Test Report

Date : 2020-03-09
No. : HM20020004

Applicant:	AB CIRCLE LIMITED Unit D, 9/F, MG Tower, 133 Hoi Bun Road, Kwun Tong, Kowloon, Hong Kong
Manufacturer:	AB CIRCLE LIMITED Unit D, 9/F, MG Tower, 133 Hoi Bun Road, Kwun Tong, Kowloon, Hong Kong
Description of Sample(s):	Product: Contactless Smart Card Reader Brand Name: AB Circle Limited Model Number: CIR215A FCC ID: 2AUVM-CIR215A
Date Sample(s) Received:	2020-02-05
Date Tested:	2020-02-10 to 2020-02-19
Investigation Requested:	Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10:2013 for FCC Certification.
Conclusion(s):	The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.
Remark(s):	---

LEUNG Kwun Hang, Joey
Authorized Signatory

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Test Report

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1.0 General Details

1.1 Equipment Under Test [EUT] Description of Sample(s)

Product:	Contactless Smart Card Reader
Manufacturer:	AB CIRCLE LIMITED Unit D, 9/F, MG Tower, 133 Hoi Bun Road, Kwun Tong, Kowloon, Hong Kong
Brand Name:	AB Circle Limited
Model Number:	CIR215A
Rating:	5Vd.c of USB port of EUT PC=120Va.c.

1.2 Description of EUT Operation

The Equipment Under Test (EUT) is 13.56MHz RFID Card reader, which is 13.56MHz transceiver fixed transmit at 13.56MHz, the modulation is ASK type which is provided by IC. The Carrier frequency of the EUT will continuous

1.3 Date of Order

2020-02-05

1.4 Submitted Sample(s):

3 Samples

1.5 Test Duration

2020-02-10 to 2020-02-19

1.6 Country of Origin

China

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013 for FCC Certification.

2.2 Test Standards and Results Summary Tables

Results Summary

Test Condition	Test Requirement	Test Method	Class / Severity	Test Result	
				Pass	Fail
Field Strength of Fundamental & Harmonics Emissions	FCC 47CFR 15.225(a-d)	ANSI C63.10:2013	N/A	☒	☐
The Frequency Tolerance of Carrier Signal	FCC 47CFR 15.225(e)	ANSI C63.10:2013	N/A	☒	☐
20 dB Bandwidth	FCC 47CFR 15.215	ANSI C63.10:2013	N/A	☒	☐
Radio Frequency powered Tags	FCC 47CFR 15.225(f)	ANSI C63.10:2013	N/A	N/A	
Radiated Emissions	FCC 47CFR 15.209	ANSI C63.10:2013	N/A	☒	☐
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐
AC power-line conducted emissions	FCC 47CFR 15.207	ANSI C63.10:2013	N/A	☒	☐

Note: N/A - Not Applicable

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3.0 Test Results

3.1 Emission

3.1.1 Field Strength of Fundamental & Harmonics Emissions

Test Requirement:	FCC 47CFR 15.225 a to d
Test Method:	ANSI C63.10:2013
Test Date:	2020-02-19
Mode of Operation:	On mode connected to PC

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. In the frequency range of 9kHz to 30MHz, The center of the loop antenna shall be 1 meter above the ground and rotated loop axis for maximum reading. The emissions worst-case are shown in Test Results of the following pages.

Remark: 3 orthogonal axis apply to hand-held device only.

*: Semi-anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd.
FCC Test Firm Registration Number 723883
Designation Number HK0001

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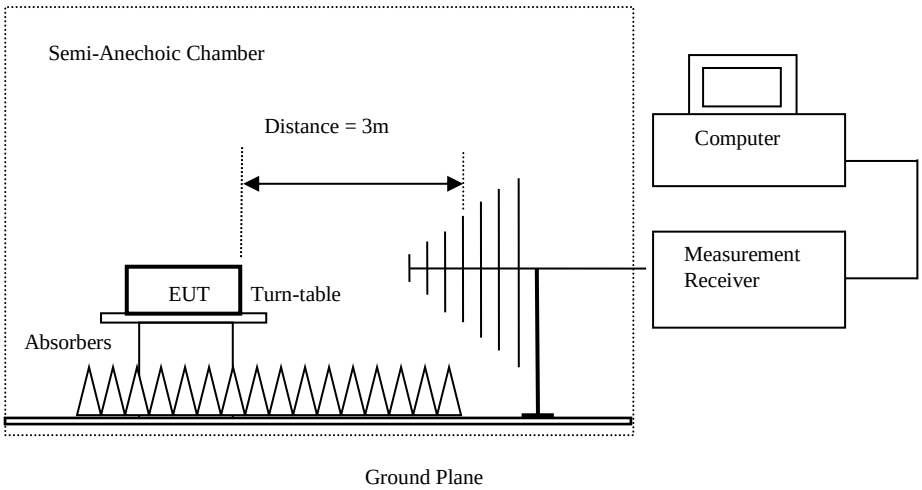
Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW:	10kHz
	VBW:	30kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
30MHz – 1GHz (QP)	RBW:	120kHz
	VBW:	120kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Pk & Av)	RBW:	3MHz
	VBW:	3MHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold

Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used,
9kHz to 30MHz loop antennas are used.
-For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground

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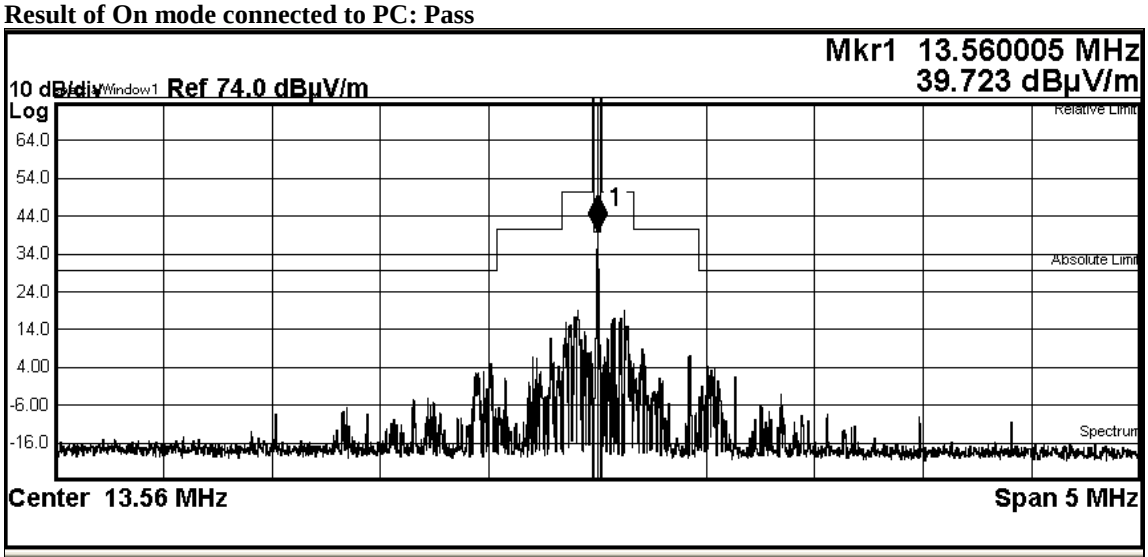
Limits for Field Strength of Fundamental & Harmonics Emissions [FCC 47CFR 15.225]:

Fundamental frequency [MHz]	Field strength of fundamental (microvolts /meter)
13.553–13.567 MHz	15848uV@30m (84dBuV/m)
13.410–13.553 MHz and 13.567–13.710 MHz	334uV@30m (50.4dBuV/m)
13.110–13.410 MHz and 13.710–14.010 MHz	106uV@30m (40.5dBuV/m)
outside of the 13.110–14.010 MHz	Refer to 15.209

Result of On mode connected to PC: Pass



Total Power -27.85 dBµV/m / 0.01 MHz **Spectrum Peak Ref** 84.00 dBµV/m

Start Freq	Stop Freq	Integ BW	dBµV/	Lower ΔLim(dB)	Freq (Hz)	<- Peak -> dBµV/	Upper ΔLim(dB)	Freq (Hz)
7.000 kHz	150.0 kHz	3.000 kHz	-87.98	(-31.49)	-74.98 k	-88.08	(-31.59)	109.5 k
150.0 kHz	450.0 kHz	3.000 kHz	-95.44	(-28.95)	-196.5 k	-98.01	(-31.53)	193.5 k
450.0 kHz	900.0 kHz	3.000 kHz	-101.96	(-24.47)	-475.4 k	-102.74	(-25.25)	497.9 k
900.0 kHz	2.500 MHz	3.000 kHz	-113.62	(-36.13)	-1.138 M	-115.34	(-37.85)	1.045 M

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Result of On mode connected to PC: Pass [FCC 47CFR 15.225a]

Frequency Range(MHz)	Highest Field strength measured @3m (dBuV/m)	Highest Field strength calculated @30m (dBuV/m)	Limit@30m (dBuV/m)
13.553 - 13.567	79.7 @13.56MHz	39.7 @13.56MHz	84.0

Result of On mode connected to PC: Pass [FCC 47CFR 15.225b]

Frequency Range(MHz)	Highest Field strength measured @3m (dBuV/m)	Highest Field strength calculated @30m (dBuV/m)	Limit@30m (dBuV/m)
13.410-13.553 and 13.567-13.710	64.4 @13.42MHz	24.4 @13.42MHz	50.4

Result of On mode connected to PC: Pass [FCC 47CFR 15.225c]

Frequency Range(MHz)	Highest Field strength measured @3m (dBuV/m)	Highest Field strength calculated @30m (dBuV/m)	Limit@30m (dBuV/m)
13.110-13.410 and 13.710-14.010	56.0 @13.14MHz	16.0 @13.14MHz	40.5

Result of On mode connected to PC: Pass [FCC 47CFR 15.225d]

Frequency Range(MHz)	Highest Field strength measured @3m (dBuV/m)	Highest Field strength calculated @30m (dBuV/m)	Limit@30m (dBuV/m)
Others frequencies < 30MHz	33.4 @12.42MHz	-6.6 @12.42MHz	29.5

Remark:
The Measurement was performed at 3m distance between the EUT and the receiving antenna, the distance factor was applied to at the spectrum analyzer, the correction factor is equal to 40.0dB. The distance factor from 3m to 30m was refer to C63.10:2013

Formula:
Highest Field strength calculated @30m = Highest Field strength measured @3m – Correction Factor

Calculated measurement uncertainty : **9kHz to 30MHz: 2.4dB**
30MHz to 18GHz: 5.0dB
18GHz – 26.5Hz: 5.24dB

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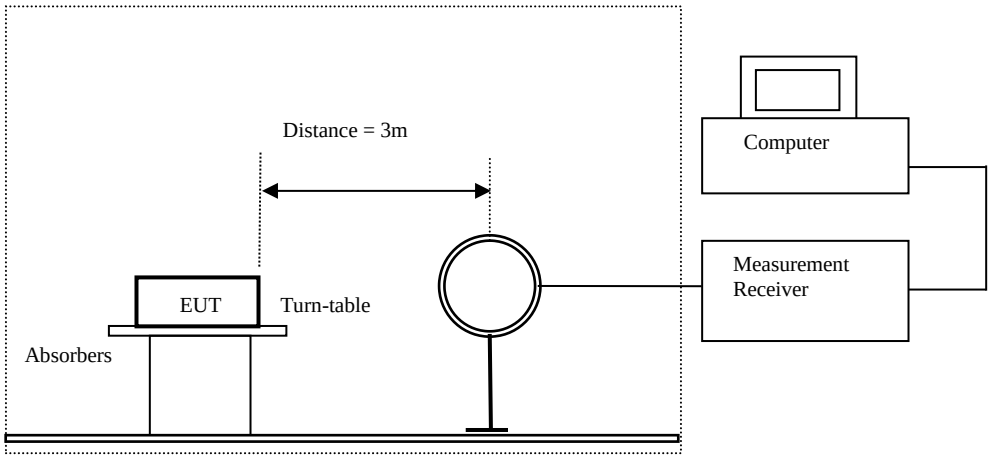
3.1.2 20DB BANDWIDTH

Ambient Temperature: 21°C Relative Humidity: 45%

Test Requirement:	FCC 47CFR 15.215
Test Method:	ANSI C63.10:2013
Test Date:	2020-02-19
Mode of Operation:	On mode connected to PC



Ground Plane

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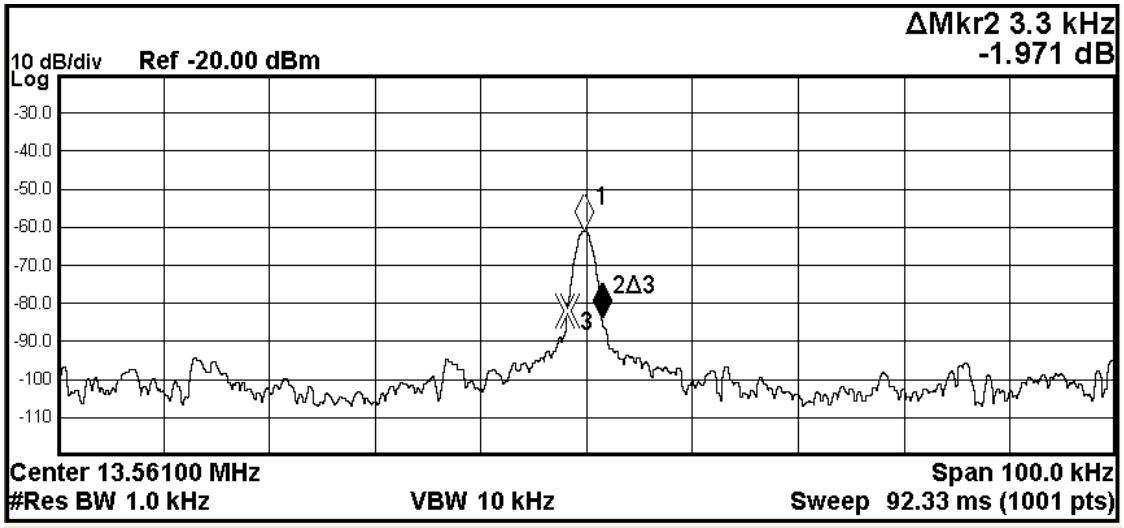
Center Frequency [MHz]	20dB Bandwidth [kHz]
13.56	3.3



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	13.560 8 MHz	-60.919 dBm			
2	Δ3	1	f	(Δ) 3.3 kHz	(Δ) -1.971 dB			
3	F	1	f	13.559 2 MHz	-82.245 dBm			
4								

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3.1.3 THE FREQUENCY TOLERANCE OF CARRIER SIGNAL

Ambient Temperature: 21°C Relative Humidity: 45%

Test Requirement: FCC 47CFR 15.225e
Test Method: ANSI C63.10:2013
Test Date: 2020-02-19
Mode of Operation: On mode connected to PC

The frequency tolerance, results: PASS

TEST CONDITIONS		Measured Frequency (MHz)	Frequency Error (%)
		FI (MHz)	Fh (MHz)
Tnom: 20 °C	Unom: 5.0Vd.c.	13.5605	N/A
Ulow: -20°C	Umax: 5.75Vd.c.	13.5607	0.0015
	Umin: 4.25Vd.c.	13.5607	0.0015
Tmax: 50°C	Umax: 5.75Vd.c.	13.5608	0.0022
	Umin: 4.25Vd.c.	13.5608	0.0022
Max. occupied frequency range (Flm… Fhm) (MHz)		13.5608	0.0022
Limit		>0.01%	
Measurement uncertainty		$<\pm 1 * 10^{-7}$	

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3.1.4 Radiated Emissions

Limits for Radiated Emissions [FCC 47 CFR 15.209]:

Frequency Range [MHz]	Quasi-Peak Limits [μV/m]
0.009-0.490	2400/F (kHz)@300m
0.490-1.705	24000/F (kHz)@30m
1.705-30	30@30m
30-88	100@3m
88-216	150@3m
216-960	200@3m
Above960	500@3m

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Remarks:

The Measurement was performed at 3m distance between the EUT and the receiving antenna. And the correction factor was included antenna factor and distance factor (3m to 30m) which shown on the pre-scan plot and the final value.

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate in the table below is the worst case rate with respect to the specific test item.
Investigation has been done on all the possible configurations for searching the worst cases.

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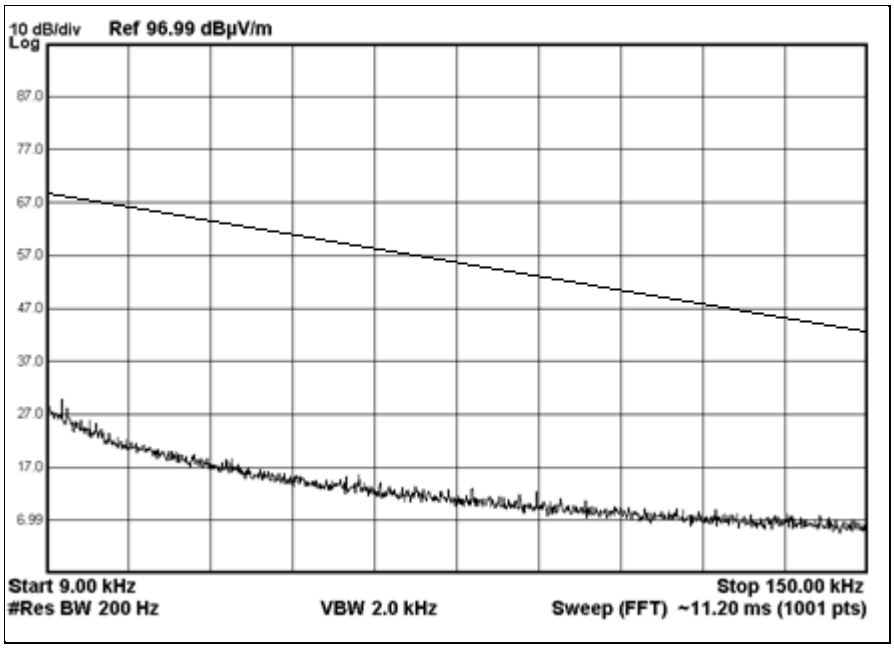
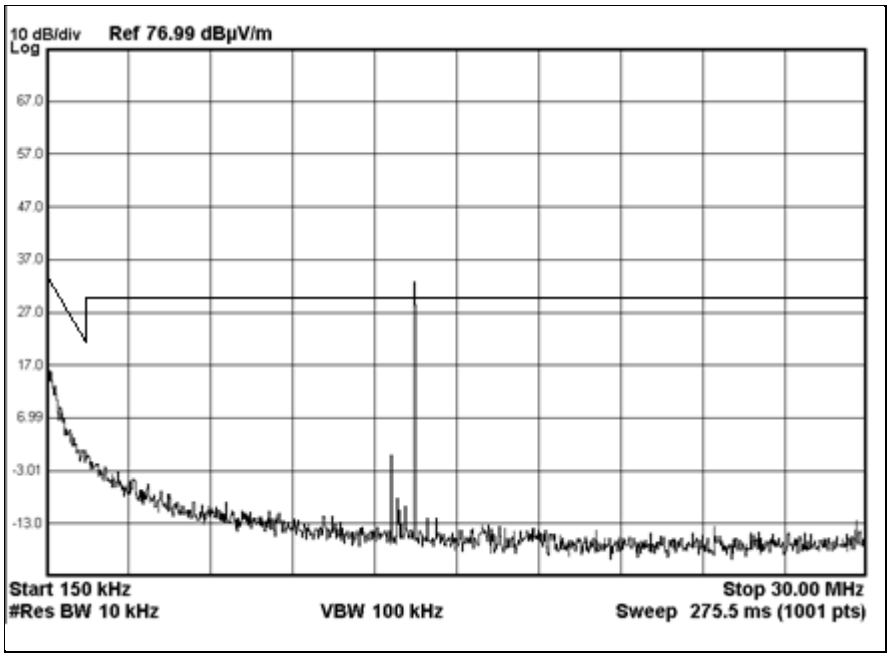
Result of On mode connected to PC, (9kHz – 30MHz): PASS





The peak value shown on the graph was 13.56MHz which the result was measured and calculated at page 7-8, others missions detected outside the spectrum mask are more than 20 dB below the FCC Limits

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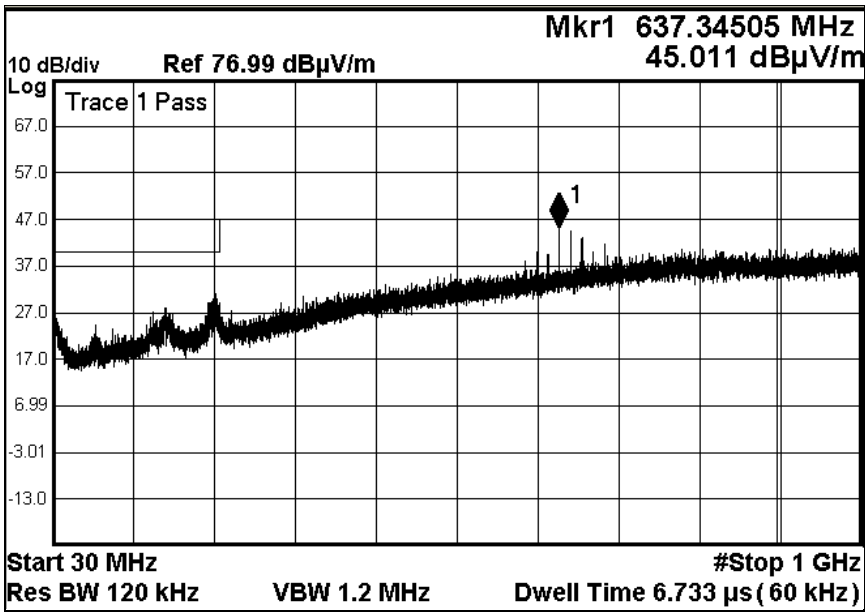
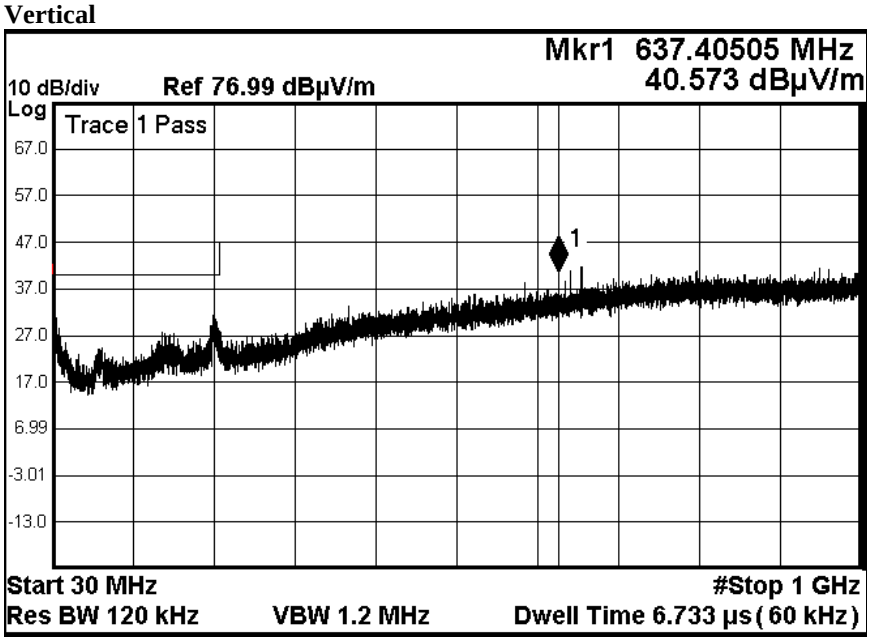
Pre-scan result of On mode connected to PC (30MHz – 1GHz):
Horizontal



Vertical



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Result of On mode connected to PC (30MHz – 1GHz): PASS

Field Strength of Fundamental and Harmonics Emissions Quasi-Peak Value						
Frequency MHz	Measured Level @3m dBμV/m	Correction Factor dBμV/m	Field Strength dBμV/m	Field Strength μV/m	Limit @3m μV/m	E-Field Polarity
39.8	5.1	13.4	18.5	8.4	100	Vertical
104.3	4.3	8.8	13.1	4.5	150	Horizontal
198.9	7.7	8.0	15.7	6.1	150	Horizontal
637.3	16.7	22.7	39.4	93.3	200	Horizontal
650.9	13.8	22.9	36.7	68.4	200	Horizontal
664.5	12.3	23.0	35.3	58.2	200	Horizontal

Result of On mode connected to PC, (1GHz – 18GHz):
Emissions detected are more than 20 dB below the FCC Limits

Remarks:

The pre-scan results are for reference, the frequencies found will perform final measurement which shown on the table below the graphs, therefore, there may be some different in measured frequencies and field strength shown on the graph and the table.

No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty : (9kHz – 30MHz): 2.4dB
(30MHz – 18GHz): 5.0dB
(18GHz - 26GHz): 5.24dB

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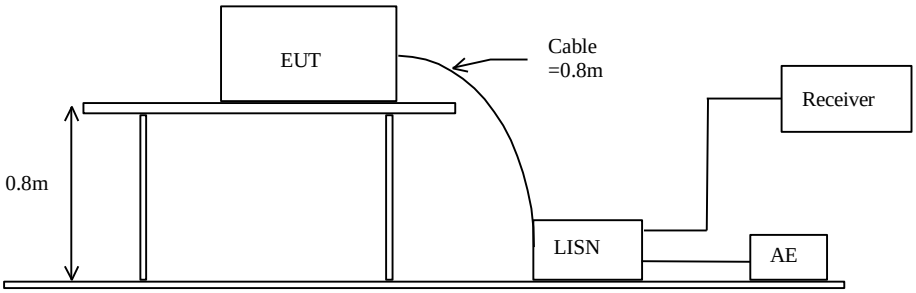
3.1.5 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207 Class B
Test Method:	ANSI C63.10: 2013
Test Date:	2020-02-10
Mode of Operation:	*On mode connected to PC

Test Method:

The test was performed in accordance with ANSI C63.10: 2013, with the following: initial measurements were performed in peak and average detection modes on the live line, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Test Setup:



Remarks: The antenna of the EUT was terminated with 50 ohm resistive load

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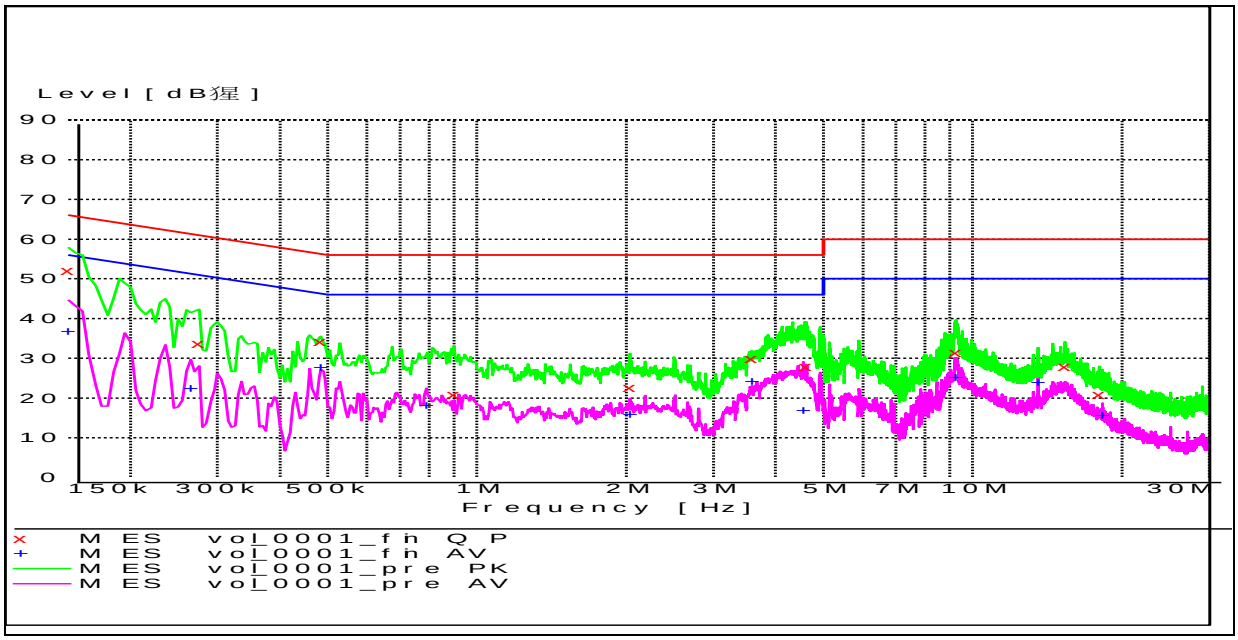
Limits for Conducted Emissions (FCC 47 CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of On mode connected to PC (Neutral): PASS
Please refer to the following diagram for individual results.



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MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.150000	52.20	9.9	66	13.8	L1	GND
0.275000	33.80	9.9	61	27.2	L1	GND
0.485000	34.20	10.0	56	22.1	L1	GND
0.900000	20.80	10.0	56	35.2	L1	GND
2.035000	22.70	10.1	56	33.3	L1	GND
3.575000	29.90	10.2	56	26.1	L1	GND
4.610000	28.10	10.3	56	27.9	L1	GND
9.260000	31.50	10.4	60	28.5	L1	GND
15.370000	28.10	10.6	60	31.9	L1	GND
18.000000	21.00	10.3	60	39.0	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.150000	36.80	9.9	56	19.2	L1	GND
0.265000	22.30	9.9	51	28.9	L1	GND
0.485000	27.60	10.0	46	18.7	L1	GND
0.790000	18.00	10.0	46	28.0	L1	GND
2.035000	15.90	10.1	46	30.1	L1	GND
3.585000	24.30	10.2	46	21.7	L1	GND
4.555000	17.00	10.3	46	29.0	L1	GND
9.220000	25.20	10.4	50	24.8	L1	GND
13.560000	24.00	10.6	50	26.0	L1	GND
18.300000	15.60	10.3	50	34.4	L1	GND

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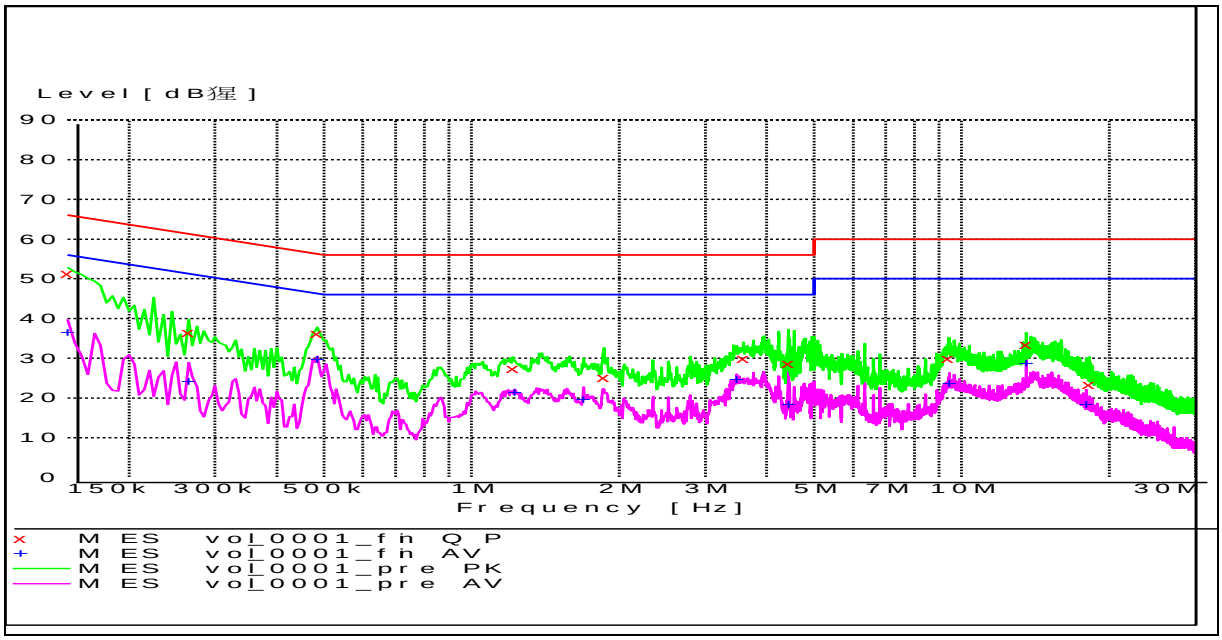
Results of On mode connected to PC (Neutral): PASS
Please refer to the following diagram for individual results.



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MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.150000	51.40	9.9	66	14.6	N	GND
0.265000	36.50	9.9	61	24.8	N	GND
0.485000	36.10	10.0	56	20.1	N	GND
1.215000	27.40	10.0	56	28.6	N	GND
1.865000	25.10	10.0	56	30.9	N	GND
3.585000	30.00	10.2	56	26.0	N	GND
4.425000	28.60	10.2	56	27.4	N	GND
9.395000	29.90	10.4	60	30.1	N	GND
13.560000	33.60	10.6	60	26.4	N	GND
18.235000	23.30	10.3	60	36.7	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.150000	36.40	9.9	56	19.6	N	GND
0.265000	24.20	9.9	51	27.1	N	GND
0.485000	29.80	10.0	46	16.5	N	GND
1.225000	21.30	10.0	46	24.7	N	GND
1.690000	19.70	10.0	46	26.3	N	GND
3.475000	24.50	10.1	46	21.5	N	GND
4.425000	18.30	10.2	46	27.7	N	GND
9.445000	23.60	10.4	50	26.4	N	GND
13.560000	28.60	10.6	50	21.4	N	GND
17.960000	18.30	10.3	50	31.7	N	GND

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3.1.6 Antenna Requirement

Ambient temperature 21°C Relative humidity 50%

Test Requirements: § 15.203

Test Specification:

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.

Test Results:

This is PCB antenna. There is no external antenna, the antenna gain =0dBi. User is unable to remove or changed the Antenna.

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Appendix A

LIST OF MEASUREMENT EQUIPMENT

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2019/04/24	2020/04/24
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM355	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00201783	2019/03/11	2021/03/11
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2019/06/12	2020/06/12
EM299	DOUBLE-RIDGED WAVEGUIDE HORN ANTENNA	ETS-LINDGREN	3115	00114120	2018/04/27	2020/04/27
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2018/05/13	2020/05/13
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/03/16	2020/03/16

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM232	LISN	SCHAFFNER	NNB41	04/100082	2019/03/03	2020/03/03
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2019/06/12	2020/06/12
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2020/01/14	2021/01/14

Remarks:

CM Corrective Maintenance
N/A Not Applicable or Not Available
TBD To Be Determined

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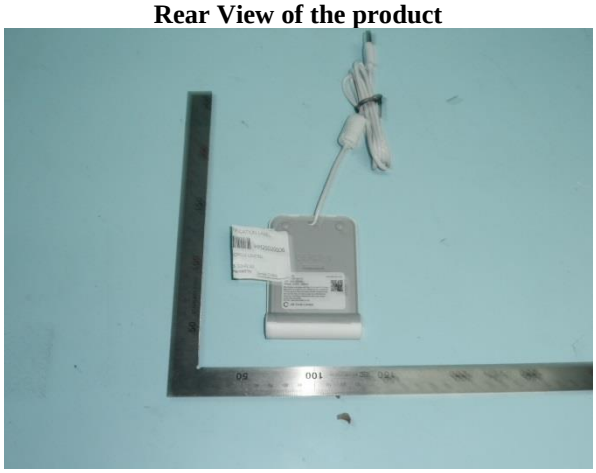
Appendix B

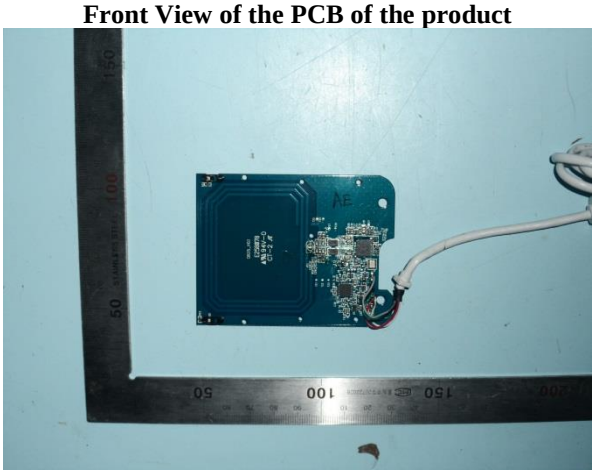
Photographs of EUT

Front View of the product

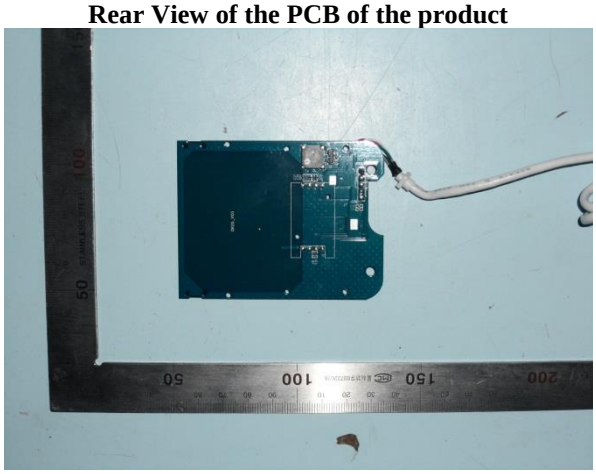
Rear View of the product



Front View of the PCB of the product



Rear View of the PCB of the product



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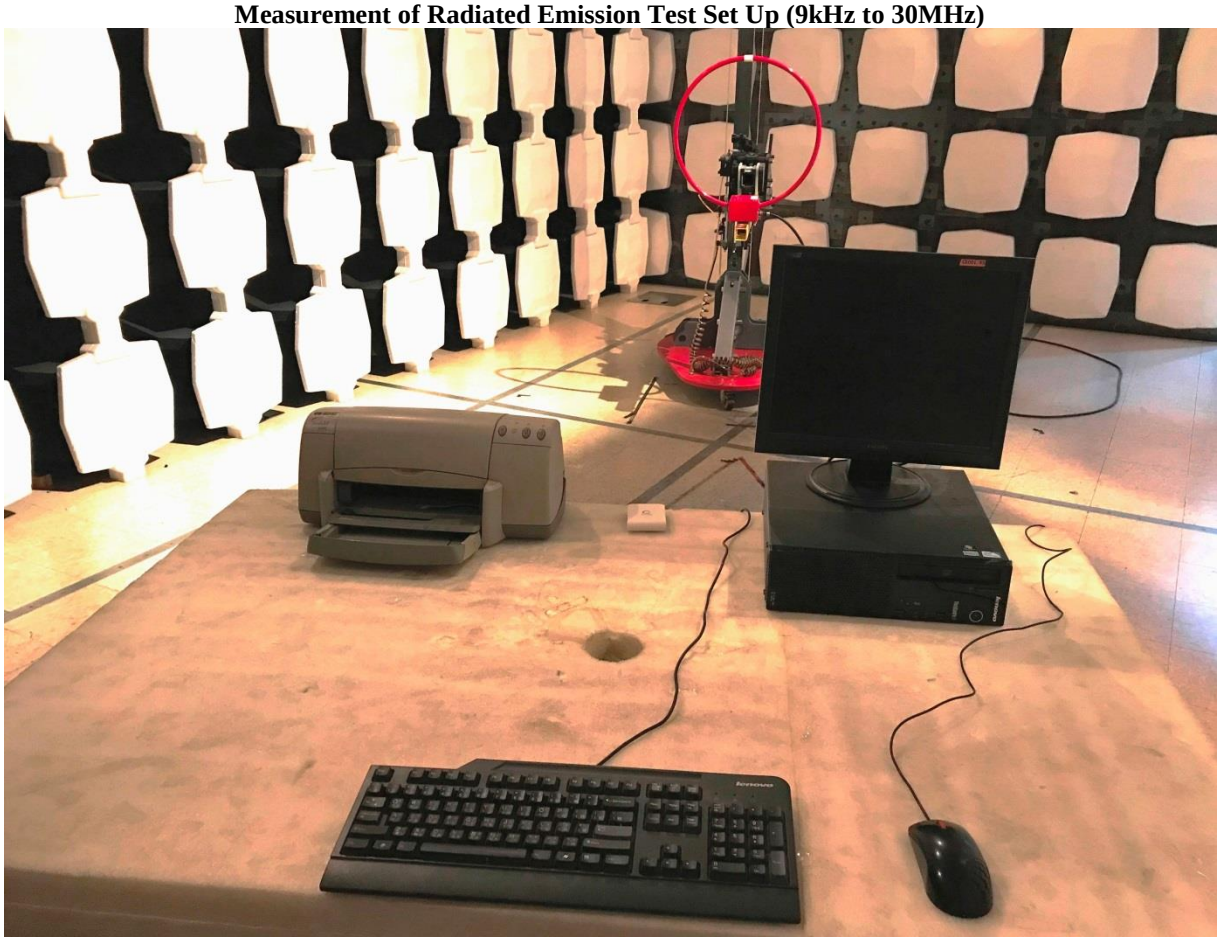
Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)



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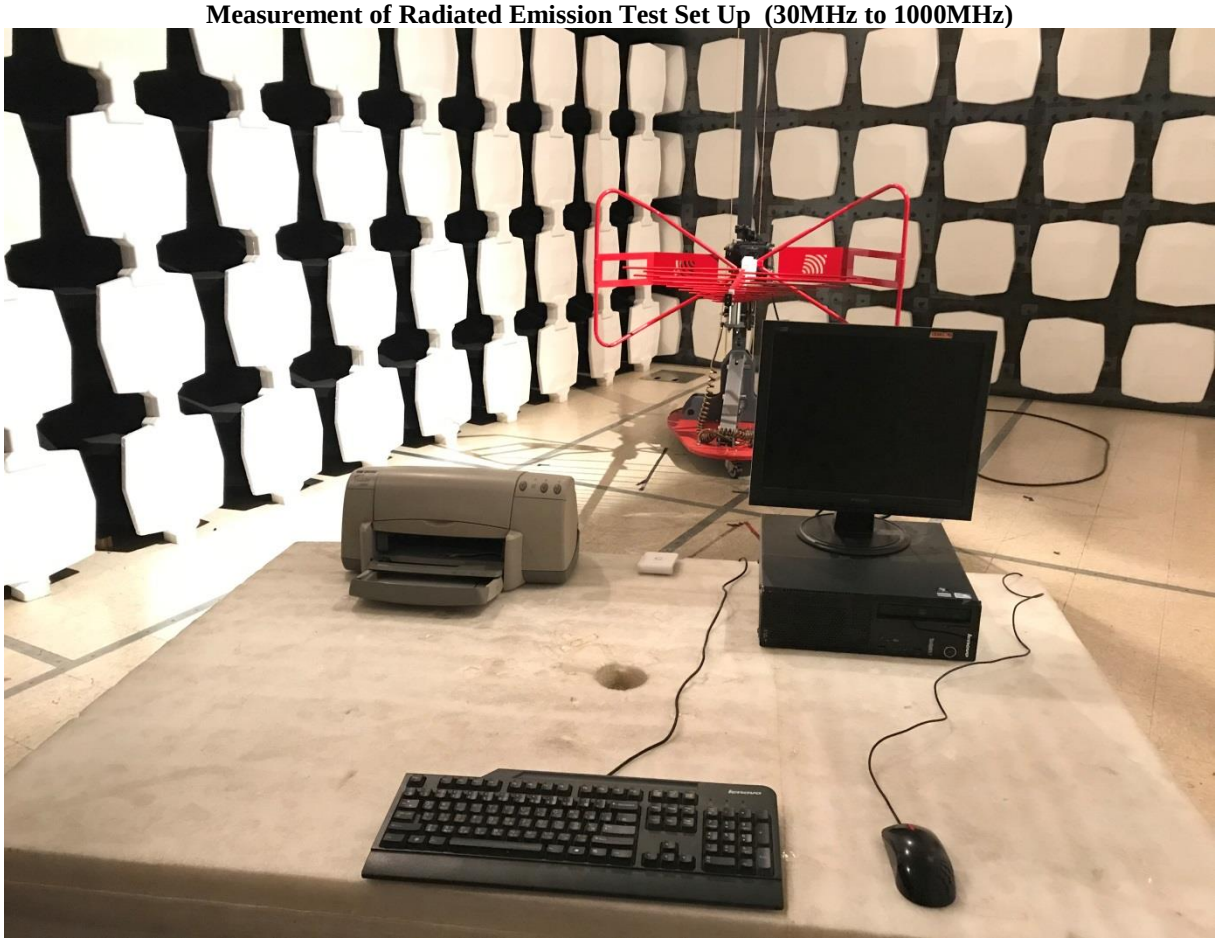
Photographs of EUT

Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



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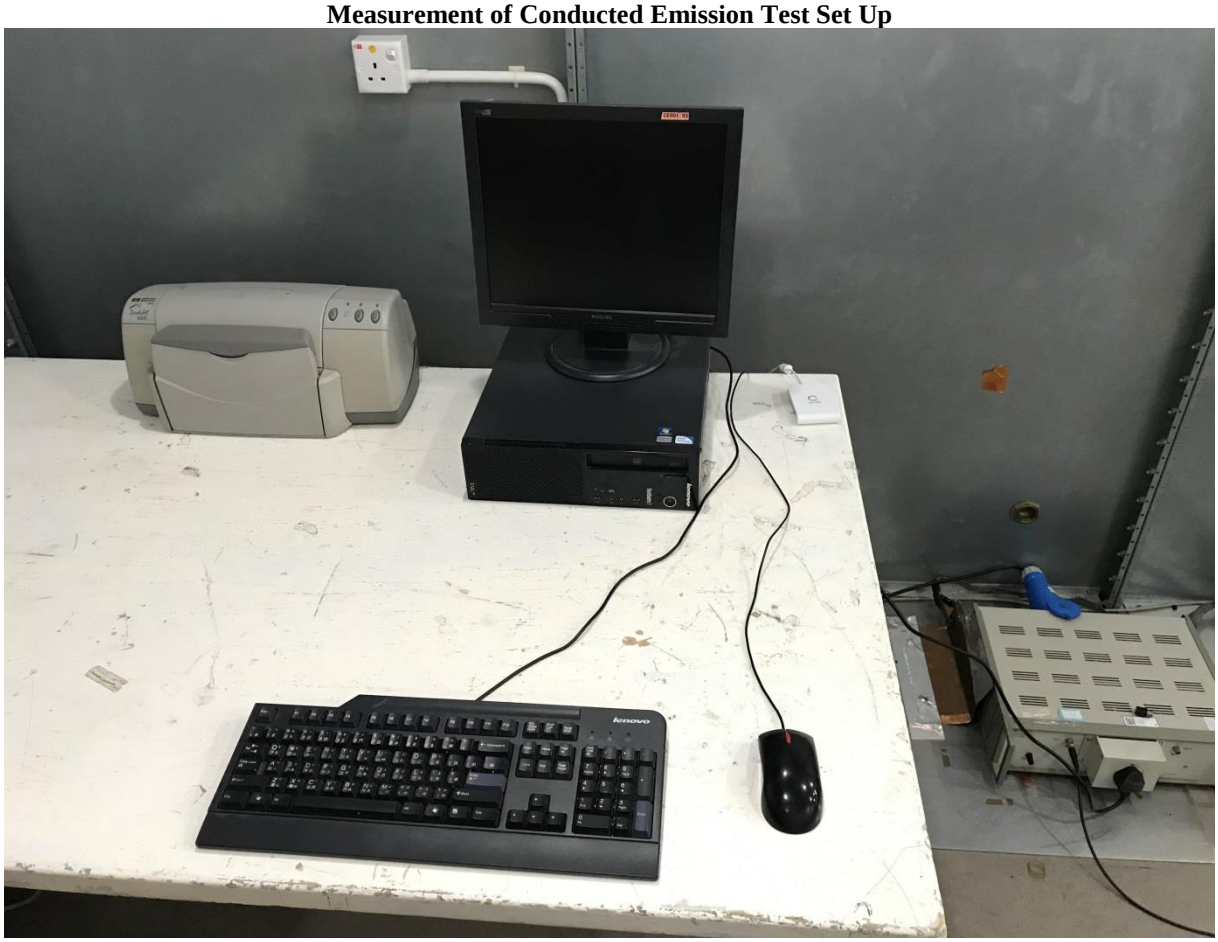
Photographs of EUT

Measurement of Conducted Emission Test Set Up



******* End of Test Report *******

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11. Subject to the variable length of retention time for test data and report stored hereinto as to otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of this test report for a period of three years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after the retention period. Under no circumstances shall we be liable for damages of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

12. Issuance records of the Report are available on the internet at www.stc.group. Further enquiry of validity or verification of the Reports should be addressed to the Company.