Product Name:	Card Reader
Model No.:	CMS305
Applicant:	Top Vending Machine Electronics Co.,Ltd. No.11, Anzhong St., Luzhu Dist., Taoyuan City 33868, Taiwan (R.O.C.)
Date of Receipt:	Oct. 06, 2020
Finished date of Test:	Oct. 20, 2020
Applicable Standards:	47 CFR Part 15, Subpart C, 15.225 ANSI C63.10: 2013

We, **Spectrum Research & Testing Laboratory Inc.**, hereby certify that one sample of the above was tested in our laboratory with positive results according to the above-mentioned standards. The records in the report are an accurate account of the results. Details of the results are given in the subsequent pages of this report.

Tested By : Richard Lin , Date: 11/13/2020

(Richard Lin)

Approved By : , Date: 11/13/2020

(Johnson Ho, Director)

Revisions History

Report No.	Issue Date	Revisions
FCCA20071702-02	Nov. 13, 2020	Initial issue

Table of Contents

1. DOCUMENT POLICY AND TEST STATEMENT

1.1 DOCUMENT POLICY

- The report shall not be reproduced except in full, without the written approval of SRT Lab, Inc.
- FCC Registered Test Site Number：TW1016

1.2 TEST STATEMENT

- The test results in the report apply only to the unit tested by SRT Lab.
- There was no deviation from the requirements of test standards during the test.
- DC power source, DC 12V from battery, was used during the test.

1.3 EUT MODIFICATION

- No modification in SRT Lab.

2. DESCRIPTION OF EUT AND TEST MODE

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Card Reader
MODEL NO.	CMS305
POWER SUPPLY	DC power source, DC 12V from battery
CABLE	NA
OPERATING FREQUENCY	13.553 MHz ~ 13.567 MHz
NUMBER OF CHANNEL	1 CH
RATED RF OUTPUT POWER	64.36 dBuV/m at 3m
MODULATION TYPE	ASK
MODE OF OPERATION	Half duplex
ANTENNA TYPE	Loop Antenna
ANTENNA GAIN	0 dBi

NOTE:
For more detailed information, please refer to the EUT's specification or user's manual provided by manufacturer.

2.2 DESCRIPTION OF EUT INTERNAL DEVICE

DEVICE	BRAND / MAKER	MODEL #	FCC ID / DOC	REMARK
N/A				

2.3 DESCRIPTION OF TEST MODE

There are test modes for each test configuration as below:

Mode		Channel	Frequency (MHz)
01	TX	CH01	13.56

NOTE:
1. Below 1 GHz were pre-tested in chamber and chosen the worst case for conducted and radiated emission test.
2. Above 1 GHz were tested individually.
3. The axis X,Y and Z we evaluate in chamber, the X axis is worst case.

2.4 EUT OPERATING CONDITION

1. For use customer provided continuous transmission EUT.
2. Turn on the power of all equipment and EUT.
3. Set the EUT under continuous transmission condition.

2.5 DESCRIPTION OF SUPPORT UNIT

The EUT was configured by the requirement of ANSI C63.10:2013. All interface ports were connected to the appropriate support units via specific cables. The support units and cables are listed below.

NO	DEVICE	BRAND	MODEL #	FCC ID/DOC	NOTE
1	Charge Battery	HITACHI	55D23R-MF	DoC	12V

NOTE: For the actual test configuration, please refer to the photos of testing.

2.6 CHANNEL AND FREQUENCY TABLE

Channel	Frequency
CH01	13.56 MHz

3. DESCRIPTION OF APPLIED STANDARDS

The EUT is a wireless product. According to the specifications provided by the applicant, it must comply with the requirements of the following standards:

47 CFR Part 15, Subpart C, 15.225

ANSI C63.10: 2013

All tests have been performed and recorded as the above standards.

3.1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

STANDARD SECTION	TEST TYPE AND LIMIT RESULTS	RESULT
15.207	Conducted Emission	N/A
15.225(a)(b)(c)(d) 15.209	Radiated Emission	PASS
15.225(e)	Frequency Tolerance Limit：0.01%	PASS
15.203	Antenna requirement	PASS

4. TECHNICAL CHARACTERISTICS TEST

4.1 CONDUCTED EMISSION TEST

4.1.1 LIMIT

Frequency (MHz)	Class A (dBμV)		Class B (dBμV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 - 0.5	79	66	66 - 56	56 - 46
0.50 - 5.0	73	60	56	46
5.0 - 30.0	73	60	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 0.50 MHz.

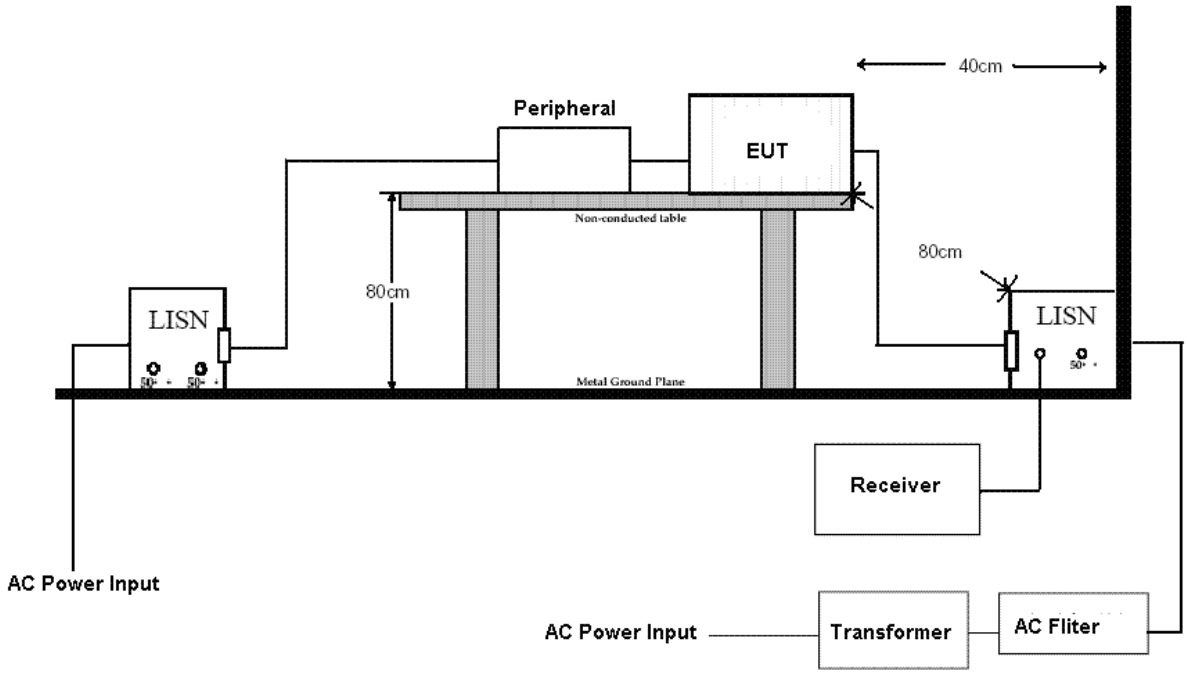
4.1.2 TEST EQUIPMENT

The following test equipment was used for the test:

EQUIPMENT/ FACILITIES	SPECIFICATIONS	MANUFACTURER	MODEL#/ SERIAL#	DUE DATE OF CAL. & CAL. CENTER
EMI TEST RECEIVER	9 kHz ~ 2.75 GHz	ROHDE & SCHWARZ	ESCS30 / 100376	JAN. 06, 2021 ETC
EMI TEST RECEIVER	9 kHz ~ 30 MHz	ROHDE & SCHWARZ	ESHS30 / 826003/008	JAN. 13, 2021 ETC
LISN	50 μH, 50 ohm	SOLAR	9252-50-R-24-BNC/9 51315	JAN. 20, 2021 ETC
LISN	50 μH, 50 ohm	SCHWARZBECK	NSLK 8127/ 8127-808	DEC. 10, 2020 ETC
50Ω BNC TYPE TERMINATOR	50 ohm	N/A	11593A/ L1TEQU005	NOV. 06, 2021 ETC
50Ω BNC TYPE TERMINATOR	50 ohm	N/A	B00-CD-357/ L1TEQU009	MAY. 25, 2021 ETC
COAXIAL CABLE	5 m	HUBER+SUHNER	RG214/U / L1TCAB013(#5m)	MAY. 25, 2021 ETC
FILTER	2 LINE, 30 A	FIL.COIL	FC-943 / 771	NCR
GROUND PLANE	2 m (H) x 3 m (W)	SRT	N/A	NCR
GROUND PLANE	2.5 m (H) x 3 m (W)	SRT	N/A	NCR
PULSE LIMITER	9 kHz ~ 30 MHz Insertion Loss= 10dB±0.3dB	ROHDE & SCHWARZ	ESH3Z2/ L1TTES009	DEC. 19, 2020 ETC
THERMO-HYGRO	15 – 40 °C, 0- 100% RH	TES	TES-1161/ 180704762	MAR. 06, 2021 ETC

NOTE:
The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

4.1.3 TEST SETUP



NOTE :
1. The EUT was put on a wooden table with 0.8m heights above ground plane, and 0.4m away from reference ground plane (> 2mx2m).
2. For the actual test configuration, please refer to the photos of testing.

4.1.4 TEST PROCEDURE

The EUT was tested according to the requirement of ANSI C63.10:2013 and CISPR22:2003. The frequency spectrum from 0.15 MHz to 30 MHz was investigated. The LISN used was 50 ohm/50μH as specified. All readings were quasi-peak and average values with 10 kHz resolution bandwidth of the test receiver. The EUT system was operated in all typical methods by users. Both lines of the power mains of EUT were measured and the cables connected to EUT and support units were moved to find the maximum emission levels for each frequency. First, find the margin or higher points at least 6 points by software, then use manual to find the maximum data. The procedure is referred on the test procedure of SRT LAB.

4.1.5 TEST RESULT

N/A

4.2 RADIATED EMISSION TEST

4.2.1 LIMIT

FCC Part15, Subpart C Section 15.225:

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

FCC Part15, Subpart C Section 15.209 limit of radiated emission for frequency below1000MHz. The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

FREQUENCY (MHz)	FIELD STRENGTH (microvolts/meter)	DISTANCE (m)	FIELD STRENGTH (dBμV/m)
0.009 - 0.490	2400/F(kHz)	300	67.6-20log(kHz)
0.490 - 1.705	24000/F(kHz)	30	87.6-20log(kHz)
1.705 - 30	30	30	30
30 - 88	100	3	40.0
88 - 216	150	3	43.5
216 - 960	200	3	46.0
Above 960	500	3	54.0

NOTE:

1. 30 dBuV (in 30m) = 70 dBuV (in 3m).
2. In the emission tables above , the tighter limit applies at the band edges.
3. Distance refers to the distance between measuring instrument, antemma, and the closest point of any part of the device or system.

4.2.2 TESR PROCEDURE

The EUT was tested according to the requirement of ANSI C63.10:2013 and CISPR 22:2003. When the frequency spectrum measured started from 9 kHz to 30 MHz, then use antenna is a loop antenna. The measurements were made at an open area test site with 3 meter measurement distance under 1 GHz and with 3m distance above 1GHz. The frequency spectrum measured started from 9kHz to 30MHz and 30 MHz to 1 GHz, all readings were quasi-peak values with 120 kHz resolution bandwidth of the test receiver. Above 1 GHz, the measurements were made at an open area test site with 3 meter measurement distance and all readings were peak or average values with 1 MHz resolution bandwidth of the test receiver. The EUT system was operated in all typical methods by users. The cables connected to EUT and support units were moved to find the maximum emission levels for each frequency. First, find the margin or higher points at least 6 points by software, then use manual to find the maximum data. The procedure is referred on the test procedure of SRT LAB.

4.2.3 TEST EQUIPMENT

Below 1 GHz The following test equipment was used during the radiated emission test:

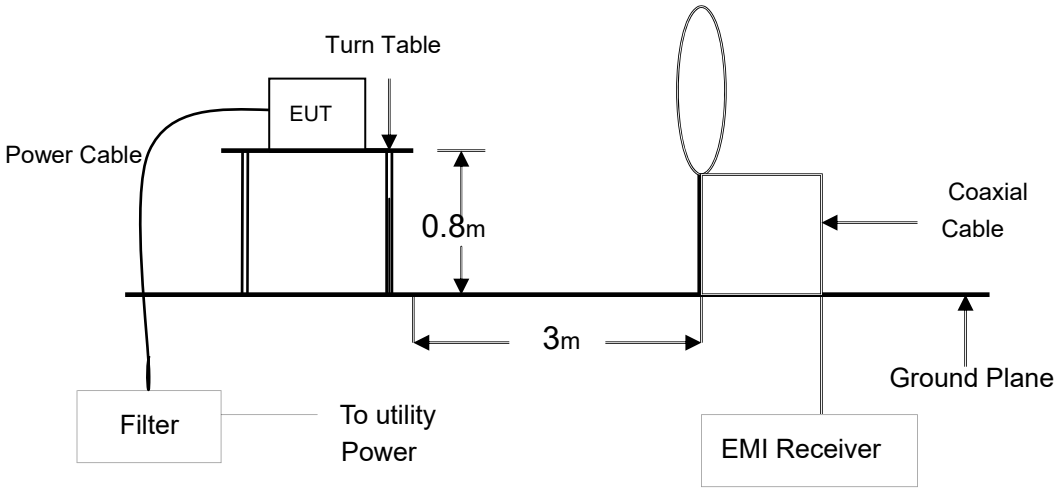
EQUIPMENT/ FACILITIES	SPECIFICATIONS	MANUFACTURER	MODEL#/ SERIAL#	DUE DATE OF CAL. & CAL. CENTER	FINAL TEST BE USED
EMI TEST RECEIVER	9 kHz ~ 2.75 GHz	ROHDE & SCHWARZ	ESCS30 / 100376	JAN. 06, 2021 ETC	■
LOOP ANTENNA	9 kHz ~ 30 MHz	ROHDE & SCHWARZ	HFH2-Z2/ 860605/002	MAY 21, 2021 ETC	■
BICONICAL ANTENNA	30 MHz ~ 200 MHz	EMCO	3108/ 2334	NOV. 14, 2021 ETC	■
LOG PERIODIC ANTENNA	200 MHz ~ 1 GHz	EMCO	3146/ 9002-2686	MAR. 01, 2021 ETC	■
OPEN AREA TEST SITE	3 – 10 M MEASUREMENT	SRT	A02 / SRT002	MAR. 06, 2021 SRT	■
COAXIAL CABLE	30 M	TIMES	LMR-400 / #30M(L1TCAB014)	JUN. 08, 2021 ETC	■
COAXIAL CABLE	9k - 1GHz	TIMES	LMR-400(#2m) / L1TCAB012	JAN. 05, 2021 ETC	■
FILTER	2 LINE, 30 A	FIL.COIL	FC-943/869	NCR	■
PRE-AMPLIFIER	0.1 MHz ~ 1.3 GHz	HP	8447D / 2944A06746	DEC. 08, 2020 ETC	■
THERMO-HYGRO	15 – 40°C, 0- 100% RH	TOP	20-A / 6644	DEC. 08, 2020 ETC	■

Above 1 GHz The following test equipment was used during the radiated emission test:

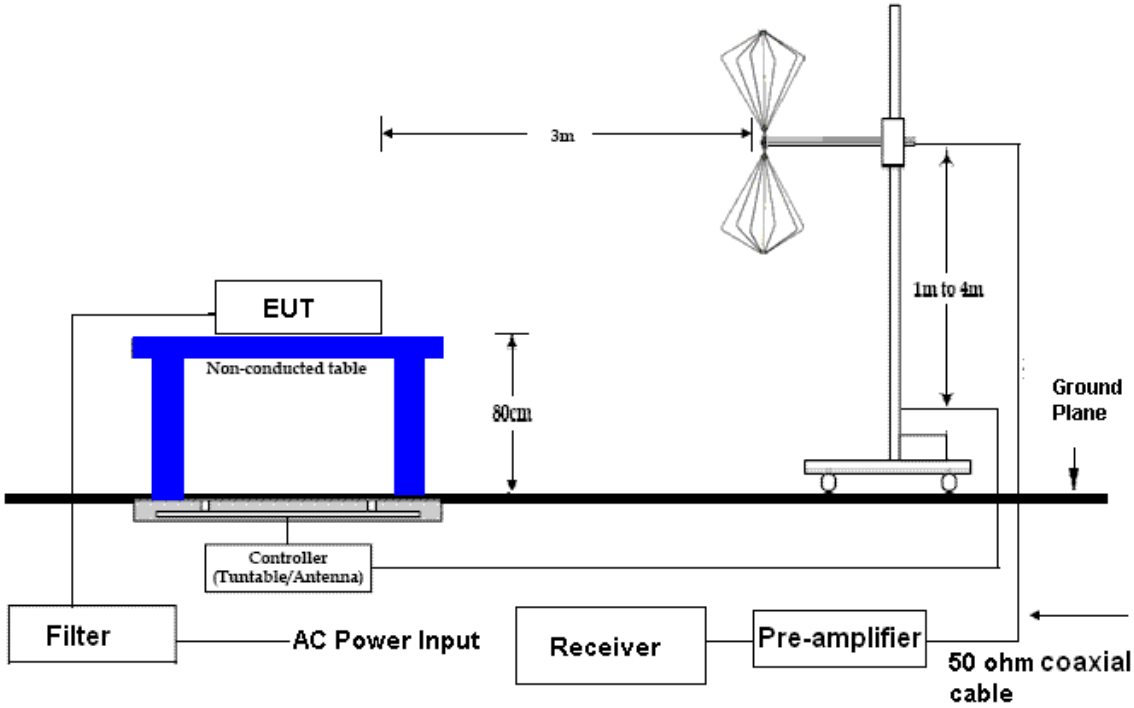
EQUIPMENT/ FACILITIES	SPECIFICATIONS	MANUFACTURER	MODEL#/ SERIAL#	DUE DATE OF CAL. & CAL. CENTER	FINAL TEST BE USED
SPECTRUM ANALYZER	9 kHz ~ 40GHz	ROHDE & SCHWARZ	FSP40 / 100093	JAN.06, 2021 ETC	■
PRE-AMPLIFIER	1 GHz ~ 26.5 GHz	AGILENT	8449B/ 3008A01995	JAN.05, 2021 ETC	■
HORN ANTENNA	1 GHz ~ 18 GHz	EMCO	3115/9602-4681	NOV.13, 2021 ETC	■
HORN ANTENNA	18 ~ 40 GHZ	ETS-LINDGREN	3116/00032255	JAN. 14, 2021 ETC	■
ANECHOIC CHAMBER	3 M MEASUREMENT	SRT	A01/SRT001	DEC. 13, 2020 SRT	■
RF CABLE	UP TO 18 GHz 1.5 m	JYEBAO	A30A30-L 142 / EQF-0035(001)	NOV. 24, 2020 ETC	■
RF CABLE	UP TO 26.5 GHz 3.5 m	EMCI	EMC104-SM-SM-3500 / 150601	NOV. 18, 2020 ETC	■
K-TYPE CABLE	UP TO 40 GHz 3 m	HUBER+SUHNER	SF102-46/2*11SK252 /MY2611/2	MAR. 15, 2021 ETC	■
K-TYPE CABLE	UP TO 40 GHz, 1 m	HUBER+SUHNER	SF102/2*11SK252 /MY3331/2	DEC. 16, 2020 ETC	■
FILTER	2 LINE, 30 A	FIL.COIL	FC-943/869	NCR	■
THERMO-HYGRO	15 – 40 ℃, 0- 100% RH	TOP	20-A / 6644	DEC. 08, 2020 ETC	■

4.2.4 TEST SET-UP

9KHz ~ 30MHz

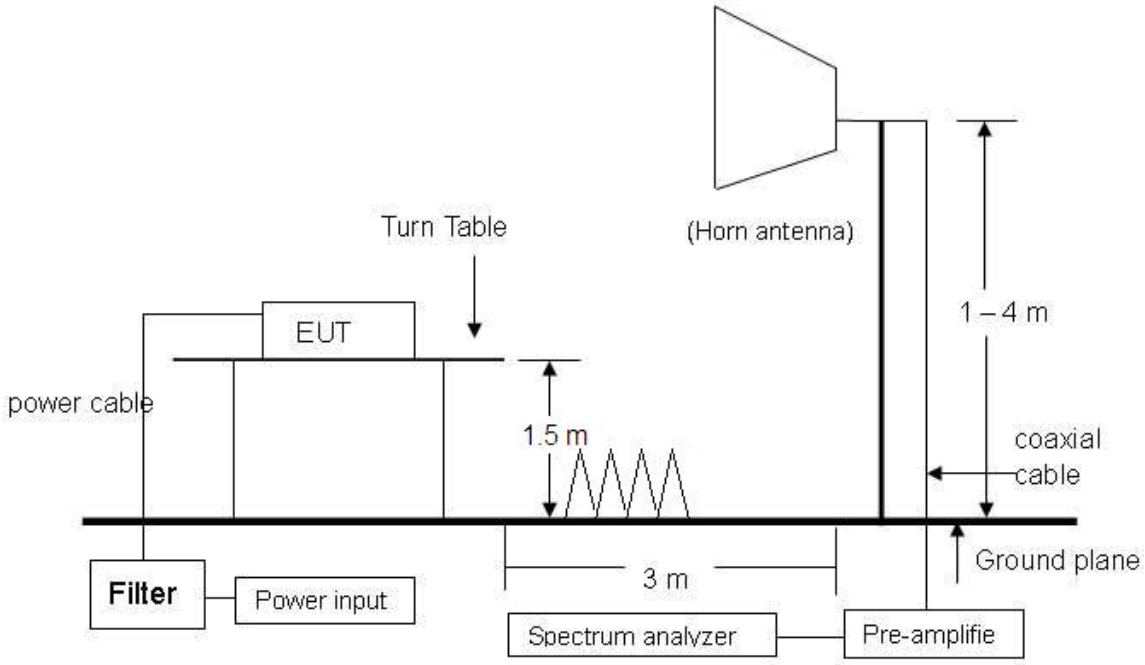


30 MHz ~ 1 GHz



NOTE: The EUT system was put on a wooden table with 1.5m heights above a ground plane. For the actual test configuration, please refer to the photos of testing.

Above 1 GHz



NOTE: The EUT system was put on a wooden table with 1.5m heights above a ground plane.
For the actual test configuration, please refer to the photos of testing.

4.2.5 TEST RESULT

Temperature:	22 °C	Humidity:	73 %RH
Frequency Range:	9 kHz – 30 MHz	Measured Distance:	3 m
Receiver Detector:	AV.	Tested Mode:	TX
Tested By:	Richard Lin	Tested Date:	Oct. 06, 2020

Frequency (MHz)	Cable Loss (dB)	Ant. Fac. (dB/m)	Reading (dBμV)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
13.56 (F)	1.07	20.90	42.39	64.36	124.00	-59.64
7.25	0.79	20.18	21.28	42.25	70.00	-27.75
16.04	1.18	21.24	21.56	43.98	70.00	-26.02
21.07	1.39	21.84	22.92	46.15	70.00	-23.85
22.01	1.42	21.88	23.07	46.37	70.00	-23.63
23.09	1.46	21.92	23.48	46.86	70.00	-23.14
24.15	1.50	21.97	23.75	47.22	70.00	-22.78

NOTE:
1. (F):The field stregth of fundamental frequency.
2. Emissiom Level = Reading Value + Ant. Factor + Correct Factor (incl.:Cable Loss and Pre-Amplifier Gain)

Temperature:	21 °C	Humidity:	69 %RH
Frequency Range:	30 M – 1 GHz	Tested Mode:	TX
Detector Type:	Quasi-peak	IF Bandwidth:	120 kHz
Tested By:	Richard	Tested Date:	Oct. 06, 2020

Antenna Polarization：Horizontal

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp (dB)	Reading Data (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	AZ(°)	EL(m)
202.18	3.12	11.90	27.59	49.04	36.47	43.50	-7.03	157	3.45
215.92	3.24	11.70	27.55	45.70	33.09	43.50	-10.41	32	3.36
269.83	3.76	13.20	27.42	50.58	40.12	46.00	-5.88	289	3.21
610.24	6.36	19.60	28.56	38.94	36.34	46.00	-9.67	102	2.94
622.70	6.44	19.90	28.54	42.40	40.20	46.00	-5.80	211	2.58
649.35	6.63	20.28	28.50	41.24	39.65	46.00	-6.35	315	1.78

Antenna Polarization：Vertical

Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp (dB)	Reading Data (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	AZ(°)	EL(m)
53.42	1.86	11.50	28.29	50.43	35.50	40.00	-4.50	64	1.05
88.17	2.15	8.00	28.18	54.57	36.54	43.50	-6.96	127	1.25
154.29	2.74	12.60	27.84	45.09	32.59	43.50	-10.91	258	1.39
202.07	3.12	11.90	27.59	47.04	34.47	43.50	-9.03	54	1.62
269.34	3.76	13.20	27.42	45.44	34.98	46.00	-11.02	188	1.88
649.55	6.63	20.28	28.50	36.14	34.55	46.00	-11.45	341	2.52

NOTE :
1. Measurement uncertainty is 4.20 dB.
2. "*": Measurement does not apply for this frequency.
3. Emissiom Level = Reading Value + Ant. Factor + Cable Loss – Pre-Amplifier.
4. The field strength of other emission frequencies were very low against the limit.

Temperature:	22 °C	Humidity:	73 %RH
Frequency Range:	1 GHz – 25 GHz	Tested Mode:	TX
Detector Type:	PK. and AV.	IF Bandwidth:	1 MHz
Tested By:	Richard Lin	Tested Date:	Oct. 06, 2020

Antenna Polarization：Horizontal

Frequency (MHz)	Correct Factor (dB)	Ant. Factor (dB/m)	Reading Data (dBμV)		Emission Level (dBμV/m)		Limit (dBμV/m)		Margin (dB)		AZ (°)	EL (m)
			PK.	AV.	PK.	AV.	PK.	AV.	PK.	AV.		
2779.33	-31.27	29.02	43.80	33.26	41.55	31.01	74	54	-32.45	-22.99	296	1.98
3256.02	-30.78	30.92	43.08	32.51	43.23	32.66	74	54	-30.77	-21.34	150	1.63
3710.96	-30.24	31.84	42.79	32.24	44.39	33.84	74	54	-29.61	-20.16	34	1.54
4578.74	-29.33	32.36	42.18	31.69	45.21	34.72	74	54	-28.79	-19.28	188	1.38
4997.57	-28.74	33.49	38.84	28.35	43.58	33.09	74	54	-30.42	-20.91	275	1.21
5459.41	-28.70	33.90	41.77	31.34	46.97	36.54	74	54	-27.03	-17.46	102	1.15

Antenna Polarization：Vertical

Frequency (MHz)	Correct Factor (dB)	Ant. Factor (dB/m)	Reading Data (dBμV)		Emission Level (dBμV/m)		Limit (dBμV/m)		Margin (dB)		AZ (°)	EL (m)
			PK.	AV.	PK.	AV.	PK.	AV.	PK.	AV.		
3211.46	-30.84	30.90	43.03	32.58	43.09	32.64	74	54	-30.91	-21.36	41	1.47
3458.11	-30.49	30.90	43.85	33.29	44.26	33.70	74	54	-29.74	-20.30	139	1.76
3802.38	-30.16	32.21	42.29	31.74	44.34	33.79	74	54	-29.66	-20.21	324	1.89
4377.98	-29.57	32.15	42.37	31.89	44.95	34.47	74	54	-29.05	-19.53	49	2.02
4586.57	-29.32	32.37	43.27	32.75	46.32	35.80	74	54	-27.68	-18.20	225	2.13
4999.24	-28.74	33.50	40.14	29.62	44.89	34.37	74	54	-29.11	-19.63	67	2.24

NOTE:

1. Measurement uncertainty is 4.04 dB.
2. Emissiom Level = Reading Value + Ant. Factor + Correct Factor (incl.:Cable Loss and Pre-Amplifier Gain)
3. The field strength of other emission frequencies were very low against the limit.
4. (F):The field stregth of fundamental frequency.

4.3 Frequency Tolerance

4.3.1 LIMIT

FCC Part15, Subpart C Section 15.225(e), The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

FREQUENCY (MHz)	LIMIT (%)
13.553 ~ 13.567	±0.01

4.3.2 TEST EQUIPMENT

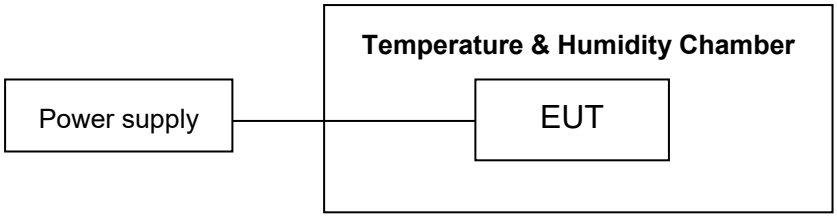
The following test equipment was used during the test：

EQUIPMENT/ FACILITIES	SPECIFICATIONS	MANUFACTURER	MODEL#/ SERIAL#	DUE DATE OF CAL. & CAL. CENTER
EMI TEST RECEIVER (INCLUDE SPECTRUM ANALYZER)	9 KHz ~ 6 GHz	ROHDE & SCHWARZ	ESL /100176	JUL. 30, 2021 ETC
TEMPERATURE & HUMIDITY CHAMBER	Temperature -20°C~180°C. R.H. 20%~95%	KSON	THS-A2C-180	MAR. 23, 2021 ETC

NOTE : The calibration interval of the above test equipment is one year and the calibrations are traceable to NML/ROC and NIST/USA.

4.3.3 TEST SET-UP

The tested unit was stayed in a Temperature & Humidity chamber and supplied with a power source for extreme condition (see configure below).



4.3.5 EUT OPERATING CONDITION

The EUT was operated in continunely transmitting mode.

4.3.6 TEST RESULT

Temperature:	25 °C	Humidity:	64 %RH
Spectrum Detector:	PK	Tested by:	Richard Lin
Test Result:	PASS	Tested Date:	Oct. 20, 2020

Operating Frequency： 13.56 MHz

Reference Voltage： 12V

Channel Frequency (MHz)		CH01 13.56 MHz			
Temperature (°C)	**Voltage (V)**	**Frequency (kHz)**	**Deviation (%)**	**Limit (%)**	**Pass/Fail**
20	10.2	13559.652	0.0025664	0.01	Pass
	12.0	13559.562	0.0032301	0.01	Pass
	13.8	13559.571	0.0031637	0.01	Pass
-20	12.0	13559.592	0.0030088	0.01	Pass
0	12.0	13559.677	0.0023820	0.01	Pass
50	12.0	13559.614	0.0028466	0.01	Pass

5. Antenna application

5.1 Antenna requirement

The EUT’s antenna is met the requirement of FCC Part 15C section 15.203.

5.2 Result

The EUT’s antenna used a Loop Antenna. Gain of 0 dBi that meet the requirement.

6. TERMS OF ABBREVIATION

AV.	Average detection
AZ(°)	Turn table azimuth
Correct.	Correction
EL(m)	Antenna height (meter)
EUT	Equipment Under Test
Horiz.	Horizontal direction
LISN	Line Impedance Stabilization Network
NSA	Normalized Site Attenuation
Q.P.	Quasi-peak detection
SRT Lab	Spectrum Research & Testing Laboratory, Inc.
Vert.	Vertical direction