Test Report

Date : 2020-03-09
No. : HM20020008

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: CIR315A FCC ID: 2AUVM-CIR315A
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

Test Report

CONTENT:

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:	CIR315A
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

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

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.

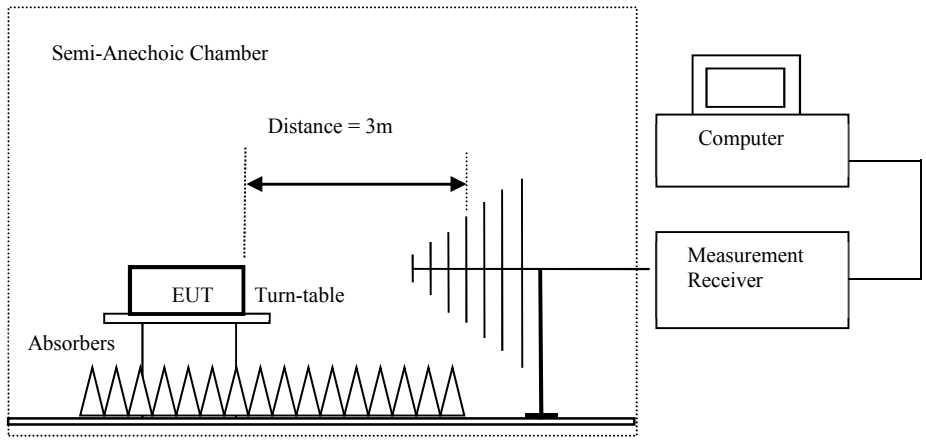
Remark: 3 orthogonal axis apply to hand-held device only.

*: 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

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:



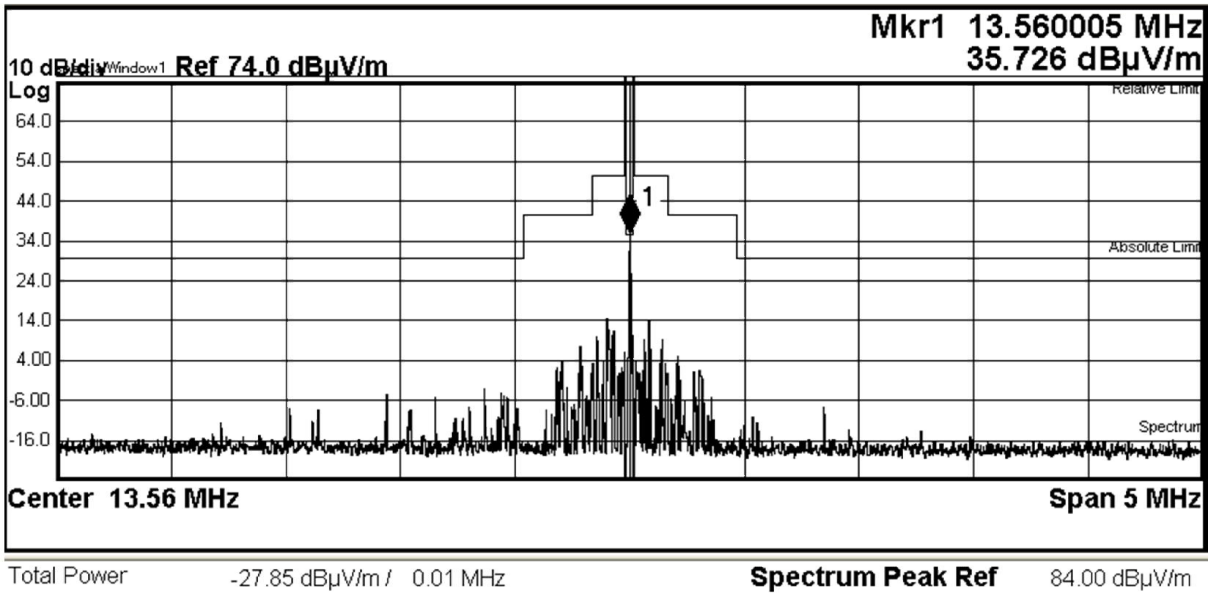
Ground Plane

- 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

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



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	-92.47	(-35.98)	-79.48 k	-93.05	(-36.56)	71.98 k
150.0 kHz	450.0 kHz	3.000 kHz	-99.49	(-33.00)	-196.5 k	-101.85	(-35.36)	196.5 k
450.0 kHz	900.0 kHz	3.000 kHz	-110.28	(-32.79)	-617.9 k	-114.75	(-37.26)	833.8 k
900.0 kHz	2.500 MHz	3.000 kHz	-111.57	(-34.08)	-1.044 M	-120.46	(-42.97)	941.8 k

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	75.7 @13.56MHz	35.7 @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	54.4 @13.43MHz	14.4 @13.43MHz	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	51.2 @13.17MHz	11.2 @13.17MHz	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	35.4 @12.27MHz	-4.6 @12.27MHz	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

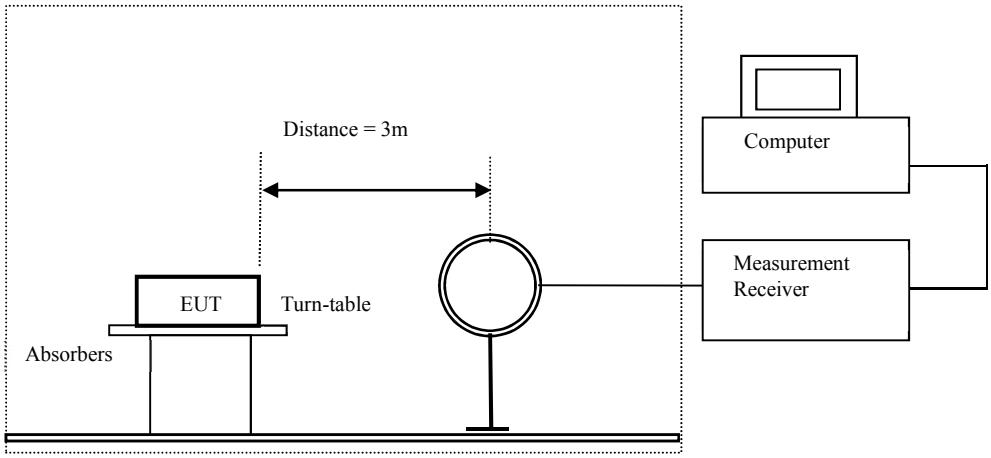
Formula:
Highest Field strength calculated @30m = Highest Field strength measured @3m – Correction Factor

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

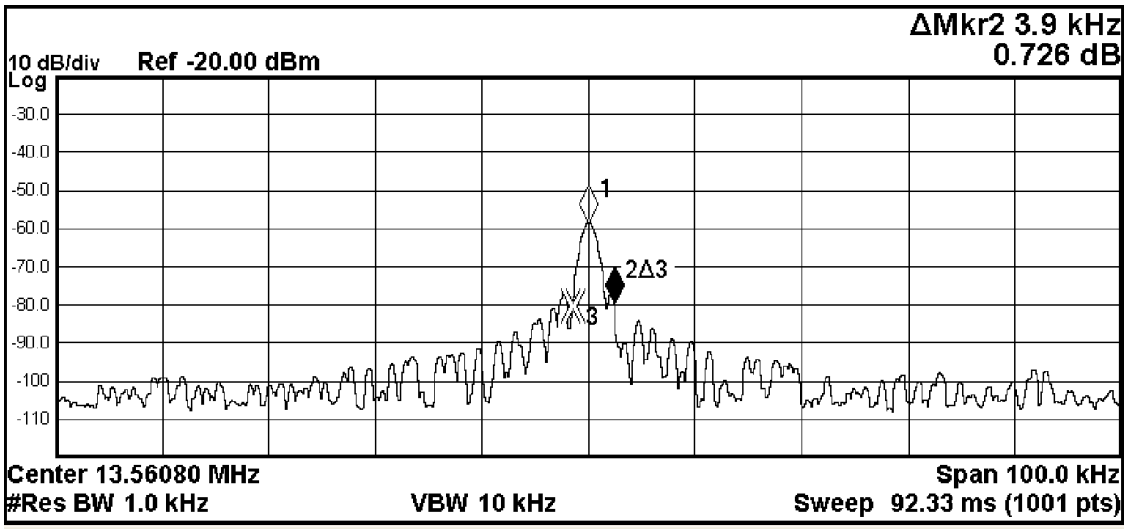
3.1.2 20DB BANDWIDTH

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



Center Frequency [MHz]	20dB Bandwidth [kHz]
13.56	3.9



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	13.560 8 MHz	-58.451 dBm			
2	Δ3	1	f	(Δ) 3.9 kHz	(Δ) 0.726 dB			
3	F	1	f	13.559 3 MHz	-80.377 dBm			
4								

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		<±1* 10^{-7}	

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

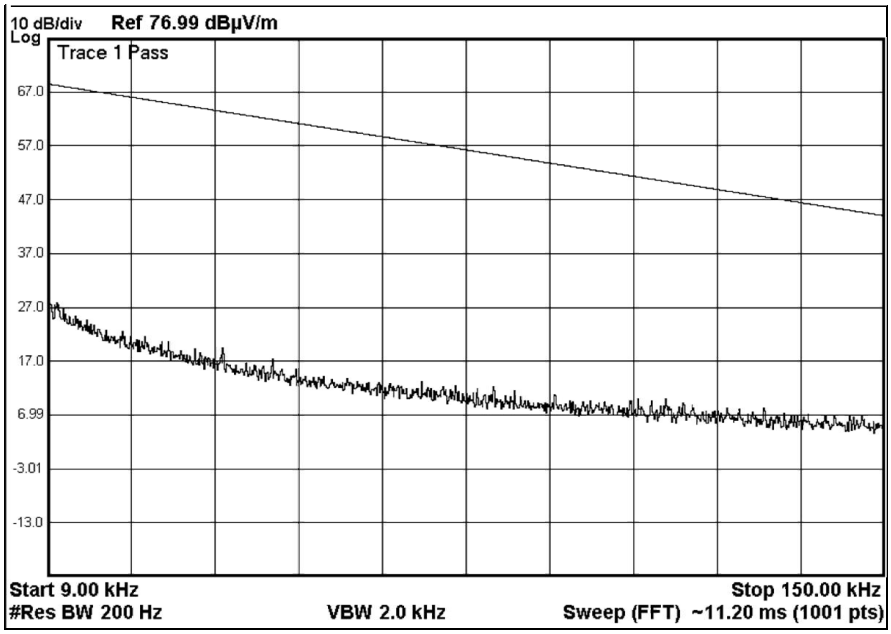
The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

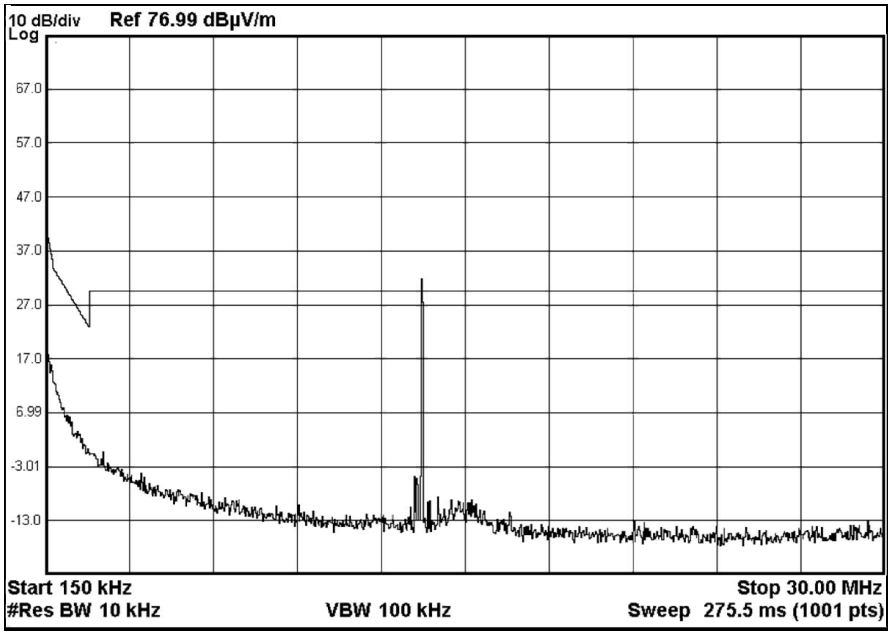
Remarks:

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.

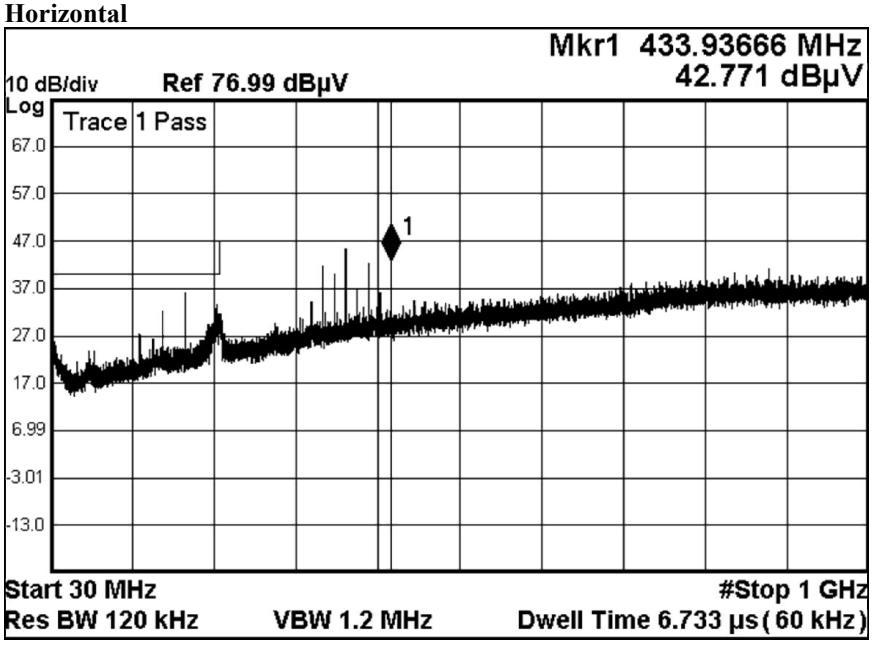
Result of On mode connected to PC, (9kHz – 30MHz): PASS



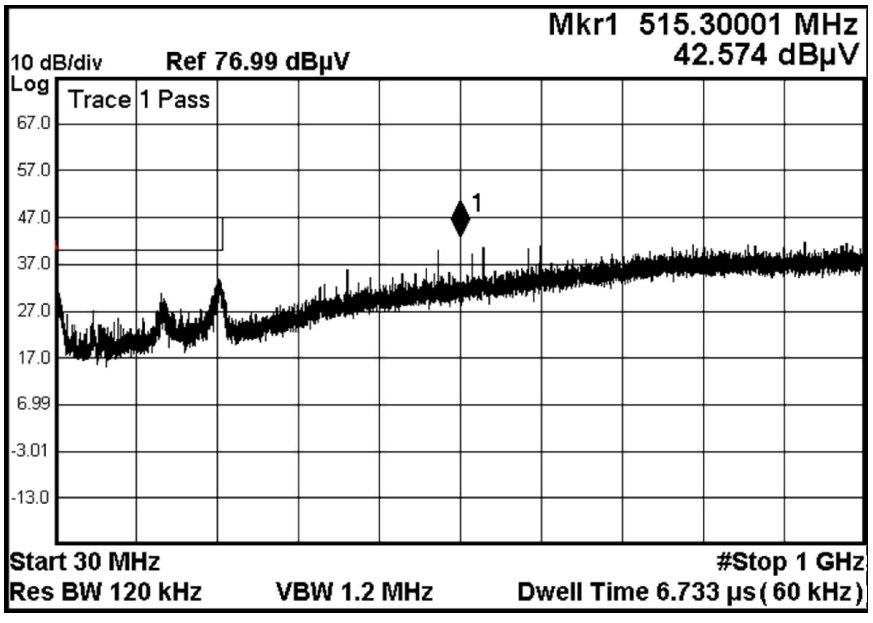


The peak value shown on the graph was 13.56MHz which the result was measured and calculated at page 7-8, others missions detected outside the spectrum mask are more than 20 dB below the FCC Limits

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



Vertical



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
36.4	7.7	13.4	21.1	11.4	100	Vertical
203.4	16.9	10.9	27.8	24.5	150	Horizontal
229.7	18.7	12.0	30.7	34.3	150	Horizontal
406.5	16.7	17.4	34.1	50.7	200	Horizontal
433.9	18.9	17.5	36.4	66.1	200	Horizontal
515.3	17.9	20.4	38.3	82.2	200	Vertical

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

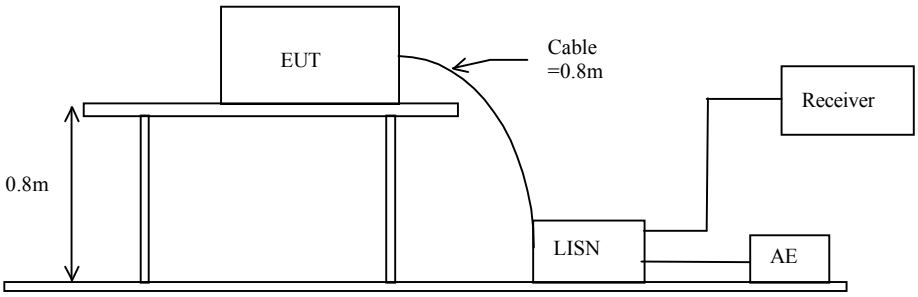
3.1.5 Conducted Emissions (0.15MHz to 30MHz)

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

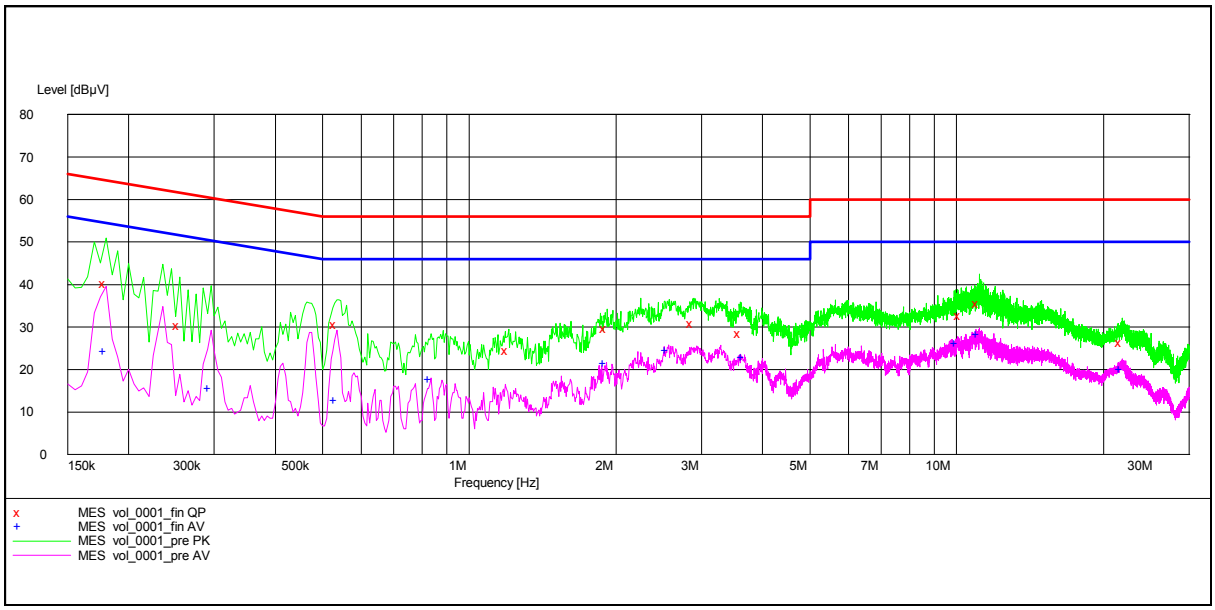
Limits for Conducted Emissions (FCC 47 CFR 15.207):

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 (Live): PASS
Please refer to the following diagram for individual results.



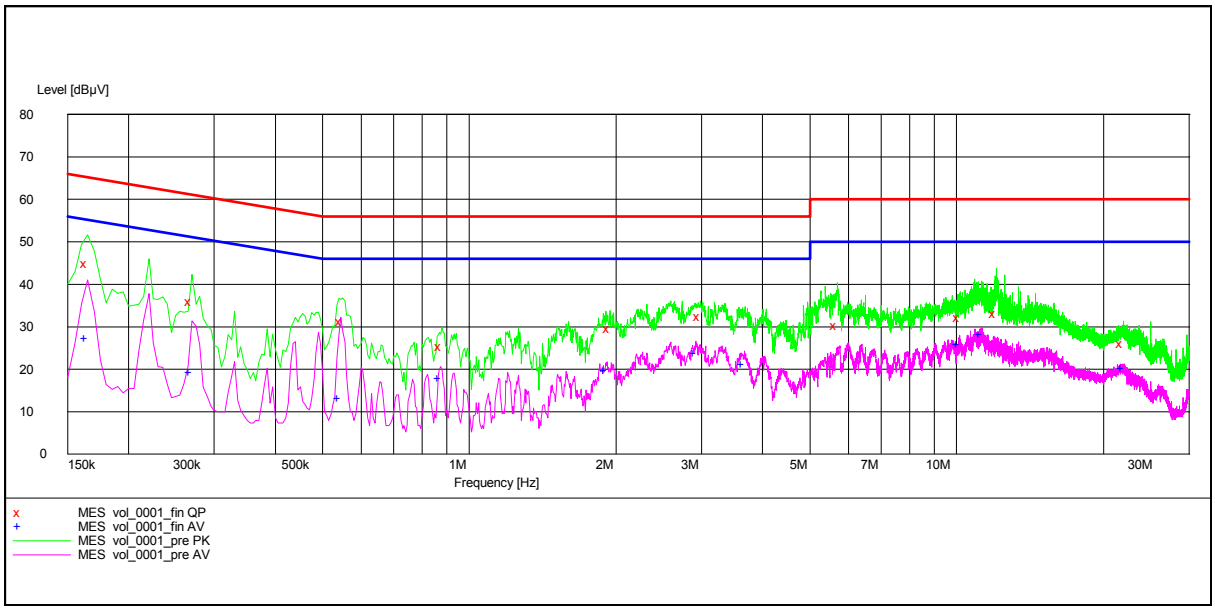
MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.180000	40.30	9.9	65	24.2	L1	GND
0.255000	30.40	9.9	62	31.2	L1	GND
0.535000	30.50	10.0	56	25.5	L1	GND
1.205000	24.50	10.0	56	31.5	L1	GND
1.920000	29.70	10.0	56	26.3	L1	GND
2.890000	30.90	10.1	56	25.1	L1	GND
3.615000	28.60	10.2	56	27.4	L1	GND
10.220000	32.60	10.4	60	27.4	L1	GND
11.145000	35.60	10.6	60	24.4	L1	GND
21.900000	26.40	10.6	60	33.6	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.180000	24.20	9.9	55	30.3	L1	GND
0.295000	15.60	9.9	50	34.8	L1	GND
0.535000	12.70	10.0	46	33.3	L1	GND
0.835000	17.70	10.0	46	28.3	L1	GND
1.910000	21.40	10.0	46	24.6	L1	GND
2.565000	24.40	10.1	46	21.6	L1	GND
3.670000	22.90	10.2	46	23.1	L1	GND
10.065000	26.20	10.4	50	23.8	L1	GND
11.135000	28.20	10.6	50	21.8	L1	GND
21.850000	19.90	10.6	50	30.1	L1	GND

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



MEASUREMENT RESULT: "vol_0001_fin QP"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.165000	44.80	9.9	65	20.4	N	GND
0.270000	35.90	9.9	61	25.2	N	GND
0.550000	31.20	10.0	56	24.8	N	GND
0.880000	25.40	10.0	56	30.6	N	GND
1.945000	29.50	10.0	56	26.5	N	GND
2.985000	32.30	10.1	56	23.7	N	GND
5.695000	30.30	10.5	60	29.7	N	GND
10.180000	32.10	10.4	60	27.9	N	GND
12.060000	33.20	10.5	60	26.8	N	GND
21.985000	26.10	10.6	60	33.9	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.165000	27.10	9.9	55	28.1	N	GND
0.270000	19.20	9.9	51	31.9	N	GND
0.545000	13.10	10.0	46	32.9	N	GND
0.875000	17.90	10.0	46	28.1	N	GND
1.915000	19.60	10.0	46	26.4	N	GND
2.920000	23.60	10.1	46	22.4	N	GND
3.670000	21.00	10.2	46	25.0	N	GND
10.150000	25.90	10.4	50	24.1	N	GND
11.265000	28.20	10.6	50	21.8	N	GND
22.055000	20.10	10.6	50	29.9	N	GND

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.

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

Appendix B

Photographs of EUT

Front View of the product

Front View of the product

Front View of the PCB of the product

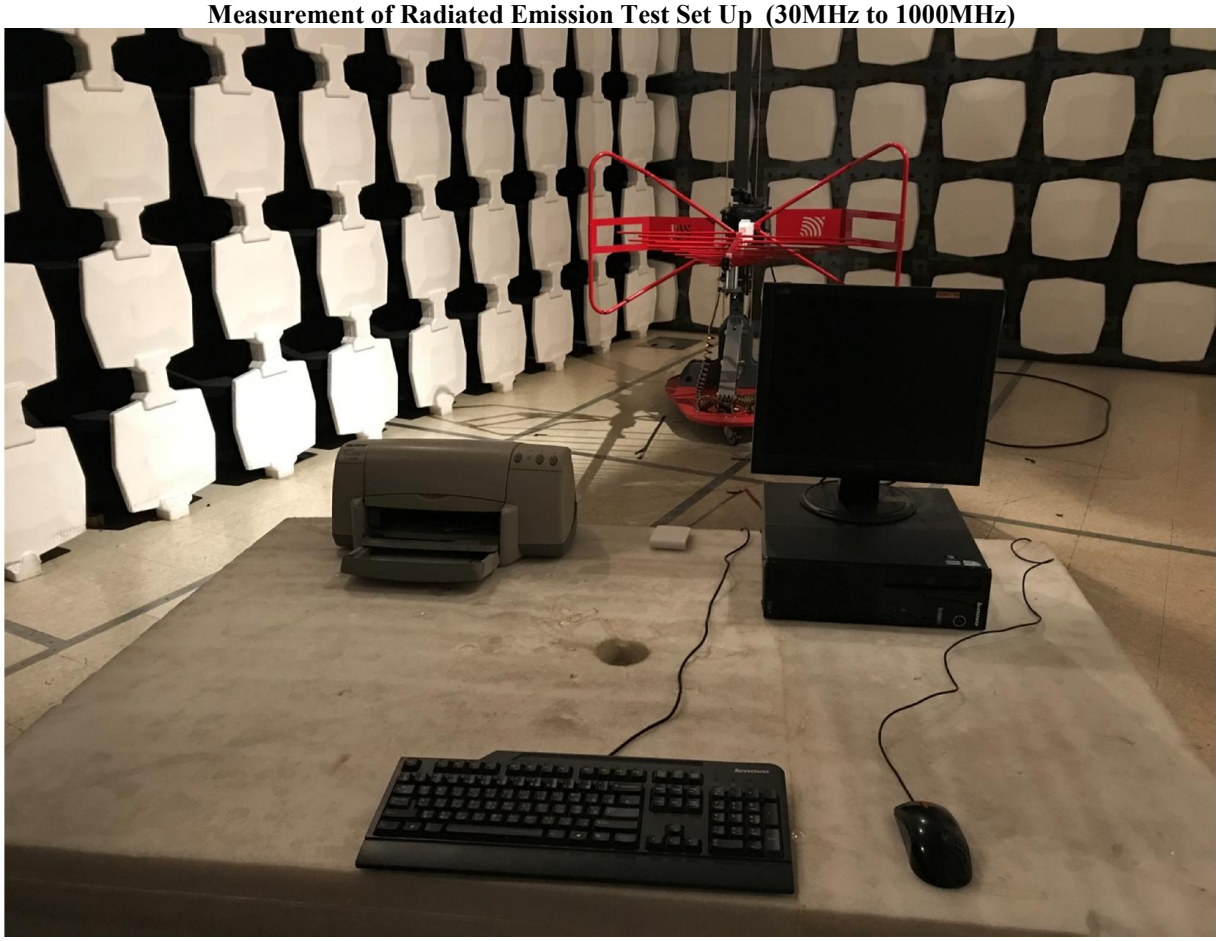
Front View of the PCB of the product

Photographs of EUT

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

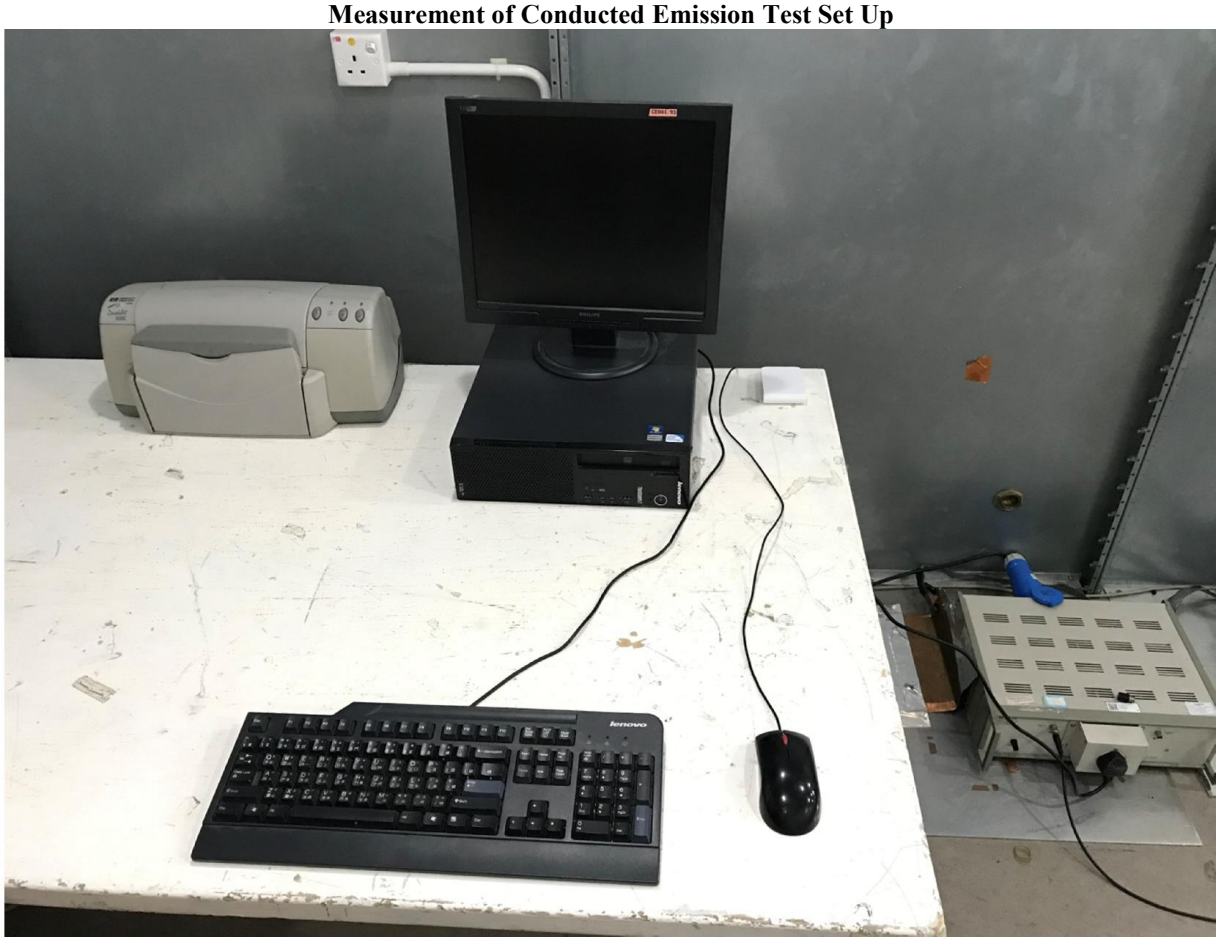
Photographs of EUT

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



Photographs of EUT

Measurement of Conducted Emission Test Set Up



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

Conditions of Issuance of Test Reports

1. All samples and goods are accepted by The Hong Kong Standards & Testing Centre Limited (the "Company") solely for testing and reporting in accordance with the following terms and conditions. The Company provides its services on the basis that such terms and conditions constitute express agreement between the Company and any person, firm or company requesting its services (the "Clients").

2. Any report issued by the Company as a result of this application for testing service (the "Report") shall be issued in confidence to the Clients and the Report will be strictly treated as such by the Company. It may not be reproduced either in its entirety or in part and it may not be used for advertising or other unauthorized purposes without the written consent of the Company. The Clients to whom the Report is issued may, however, show or send it, or a certified copy thereof prepared by the Company to his customer, supplier or other persons directly concerned. Subject to clause 3, the Company will not, without the consent of the Clients, enter into any discussion or correspondence with any third party concerning the contents of the Report, unless required by the relevant governmental authorities, laws or court orders.

3. The Company shall be at liberty to disclose the testing-related documents and/or files anytime to any third-party accreditation and/or recognition bodies for audit or other related purposes. No liabilities whatsoever shall attach to the Company's act of disclosure.

4. The Company shall not be called or be liable to be called to give evidence or testimony on the Report in a court of law without its prior written consent, unless required by the relevant governmental authorities, laws or court orders.

5. The results in Report apply only to the sample as received and do not apply to the bulk, unless the sampling has been carried out by the Company and is stated as such in the Report.

6. When a statement of conformity to a specification or standard is provided, the ILAC-G8 Guidance document (and/or IEC Guide 115 in the electrotechnical sector) will be adopted as a decision rule for the determination of conformity unless it is inherent in the requested specification or standard, or otherwise specified in the Report.

7. In the event of the improper use the report as determined by the Company, the Company reserves the right to withdraw it, and to adopt any other additional remedies which may be appropriate.

8. Sample submitted for testing are accepted on the understanding that the Report issued cannot form the basis of, or be the instrument for, any legal action against the Company.

9. The Company will not be liable for or accept responsibility for any loss or damage howsoever arising from the use of information contained in any of its Reports or in any communication whatsoever about its said tests or investigations.

10. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.

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.