FCC RF Test Report

FCC ID	:	**UZ7EM45A2**
EQUIPMENT	:	**Enterprise Mobile**
BRAND NAME	:	**Zebra**
MODEL NAME	:	**EM45A2**
APPLICANT	:	**Zebra Technologies Corporation** **3 Overlook Point, Lincolnshire, IL 60069, United States**
MANUFACTURER	:	**Zebra Technologies Corporation** **3 Overlook Point, Lincolnshire, IL 60069, United States**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DSS) Spread Spectrum Transmitter**
TEST DATE(S)	:	**Jun. 16, 2024 ~ Jul. 13, 2024**

We, Sporton International Inc. (Kunshan), 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. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED Cert #5145.02

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People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR460505E	Rev. 01	Initial issue of report	Sep. 05, 2024

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)	Number of Channels	≥ 50Chs	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	≥ 25KHz or 20dB BW	Pass	-
3.3	15.247(a)(1)	Dwell Time of Each Channel	≤ 0.4sec in 20sec period	Pass	-
3.4	15.247(a)(1)	20dB Bandwidth	500 KHz	Pass	-
3.4	2.1049	99% Bandwidth	-	Report only	-
3.5	15.247(b)(1)	Peak Output Power	≤ 1W	Pass	-
3.6	15.247(d)	Conducted Band Edges	≤ 20dBc	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	-
3.8	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 6.30 dB at 914.750 MHz
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 12.13 dB at 2.664 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	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.

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Enterprise Mobile
Brand Name	Zebra
Model Name	EM45A2
FCC ID	UZ7EM45A2
IMEI Code	Conducted: 352991990029617/352991990029732 Radiation: 352991990035184/352991990035382 Conduction: 352991990029245/352991990029427
HW Version	EV2.5
SW Version	13-32-08.00-TG-U06-STD-ATH-04
MFD	08AUG24
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Specification of Accessory				
Battery	**Brand Name**	Zebra	**Model**	BT-000501
			Part Number	BT-000501-2000

Supported Unit used in test configuration and system				
AC Adapter 1 (Type C Wall Charger 1)	**Brand Name**	Zebra	**Model**	SAWA-102-22520A
			Part Number	PWR-WUA5V45W1US
AC Adapter 2 (Type A Wall Charger 2)	**Brand Name**	Zebra	**Model**	SAWA-65-20005A
			Part Number	PWR-WUA5V12W0US
Earphone 1 (Wired headset USB-C)	**Brand Name**	Zebra	**Part Number**	HDST-USBC-PTT1-01
Earphone 2 (Rugged Bluetooth Headset)	**Brand Name**	Zebra	**Part Number**	HS3100-OTH
Earphone 3 (3.5mm PTT Headset)	**Brand Name**	Zebra	**Part Number**	HDST-35MM-PTT1-02
Earphone 4 (Rugged Headset)	**Brand Name**	Zebra	**Part Number**	HS2100-OTH
3.5mm to 3.5mm audio connector	**Brand Name**	Zebra	**Part Number**	CBL-HS2100-3MS1-01
Type C-Audio Cable (Type C to 3.5mm)	**Brand Name**	Zebra	**Part Number**	ADP-USBC-35MM1-01
USB Cable 1 (USB-C to C Cable)	**Brand Name**	Zebra	**Part Number**	CBL-EC5X-USBC3A-01
USB Cable 2 (USB-A to C Cable)	**Brand Name**	Zebra	**Part Number**	CBL-TC5X-USBC2A-01
EM45 Protective Case	**Brand Name**	Zebra	**Part Number**	SG-EM45EXO1-01

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	902.75 MHz ~ 927.25 MHz
Number of Channels	50
Channel Spacing	0.5 MHz
Maximum Output Power to Antenna	24.36 dBm (0.2729 W)
99% Occupied Bandwidth	0.056 MHz
Antenna Type / Gain	IFA Antenna type with gain -3.50 dBi
Type of Modulation	ASK

1.3 Modification of EUT

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

1.4 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309

1.5 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH06-KS	AUDIX	E3	210616
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.6 Applicable Standards

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

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark:

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

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902.75-927.25 MHz	1	902.75	26	915.25
	2	903.25	27	915.75
	3	903.75	28	916.25
	4	904.25	29	916.75
	5	904.75	30	917.25
	6	905.25	31	917.75
	7	905.75	32	918.25
	8	906.25	33	918.75
	9	906.75	34	919.25
	10	907.25	35	919.75
	11	907.75	36	920.25
	12	908.25	37	920.75
	13	908.75	38	921.25
	14	909.25	39	921.75
	15	909.75	40	922.25
	16	910.25	41	922.75
	17	910.75	42	923.25
	18	911.25	43	923.75
	19	911.75	44	924.25
	20	912.25	45	924.75
	21	912.75	46	925.25
	22	913.25	47	925.75
	23	913.75	48	926.25
	24	914.25	49	926.75
	25	914.75	50	927.25

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, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report, and the worst mode of radiated spurious emissions is recorded in this report.

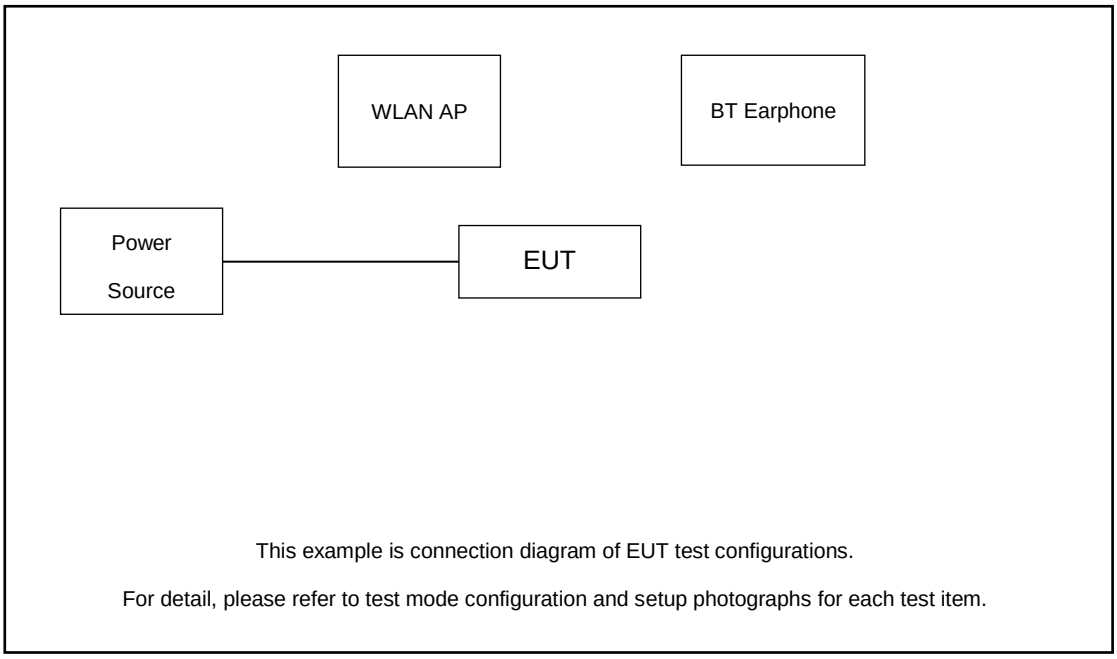
b. AC power line Conducted Emission was tested under maximum output power.

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

Summary table of Test Cases	
Test Item	**UHF RFID**
Conducted Test Cases	Mode 1: RFID Tx 902.75 MHz Mode 2: RFID Tx 914.75 MHz Mode 3: RFID Tx 927.25 MHz
Radiated Test Cases	**UHF RFID**
	Mode 1: RFID Tx 902.75 MHz Mode 2: RFID Tx 914.75 MHz Mode 3: RFID Tx 927.25 MHz
AC Conducted Emission	Mode 1 : RFID read + USB Cable1 + Charging from AC Adapter 1 + Battery
Remark: For Radiated Test Cases, The tests were performed with Adapter 1 and USB Cable 1.	

2.3 Connection Diagram of Test System

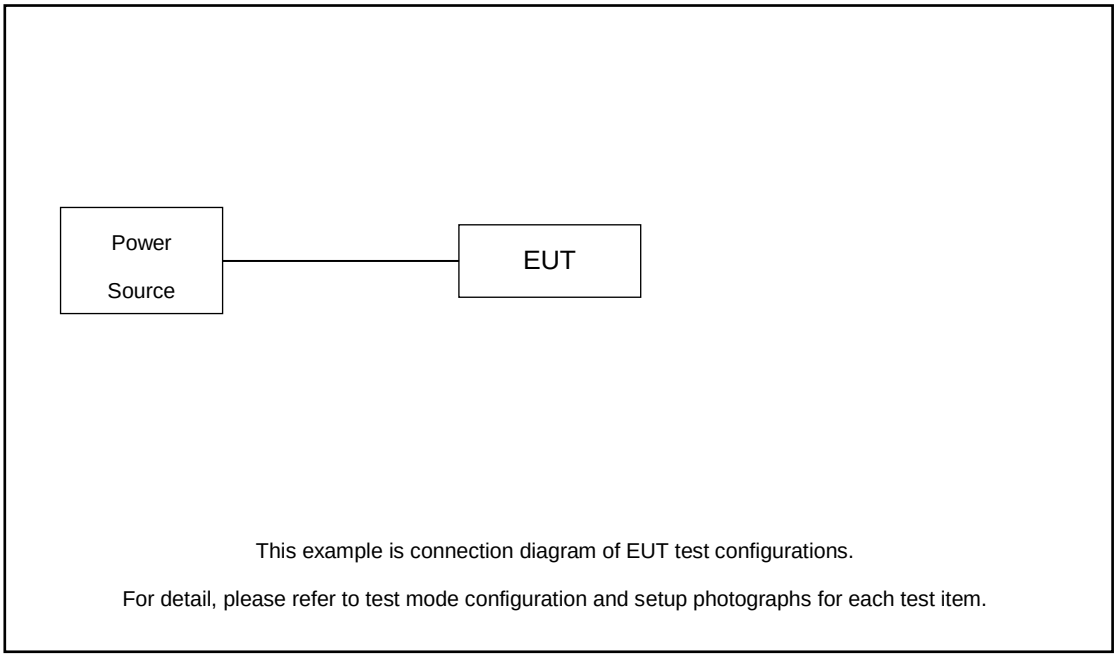
For Conducted Emission



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

For Radiated Emission



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
2.	SD Card	Kingston	8GB	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, RFID Read sofaware was installed in order to make the EUT get into the engineering modes to provide channel selection, power level 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 0.50 dB and 10dB attenuator.

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

= 0.50 + 10 = 10.50 (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.

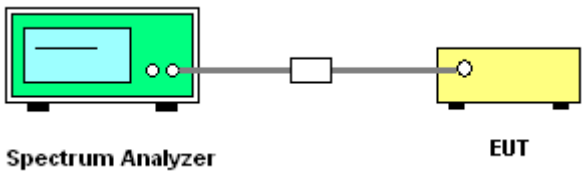
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation;
   Set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller; 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.

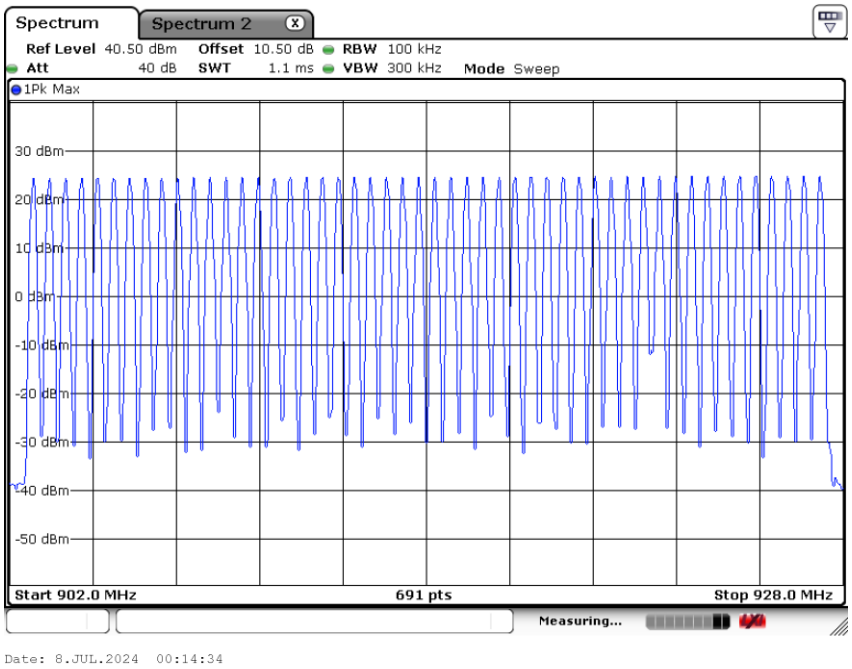
3.1.4 Test Setup



3.1.5 Test Result of Number of Hopping Frequency

TestMode	Result[Num]	Limit[Num]	Verdict
RFID	50	≥50	PASS

Number of Hopping Channel Plot on Channel 00 - 49



3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems 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.

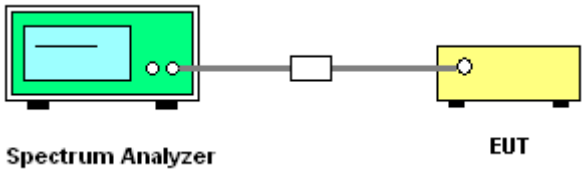
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels;
   RBW Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

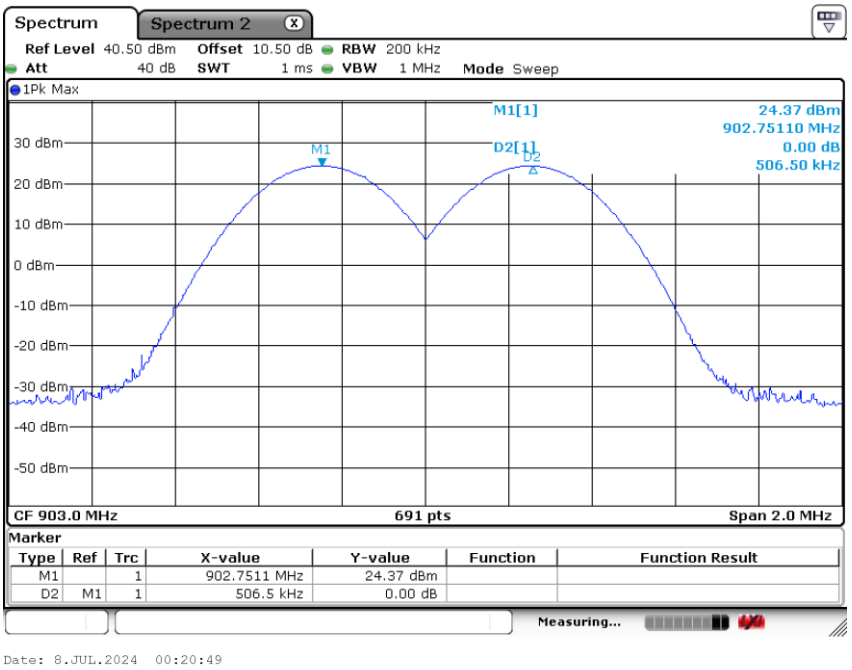
3.2.4 Test Setup



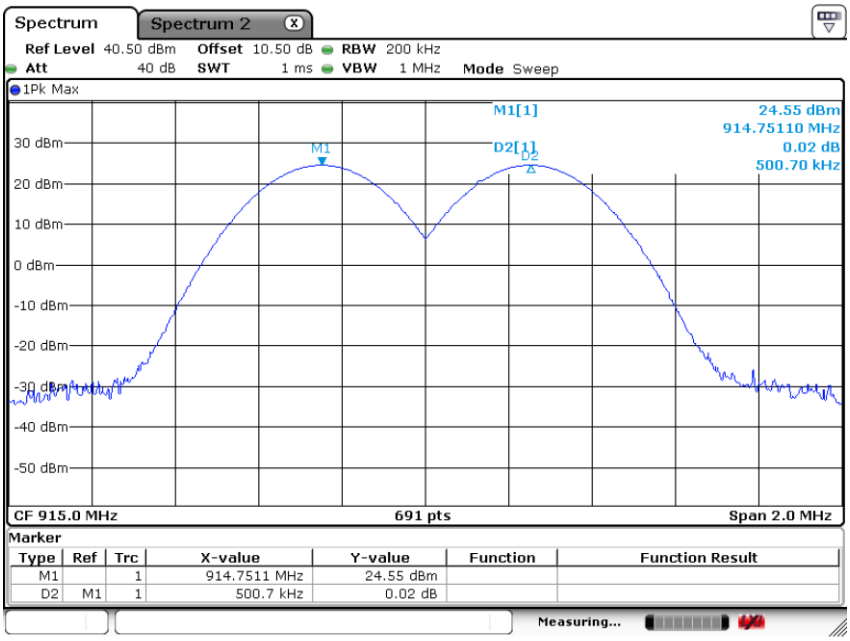
3.2.5 Test Result of Hopping Channel Separation

TestMode	NTX	Freq(MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
RFID	1	902.75	0.507	0.056	PASS
RFID	1	914.75	0.501	0.056	PASS
RFID	1	927.25	0.498	0.056	PASS

Channel Separation Plot on 902.75 MHz

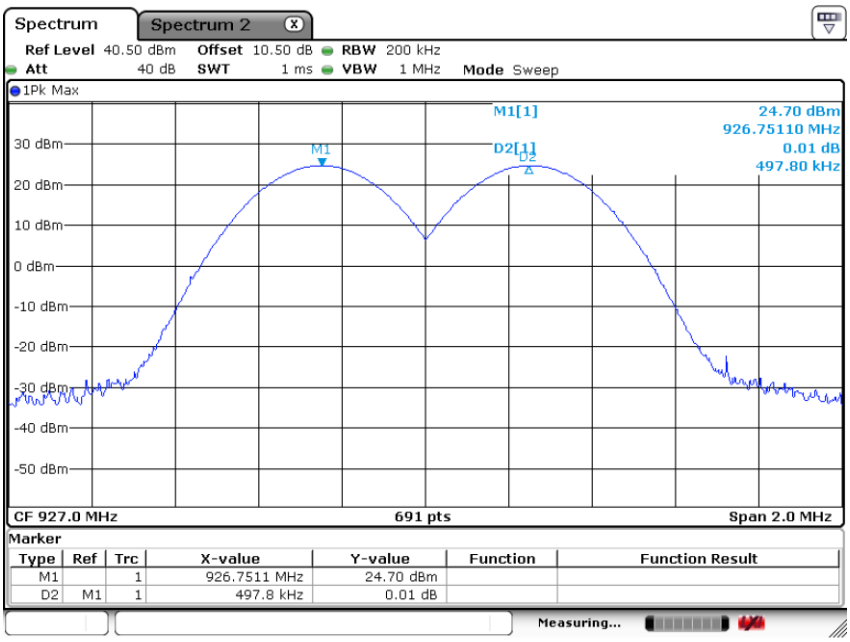


Channel Separation Plot on 914.75 MHz



Date: 8.JUL.2024 00:21:56

Channel Separation Plot on 927.25 MHz



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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

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

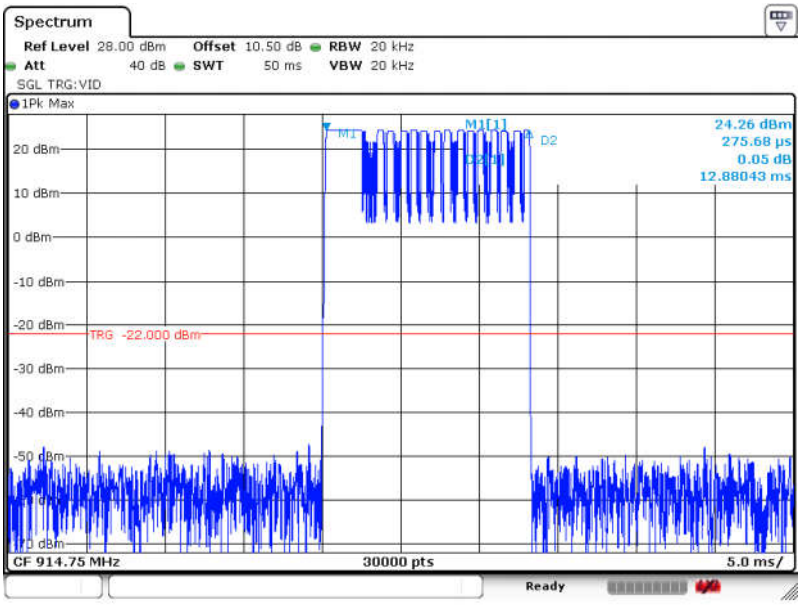
1. The testing follows ANSI C63.10-2013 clause 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T; 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

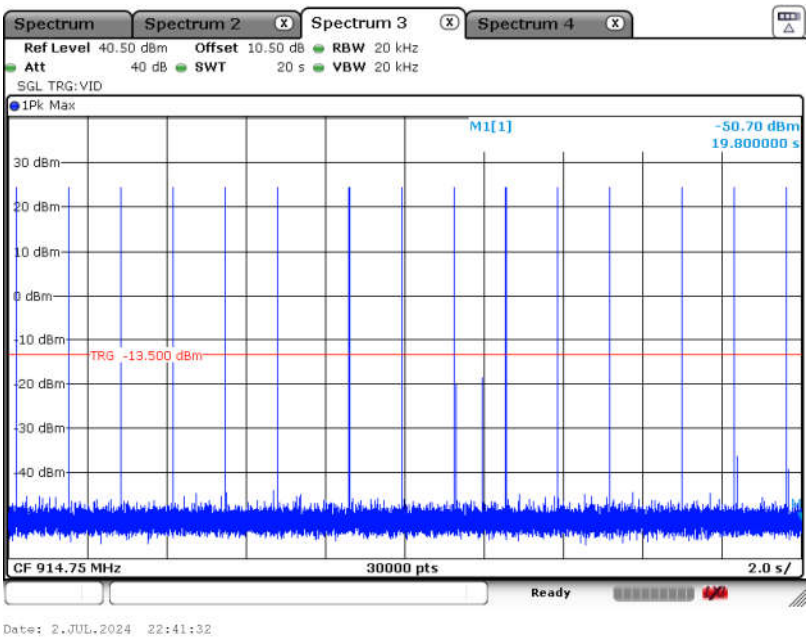
3.3.5 Test Result of Dwell Time

Mod.	DT On-time per hop (ms)	Total hops over 20sec	Dwell Time (sec)	Limits (sec)	Pass/Fail
RFID	12.88043	15.00	0.193	0.4	Pass

RFID _ DT On-time per hop



RFID _ Total hops over 20sec



Remark: Dwell Time(s) = DT On-time per hop * Hops Over Occupancy Time (hops)

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

For frequency hopping systems operating in the 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

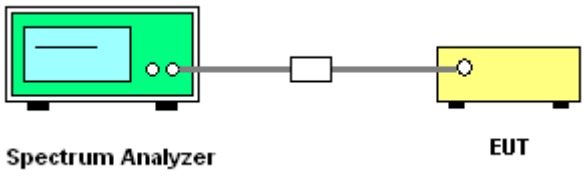
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

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

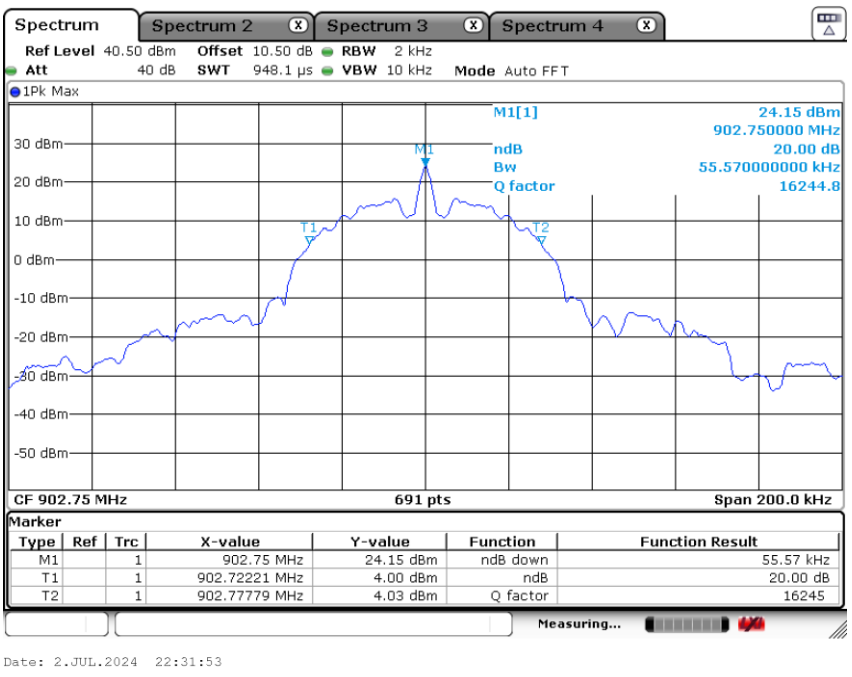
3.4.4 Test Setup



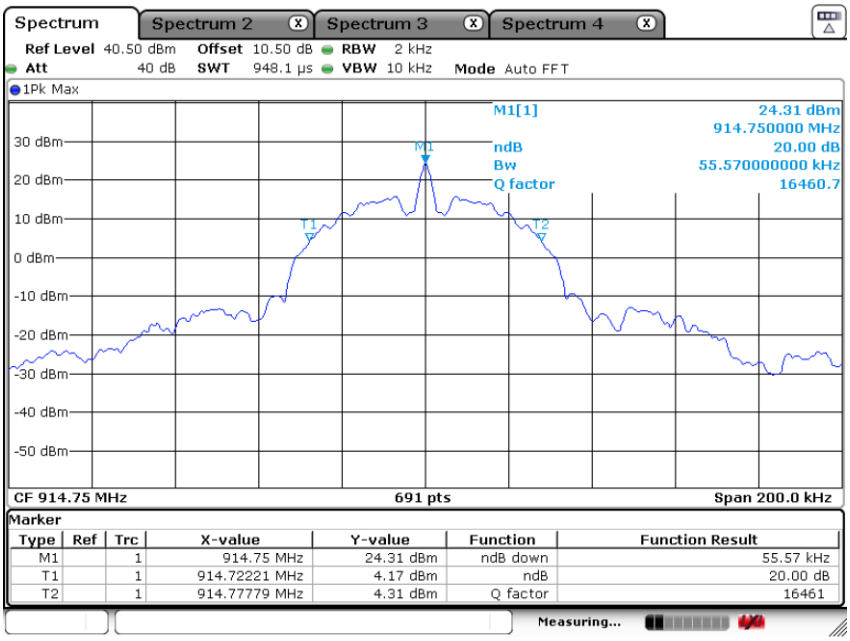
3.4.5 Test Result of 20dB Bandwidth

Mod.	NTX	Freq. (MHz)	20dB BW (MHz)	20dB BW Limit (MHz)	Pass/Fail
RFID	1	902.75	0.056	0.5	Pass
RFID	1	914.75	0.056	0.5	Pass
RFID	1	927.25	0.056	0.5	Pass

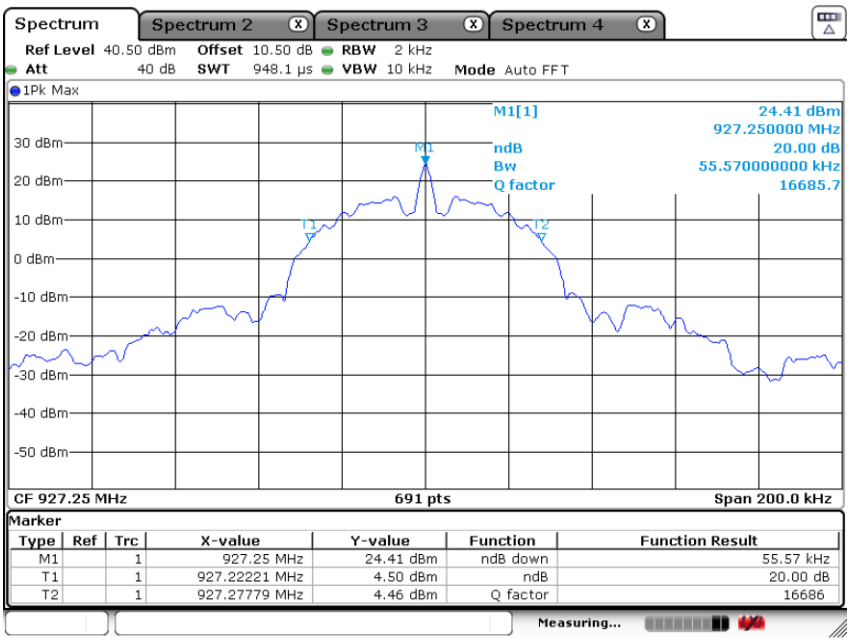
20 dB Bandwidth Plot on 902.75 MHz



20 dB Bandwidth Plot on 914.75 MHz



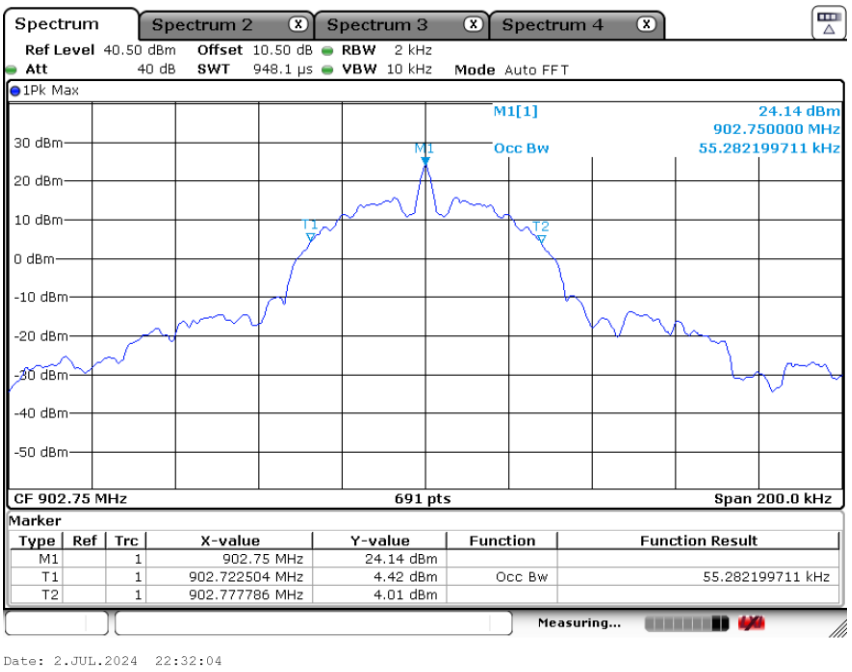
20 dB Bandwidth Plot on 927.25 MHz



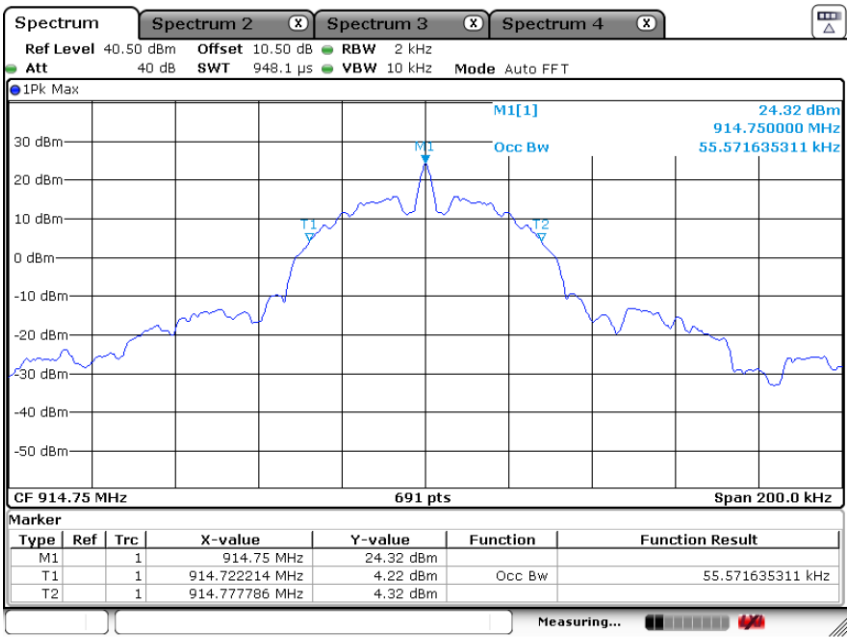
3.4.6 Test Result of 99% Occupied Bandwidth

Mod.	NTX	Freq. (MHz)	99% Bandwidth (MHz)	Pass/Fail
RFID	1	902.75	0.055	Pass
RFID	1	914.75	0.056	Pass
RFID	1	927.25	0.056	Pass

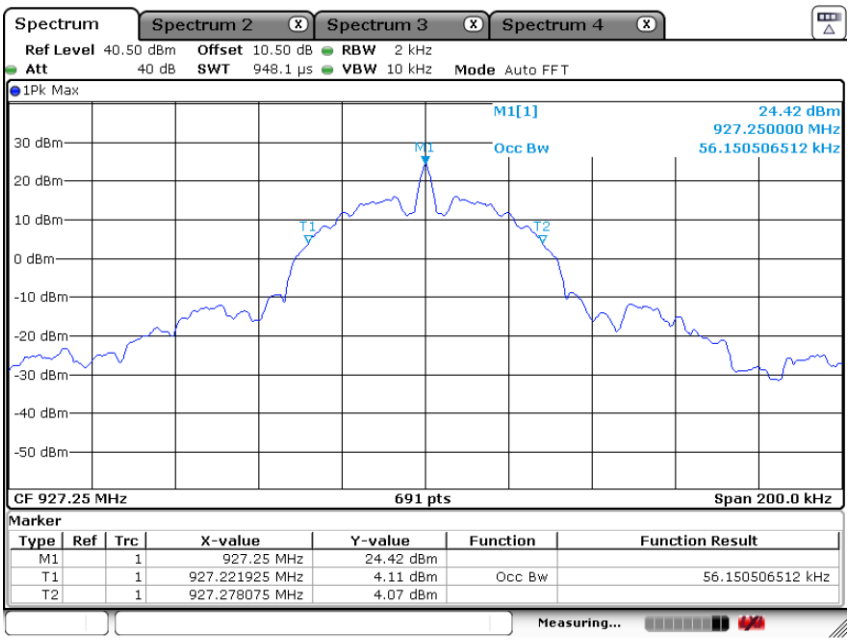
99% Occupied Bandwidth Plot on 902.75 MHz



99% Occupied Bandwidth Plot on 914.75 MHz



99% Occupied Bandwidth Plot on 927.25MHz



3.5 Output Power Measurement

3.5.1 Limit of Output Power

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

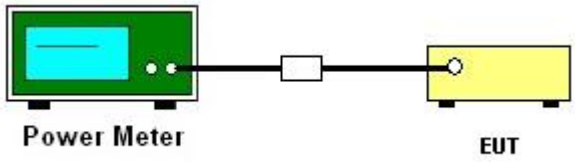
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Peak Output Power

DH	Freq. (MHz)	NTX	Peak Power (dBm)	Power Limit (dBm)	Test Result
RFID	902.75	1	24.12	30.00	Pass
	914.75	1	24.24	30.00	Pass
	927.25	1	24.36	30.00	Pass

3.5.6 Test Result of Average Output Power (Reporting Only)

DH	Freq. (MHz)	NTX	Average Power (dBm)	Power Setting
RFID	902.75	1	23.84	24
	914.75	1	24.12	24
	927.25	1	24.29	24

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.

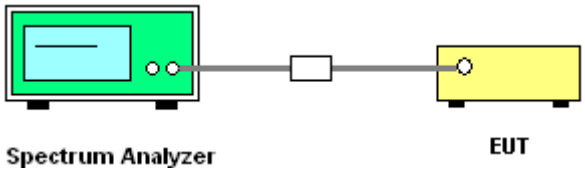
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

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

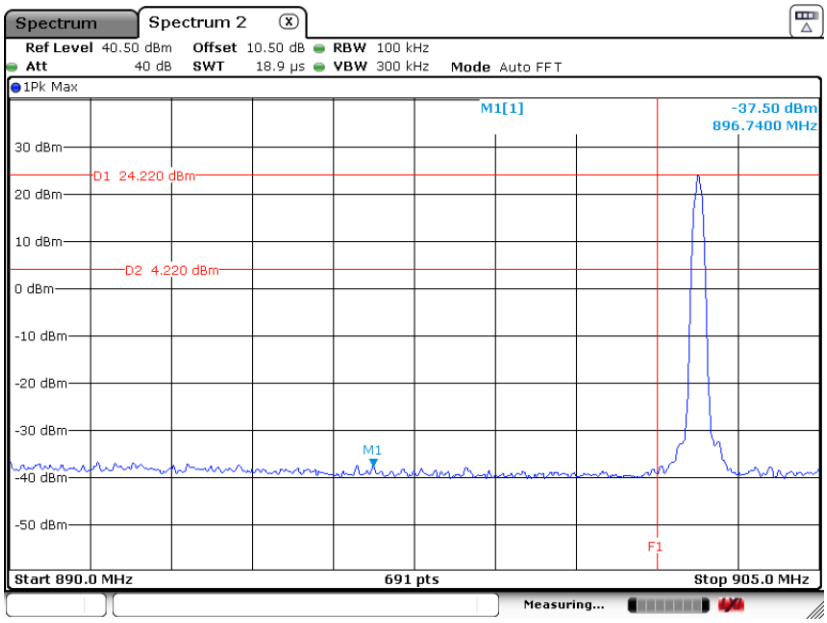
3.6.4 Test Setup



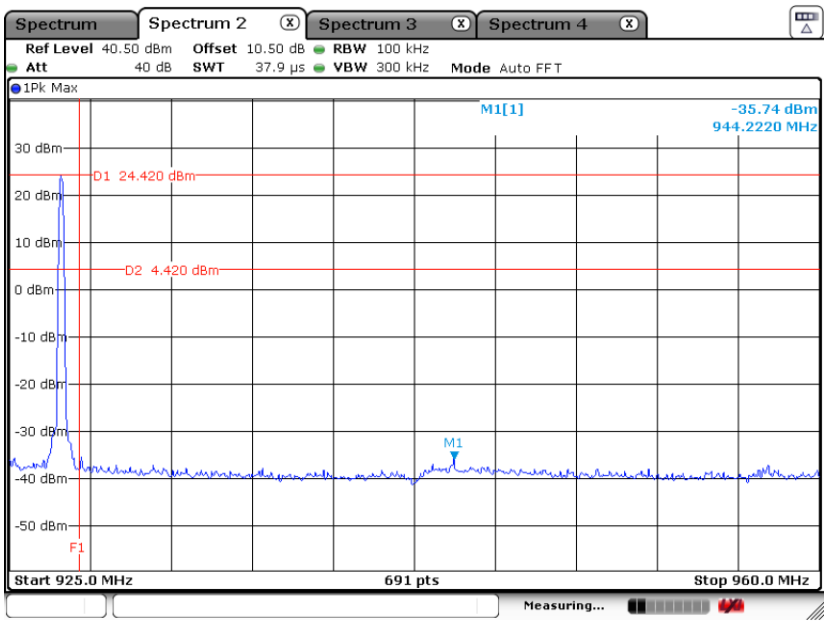
3.6.5 Test Result of Conducted Band Edges

<RFID>

Low Band Edge Plot on 902.75 MHz



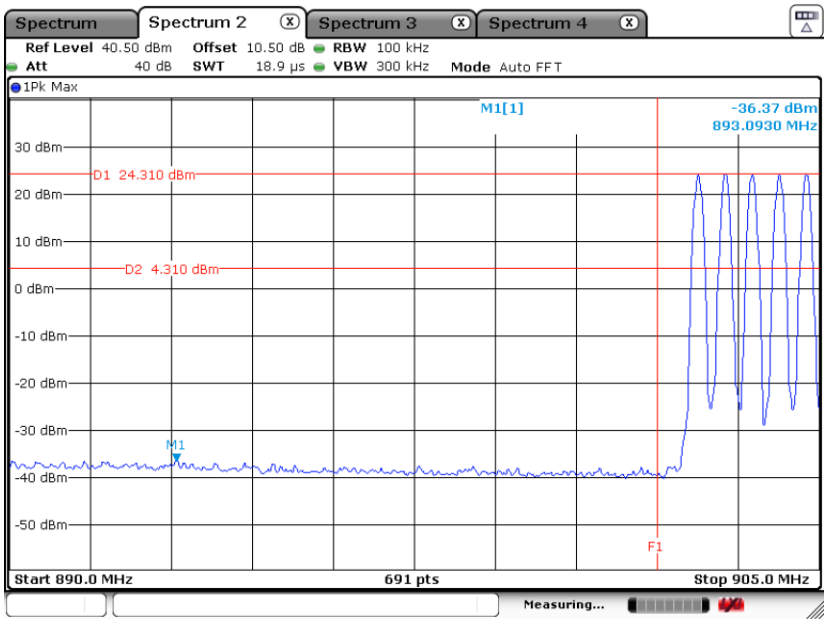
High Band Edge Plot on 927.25 MHz



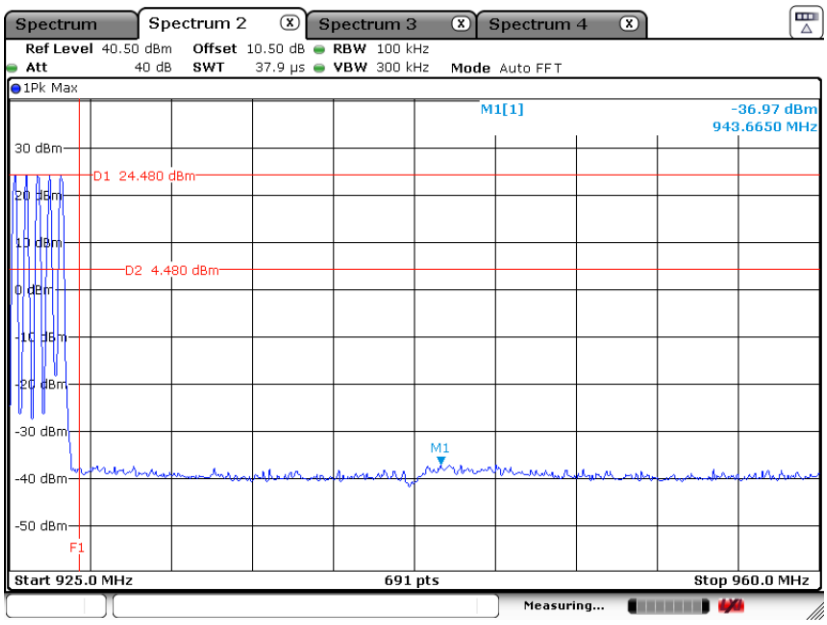
3.6.6 Test Result of Conducted Hopping Mode Band Edges

<RFID>

Hopping Mode Low Band Edge Plot on 902.75 MHz



Hopping Mode High Band Edge Plot on 927.25 MHz



3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

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

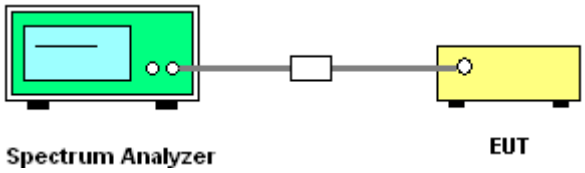
3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.7.3 Test Procedure

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

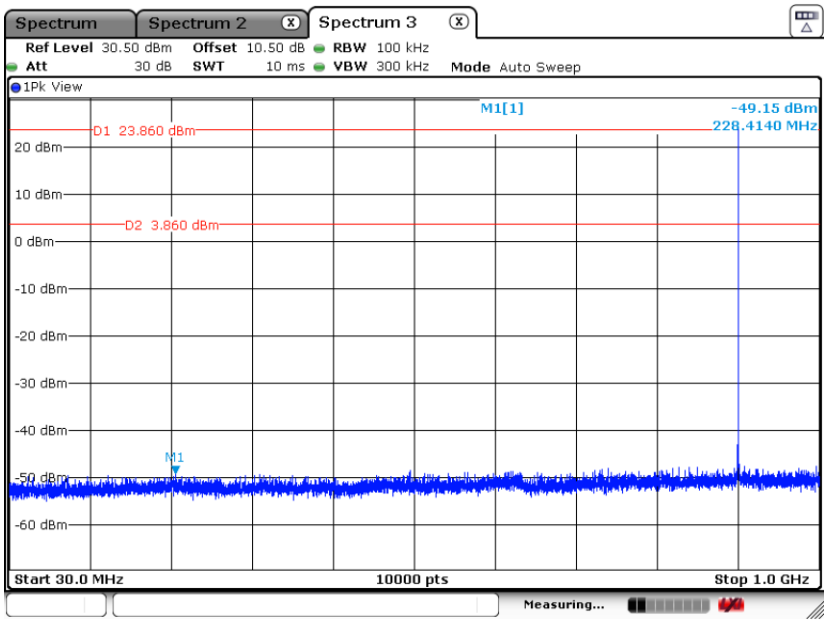
3.7.4 Test Setup



3.7.5 Test Result of Conducted Spurious Emission

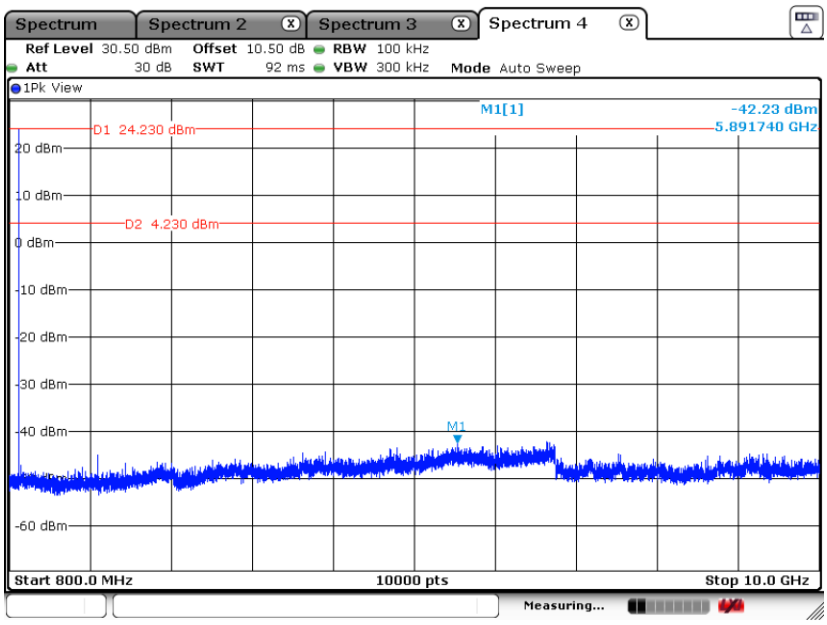
<RFID>

CSE Plot on Ch 902.75 MHz



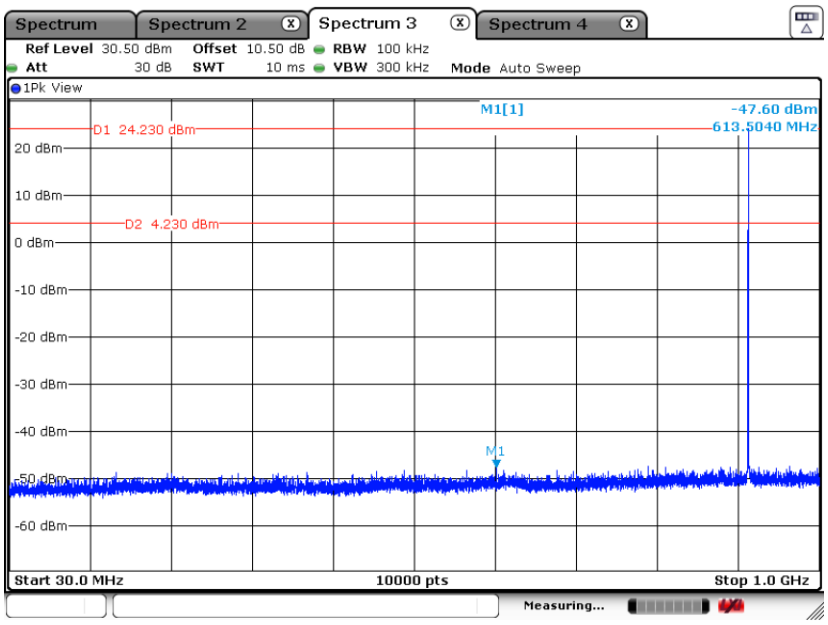
Date: 2.JUL.2024 22:10:54

CSE Plot on Ch 902.75 MHz



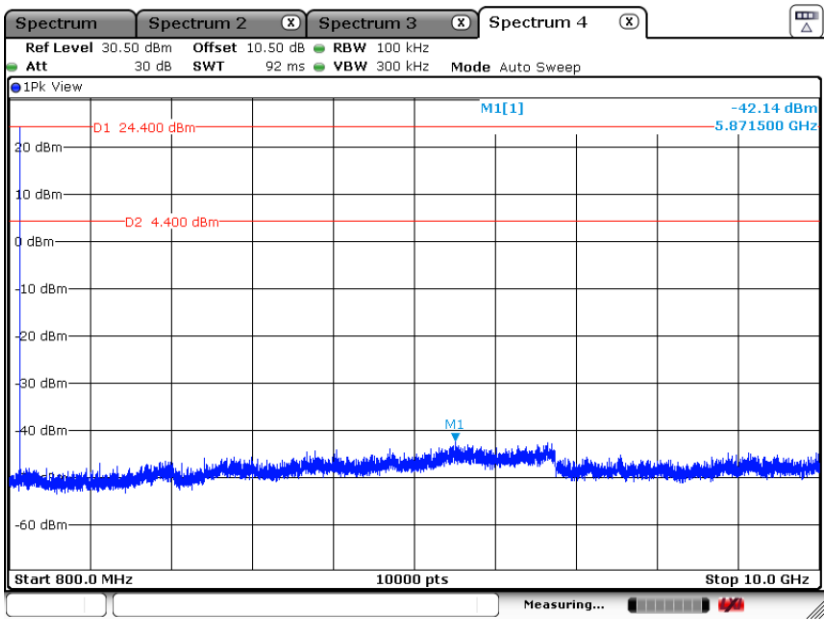
Date: 2.JUL.2024 22:12:40

CSE Plot on Ch 914.75 MHz



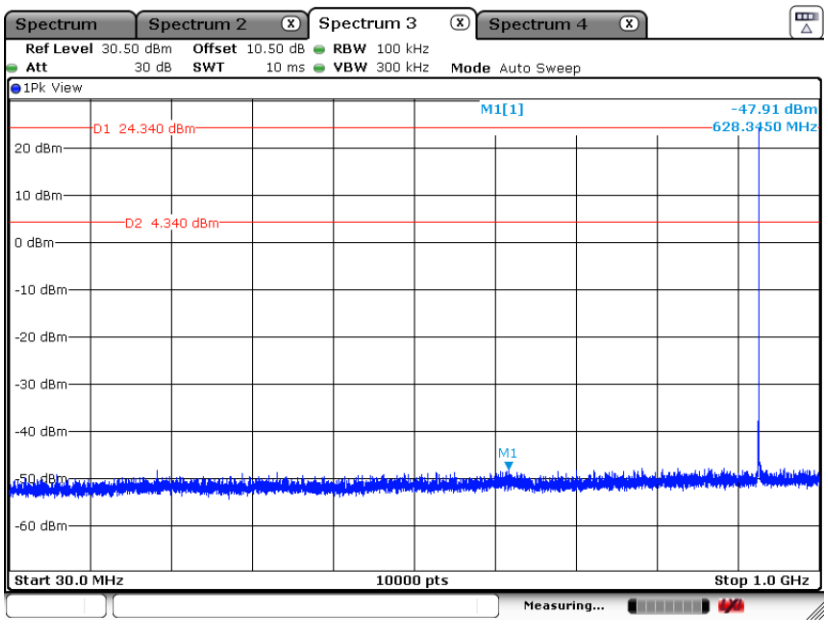
Date: 2.JUL.2024 22:28:50

CSE Plot on Ch 914.75 MHz



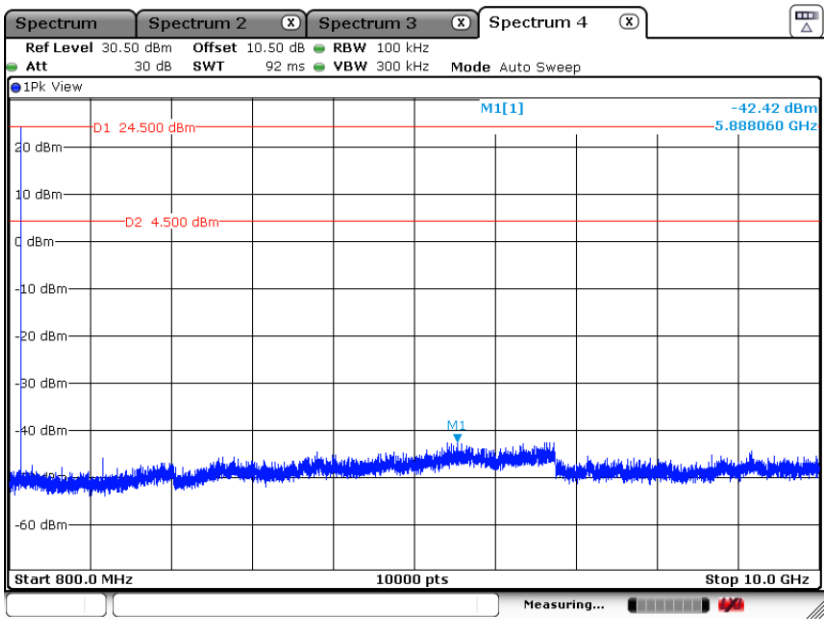
Date: 2.JUL.2024 22:29:32

CSE Plot on Ch 927.25 MHz



Date: 2.JUL.2024 22:35:03

CSE Plot on Ch 927.25 MHz



Date: 2.JUL.2024 22:35:42

3.8 Radiated Band Edges and Spurious Emission Measurement

3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

3.8.2 Measuring Instruments

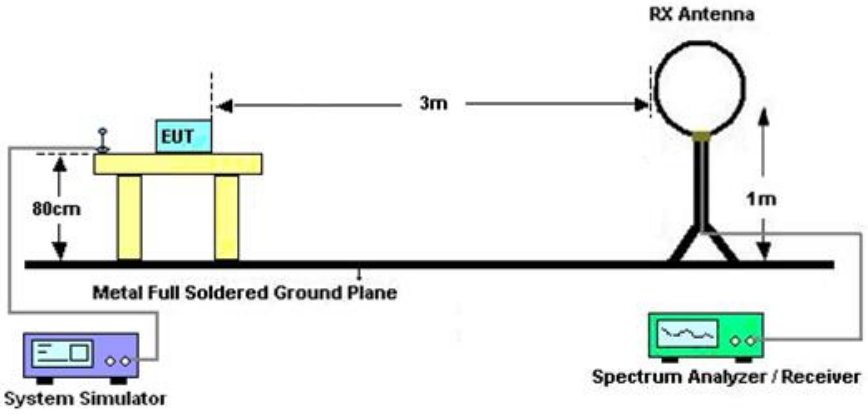
The measuring equipment is listed in the section 4 of this test report.

3.8.3 Test Procedures

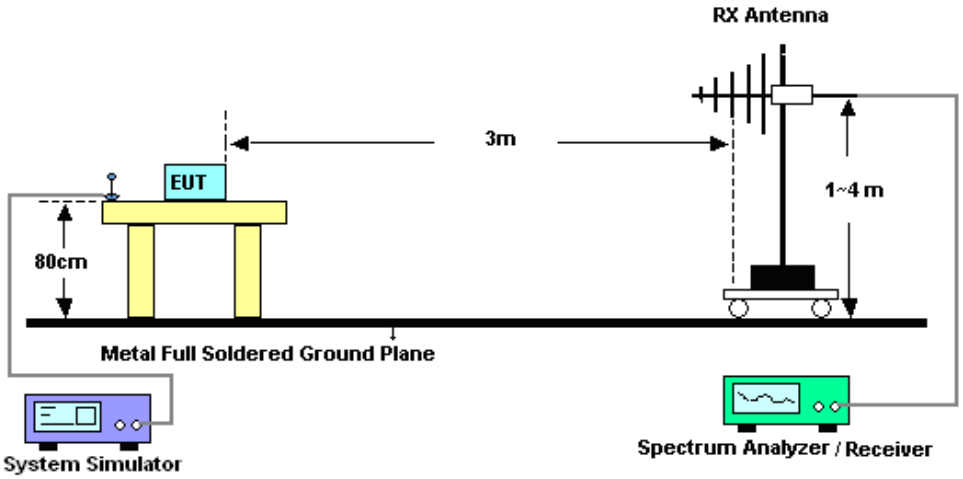
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
   (3) For average measurement: use duty cycle correction factor method per 15.35(c).
   Duty cycle = On time/100 milliseconds
   On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
   Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
   Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
7. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
8. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.8.4 Test Setup

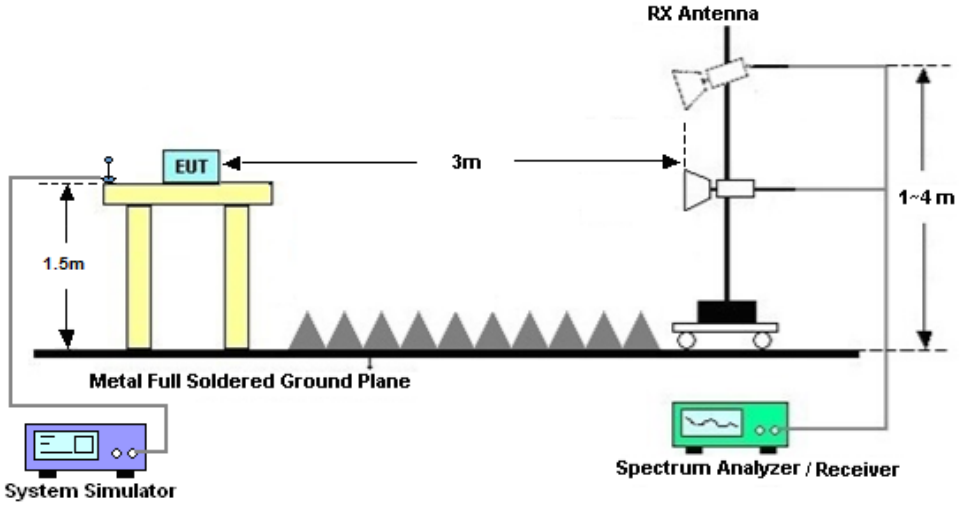
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.8.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix B.

3.8.8 Duty cycle correction factor for average measurement

Please refer to Appendix C.

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.

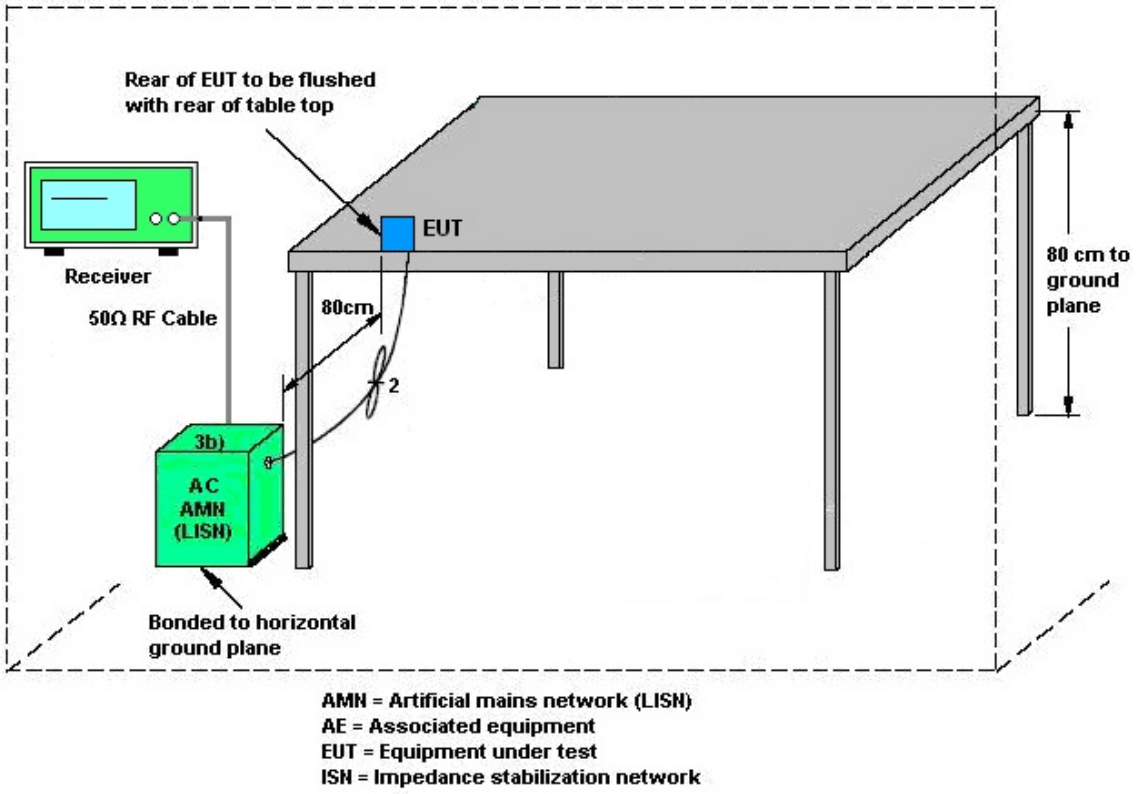
3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

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

3.9.4 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 A.

3.10 Antenna Requirements

3.10.1 Standard Applicable

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

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

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

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A	MY56400023	3Hz~8.5GHz;Max 30dBm	Jan. 02, 2024	Jul. 13, 2024	Jan. 01, 2025	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz-44GHz	Oct. 11, 2023	Jul. 13, 2024	Oct. 10, 2024	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Sep. 11, 2023	Jul. 13, 2024	Sep. 10, 2024	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	59915	30MHz-1GHz	Aug. 19, 2023	Jul. 13, 2024	Aug. 18, 2024	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 11, 2024	Jul. 13, 2024	Apr. 10, 2025	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 06, 2024	Jul. 13, 2024	Jan. 05, 2025	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	372171	9KHz ~1GHZ	Jan. 02, 2024	Jul. 13, 2024	Jan. 01, 2025	Radiation (03CH06-KS)
Amplifier	EM	EM18G40GA	060728	18~40GHz	Jan. 02, 2024	Jul. 13, 2024	Jan. 01, 2025	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2082395	1Ghz-18Ghz	Jan. 02, 2024	Jul. 13, 2024	Jan. 01, 2025	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 11, 2023	Jul. 13, 2024	Oct. 10, 2024	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jul. 13, 2024	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jul. 13, 2024	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jul. 13, 2024	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr 18, 2024	Jun. 16, 2024	Apr 17, 2025	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Jun. 16, 2024	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Apr 18, 2024	Jun. 16, 2024	Apr 17, 2025	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Jun. 16, 2024	Oct. 10, 2024	Conduction (CO01-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Jul. 02, 2024~ Jul. 08, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 02, 2024	Jul. 02, 2024~ Jul. 08, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Jul. 02, 2024~ Jul. 08, 2024	Jan. 01, 2025	Conducted (TH01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Conducted Spurious Emission & Bandedge	**±2.22 dB**
Occupied Channel Bandwidth	**±0.1%**
Conducted Power	**±0.50 dB**
Conducted Power Spectral Density	**±0.90 dB**
Frequency	**0.04ppm**

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.84 dB**

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**3.30 dB**

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.06 dB**

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.18 dB**

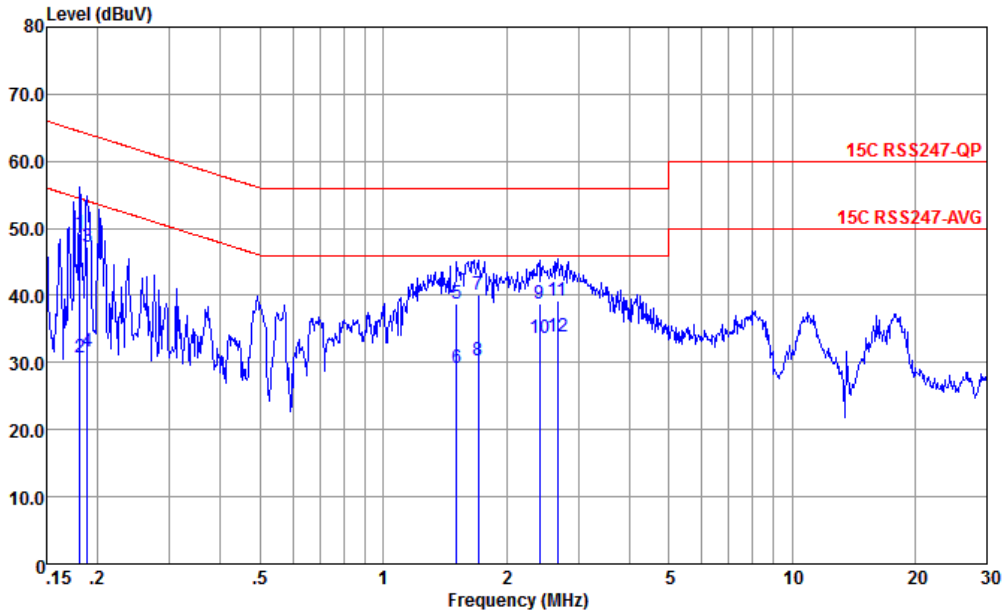
Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.38 dB**

---------- THE END ----------

Appendix A. AC Conducted Emission Test Results

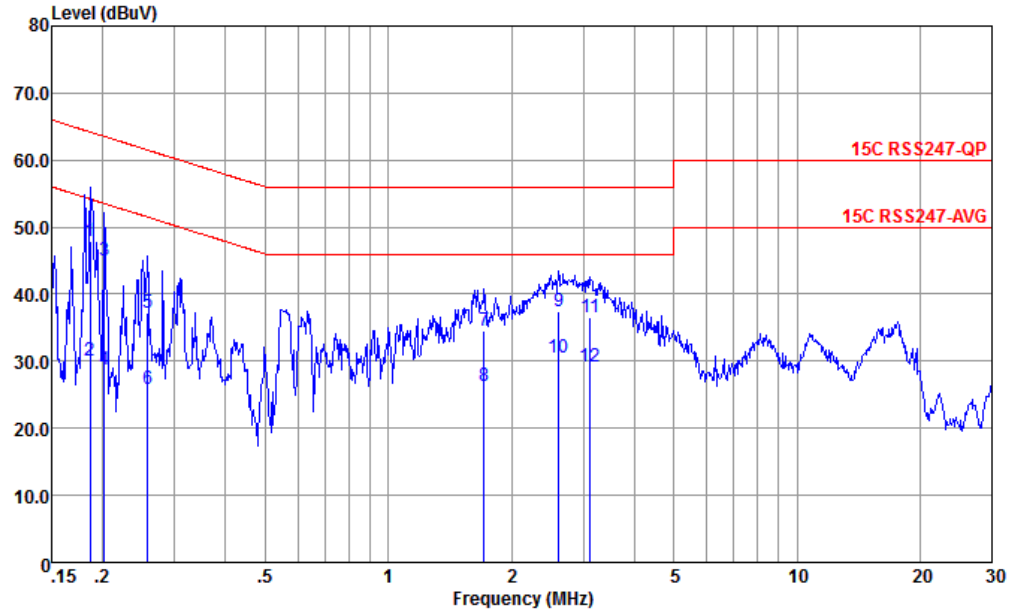
Test Engineer :	Amos Zhang	**Temperature :**	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-L 2023 LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.181	49.25	-15.21	64.46	38.80	0.04	10.41	QP
2		0.181	30.75	-23.71	54.46	20.30	0.04	10.41	Average
3		0.188	47.35	-16.76	64.11	36.91	0.03	10.41	QP
4		0.188	31.65	-22.46	54.11	21.21	0.03	10.41	Average
5		1.511	38.76	-17.24	56.00	28.80	-0.12	10.08	QP
6		1.511	29.16	-16.84	46.00	19.20	-0.12	10.08	Average
7		1.707	40.15	-15.85	56.00	30.20	-0.13	10.08	QP
8		1.707	30.25	-15.75	46.00	20.30	-0.13	10.08	Average
9		2.409	38.86	-17.14	56.00	28.90	-0.11	10.07	QP
10		2.409	33.56	-12.44	46.00	23.60	-0.11	10.07	Average
11		2.664	39.17	-16.83	56.00	29.20	-0.10	10.07	QP
12	*	2.664	33.87	-12.13	46.00	23.90	-0.10	10.07	Average

Test Engineer :	Amos Zhang	Temperature :	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-N 2023 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.186	47.96	-16.24	64.20	37.50	0.05	10.41	QP
2	0.186	30.06	-24.14	54.20	19.60	0.05	10.41	Average
3	0.202	44.96	-18.58	63.54	34.50	0.05	10.41	QP
4	0.202	28.66	-24.88	53.54	18.20	0.05	10.41	Average
5	0.258	37.16	-24.35	61.51	26.81	-0.01	10.36	QP
6	0.258	25.86	-25.65	51.51	15.51	-0.01	10.36	Average
7	1.716	34.46	-21.54	56.00	24.50	-0.12	10.08	QP
8	1.716	26.26	-19.74	46.00	16.30	-0.12	10.08	Average
9	2.608	37.45	-18.55	56.00	27.51	-0.13	10.07	QP
10 *	2.608	30.55	-15.45	46.00	20.61	-0.13	10.07	Average
11	3.123	36.54	-19.46	56.00	26.60	-0.13	10.07	QP
12	3.123	29.24	-16.76	46.00	19.30	-0.13	10.07	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix B. Radiated Spurious Emission Test Data

Test Engineer :	levi zhao	Relative Humidity :	41 ~ 42 %
		Temperature :	22 ~ 23 ℃

Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Antenna	Modulation	Channel	Data Rate	RU	Remark
Mode 1	902.75-927.25	0	RFID	902.75	-	-	-
Mode 2	902.75-927.25	0	RFID	914.75	-	-	-
Mode 3	902.75-927.25	0	RFID	927.25	-	-	-

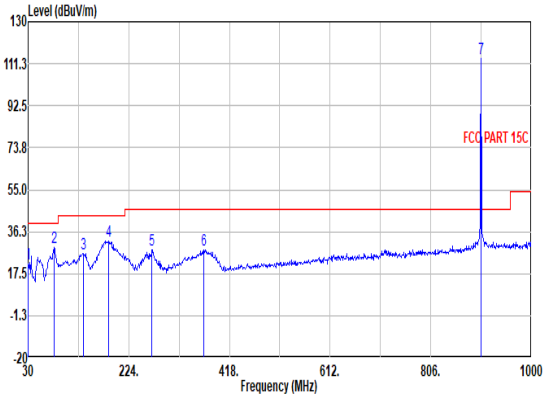
Summary of each worse mode

Mode	Modulation	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	RFID_ASK	49.40	33.16	40	-6.84	V	Peak	-	Band Edge
1	RFID_ASK	2708.2	38.06	74	-35.94	H	Peak	-	Harmonic
2	RFID_ASK	46.49	33.70	40	-6.3	V	Peak	-	Band Edge
2	RFID_ASK	2744.20	38.67	74	-35.33	V	Peak	-	Harmonic
3	RFID_ASK	52.31	32.35	40	-7.65	V	Peak	-	Band Edge
3	RFID_ASK	2782	37.54	74	-36.46	H	Peak	-	Harmonic

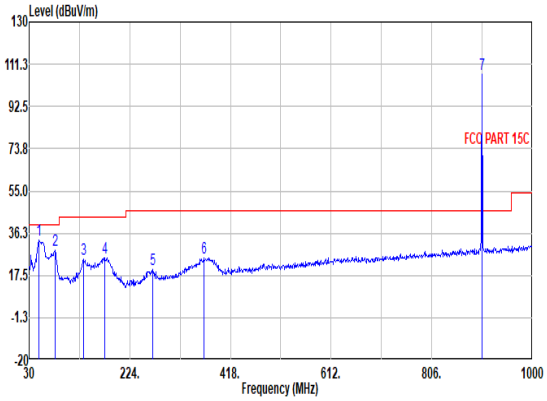
Mode	1	
	BE	
	RFID 902.75	
ANT	0	
Pol.	Horizontal	Vertical

Peak

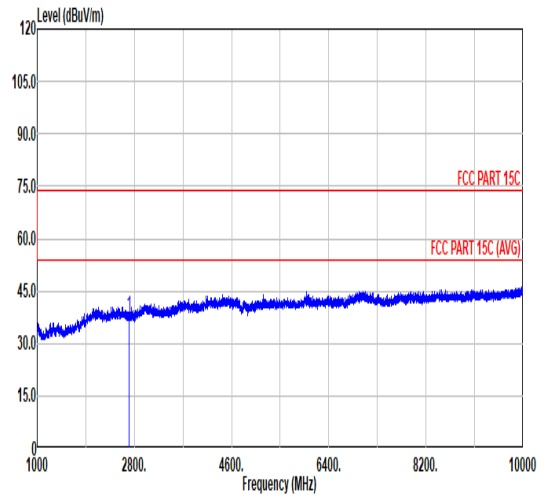
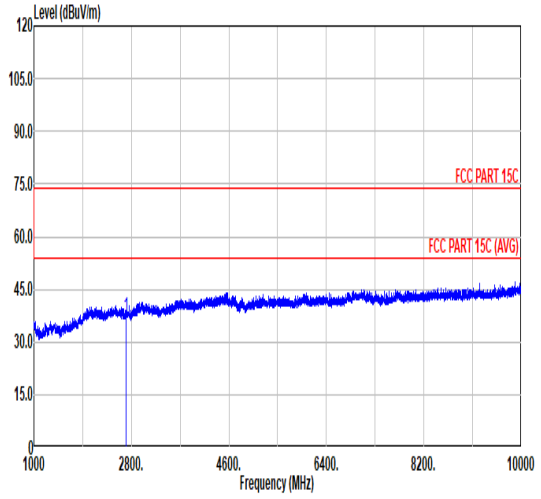
Avg



	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	30.00	21.74	40.00	-18.26	28.19	25.74	0.76	32.95	0.00	---	---	Peak
2	80.44	29.23	40.00	-10.77	47.01	13.57	1.31	32.66	0.00	---	---	Peak
3	136.70	26.58	43.50	-16.92	39.99	17.56	1.72	32.69	0.00	---	---	Peak
4	185.20	31.99	43.50	-11.51	47.74	15.07	1.99	32.81	0.00	---	---	Peak
5	268.62	28.37	46.00	-17.63	39.75	19.34	2.26	32.98	0.00	---	---	Peak
6	368.53	28.21	46.00	-17.79	37.41	21.08	2.84	33.12	0.00	---	---	Peak
7	902.75	113.70	46.00	67.70	112.67	29.13	4.49	32.59	0.00	---	---	Peak



	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	49.40	33.16	40.00	-6.84	50.14	14.95	0.99	32.92	0.00	---	---	Peak
2	80.44	28.78	40.00	-11.22	46.56	13.57	1.31	32.66	0.00	---	---	Peak
3	134.76	24.50	43.50	-19.00	37.93	17.56	1.71	32.70	0.00	---	---	Peak
4	176.47	25.18	43.50	-18.32	40.64	15.36	1.94	32.76	0.00	---	---	Peak
5	268.62	20.16	46.00	-25.84	31.54	19.34	2.26	32.98	0.00	---	---	Peak
6	367.56	25.41	46.00	-20.59	34.63	21.06	2.84	33.12	0.00	---	---	Peak
7	902.75	107.06	46.00	61.06	106.03	29.13	4.49	32.59	0.00	---	---	Peak

Mode	1	
	Harmonic	
	RFID 902.75	
ANT	0	
Pol.	Horizontal	Vertical
Peak Avg		

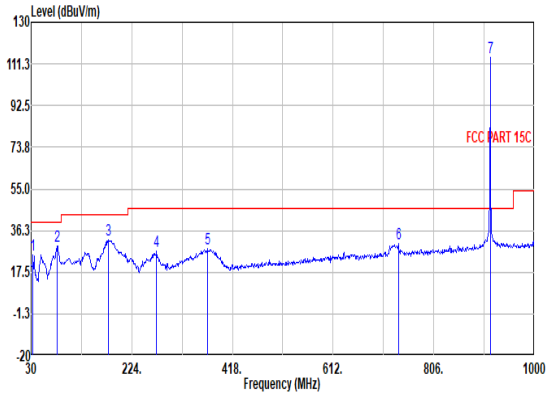
	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	2708.20	38.06	74.00	-35.94	60.99	31.73	7.05	61.71	0.00	---	---	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	2708.20	37.25	74.00	-36.75	60.18	31.73	7.05	61.71	0.00	---	---	Peak

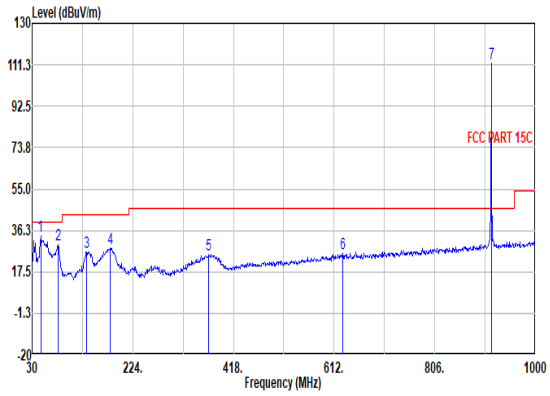
Mode	2	
	BE	
	RFID 914.75	
ANT	0	
Pol.	Horizontal	Vertical

Peak

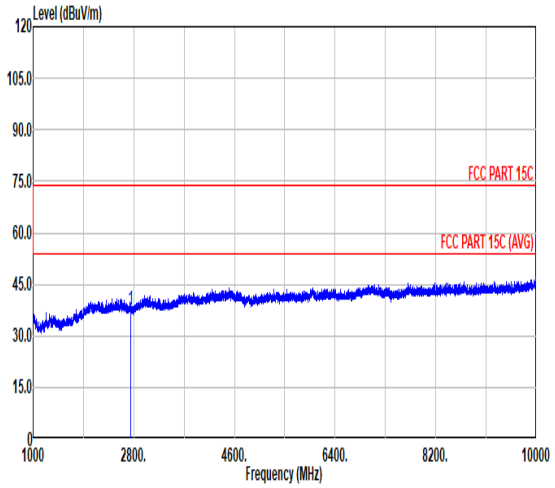
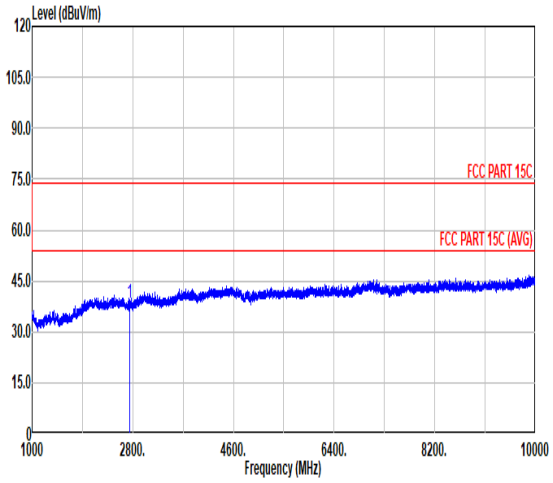
Avg



	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	33.88	25.40	40.00	-14.60	34.51	23.10	0.76	32.97	0.00	---	---	Peak
2	80.44	29.31	40.00	-10.69	47.09	13.57	1.31	32.66	0.00	---	---	Peak
3	178.41	32.02	43.50	-11.48	47.61	15.23	1.95	32.77	0.00	---	---	Peak
4	271.53	26.94	46.00	-19.06	38.37	19.24	2.29	32.96	0.00	---	---	Peak
5	369.50	27.93	46.00	-18.07	37.10	21.11	2.85	33.13	0.00	---	---	Peak
6	738.10	30.27	46.00	-15.73	32.30	27.28	4.04	33.35	0.00	---	---	Peak
7	914.75	113.96	46.00	67.96	112.57	29.31	4.51	32.43	0.00	---	---	Peak



	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	46.49	33.70	40.00	-6.30	49.50	16.19	0.96	32.95	0.00	---	---	Peak
2	79.47	29.86	40.00	-10.14	47.40	13.75	1.30	32.59	0.00	---	---	Peak
3	134.76	26.63	43.50	-16.87	40.06	17.56	1.71	32.70	0.00	---	---	Peak
4	180.35	28.26	43.50	-15.24	43.99	15.09	1.96	32.78	0.00	---	---	Peak
5	370.47	25.55	46.00	-20.45	34.70	21.13	2.85	33.13	0.00	---	---	Peak
6	628.49	25.76	46.00	-20.24	29.26	26.34	3.69	33.53	0.00	---	---	Peak
7	914.75	112.05	46.00	66.05	110.66	29.31	4.51	32.43	0.00	---	---	Peak

Mode	2	
	Harmonic	
	RFID 914.75	
ANT	0	
Pol.	Horizontal	Vertical
Peak Avg		

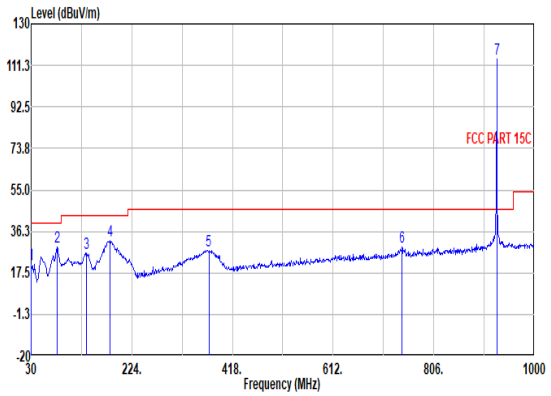
	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	2744.20	37.80	74.00	-36.20	60.50	31.88	7.11	61.69	0.00	---	---	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	2744.20	38.67	74.00	-35.33	61.37	31.88	7.11	61.69	0.00	---	---	Peak

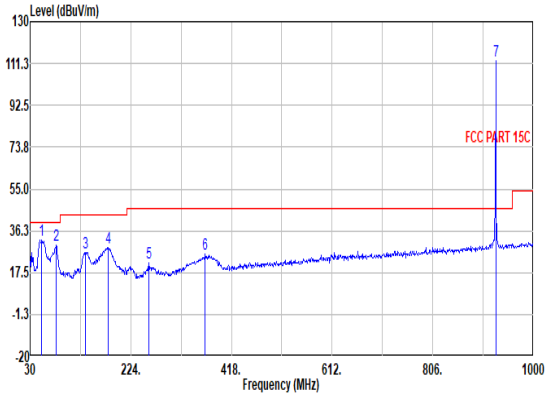
Mode	3	
	BE	
	RFID 927.25	
ANT	0	
Pol.	Horizontal	Vertical

Peak

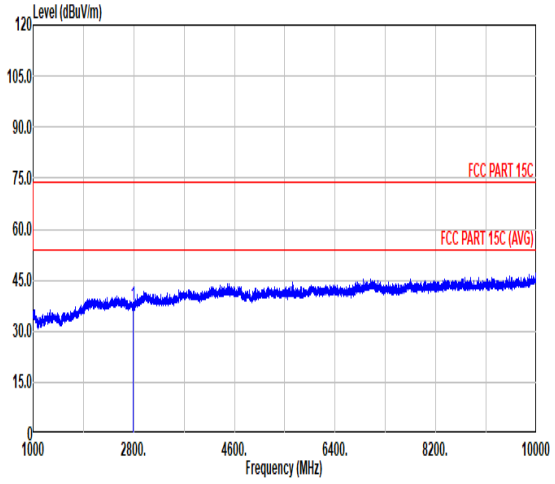
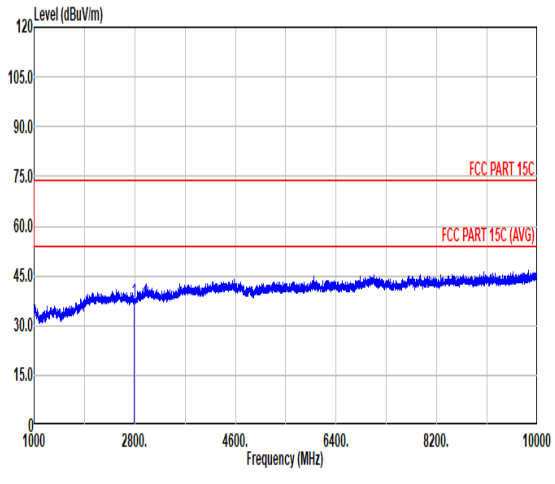
Avg



	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	30.00	21.55	40.00	-18.45	28.00	25.74	0.76	32.95	0.00	---	---	Peak
2	80.44	28.97	40.00	-11.03	46.75	13.57	1.31	32.66	0.00	---	---	Peak
3	136.70	26.27	43.50	-17.23	39.68	17.56	1.72	32.69	0.00	---	---	Peak
4	181.32	31.84	43.50	-11.66	47.57	15.09	1.97	32.79	0.00	---	---	Peak
5	372.41	27.72	46.00	-18.28	36.82	21.18	2.86	33.14	0.00	---	---	Peak
6	744.89	29.34	46.00	-16.66	31.21	27.38	4.06	33.31	0.00	---	---	Peak
7	927.25	114.08	46.00	68.08	112.29	29.50	4.54	32.25	0.00	---	---	Peak

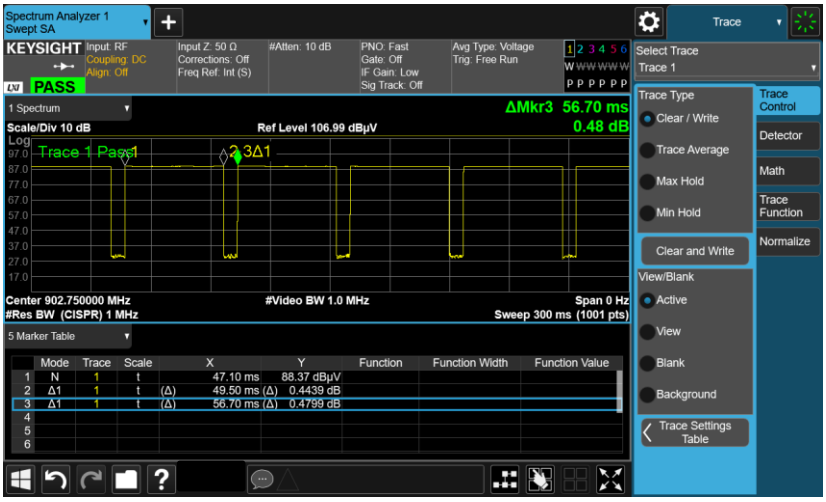


	Freq	Level	Limit Line	Over Limit	Read Level	Ant Factor	Cable Loss	Preamp Factor	Aux Factor	APos	TPos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB	dB	cm	deg	
1	52.31	32.35	40.00	-7.65	50.17	14.02	1.00	32.84	0.00	---	---	Peak
2	80.44	29.55	40.00	-10.45	47.33	13.57	1.31	32.66	0.00	---	---	Peak
3	136.70	26.46	43.50	-17.04	39.87	17.56	1.72	32.69	0.00	---	---	Peak
4	180.35	28.69	43.50	-14.81	44.42	15.09	1.96	32.78	0.00	---	---	Peak
5	258.92	21.72	46.00	-24.28	33.02	19.56	2.17	33.03	0.00	---	---	Peak
6	367.56	25.69	46.00	-20.31	34.91	21.06	2.84	33.12	0.00	---	---	Peak
7	927.25	112.37	46.00	66.37	110.58	29.50	4.54	32.25	0.00	---	---	Peak

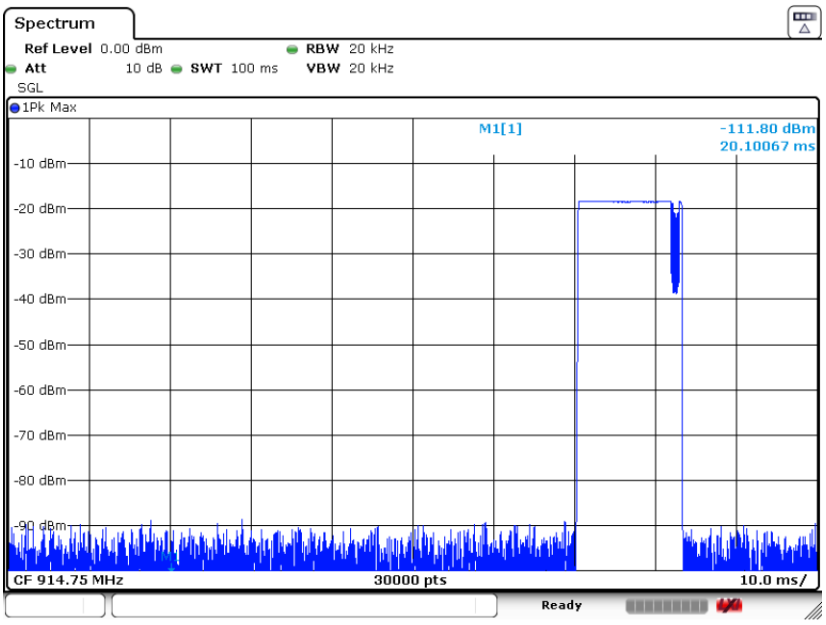
Mode	3	
	Harmonic	
	RFID 927.25	
ANT	0	
Pol.	Horizontal	Vertical
Peak Avg	 Freq Level Limit Line Over Limit Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2782.00 37.54 74.00 -36.46 60.08 31.96 7.16 61.66 0.00 --- --- Peak	 Freq Level Limit Line Over Limit Read Level Ant Factor Cable Loss Preamp Factor Aux Factor APos TPos Remark MHz dBuV/m dBuV/m dB dBuV dB/m dB dB dB cm deg 1 2782.00 37.13 74.00 -36.87 59.67 31.96 7.16 61.66 0.00 --- --- Peak

Appendix C. Duty Cycle Plots

RFID on time (One Pulse) Plot



RFID on time (Count Pulses) Plot



Note:

1. Worst case Duty cycle = on time/100 milliseconds = 1 * 49.5 / 100 = 49.50 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -6.11 dB
3. RFID has the highest duty cycle worst case and is reported.