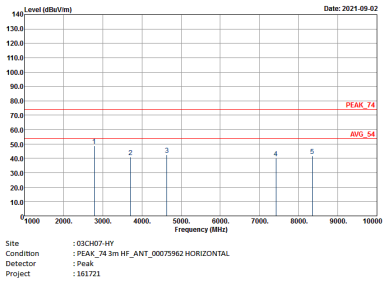
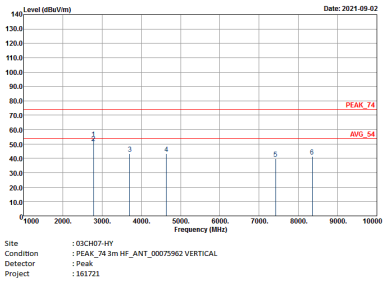
RFID	RFID 902~928MHz	
	RFID 927.6MHz	
	Horizontal	Vertical
Peak Avg.		

RFID 902~928MHz

RFID (Harmonic @ 3m)

RFID	RFID 902~928MHz	
	RFID 902.4Mhz	
	Horizontal	Vertical
Peak Avg.		

RFID	RFID 902~928MHz	
	RFID 915MHz	
	Horizontal	Vertical
Peak Avg.		

RFID	RFID 902~928MHz	
	RFID 927.6MHz	
	Horizontal	Vertical
Peak Avg.		

Appendix E. Duty Cycle Plots

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

RFID UHF