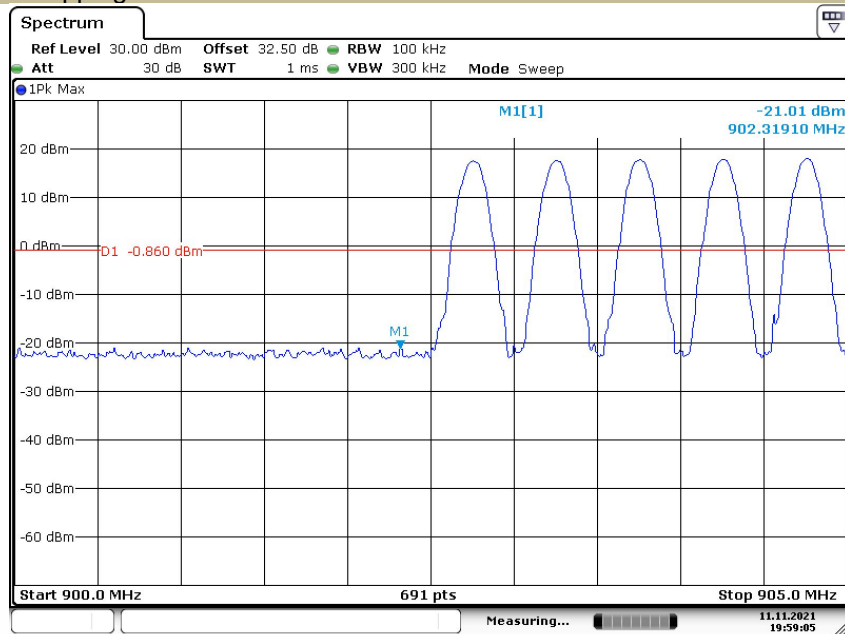


Test Model

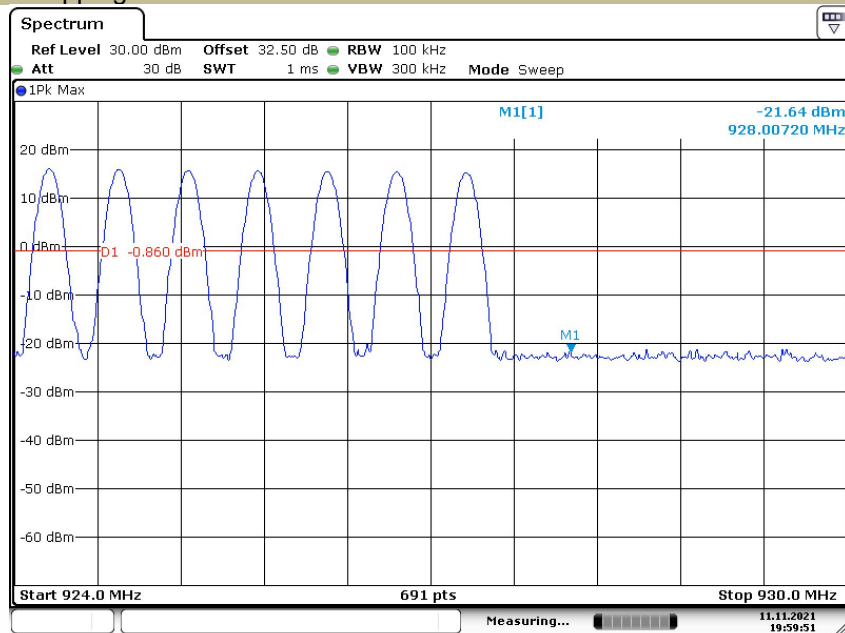
Band-edge Conducted Emissions
RFID
Hopping



Date: 11.NOV.2021 19:59:05

Test Model

Band-edge Conducted Emissions
RFID
Hopping



Date: 11.NOV.2021 19:59:52

8.7 RADIATED SPURIOUS EMISSION

8.7.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and KDB 558074: D01 15.247 Meas Guidance v05r02

8.7.2 Conformance Limit

According to FCC Part 15.247(d): radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to FCC Part 15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part 15.205, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (uV/m)	300
0.490-1.705	24000/F(KHz)	20 log (uV/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Remark :1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. Distance extrapolation factor =40log(Specific distance/ test distance)(dB);

Limit line=Specific limits(dBuV) + distance extrapolation factor.

for the frequency ranges below 30 MHz, a narrower RBW is used for these ranges but the measured value should add a RBW correction factor (RBWCF) where RBWCF [dB] =10*Ig(100 [kHz]/narrower RBW [kHz]). , the narrower RBW is 1 kHz and RBWCF is 20 dB for the frequency 9 kHz to 150 kHz, and the narrower RBW is 10 kHz and RBWCF is 10 dB for the frequency 150 kHz to 30 MHz.

8.7.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

8.7.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

For Above 1GHz:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 1GHz:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 100 kHz for

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 30MHz:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 9kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 150KHz:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 200Hz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Repeat above procedures until all frequency measured was complete.

8.7.5 Test Results

■ Spurious Emission below 30MHz (9KHz to 30MHz)

Temperature:	26° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance/ test distance})$ (dB);

Limit line = Specific limits(dBuV) + distance extrapolation factor.



Spurious Emission Above 1GHz (1GHz to 10GHz)

Test mode: ASK Frequency: Channel 01: 902.75MHz

Freq. (MHz)	Ant.P ol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
2128.139	V	51.03	36.20	74	54	-22.97	-17.8
2564.484	V	53.99	38.50	74	54	-20.01	-15.50
3475.362	V	50.98	35.60	74	54	-23.02	-18.40
2133.045	H	51.03	35.30	74	54	-22.97	-18.7
2564.484	H	53.99	38.90	74	54	-20.01	-15.10
3475.362	H	50.98	36.10	74	54	-23.02	-17.90

Test mode: ASK Frequency: Channel 01: 915.75MHz

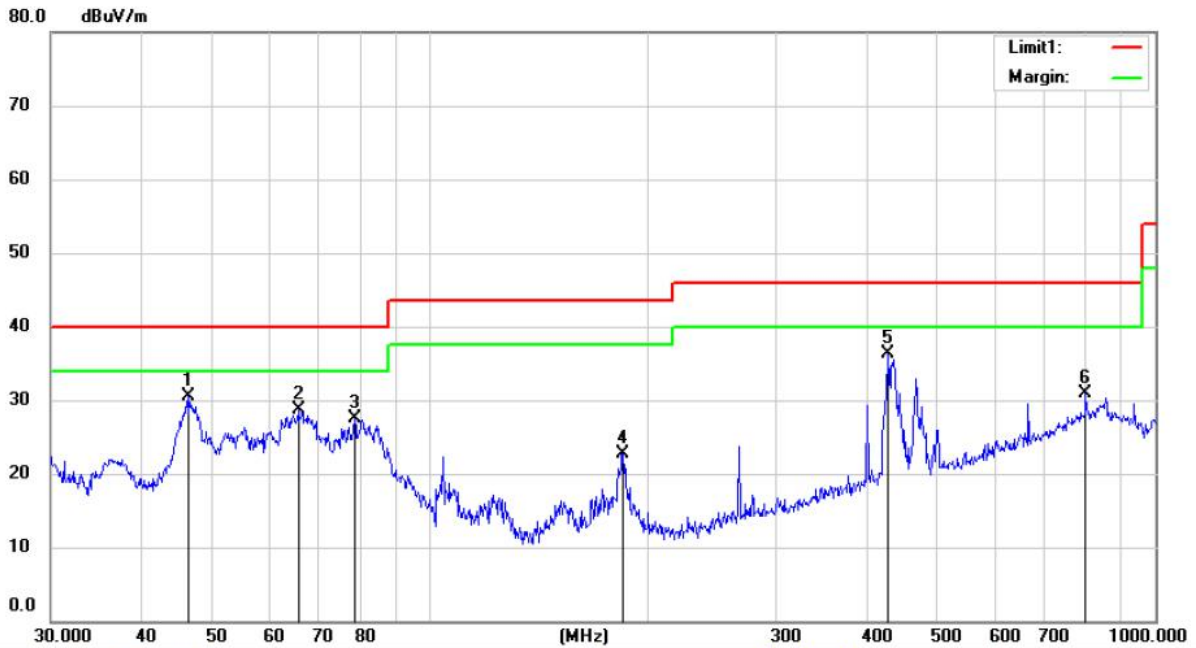
Freq. (MHz)	Ant.P ol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
1807.174	V	50.77	34.40	74	54	-23.23	-19.6
2564.484	V	50.97	36.10	74	54	-23.03	-17.90
3451.437	V	50.78	35.20	74	54	-23.22	-18.80
1807.174	H	51.38	35.40	74	54	-22.62	-18.6
2471.724	H	49.94	34.60	74	54	-24.06	-19.40
3483.373	H	50.01	34.90	74	54	-23.99	-19.10

Test mode: ASK Frequency: Channel 50: 927.25MHz

Freq. (MHz)	Ant.P ol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
1845.015	V	50.99	35.50	74	54	-23.01	-18.5
2471.724	V	52.04	36.90	74	54	-21.96	-17.10
3451.437	V	52.05	37.10	74	54	-21.95	-16.90
1845.015	H	51.05	35.80	74	54	-22.95	-18.2
2471.724	H	52.23	36.80	74	54	-21.77	-17.20
3443.499	H	53.24	37.60	74	54	-20.76	-16.40

- Note:**
- (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
 - (2) Emission Level= Reading Level+Probe Factor +Cable Loss.
 - (3)The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
 - (4) R* is short for Restricted band, F* is short for Fundamental frequency.

■ Spurious Emission below 1GHz (30MHz to 1GHz)



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

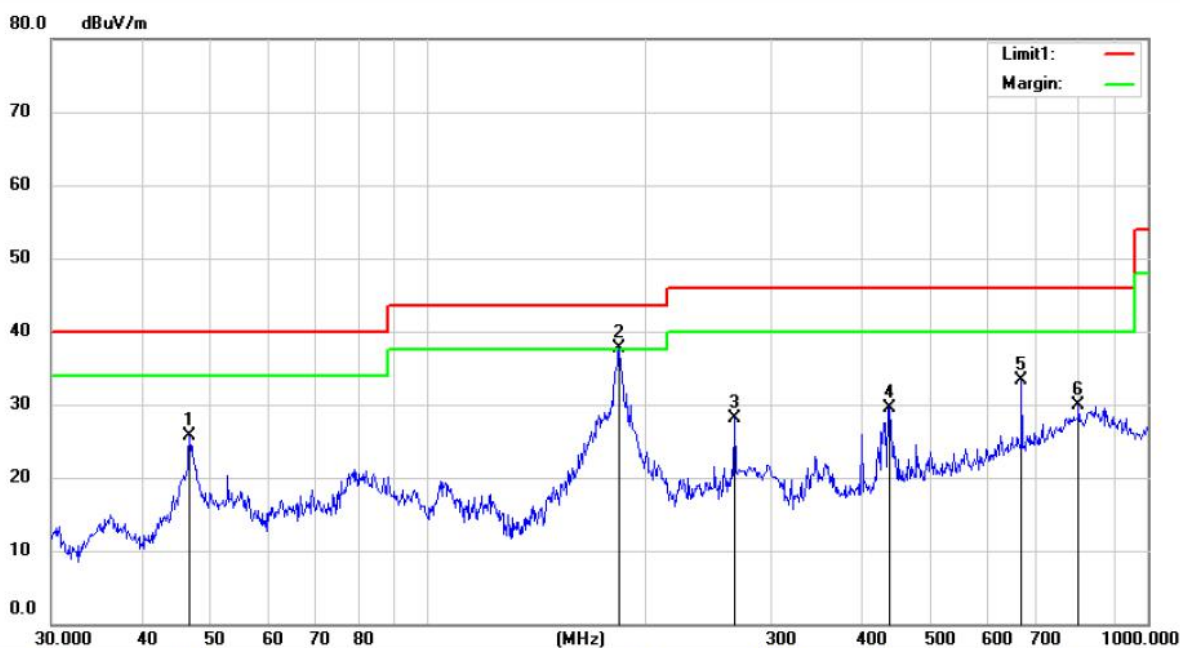
Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID L

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	46.5030	45.80	-15.26	30.54	40.00	-9.46	QP		
2		65.8031	43.68	-15.03	28.65	40.00	-11.35	QP		
3		78.6888	45.00	-17.57	27.43	40.00	-12.57	QP		
4		184.4898	39.87	-17.08	22.79	43.50	-20.71	QP		
5		428.0193	44.98	-8.58	36.40	46.00	-9.60	QP		
6		801.7863	30.54	0.35	30.89	46.00	-15.11	QP		



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

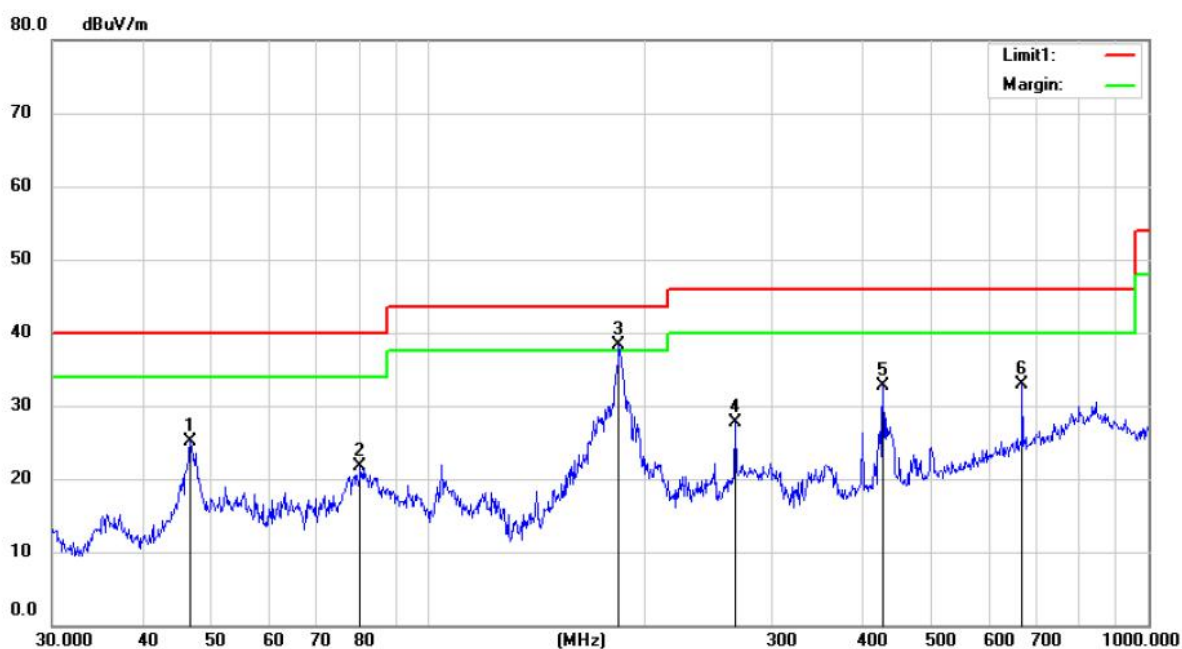
Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID L

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		46.6664	41.03	-15.26	25.77	40.00	-14.23	QP		
2	*	184.4898	54.69	-17.08	37.61	43.50	-5.89	QP		
3		266.6090	42.33	-14.24	28.09	46.00	-17.91	QP		
4		437.1200	38.14	-8.57	29.57	46.00	-16.43	QP		
5		668.1423	36.78	-3.40	33.38	46.00	-12.62	QP		
6		801.7863	29.46	0.35	29.81	46.00	-16.19	QP		



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID M

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		46.6664	40.27	-15.26	25.01	40.00	-14.99	QP		
2		80.3620	39.48	-17.81	21.67	40.00	-18.33	QP		
3	*	183.8440	55.46	-17.14	38.32	43.50	-5.18	QP		
4		266.6090	41.95	-14.24	27.71	46.00	-18.29	QP		
5		428.0193	41.23	-8.58	32.65	46.00	-13.35	QP		
6		668.1423	36.35	-3.40	32.95	46.00	-13.05	QP		



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID M

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	45.8553	42.99	-15.24	27.75	40.00	-12.25	QP		
2		67.2022	42.39	-15.32	27.07	40.00	-12.93	QP		
3		82.6482	42.73	-18.06	24.67	40.00	-15.33	QP		
4		184.4898	36.39	-17.08	19.31	43.50	-24.19	QP		
5		437.1200	40.69	-8.57	32.12	46.00	-13.88	QP		
6		848.0563	28.50	1.08	29.58	46.00	-16.42	QP		



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

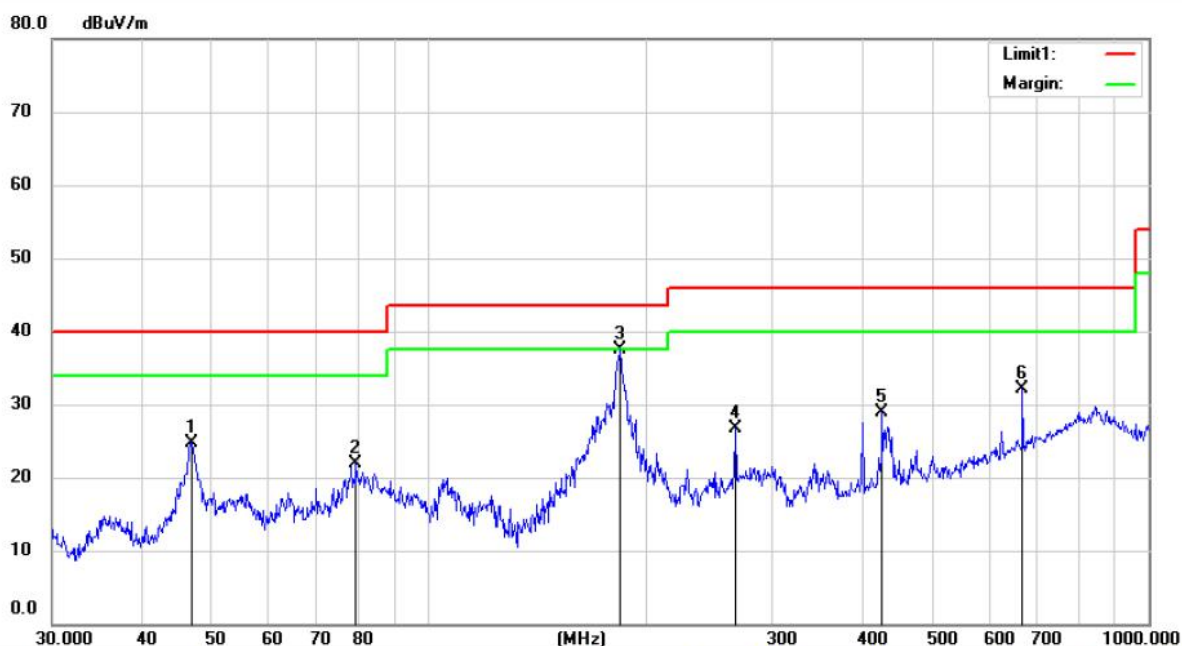
Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID H

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	*	46.5030	46.43	-15.26	31.17	40.00	-8.83	QP		
2		66.9670	43.89	-15.27	28.62	40.00	-11.38	QP		
3		183.8440	39.50	-17.14	22.36	43.50	-21.14	QP		
4		266.6090	39.07	-14.24	24.83	46.00	-21.17	QP		
5		434.0651	43.61	-8.53	35.08	46.00	-10.92	QP		
6		839.1818	28.71	1.04	29.75	46.00	-16.25	QP		



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22.9 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 58 %

Mode:RFID H

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		46.6664	39.88	-15.26	24.62	40.00	-15.38	QP		
2		79.2426	39.51	-17.65	21.86	40.00	-18.14	QP		
3	*	184.4898	54.51	-17.08	37.43	43.50	-6.07	QP		
4		266.6090	40.93	-14.24	26.69	46.00	-19.31	QP		
5		426.5210	37.48	-8.65	28.83	46.00	-17.17	QP		
6		668.1423	35.53	-3.40	32.13	46.00	-13.87	QP		

8.8 CONDUCTED EMISSION TEST

8.8.1 Applicable Standard

According to FCC Part 15.207(a)

8.8.2 Conformance Limit

Conducted Emission Limit		
Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50
Note: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.		

8.8.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

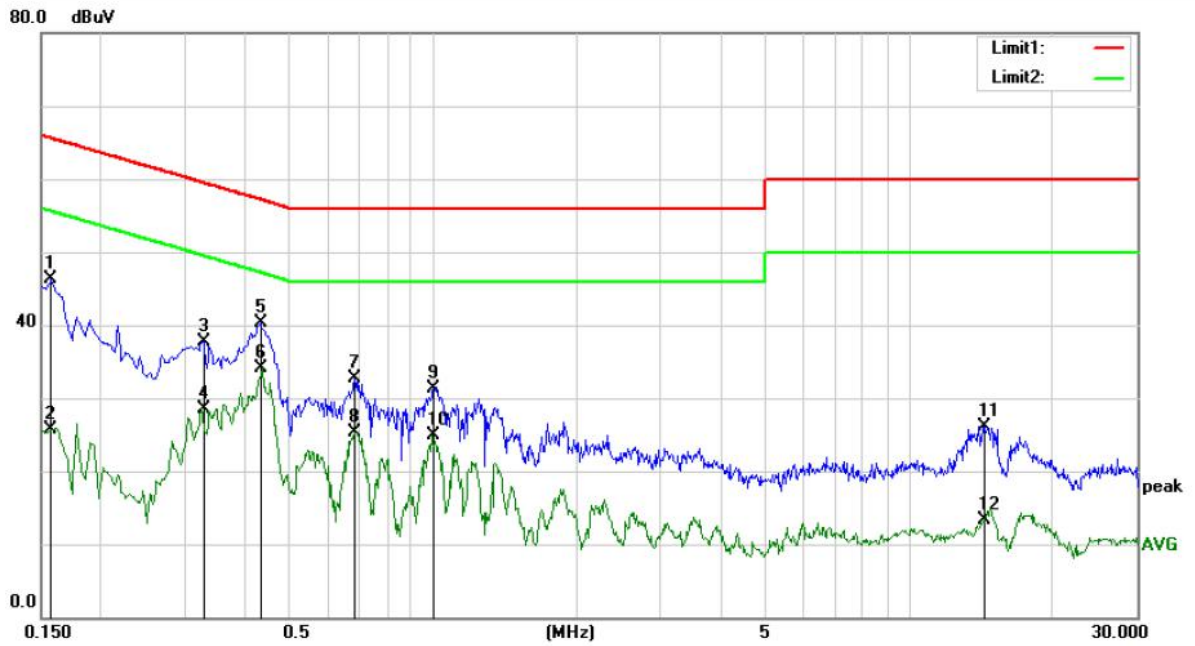
8.8.4 Test Procedure

The EUT was placed on a table which is 0.8m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Repeat above procedures until all frequency measured were complete.

8.8.5 Test Results

PASS.

Please refer to the following pages.



Site Conduction #2

Phase: **N**

Temperature: 23.5

Limit: (CE)FCC PART 15 class B_QP

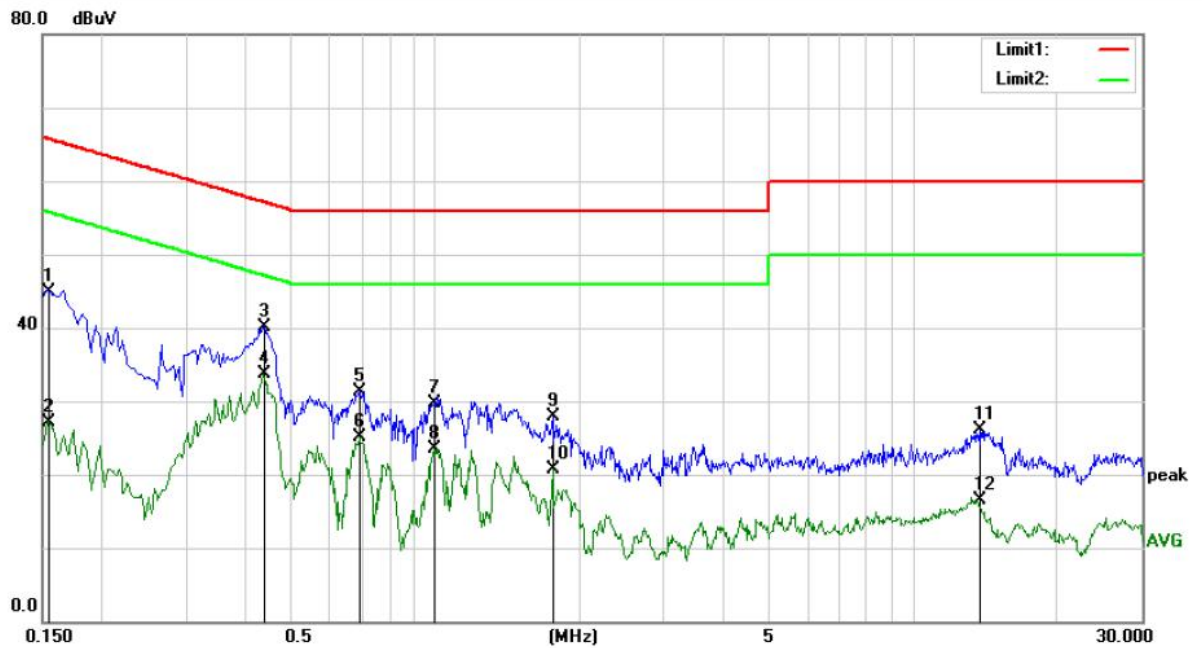
Power: AC 120V/60Hz

Humidity: 37 %

Mode: RF MODE

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1580	35.74	10.48	46.22	65.57	-19.35	QP	
2		0.1580	15.18	10.48	25.66	55.57	-29.91	AVG	
3		0.3268	27.31	10.39	37.70	59.53	-21.83	QP	
4		0.3268	18.21	10.39	28.60	49.53	-20.93	AVG	
5		0.4340	30.01	10.37	40.38	57.18	-16.80	QP	
6	*	0.4340	23.71	10.37	34.08	47.18	-13.10	AVG	
7		0.6860	22.36	10.35	32.71	56.00	-23.29	QP	
8		0.6860	14.96	10.35	25.31	46.00	-20.69	AVG	
9		1.0020	20.92	10.42	31.34	56.00	-24.66	QP	
10		1.0020	14.49	10.42	24.91	46.00	-21.09	AVG	
11		14.4060	15.44	10.71	26.15	60.00	-33.85	QP	
12		14.4060	2.61	10.71	13.32	50.00	-36.68	AVG	



Site Conduction #2

Phase: **L1**

Temperature: 23.5

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

Humidity: 37 %

Mode: RF MODE

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1547	34.48	10.48	44.96	65.74	-20.78	QP	
2		0.1547	16.57	10.48	27.05	55.74	-28.69	AVG	
3		0.4380	29.84	10.36	40.20	57.10	-16.90	QP	
4	*	0.4380	23.29	10.36	33.65	47.10	-13.45	AVG	
5		0.6900	20.94	10.35	31.29	56.00	-24.71	QP	
6		0.6900	14.74	10.35	25.09	46.00	-20.91	AVG	
7		0.9940	19.29	10.42	29.71	56.00	-26.29	QP	
8		0.9940	13.14	10.42	23.56	46.00	-22.44	AVG	
9		1.7540	17.55	10.34	27.89	56.00	-28.11	QP	
10		1.7540	10.35	10.34	20.69	46.00	-25.31	AVG	
11		13.7300	15.31	10.72	26.03	60.00	-33.97	QP	
12		13.7300	5.80	10.72	16.52	50.00	-33.48	AVG	

8.9 ANTENNA APPLICATION

8.9.1 Antenna Requirement

Standard	Requirement
FCC CRF Part 15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

8.9.2 Result

PASS.

The EUT antenna is External Antenna, the antenna gain is 9 dBi.

- Note:
- ☒ Use of permanent, industrial epoxy, "Loctite" or solder to make the connection permanent prior to shipping.
 - ☐ Allow use of standard connector if the transmitter has a sensing circuitry that disables the transmitter if an unauthorized antenna is used. An application should detail how this is accomplished.
 - ☐ Use of a standard connect is also allowed if the connectors is within the transmitter enclosure and can only be accessed by disassembly of the transmitter, where such disassembly is not normally required. The user manual must not show that user has access to the connector.
 - ☐ BIOS lock-Radio card and host (e.g., laptop computer) exchange code to ensure only the authorized transmission system works in the host.

which in accordance to section 15.203, please refer to the EUT photos.

Detail of factor for radiated emission

Frequency(MHz)	Ant_F(dB)	Cab_L(dB)	Preamp(dB)	Correct Factor(dB)
0.009	20.6	0.03	\	20.63
0.15	20.7	0.1	\	20.8
1	20.9	0.15	\	21.05
10	20.1	0.28	\	20.38
30	18.8	0.45	\	19.25
30	11.7	0.62	27.9	-15.58
100	12.5	1.02	27.8	-14.28
300	12.9	1.91	27.5	-12.69
600	19.2	2.92	27	-4.88
800	21.1	3.54	26.6	-1.96
1000	22.3	4.17	26.2	0.27
1000	25.6	1.76	41.4	-14.04
3000	28.9	3.27	43.2	-11.03
5000	31.1	4.2	44.6	-9.3
8000	36.2	5.95	44.7	-2.55
10000	38.4	6.3	43.9	0.8
12000	38.5	7.14	42.3	3.34
15000	40.2	8.15	41.4	6.95
18000	45.4	9.02	41.3	13.12
18000	37.9	1.81	47.9	-8.19
21000	37.9	1.95	48.7	-8.85
25000	39.3	2.01	42.8	-1.49
28000	39.6	2.16	46.0	-4.24
31000	41.2	2.24	44.5	-1.06
34000	41.5	2.29	46.6	-2.81
37000	43.8	2.30	46.4	-0.3
40000	43.2	2.50	42.2	3.5

----- End of Report -----